

Chandos Street Noise Wall Installation

Review of Environmental Factors

Roads and Maritime Services | November 2018



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Prepared by Arup and Roads and Maritime Services

RMS: 18.1103

ISBN: 978-1-925891-01-0

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Approval and authorisation

Title	Chandos Street noise wall installation review of environmental factors
Accepted on behalf of NSW Roads and Maritime Services by:	Adam Price Project Manager, Motorways Division
Signed:	
Dated:	November 2018

Executive summary

The proposal

Roads and Maritime Services (Roads and Maritime) proposes to install a noise wall along the western side of the Warringah Freeway close to the Brook Street interchange at Crows Nest to benefit residents living on Jenkins Lane, Chandos Street and Mathew Lane.

The noise wall would be about 180 metres long and 4.5 metres high between St. Thomas' Rest Park and the existing brick property boundary wall at the end of Jenkins Lane. A three-metre-high noise wall about 17 metres long would also be built out from the existing brick property boundary wall at the end of Jenkins Lane to Brook Lane. It would be built using solid modular panels except at the end of Chandos Street where transparent panels would be installed along the top two metres to reduce overshadowing. Each solid panel would be painted and landscape planting would be provided to improve its urban design and visual setting. Other associated proposed work would include utility and street lighting adjustments, drainage improvements, vegetation and tree removal, landscape planting, rock cutting, potential rock-bolt installation, and the installation of a maintenance access path.

Subject to determination, construction is expected to start in early 2019 and the work would take about eight to ten months to complete.

Need for the proposal

The NSW Government recognises that in certain circumstances the continued increase in traffic on the State's roads has led to people being exposed to high levels of road traffic noise. Roads and Maritime, in its role as the State road authority, has accordingly developed the Noise Abatement Program (NAP) to address this. The program defines criteria where people are eligible for the consideration of treatment due to existing road traffic noise levels. More information can be found via the following link:

www.rms.nsw.gov.au/documents/about/forms/45064839-noise-abatement-program-application.pdf

Properties near the Warringah Freeway, between St. Thomas' Rest Park and Brook Street, were identified as experiencing road traffic noise at levels that satisfy the eligibility criteria of the NAP. As a result, the need to provide noise treatment for these properties was investigated.

Proposal objectives and development criteria

The proposal's objectives include:

- Reducing road traffic noise levels at affected properties
- Ensuring high-quality urban design outcomes sympathetic to the surrounding environment
- Minimising environmental, property and amenity impacts where feasible and reasonable
- Avoiding utility and road infrastructure impacts where feasible and reasonable
- Ensuring future maintenance access.

In developing the proposal, consideration was also given to addressing the requirements of the Noise Mitigation Guideline (NMG, Roads and Maritime, 2015), achieving at least a 5 dB(A) reduction in ambient noise in the local area, and ensuring the wall was designed to the specifications in R271: The Design and Construction of Noise Walls (Roads and Maritime, 2017) and the Noise Wall Design Guidelines (RTA, 2006).

Options considered

The NMG sets out a preferred order of mitigation, where road design and traffic management measures are preferred over installing quieter road pavement surfaces, which in turn is preferred over building noise barriers and walls, which in turn are preferred over providing at-property architectural treatment.

In the case of the proposal, Roads and Maritime identified two options; doing-nothing and installing a noise wall with at-property treatments. The two options were considered against the proposal objectives and the definition of what constitutes reasonable under the NMG in terms of balancing benefit, impact and cost.

It was confirmed that the option of doing nothing would fail to meet the core objective of reducing external road traffic noise levels at affected properties. As such, properties would continue to experience noise levels above the NAP criteria. The second option of building a noise wall was shown to meet the proposal objectives when supplemented with at-property treatment. As such, this was taken forward as the preferred option. The decision was then taken to build a 4.5-metre-high noise wall alongside the Warringah Freeway between St. Thomas' Rest Park and maintain an existing property boundary wall at the end of Jenkins Lane, a three-metre high noise wall would be built out from the existing property boundary wall to Brook Lane. The preferred height was chosen to provide a balance between delivering acoustic benefit compared to limiting adverse overshadowing and visual impacts to neighbouring properties.

With the preferred design, alignment and configuration of the wall selected, consideration was then given as to whether the wall would still unduly overshadow certain properties. This led Roads and Maritime to refine its proposal to include transparent panels along the top section of the wall at the end of Chandos Street next to properties.

Statutory and planning framework

State Environmental Planning Policy (Infrastructure) 2007 permits road-related development to be carried out by, or on behalf of, a public authority without third-party consent providing it is not of State-significance.

As the proposal is for Roads and Maritime to develop a road infrastructure facility, and it is not predicted to have any significant impacts, it can be self-determined under division 5.1 of the *Environmental Planning and Assessment Act 1979*. This review of environmental factors (REF) has been prepared to help Roads and Maritime fulfil its obligations under the objects and provisions of the above Act and the factors set out in clause 228(2) of the supporting Environmental Planning and Assessment Regulation 2000. While development consent for the proposal is not needed, Roads and Maritime would need to separately secure a licence to 'occupy' the road and carry out various work consistent with the provisions of the *Roads Act 1993*. Roads and Maritime also has an obligation to adhere to legislation, policy and regulation in terms of managing the work to minimise its environmental impacts.

Accordingly, this REF describes the proposal's potential environmental impacts and the safeguards and management measures that would be put in place to either avoid or minimise any adverse outcomes.

Community and stakeholder consultation

A detailed consultation strategy for the proposal has been developed. It identifies key stakeholders such as the residents, road users and businesses that may be impacted or benefitted by the proposal. Specifically, the strategy identified the need to consult with affected residents and other parties about the proposal while it is being designed and leading up to and during construction. The strategy provides for issuing letters and holding community information sessions. It also includes provisions to hold one-on-one meetings and carry out doorknocking to inform people about the proposal and to seek feedback. The strategy also describes how the community can contact Roads and Maritime at any point by telephone, letter or email, and the need for Roads and Maritime to make a response in a timely manner.

Several stakeholders have been consulted to date, and their issues taken into consideration in developing the proposal's concept design. Key has been the consultation with residents and directly affected property owners. A community information and feedback session was held on 8 August 2018 to discuss specific elements of the wall's design and its planned construction.

Consultation feedback to date has sought to confirm: the noise wall's distance from property boundaries; overshadowing impacts; the need to carry out night work to install the wall; and if pre-condition building surveys would be carried out. Roads and Maritime has sought to clarify each of these points with the community, and where needed, it has revised its design or included safeguard commitments to avoid or minimise impacts.

Other stakeholders consulted to date include North Sydney Council, key transport agencies, and the Transport Management Centre. Again, their feedback and issues have been taken into consideration in developing the concept design and setting out subsequent mitigation measures.

The local community and all interested stakeholders can make a submission on the exhibited REF, and issues raised will be considered and responded to in a submissions report.

Environmental impacts

The proposal's construction and operation has the potential to impact on the local environment where the noise wall would be installed. The key potential impacts associated with the proposal relate to construction noise and vibration, changes in landscape character and visual amenity, overshadowing, effects on non-Aboriginal heritage values, temporary traffic, transport and access disruption, and associated amenity effects on the local community. Conversely, the proposal would deliver a long-term benefit from reducing noise levels for Crows Nest residents and users of the section of St. Thomas' Rest Park alongside the Warringah Freeway.

Noise and Vibration

There is potential for construction noise to affect sensitive receivers up to 400 metres from the proposal and for construction vibration to affect properties and people up to 50 metres from the proposal; particularly when installing the noise wall, clearing vegetation and carrying out the earthworks. The technical noise and vibration report prepared to support the REF concluded that there would be the following exceedances of the noise criteria during construction when night work takes place:

- More than 25 dB(A) for residents within about 50 metres of the proposal
- Between 15 and 25 dB(A) for residents within about 100 metres of the proposal
- Between 5 and 15 dB(A) for residents within about 300 metres of the proposal
- Up to 5 dB(A) for residents within 400 metres of the proposal.

The predicted construction noise levels are also sufficient to potentially cause sleep disturbance for residents within 100 metres of the proposal.

Given the predicted noise and vibration impacts, additional assessment and monitoring would be carried out before construction to confirm absolute noise and vibration levels, exact exceedances above existing ambient noise levels, and the number of times noise will exceed management levels every night. This would be supported by pre-condition building surveys. Impacts would then be managed through introducing respite periods during construction, installing hoardings/acoustic screens around equipment, and scheduling key impacting activities to be carried out before midnight. This would be supplemented by directly contacting and informing residents before carrying out night work and providing the means for people to contact Roads and Maritime. Alternate accommodation may be offered to residents in NCA 1 where the predicted noise level exceeds the noise management level by greater than 25 dB(A). Alternate accommodation will also be reviewed in response to receiving a complaint.

Landscape and visual

The introduction of equipment along the road corridor and use of lighting during the evening and night work would create a temporary visual amenity impact for residents, road users and users of the St. Thomas' Rest Park during construction. A combination of site management practices, and directional lighting, would be used to minimise these impacts.

The need for tree and vegetation removal alongside the Warringah Freeway and the installation of the noise wall would have a moderate adverse impact on the area's landscape character and a moderate-to-high adverse visual impact. This is due to the noise wall blocking or reducing views to the east from certain properties on Matthew Lane, Chandos Street, Jenkins Lane and Brook Street and the loss of urban amenity in the local area. The design of the noise wall, combined with the provision of landscape planting behind the wall, would be used to reduce the magnitude of the above impacts. These measures would be refined during the detailed design in consultation with property owners, residents and North Sydney Council. They would be supplemented by measures to reduce tree loss where possible.

Non-Aboriginal heritage

The proposal would be built nearby areas of cultural heritage value; St. Thomas' Rest Park (an area of local landscape heritage value) and the Holtermann Estate Conservation Area. Importantly, the noise wall would not be installed within the footprint of either the park or conservation area, however it would be visible from locations within both areas. Therefore, the urban design and landscape planting strategy has been developed to reduce the magnitude of the proposal's visual impact as described above. Beneficially, the noise wall would reduce noise levels to people using the park and homes within the heritage conservation area. This would improve their amenity value and therefore user enjoyment.

The construction contractor would need small vehicles to access the St. Thomas' Rest Park during construction to assist with lifting the noise wall panels into place. Vehicles would access the park via the existing gate on West Street and travel to the north-west corner of the park. These vehicles are likely to be similar in size and type to those used to maintain the park, and providing standard management controls are put in place when vehicles track across the area, then any impacts can be adequately managed.

Traffic and Transport

The proposal is to close the inside lane on the Brook Street off ramp for eight to ten months to carry out the work. This would make it easier to install the wall and carry out the work, therefore reducing the overall construction program. Speed restrictions and traffic management controls would also need introducing on the off ramp to support the inside lane closure. These measures would inconvenience road users. The key impact would be a likely increase in queuing traffic at the bottom of the off ramp close to Brook Street. Notably however, the traffic signal timings at the intersection may be temporarily adjusted to help improve traffic flows and prevent any traffic from backing up onto the Warringah Freeway.

There may also be occasions when additional lanes would need to be temporarily closed on the off ramp, mainly to position, lift and install the main noise wall panels. This specialist work, and associated additional lane closures, would be programmed to be carried out when there would be less traffic on the road including school holidays, weekends and at night. The road occupancy licence would outline when any lane closures would be permitted and what other traffic management controls would need to be introduced when working in the Warringah Freeway corridor at specific times and days. Traffic diversions or full closures of the off ramp are considered unlikely.

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Traffic and Transport

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There may also be occasions when additional lanes would need to be temporarily closed on the off ramp, mainly to position, lift and install the main noise wall panels. This specialist work, and associated additional lane closures, would be programmed to be carried out when there would be less traffic on the road including school holidays, weekends and at night. The road occupancy licence would outline when any lane closures would be permitted and what other traffic management controls would need to be introduced when working in the Warringah Freeway corridor at specific times and days. Traffic diversions or full closures of the off ramp are considered unlikely.

The limited space around the construction footprint may result in the need for workers to occasionally park small vehicles on the streets local to the proposal. These streets are also used during the week by people working in Crows Nest. As such, affected residents would be consulted before starting work to inform them of any planned traffic management and access restrictions. Roads and Maritime would also aim to adjust its program to accommodate local needs (including parking) and all light construction vehicles would be parked to the south east of the construction footprint on West Street, where feasible and reasonable.

Construction is considered unlikely to have any impact on pedestrians and cyclists other than the temporary closure of the private and public pedestrian access alongside the freeway and the informal pedestrian access at the end of Chandos Street/Matthew Lane through to St. Thomas' Rest Park. Despite this inconvenience, alternatives are available that would still allow people to access their properties and the park during construction. Roads and Maritime is continuing its consultation with affected parties to ensure their access needs and requirements are accommodated in the construction program.

Socio-economic, property and land use

The local community, road users and users of the St. Thomas' Rest Park would have their amenity temporarily affected during construction through increased noise levels and the visual impacts as described above. These impacts would also include loss of amenity at night due to the use of site and security lighting and the potential for sleep disturbance. There is also the potential for amenity impacts relating to the vibration caused by using heavy plant and equipment close to residential properties and the potential for generating dust onsite through the earthworks and rock cutting.

The freeway boundary fence in the north-west corner of the St. Thomas' Rest Park and the section between Matthew Street and Chandos Street would need removing to install the noise wall. The remainder of the boundary fence would remain in place. This fencing does not form part of the heritage listing and is of limited amenity value.

The noise wall would have an overshadowing impact on the north-western corner of St. Thomas' Rest Park and the rear garden of an individual property at Matthew Lane, noting it would not impact on the property façade. Some overshadowing is also predicted for properties at Chandos Street and Jenkins Lane. By installing transparent panels this would reduce impact at the property façades next to the freeway. The impacts would be greatest on the shortest-day of the year as this is when the longest shadows are cast. Conversely, the above locations would not be impacted on the longest day, when the shortest shadows are cast.

Despite the proposal requiring the removal of several trees and resulting in the introduction of a new built structure that would have a visual and overshadowing impact on certain receivers, the urban design and landscape planting strategy, in combination with the inclusion of transparent panels, all serve to reduce the proposal's amenity impact.

No surface property acquisition, access or land use changes are needed to deliver the proposal. If rock bolts are installed alongside the Warringah Freeway this may result in the need for subsurface acquisition. This would be carried out in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*, the supporting NSW Government Land Acquisition Reform 2016 and the Land Acquisition Guide (Roads and Maritime, 2014).

Justification and conclusion

The proposal is justified as it would introduce a noise benefit for residents living on Jenkins Lane, Chandos Street and Mathew Lane and users of the St. Thomas' Rest Park. The proposal achieves a 5dB(A) reduction in road traffic noise and reduces noise at 13 properties to within the NAP criteria. While the introduction of a noise wall would have an overshadowing and visual impact close to its point of installation, the magnitude of these impacts can be reduced through implementing an effective urban design and landscape strategy as proposed.

A range of safeguards and management measures, as identified in this REF, would be introduced before and during construction to avoid and minimise potential impacts on the receiving environment. This includes several specified traffic, noise, vibration and pollution management controls and other best practices developed under guidance proven to provide effective environmental protection. This would ensure the proposal is delivered in accordance with the objective of minimising its environmental impacts.

Overall, the proposal is considered justified against its needs and objectives. It is also considered a road infrastructure facility within the meaning and definition of State Environmental Planning Policy (Infrastructure) 2007. As it is concluded that the proposal would have no significant environmental impact on matters of national environmental significance protected under the Commonwealth *Environmental Biodiversity Conservation Act 1999*, Roads and Maritime can determine if it should proceed in accordance with division 5.1 of the *Environmental Planning and Assessment Act 1979*. It also means that the proposal has not been referred to the Australian Department of the Environment and Energy or subject to strategic assessment.

The REF is being displayed for comment on the project website and at North Sydney Council, 200 Miller Street Sydney. Submissions will be accepted during the display of the REF, and Roads and Maritime will consider and provide responses in a corresponding submissions report.

Contents

Executive summary	i
Contents	vii
1. Introduction	11
1.1 Proposal identification	11
1.2 Purpose of the report	13
2. Need and options considered	15
2.1 Strategic need for the proposal	15
2.2 Existing infrastructure	16
2.3 Proposal objectives and development criteria	18
2.4 Alternatives and options considered	19
2.5 Preferred option	20
2.6 Design refinements.....	21
3. Description of the proposal	23
3.1 The proposal	23
3.2 Design.....	24
3.3 Construction activities.....	31
3.4 Ancillary facilities	36
3.5 Public utility adjustment.....	38
3.6 Property acquisition	38
4. Statutory and planning framework	42
4.1 Environmental Planning and Assessment Act 1979	42
4.2 Other relevant NSW legislation	44
4.3 Commonwealth legislation.....	46
4.4 Confirmation of statutory position.....	47
5. Consultation	48
5.1 Consultation strategy	48
5.2 Community involvement	50
5.3 Aboriginal community involvement.....	52
5.4 ISEPP consultation	52
5.5 Government agency and stakeholder involvement.....	52
5.6 Ongoing or future consultation	53
6. Environmental assessment	55
6.1 Noise and vibration	55
6.2 Landscape character and visual impact.....	72
6.3 Non-Aboriginal heritage	83
6.4 Biodiversity.....	87
6.5 Traffic and transport.....	99
6.6 Socio-economic, property and land use.....	102
6.7 Other impacts.....	118
6.8 Cumulative impacts	125
7. Environmental management	131

7.1	Environmental management plans	131
7.2	Summary of safeguards and management measures.....	132
7.3	Licensing and approvals	146
8.	Conclusion.....	148
8.1	Justification	148
8.2	Objects of the EP&A Act.....	149
8.3	Conclusion	152
9.	Certification	153
10.	References.....	154
	Terms and acronyms used in this REF.....	156

Tables

Table 2-1:	Form of treatment and reasonable mitigation options	20
Table 3-1:	Design criteria.....	26
Table 3-2:	Engineering and development constraints.....	26
Table 3-3:	Key urban design features	29
Table 3-4:	Proposed construction staging and typical activities	32
Table 3-5:	Indicative plant and equipment	34
Table 4-1:	Relevant North Sydney Council LEP local planning objectives and land use zoning policies	43
Table 4-2:	Other relevant NSW legislation	45
Table 5-1:	Summary of issues raised by the community	50
Table 6-1:	Noise monitoring location	57
Table 6-2:	Ambient noise levels	58
Table 6-3:	Measured road traffic noise levels in 2010	58
Table 6-4:	NMLs at residential receivers	58
Table 6-5:	Construction noise criteria.....	59
Table 6-6:	LA1,1min (or LAmax) Sleep disturbance assessment levels.....	60
Table 6-7:	Additional management measures for NCAs.....	67
Table 6-8:	Specific mitigation options being investigated	67
Table 6-9:	Recommended minimum working distances for vibration intensive plant	68
Table 6-10:	Noise and vibration management measures	69
Table 6-11:	Landscape character zones.....	73
Table 6-12:	Visual receivers (viewpoints).....	75
Table 6-13:	Landscape character assessment	77
Table 6-14:	Visual impact ratings	78
Table 6-15:	Landscape character and visual impact safeguards and management measures.....	82
Table 6-16:	Local heritage listings in the North Sydney LEP.....	84
Table 6-17:	Non-Aboriginal heritage safeguards and management measures.....	86
Table 6-18:	Statutorily protected biodiversity within 10 kilometres of the proposal.....	89
Table 6-19:	Declared noxious weeds in North Sydney LGA.....	90
Table 6-20:	Biodiversity safeguards and management measures	97
Table 6-21:	Traffic and access safeguards and management measures	101

Table 6-22: Socio-economic safeguards and management measures.....	117
Table 6-23: Other environmental aspects	118
Table 6-24: Other safeguard and management measures.....	122
Table 6-25: Projects currently under construction or proposed for the future	126
Table 6-26: Potential cumulative impacts of the proposal and other developments in the area.....	128
Table 6-27: Safeguards and management measures for cumulative impacts	130
Table 7-1: Summary of safeguards and management measures.....	132
Table 7-2: Summary of licensing and approvals required	146
Table 8-1: Objects of the EP&A Act.....	149

Figures

Figure 1-1: Location of the proposal	12
Figure 1-2: The proposal	13
Figure 2-1: Existing properties and recreational area (grey shading represents the extent of the heritage listed area of St. Thomas' Rest Park)	17
Figure 2-2: Transparent panel locations	22
Figure 3-1: Construction footprint	23
Figure 3-2: Photomontage of the proposed noise wall	24
Figure 3-3: Typical cross section of the Warringah Freeway once the noise wall is installed	25
Figure 3-4: Landscape plan	30
Figure 3-5: Indicative vehicle access routes through St. Thomas' Rest Park	36
Figure 3-6: Location of Site compound	37
Figure 3-7: Cross section showing examples of rock bolt locations	39
Figure 3-8: Subsurface property acquisition plan.....	40
Figure 3-9: Acquisition of North Sydney Council Land	41
Figure 4-1: Land zoning in the study area.....	44
Figure 5-1: Stages of the communication and consultation strategy	49
Figure 6-1: Measurement location for ambient noise and local land use.....	57
Figure 6-2: Predicted $L_{Aeq(15min)}$ construction noise levels generated by building the proposed noise wall which exceed the night-time NML.....	62
Figure 6-3: Predicted $L_{Aeq(15min)}$ construction noise levels generated by the construction compound which exceed the night-time NML.....	63
Figure 6-4: Areas with the potential to be impacted by sleep disturbance due to construction work associated with building the proposal	64
Figure 6-5: Areas with the potential to be impacted by sleep disturbance due to activities carried out at the construction compound.....	65
Figure 6-6 Properties eligible for at-property treatment.....	66
Figure 6-7: Landscape character zones.....	74
Figure 6-8: Representative viewpoints.....	75
Figure 6-9: Photomontages showing the future view at each viewpoint with the proposed noise wall built ..	81
Figure 6-10: Local heritage listings in the North Sydney LEP	84
Figure 6-11: Retention value of trees within the construction footprint	90
Figure 6-12: Impacts on trees close due to construction footprint of the proposal	95

Figure 6-13: Existing overshadowing environment on the shortest day.....	105
Figure 6-14: Existing overshadowing environment on the longest day.....	106
Figure 6-15: Sunlight hours at the facades of properties on Chandos Street and Jenkins Lane on the shortest day.....	108
Figure 6-16: Aerial view of overshadowing with a solid noise wall	109
Figure 6-17: Aerial view of overshadowing with the noise wall with transparent panels	110
Figure 6-18: Shadows cast by the proposed noise wall at 9am, 12 noon and 3pm for each of the days assessed for properties at Chandos Street.....	114
Figure 6-19: Shadows cast by the proposed noise wall at 9am, 12 noon and 3pm for each of the days assessed for properties at Jenkins Lane and Brook Street	116

Appendices

Appendix A	Consideration of clause 228(2) factors and matters of national environmental significance
Appendix B	Statutory consultation checklists
Appendix C	Noise and vibration assessment
Appendix D	Urban design strategy, landscape character and visual impact assessment
Appendix E	Community engagement report
Appendix F	Arboricultural assessment
Appendix G	Biodiversity searches
Appendix H	Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) stage 1 assessment

1. Introduction

This chapter introduces the proposal and provides the context of the environmental assessment. In introducing the proposal, the objectives and development history are detailed and the purpose of this report is provided.

1.1 Proposal identification

The Warringah Freeway is a three-kilometre section of road located on Sydney's lower north shore, linking the Sydney Harbour Tunnel with the Lane Cove Tunnel. The road is heavily trafficked and generates noise for nearby communities.

Residences located on Matthew Lane, Chandos Street, Jenkins Lane and part of Brook Street were identified as being affected by road traffic noise from the Warringah Freeway at levels above the NSW Noise Abatement Program (NAP) eligibility criteria.

The NAP is funded by the NSW Government and is delivered by Roads and Maritime Services (Roads and Maritime). Its purpose is to mitigate impacts for noise-sensitive land-uses that are exposed to high levels of road traffic noise from State and Commonwealth roads.

Roads and Maritime proposes to install a noise wall along the western side of the Warringah Freeway between St. Thomas' Rest Park and Brook Lane.

While providing a community benefit, the wall would also reduce noise exposure at key properties affected at levels that exceed criteria set under the NAP. These criteria define eligibility for the consideration of treatment measures where people are affected by existing road traffic noise levels.

Key features of the proposal include:

- Installing a 4.5-metre-high noise wall for about 180 metres on the western side of the Warringah Freeway between St. Thomas' Rest Park and an existing brick property boundary wall at the end of Jenkins Lane
- Installing a three-metre-high noise wall about 17 metres long out from the existing brick property boundary wall at the end of Jenkins Lane to Brook Lane
- Relocating existing roadside infrastructure such as light poles and utilities
- Introducing landscape planting and urban design measures.

The noise wall would be built from solid panels, except in one location where transparent panels would be used along the top two metres to reduce overshadowing. Each solid panel would be painted and landscape planting would be provided in key locations to improve its urban design and visual setting.

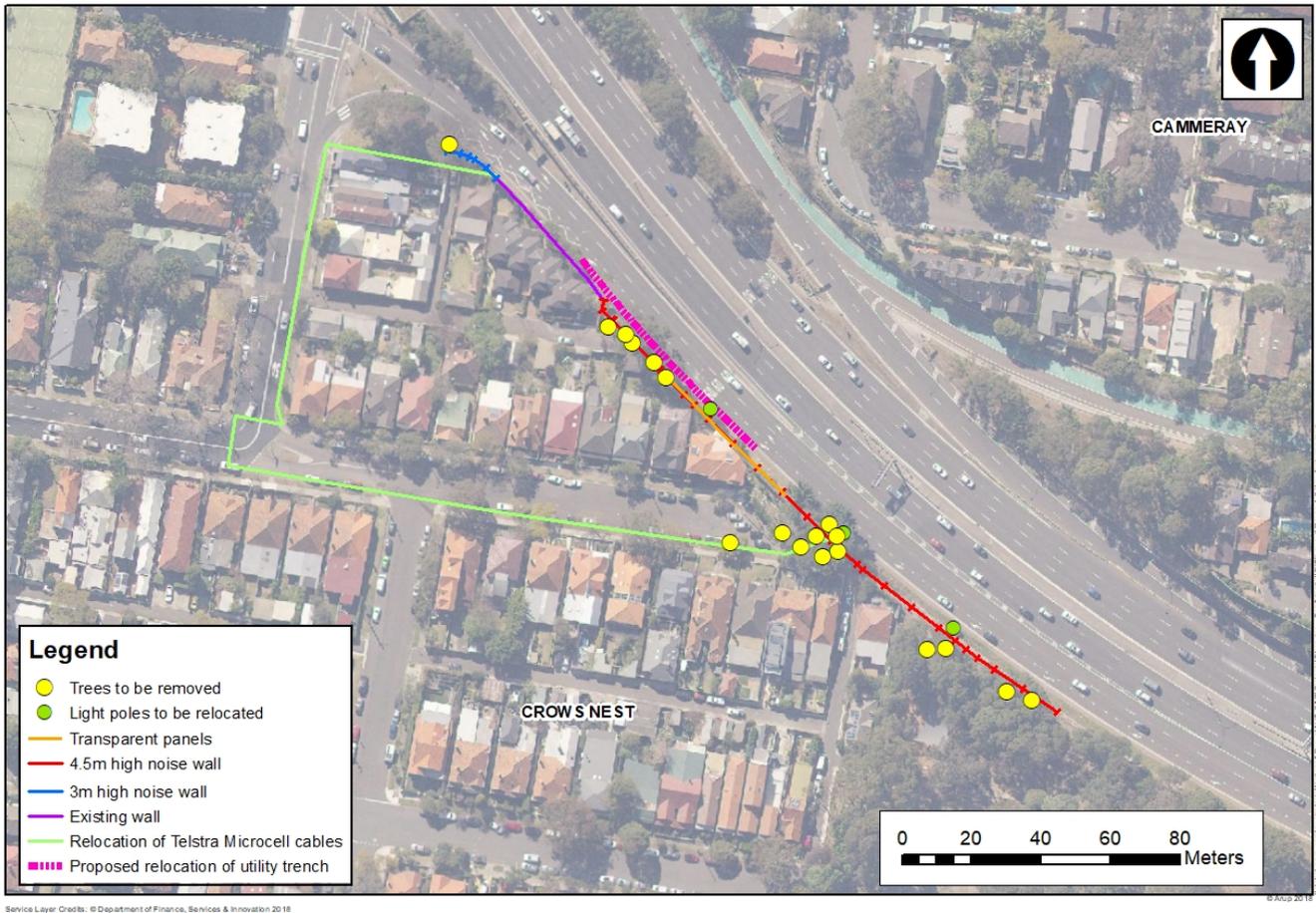
The location of the proposal is shown in Figure 1-1 and an overview of the proposal is provided in Figure 1-2. Chapter 3 describes the proposal in more detail.

Construction of the proposal is expected to start in early-2019 and site work is expected to last for about eight to ten months.



Source: Arup

Figure 1-1: Location of the proposal



Source: Arup

Figure 1-2: The proposal

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Arup on behalf of Roads and Maritime Motorway Division. For the purposes of these works, Roads and Maritime is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (*Is an EIS required? Guidelines*, Department of Urban Affairs and Planning, DUAP, 1995/1996), *Roads and Related Facilities EIS Guideline* (DUAP 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government’s *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of:

- Section 5.5 of the EP&A Act including that Roads and Maritime “examine and take into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity”.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act, and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured.

The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of the Environment and Energy for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2. Need and options considered

This chapter describes the proposal's strategic setting and operational need. It identifies the various options considered, and the process for selecting the preferred option for the proposal.

2.1 Strategic need for the proposal

The NSW Government recognises that in certain circumstances the continued increase in traffic on the State's roads has led to people being exposed to high levels of road traffic noise. Roads and Maritime, in its role as the State road authority, has accordingly developed the NAP to address this. Access to treatment under the NAP is subject to satisfying the seven eligibility criteria described on page two of the following link:

www.rms.nsw.gov.au/documents/about/forms/45064839-noise-abatement-program-application.pdf

In summary these criteria are:

- For there to be at least one eligible applicant
- The applicant's property to be classified as a sensitive receiver
- The property is being impacted by an existing road that is not proposed to be upgraded within a reasonably foreseeable timeframe
- External noise levels are at least 65 decibels, dB(A) during the day/evening (7am to 10pm) or 60 dB(A) at night (10pm to 7am)
- Treatment is deemed cost-effective, equitable and practical
- Approval to build the owner's property was granted before 1 January 2009, which is the date mandatory requirements for providing noise mitigation for new buildings alongside busy roads were set out in State Environmental Planning Policy (Infrastructure) 2007.

Mitigation available under the NAP includes the use of barriers/walls, mounds and architectural acoustic treatments. Any measures will only be installed where feasible and reasonable and shown to provide a noticeable reduction in road traffic noise exposure for the occupants/users. The NAP states that measures must be assessed as being feasible and reasonable using the process described in the Noise Mitigation Guideline (NMG, Roads and Maritime, 2015). The NMG contains procedures to define feasible and reasonable measures. These are based on considering aspects such as constructability, safety, maintenance, level of noise reduction, extent of noise benefit and cost. The NMG also describes it being reasonable to build a noise wall where it provides at least a 5 dB(A) reduction in noise for the community or local residents, referred to as an 'insertion loss' benefit. The guideline also recognises that it is more effective to use a noise wall to treat several properties located next to each other instead of installing architectural treatment measure at each individual property.

If an affected eligible property is part of a complex, set of units, or is divided into multiple dwellings, then the other properties are also considered eligible for treatment under the NAP.

Properties close to the Warringah Freeway, between St. Thomas' Rest Park and Brook Street, were identified as experiencing road traffic noise at levels that satisfy the eligibility criteria of the NAP. As a result, the need for noise treatment measures were investigated in this area.

2.2 Existing infrastructure

This section describes the existing infrastructure of the proposal footprint and local area.

Warringah Freeway

The Warringah Freeway typically a north-south running seven-lane road with three lanes northbound and four lanes southbound. The off ramp to Brook Street includes an additional three slip lanes; comprising two dedicated right-turn lanes and one dedicated left-turn lane. There has been about a four per cent increase in traffic on the freeway annually over the past 13 years. Currently, about 170,000 vehicles travel along the freeway on average each day at the Brook Street Interchange, making it one of the busiest roads in the State.

Brook Street interchange

Brook Street is a half-diamond interchange, with south facing ramps. This means traffic can only join the Warringah Freeway via an on ramp to travel south and leave the freeway via an off ramp when travelling north. The on and off ramps connect to Brook Street via two signalised intersections (ie one for the on ramp and one for the off ramp). The interchange provides access to Crows Nest to the west, via Chandos Street and Willoughby Road, and Willoughby and Northbridge to the east, via Brook Street.

Changing topography and road verge

The changing topography means that sections of the Warringah Freeway are in cutting while other sections are raised above the surrounding area. The noise wall would be built in an area of changing topography.

The off ramp near Chandos Street begins next to a section of freeway in cutting. It then follows the natural topography sloping down to the signalised intersection at Brook Street, while the freeway remains on a similar level to bridge over Brook Street.

The western road verge is limited to a maximum width of about four metres. It includes a narrow two metre verge strip, with the rest of the verge taken up by cutting, roadside utilities, amenity planting, and property boundary walls. The road verge utilities include street lights, power poles, signage, and cables and conduits. The amenity planting includes grassed sections and mature trees (Sydney blue gums) planted at the time the freeway was built.

Adjacent land uses

A mix of low-rise residential units and double-storey houses face and back onto the freeway as shown in Figure 2-1. At the start of the off ramp, people living at the eastern end of Chandos Street overlook the freeway. Residents living at the eastern end of Jenkins Lane back onto the off ramp. The relative height of these properties changes over the length of the ramp due to the change in topography. The properties on Chandos Street are up to six metres above freeway, while properties near the Brook Street interchange are about seven metres below the freeway.

St. Thomas' Rest Park runs alongside the Warringah Freeway for about 150 metres between West Street and Matthew Lane. The park overlooks the freeway and its boundary is about six metres from the western kerb line. The park is about seven metres above the freeway, however the cutting height varies over the common boundary between the freeway and the park. Part of the park, set back from the freeway, is designated as a locally listed landscape heritage item in the North Sydney local environment plan (LEP).



Source: Google maps

Figure 2-1: Existing properties and recreational area (greys shading represents the extent of the heritage listed area of St. Thomas' Rest Park)

2.3 Proposal objectives and development criteria

This section describes the objectives and criteria that were adopted and used to develop options and select a preferred option.

2.3.1 Proposal objectives

The objectives of the proposal include:

- Reducing road traffic noise levels at affected properties
- Ensuring high-quality urban design outcomes sympathetic to the surrounding environment
- Minimising environmental, property and amenity impacts where feasible and reasonable
- Avoiding utility and road infrastructure impacts where feasible and reasonable
- Ensuring future maintenance access.

2.3.2 Development criteria

The development criteria of the proposal include:

- Addressing the requirements of the NAP when designing the proposal
- Providing at least a 5 dB(A) reduction in noise in the local area consistent with the 'insertion loss' criteria set out in the NMG
- Designing the noise wall to the specifications in R271: The Design and Construction of Noise Walls (Roads and Maritime, 2017)
- Responding to the noise treatment principles described in the NMG and the Noise Wall Design Guidelines (RTA, 2006).

2.3.3 Urban design objectives

The urban design objectives for the proposal are taken from Noise Wall Design Guidelines (RTA, 2006) and Beyond the Pavement (Roads and Maritime, 2010); the document that sets out Roads and Maritime's urban design policy, requirements and principles.

The urban design objectives of the proposal include:

- Contributing to urban structure and revitalisation
- Fitting-in with the built fabric and landform
- Responding to the natural topography of the environment
- Incorporating heritage and cultural contexts
- Achieving an integrated and minimal maintenance design.

These objectives were considered during development of the urban design strategy for the proposal.

2.4 Alternatives and options considered

This section describes the options considered for the proposal and demonstrates why the preferred option was chosen.

2.4.1 Methodology for selection of preferred option

The method for selecting the preferred option was based on responding to the provisions of the NMG.

The NMG sets out a preferred order of mitigation as:

- Road design and traffic management measures, including shielding the road with natural landscape features, minimising the need for compression release engine braking, and introducing signage
- Quieter road pavement surfaces, including different asphalt types and mixes
- Noise barriers in the form of walls and mounds
- At-property treatments, including architectural upgrades such as sealing windows and mechanical ventilation, or localised screening.

Other guidelines, such as the Road Noise Policy (RNP, DECCW, 2011), supplement this by defining what constitutes reasonable mitigation as being a balance of whether the overall noise benefits outweigh the adverse social, economic and environmental effects and implementation costs. To judge what constituted reasonable mitigation consideration is given to:

- Existing noise and amenity levels
- Noise mitigation benefits
- Value for money
- Community views.

The identified options also considered the following engineering issues set out in the NMG to determine what can be feasibly built within the confines and constraints of the local area:

- Safety issues, such as restrictions on road vision
- Space limitations and other constraints along the road corridor
- Access requirements
- Maintenance access and requirements
- Suitability and effectiveness of the affected buildings to receive at-property treatments
- Local government planning policy objectives
- Utility service relocation costs.

In summary, the method for identifying options and selecting a preferred option was two-staged:

- Consideration whether the proposal in any configuration could be justified, this is an evaluation of comparing the option of doing nothing over doing something.
- Evaluation options by referring to their respective impacts and benefits.

At each stage, the identified options were compared against the proposal objectives described in section 2.3.1.

2.4.2 Identified options

The two options in Table 2-1 were identified and analysed.

Table 2-1: Form of treatment and reasonable mitigation options

Ref	Description
1	Do-nothing option – no provision of noise abatement measures at the site
2	Install a noise wall with at-property treatments of qualifying residences

2.4.3 Analysis of options

This section describes how each option was evaluated and compared against the proposal objectives and how this led to the selection of the preferred option.

The option of 'doing nothing' (Option 1) would fail to meet the core objective of reducing external road traffic noise levels at properties currently affected. As such, these properties would continue to experience noise levels above the NAP criteria. Noise levels are also likely to increase over time due to the four per cent increase in traffic each year on the Warringah Freeway as discussed in section 2.2. Doing nothing only becomes preferred in circumstances where the engineering constraints, associated costs, and/or environmental and community impacts of proceeding outweigh the benefits.

In this case, and on balance, it was concluded that there were feasible and reasonable engineering solutions that could deliver a value-for-money noise benefit without having a significant environmental or social impact. This made the option of installing a noise wall (Option 2) the only measure that could be feasibly or reasonably taken forward.

Option 2 meets the first proposal objective by reducing road traffic noise levels at all affected properties.

The design of noise attenuation measures as part of Option 2 has followed the requirements of the NMG to determine if measures are feasible and reasonable by assessing the reduction in noise from building the noise wall (referred to as an insertion loss in the guidelines) at nearby properties. Future road traffic noise levels at properties, with the noise wall in place, have also been assessed against the NAP criteria.

Urban design has been considered throughout the development of Option 2, to provide outcomes sympathetic to the surrounding environment in line with the second proposal objective. This is evidenced by the inclusion of transparent panels to minimise overshadowing and visual impacts (refer to section 2.6) and the provision of landscaping to screen the noise wall.

While Option 2 would have greater environmental impacts compared to Option 1, and would require some relocation of utilities and roadside infrastructure, it has been developed to minimise impacts where feasible and reasonable and is therefore consistent with the relevant proposal objectives.

Option 2 has also been developed to allow future maintenance access to both sides of the proposed noise wall to be consistent with the final proposal objective.

2.5 Preferred option

Option 2 was selected as the preferred option. The noise wall would be built at the top of the cutting following the natural topography and is aligned to minimise the need to relocate utilities and roadside infrastructure as far as practicable. The existing property boundary wall at the end of Jenkins Lane would be retained and a short section of noise wall at the same height (e.g. three metres) would be built to Brook

Lane. The proposal would need supplementing with at-property treatment measures for those locations where road traffic noise levels would continue to exceed and the NAP eligibility criteria.

The principles of ecologically sustainable development (ESD) were also considered in selecting the preferred option, where a simple cost-effective design was selected that; makes use of the existing infrastructure along the Warringah Freeway, provides a socially-beneficial outcome that reduces noise for existing and future generations, offers a solution that has no material impact on key ecological values in the area, and, provides an outcome where the impacts can be mitigated to acceptable levels by adopting a range of standard and specific safeguards and management measures. Section 8.2 considers the ESD principles associated with the preferred option in more detail.

2.6 Design refinements

Following selection of the preferred option, analysis was carried out to determine the required height of the proposed noise wall.

Section 6 of Appendix C describes the assessment carried out under the provisions of the NMG to determine what height the wall would need to be built at to treat the affected properties. This assessment confirmed that the initial design barrier height in accordance with the NMG was eight metres. However, this height was not considered reasonable or feasible for the following reasons:

- Potential visual amenity and overshadowing impacts to adjoining properties
- Significant constructability challenges associated with installing an eight metre high noise wall in that location due to the positioning on top of a rock cutting and associated access constraints
- Consideration of potential impacts on private property, as an eight metre high noise wall would require larger structural supports.

Further, even if a wall was built to the maximum height of eight metres as set out in the NMG it would not treat all affected properties.

Consideration was then given as to what height it would be reasonable to build a noise wall accounting for the above factors.

It was concluded that a reduction of at least 5 dB(A) could be cumulatively achieved by building a 4.5 metre high noise wall across most of the proposal footprint, thus achieving the insertion loss benefit described in section 2.1. This provided the preferred height of the noise wall while also confirming the need to provide supplementary at-property treatment measures.

The preferred height for the additional section of noise wall between the existing property boundary wall and Brook Lane was determined to be three metres, to match the height of existing property boundary wall. This would provide the most beneficial outcome from a visual impact and urban design perspective.

For the section of noise wall between St. Thomas' Rest Park and the existing property boundary wall at the end of Jenkins Lane, consideration was then given as to whether a 4.5-metre-high noise wall along its chosen alignment would overshadow and visually impact on adjacent properties. As a result, the design was further refined at one location to incorporate transparent panels along the top two metres of the noise wall.

Figure 2-2 shows in orange the location where the top two metres of the wall would include transparent panels. Section 6.2 and section 6.6 provide the full overshadowing and visual amenity impacts assessment.



Service Layer Credits: © Department of Finance, Services & Innovation 2018

© Arup 2018

Source: Arup

Figure 2-2: Transparent panel locations

3. Description of the proposal

This chapter describes the proposal, design parameters, major features, construction method, and associated infrastructure and activities.

3.1 The proposal

The proposal involves building a new noise wall next to the western side of the Brook Street off ramp of the Warringah Freeway.

Key features of the proposal include:

- Installing a 4.5-metre-high noise wall for about 180 metres along the western side of the Warringah Freeway between St. Thomas' Rest Park and the existing brick property boundary wall at the end of Jenkins Lane
- Installing a three-metre-high noise wall about 17 metres long out from the existing brick property boundary wall at the end of Jenkins Lane to Brook Lane
- Relocating existing roadside infrastructure such as light poles and utilities
- Introducing landscape planting and urban design measures.

Figure 1-2 shows the key features of the proposal. Figure 3-1 shows the construction footprint where the work needed to build the proposal would be carried out. The additional space included in the construction footprint is set aside for access and storage.



Source: Arup

Figure 3-1: Construction footprint

Figure 3-2 shows a montage of the final wall design once it is installed and the landscape planting has established and matured.



Source: Arup

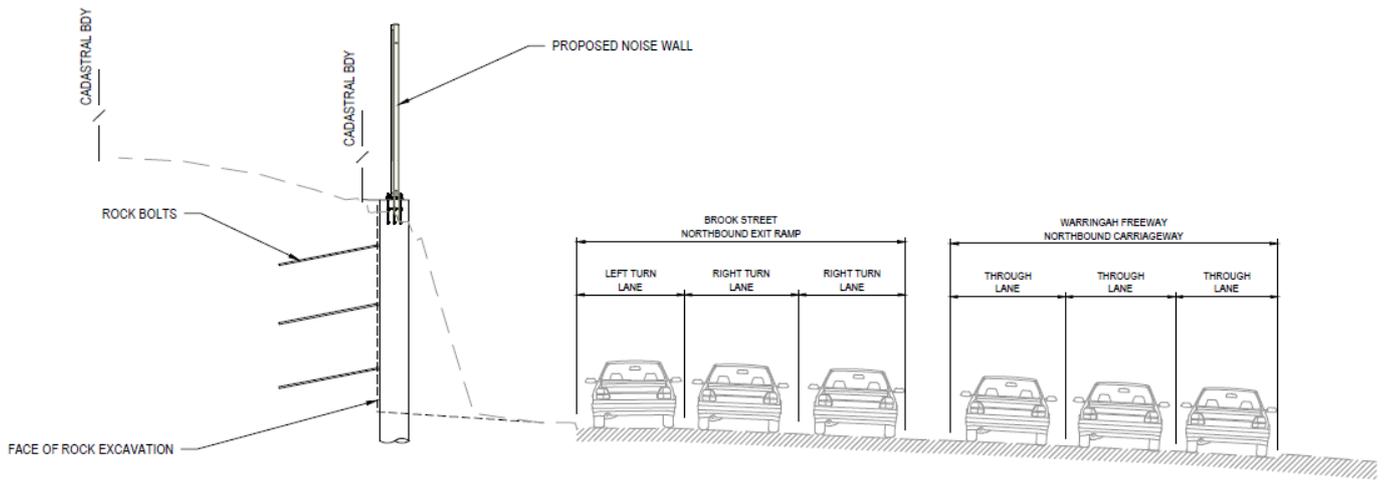
Figure 3-2: Photomontage of the proposed noise wall

The proposal is subject to detailed design, during which, further investigation may result in minor changes to the proposal. The detailed design would also be used to confirm the specifics of the at-property treatments. Where changes are identified, Roads and Maritime would determine the need for any further environmental assessment.

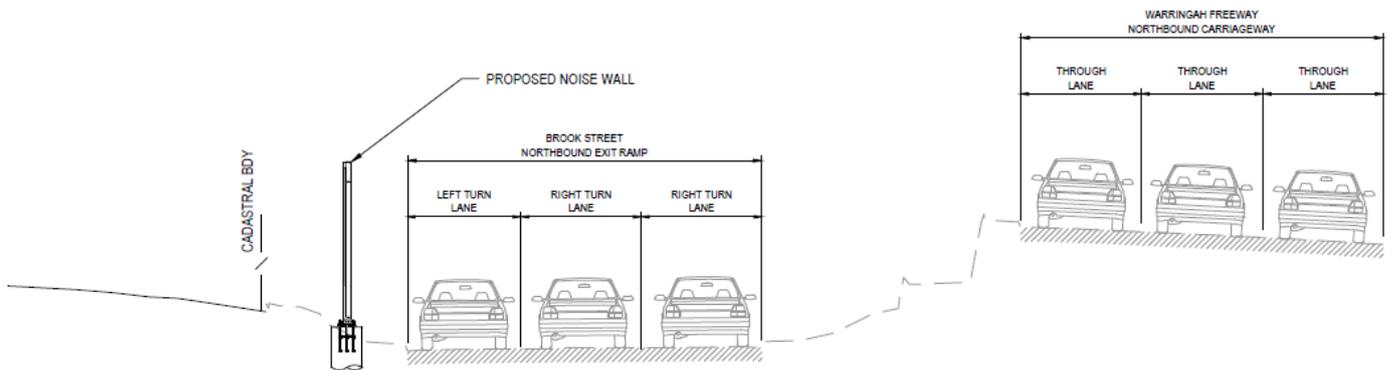
3.2 Design

The concept design is described below, including the adopted criteria, constraints to development and a specification of the key features.

Figure 3-3 shows a typical cross section of the noise wall at two locations once it is installed, representative of the area where the Warringah Freeway is in cutting and at the Brook Lane.



Noise wall on cutting



Noise wall at grade

Source: Arup

Figure 3-3: Typical cross section of the Warringah Freeway once the noise wall is installed

3.2.1 Design criteria

The proposal has been designed to NSW and Australian engineering, road safety and environmental standards developed by Roads and Maritime, Austroads and Standards Australia. It has also adopted the key design requirements and processes listed in quality assurance specification R271: Design and Construction of Noise Walls (Roads and Maritime, 2017). Table 3-1 includes the design criteria adopted for the proposal's concept design.

Table 3-1: Design criteria

Aspect	Design criteria
Alignment along the road	Installed within the road reserve typically about one to two metres from the kerb line on the at-grade sections and four to six metres from the kerb line at the top of the rock face cutting.
Height, length and location	<ul style="list-style-type: none"> • Wall height 4.5 metres above its installation point • About 180 metres long starting next to St. Thomas' Rest Park extending north to the existing property boundary wall at the end of Jenkins Lane • Overall relative height varies depending on the natural topography • A three-metre-high wall will be installed from the existing property boundary wall about 17 metres to the north to Brook Lane.
Material selection and thickness	<ul style="list-style-type: none"> • The noise wall panels would be up to 0.1 metres wide along its length • Formed of solid panels. Modular solid panels are recognised for their strength, durability, noise absorption, and shatter and fire resistance. It also provides a low-maintenance design.
Drainage requirements	Refer to section 3.2.3.
Fences and gates	Gates would be installed to provide maintenance access behind the noise wall between Chandos Street and Matthew Lane.
Architectural treatment	<ul style="list-style-type: none"> • The solid panels would be painted along both sides of the entire noise wall as an urban design architectural treatment, which would be finalised during detailed design • Transparent panels would be cut to size and installed for the top two metres of the noise wall at the end of Chandos Street to minimise overshadowing and visual impacts.

3.2.2 Engineering constraints

Table 3-2 lists the main constraints to development and how they have been addressed in the design.

Table 3-2: Engineering and development constraints

Constraint	Constraint management
<i>Live traffic conditions:</i> the high traffic volumes along	Working with the Transport Management Centre to develop and deliver a Traffic Management Plan, Traffic Control Plan, and construction program. The proposed closure of the inside lane of the Brook Street off ramp for

Constraint	Constraint management
the freeway and the need to work under live conditions	eight to ten months to allow construction to be carried out in a safe and efficient manner.
<i>Warringah Freeway</i> : limited space along the existing road corridor for access.	Selecting a preferred option that minimises property impacts while having the wall sufficiently set back from the kerb line to meet safety design requirements. Working with the Transport Management Centre to develop and deliver a Traffic Management Plan, Traffic Control Plan, and construction program, which protects road users, residents, construction workers and other members of the public.
<i>Topography</i> : the changing levels along the road relative to the surrounding noise sensitive receivers	Selecting a preferred option that has ensured that the top of the noise wall would be stepped in a regular pattern to remain constant against the changing topography.
<i>Residential properties</i> : the limited space between the freeway boundary and adjacent properties	Selecting a design that is consistent with road safety design requirements and avoids property acquisition, while retaining property access.
<i>Existing mature trees</i> : amenity planted trees along the road boundary	Altering the noise wall alignment and height to minimise vegetation removal and tree loss (including pruning), especially around the Brook Street interchange.
<i>Utilities</i> : the presence of electrical and telecommunication cables within the proposal footprint.	Selecting a design solution located back from the kerb line where feasible to avoid known utilities, carrying out early investigation work to confirm the location and specification of unavoidable utilities, and developing a relocation plan in consultation with the service providers.
<i>Poor rock quality</i> : the presence of weak sandstone associated with the existing rock face cutting	Installing rock bolts along the rock face cutting to improve its engineering strength to support the noise wall and protect adjacent residential properties.
<i>Other work activities and events</i> : activities taking place on this section of the Warringah Freeway at the same time.	Working with the Transport Management Centre to develop and deliver a construction program that accounts for the closure of the Sydney Harbour Bridge for key events plus ensuring the work aligns with other projects taking place on the freeway locally such as the upgrade of the Northern Toll Plaza which is scheduled for the second half of 2018 over a ten-month period (refer to section 6.8).

3.2.3 Major design features

The proposal includes the following key design features.

Noise wall

The noise wall would form a continuous structure between St. Thomas' Rest Park and the existing property boundary wall at the end of Jenkins Lane. It would be installed on top of rock face cutting set back from the freeway kerb line. Due to constructability challenges along this section of the proposal, the footings of the noise wall would vary and include strip footings with L-shaped retaining walls, a bridging beam and piled steel support posts for some sections of the wall. The noise wall would tie in to the existing property boundary wall at the end of Jenkins Lane. The freeway boundary fence in the north-west corner of St. Thomas' Rest Park and the section between Matthew Street and Chandos Street would need to be removed to install the noise wall.

If adverse defects are identified in the rock cutting on top of which the noise wall sits, bolts would be drilled up to three metres into the rock cutting to provide added engineering strength.

The section of noise wall from the existing property boundary wall to Brook Lane would be built at grade and would tie into the existing wall. This section would be installed on steel support posts.

Transparent panels would be installed for the top two metres of the wall at the end of Chandos Street as described in section 2.6.

Figure 3-2 shows the varying height of the wall and how it would look from the Warringah Freeway.

Drainage

By installing a noise wall this would affect overland stormwater runoff. The following low-maintenance drainage provisions would be installed to manage runoff to prevent water from ponding against the noise wall or discharging overland to adjacent properties.

A drainage channel would be installed behind the noise wall between Matthew Lane and St. Thomas' Rest Park. It would tie into the existing stormwater drainage channel at the edge of St. Thomas' Rest Park.

A swale drainage channel would be installed along the base of the noise wall at Jenkins Lane. It would connect into existing drainage system at the Brook Street interchange.

The final drainage arrangement would be confirmed during the detailed design.

Supporting infrastructure

While the specifics of the work to relocate or install supporting road infrastructure, lighting, signage and street furniture would be confirmed during the detailed design, it would likely include:

- Relocating utilities (see section 3.5)
- Any w-beam road barriers, kerb and gutter and signage that is impacted by the works in Chandos Street and Matthew Lane will be reinstated at completion of the works.

Urban design and landscaping

The urban and landscape design strategy (refer to section 4 of Appendix D) responds to the provisions and specifications of R271: The Design and Construction of Noise Walls and Beyond the Pavement.

Urban design

Section 2.3.3 describes the urban and landscape design objectives as adopted from Beyond the Pavement (Roads and Maritime, 2010). Table 3-3 describes the current key urban design features responding to these objectives.

Table 3-3: Key urban design features

Design feature	Urban design consideration
Alignment	Install the noise walls parallel to the kerb and set back between one and six metres from the kerbside to reduce the perceived mass and improve the setting within the road corridor and wider landscape.
Maintenance access	Ensure there is a minimum clearance of 0.8 metres behind the noise wall for maintenance access where practical.
Achieve a high-quality landscape solution throughout	Introduce new native tolerant low-maintenance dense amenity planting along the base of the wall where feasible to mitigate against vegetation removal and to improve urban amenity. Introduce similar amenity planting along the inside of the wall along its interface with the St. Thomas' Rest Park to visually reduce the appearance, mass and scale of the wall in this landscape setting.
Facing treatment (front)	Paint the wall to ensure consistency within the existing Warringah Freeway corridor setting.
Facing treatment (back)	Treat the back of the noise wall panels by using appropriate plain colours, textures and integrated fixings to improve its appearance and visual setting.
Panel connection and installation	Step the noise wall panels at a regular interval to provide consistency and continuity in the visual form. Treat and infill the cut recesses to provide visual continuity and preserve the urban form and value of the exposed rock faces.

Landscape plan

Figure 3-4 shows the proposed landscape plan. It includes vegetation and tree preservation where feasible and reasonable, new groundcover planting, and low-level tolerant dense native shrubs along the rear side of the wall to integrate it into the setting and context of the surrounding landscape and reduce its overall visually mass and scale.



Source: Arup

Figure 3-4: Landscape plan

3.3 Construction activities

The appointed contractor would confirm the final construction activities in discussion with Roads and Maritime. As such, this section only indicates a likely method and work plan. The work method and plan may vary due to the identification of additional constraints, detailed design refinements, community and stakeholder consultation feedback, and contractor requirements/limitations. Should the work method materially differ from what is proposed in this REF, then the contractor would consult Roads and Maritime to determine if additional assessment and/or safeguards and management measures are needed.

3.3.1 Work methodology

The proposal would be built under Roads and Maritime specifications as managed by a contractor under a construction environmental management plan (CEMP). These specifications cover environmental performance and management supplemented by aspects such as vegetation removal, stockpile management, and erosion and sediment control.

Staging

The proposal would be likely built in several stages to reflect contractor requirements, road occupancy restrictions, delivery schedules, and material and equipment availability. The staging process would also allow for effective site and environmental management from the point of not placing too much demand on the ancillary facilities, haul routes, and local community. Various physical and operational constraints may also affect how the proposal is built, key of which are the need to:

- Work in a live traffic environment
- Maintain operational traffic flows, access and travel speeds especially during peak periods
- Lift large pieces of equipment into place above the Warringah Freeway
- Carry out work close to residential properties.

Broadly, the staging would involve sequenced packages of early work, temporary work and main work as described below.

Early work

Early work would take place before the main work. It would be used to benefit the timing and sequencing of constructing the proposal. The early work expected to take place under the proposal would involve:

- Obtaining leases and licences (refer to section 7.3)
- Notifying the public, businesses, public transport companies, Council and other stakeholders before work starts
- Carrying-out pre-clearance inspections, geotechnical investigations, precondition surveys, and other investigation work as needed (refer to chapter 7)
- Setting out, demarking and fencing the area to establish routes, accesses, and no-go zones
- Protecting and relocating existing utilities and lighting cabling
- Clearing land (vegetation removal, clearing, grubbing and mulching) and temporarily removing any structures such as boundary fencing, signs and other street furniture.

Temporary work

Temporary work includes the ancillary facilities and management controls that would be needed to support construction. It would include:

- Introducing:
 - Environmental management provisions, including hoardings and erosion and sedimentation and drainage controls
 - Traffic management controls and site entry and exit points, when working on the Warringah Freeway or Brook Street under a road occupancy licence
- Establishing the construction compound within the verge of Metcalfe Street and under the West Street overbridge, access and haul routes, and other ancillary facilities.

Main work

The proposed staging of the main work would likely involve:

- Stage 1: building the noise wall
- Stage 2: introducing the urban design treatments and landscape planting
- Stage 3: finalising the site work and handing back.

Table 3-4 provides elements of the proposal that would be likely constructed under each stage.

Table 3-4: Proposed construction staging and typical activities

Stages	Typical activities
Stage 1: building noise wall	<ul style="list-style-type: none">• Realign services and lighting cabling where required• Cut back the rock face to prepare for the future upgrade of the Warringah Freeway• Carry-out localised rock cuttings• Drill, install and secure the rock bolts• Treat and infill the cut recesses• Pile and form foundations• Place reinforcement and install formwork• Pour the concrete foundations• Receive, lift and install the modular solid and transparent panels• Excavate and install the required drainage channels.
Stage 2: urban design and landscape planting work	<ul style="list-style-type: none">• Install the panel surface treatments• Carry-out the landscape planting.
Stage 3: finalisation and handback	<ul style="list-style-type: none">• Relocate/install street lights, conduits and cabling• Remove the temporary environmental and traffic management controls• Clean-up and hand back the site and recycle/dispose of surplus material.

Workforce

It is expected that there would be about 20 people onsite at any time, however this may increase to about 50 during the main construction activities such as lifting and placing the panel sections. Should the various sections of wall be installed at the same time then the number of people onsite would proportionally increase.

3.3.2 Construction hours and duration

This section describes the expected construction start date, duration of work and expected working hours.

Start date and length of construction

Subject to determination, work is expected to start in early 2019 with work expected to last eight to ten months.

Working hours

Approval has been sought from the Transport Management Centre to close the inside lane on the Brook Street off ramp for the duration of the work. This allows the construction phase to be shortened as proposed work can be completed behind road barriers, allowing most of work to be undertaken within standard work hours. However, some work would still need to take place during the evening and night to minimise traffic disruption on the Warringah Freeway and Brook Street off ramp.

Standard work hours are:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm.

However, certain work activities would need to take place outside of these hours. Proposed night work construction hours would be 8pm to 5am, excluding Saturdays, taking place for up to 60 shifts over about 20 weeks. The noisiest work would be completed by midnight (breaking rock, jack hammering, piling into rock) with less noisy construction activities still taking place after midnight. Proposed night work construction hours were developed in consultation with the community during September 2018, as discussed further in section 5.2.

3.3.3 Plant and equipment

The plant and equipment needed to build the proposal would be typical to road work and it would vary depending on the construction activity. The largest and most complex equipment needed would be to receive, lift and install the noise wall panels.

Table 3-5 indicates the plant and equipment that would be likely used to build the proposal however this would be finalised by the contractor and it is not exhaustive.

Table 3-5: Indicative plant and equipment

Construction phase	Plant and equipment		
Enabling work	Chainsaw Cherry picker or Hiab truck Chipper and mulcher	Crane Daymaker (site lights) Dump truck Power generator Compressor	Excavator Hand tools Stump grinder Elevated work platform
Temporary work	Concrete truck Containment screens Daymaker (site lights) Dump truck Excavator	Franna crane Hand tools Light vehicles Power generator Compressor	Profiler Rigid Truck Elevated work platform Water cart
Main work			
Stage 1: Constructing the noise wall	Air track drill Backhoe Elevated work platform Compressor Concrete pump Concrete vibrator Daymaker (site lights) Dump truck	Excavator Excavator with hammer attached Excavator with rock saw Excavator with rock saw Grinder Mobile crane	Piling/drilling rig Pneumatic hammer Power generator Power saw Vacuum truck Water cart Welding equipment Franna crane 40-50 Tonne Crane
Stage 2: Urban design and planting	Hand tools Light vehicles	Excavator Trucks	Water cart
Stage 3: Finalisation and handback	Asphalt truck and sprayer Daymaker (site lights) Dump truck Franna crane	Front end loader Pavement laying machine Pavement profiler	Road truck Scissor lift Smooth drum roller Power generator

3.3.4 Earthworks

Excavated material would be generated during the work from the bored piles and cutting excavations. The material will either be used on site or transported offsite to a licenced disposal facility.

3.3.5 Source and quantity of materials

Various standard construction materials that are readily available across Sydney would be needed to build the proposal. This would include prefabricated units ready for installation (eg noise wall panels), or materials that would be stored at the construction compound (refer to section 3.4). Material quantities would be small and would include:

- Noise wall panels both solid and transparent
- Reinforcing Steel for concrete elements
- Rock bolts (if installed)
- Steel noise wall posts
- Concrete for the foundations
- Wood for the formwork and temporary works
- Hard and soft landscaping materials such as trees, shrubs, seedlings, mulch, chippings and turf
- Additional materials such as small quantities of paint, oils and fuels.

In sourcing materials, Roads and Maritime would require the contractor to use local suppliers as a priority, provided the materials sourced meet the specifications.

Water would also be needed to control dust, mainly during the earthworks and rock cutting. This would be carted to site.

3.3.6 Traffic management and access

Existing road traffic would be managed in accordance with a proposal-specific traffic management plan and traffic control plan that would be developed in accordance with requirements of the issued road occupancy licences. Lane closures and speed restrictions would be implemented on the Brook Street off ramp to undertake most of work activities. Temporary lane closures may be needed at Brook Street during the utility relocation work. Road Occupancy Licences (ROL) would be obtained where needed to carry out the work.

During the lane closure, traffic would divert to use the outside lanes of the Brook Street off ramp. Additional lane closures would only be needed occasionally to carry out key activities such as lifting and placing the noise wall sections. This work would be timed to avoid peak periods where feasible and reasonable.

It is expected that during construction there would be about 10 heavy-vehicle (including semi-trailers, rigid trucks and cranes) and 10 light-vehicle movements per shift to and from site. These vehicles would be needed to deliver equipment, remove waste and transport construction workers. Vehicles would typically arrive and leave site via the Warringah Freeway except where light vehicles and some small plant and equipment are used for day work, where they would access, and park on, the local roads near the construction footprint, potentially haven driven to site either via the Warringah Freeway or Pacific Highway.

Vehicular access from West Street into St. Thomas' Rest Park may also be needed to assist with the installation of the noise wall. The contractor would need to seek approval from North Sydney Council and make-good any adjustments to the existing fence or landscaping to allow vehicles to access the north-west corner of the park. Figure 3-5 shows an indicative access path through St. Thomas' Rest Park.



Source: Roads and Maritime

Figure 3-5: Indicative vehicle access routes through St. Thomas' Rest Park

3.4 Ancillary facilities

Figure 3-6 shows the proposed location of the construction compound on the verge of the Warringah Freeway under the West Street overbridge. This facility would be used for:

- Refuelling
- Vehicle wash down
- Material storage and laydown
- Staff parking, site offices and amenities
- Construction equipment, plant and vehicle storage.

The proposed site was chosen to best respond to the following criteria:

- At least 40 metres away from the nearest waterway
- Of low ecological and heritage conservation significance
- Located away from residential dwellings and other land uses that may be sensitive to noise
- On relatively level ground
- Outside the 1-in-10-year average return interval (ARI) floodplain.

Additional temporary self-contained toilet and welfare facilities would be located close to where the wall would be installed, while a small shipping container may be used to store small equipment and essential materials. During any night work it would be for the appointed contractor to demonstrate how it can mobilise and demobilise at the end of each work shift, while managing equipment, materials and waste.

The construction compound would be secured with fencing and lockable gates. It would be powered and lit, while communications would be installed. Erosion and sediment control provisions and other Council and contractual requirements would be installed to ensure the compound is maintained in a good condition.

Upon completion of the work the compound and associated work areas would be removed, cleared of all rubbish and rehabilitated. It is recognised that the proposed construction compound would be located close to residents on Metcalfe Street, which is unavoidable due to the lack of suitable alternatives nearby. There is an existing noise wall between the Warringah Freeway and Metcalfe Street that would help protect associated residents from the noise generated at the proposed site compound. Chapter 7 discusses the standard measures that would be adopted at the site compound to minimise amenity-related impacts.



Source: Arup

Figure 3-6: Location of Site compound

3.5 Public utility adjustment

Existing street lighting poles and underground electrical connections, along with buried communication cables would need relocating to support the proposal. The following utility relocations and adjustments are proposed:

- Light poles on the western verge of the Warringah Freeway would be moved farther from the road and recessed back into the rock cutting
- A utilities trench for power for street lighting would be moved closer to the verge of the Warringah Freeway
- Associated lighting conduits and cabling would be relocated to support the light pole relocations
- A Telstra telecommunications microcell on one of the lighting poles would be relocated with the light pole
- The cabling for the Telstra telecommunications microcell would be relocated from Brook Street and the verge of the Warringah Freeway to Chandos Street, where it would reconnect with the microcell and associated light pole at the end of Chandos Street
- A Telstra cabinet on a concrete plinth would be installed at the rear of the noise wall at the end of Chandos Street to house cables and conduits as part of the relocation of Telstra utilities
- Electrical and communication cables would be locally relocated to avoid the footprint of the wall so as to allow for future access and maintenance.

Temporary outages of the light poles and the Telstra communications microcell are anticipated during relocation. However, all utility relocation work would be programmed in consultation with the utility companies and to minimise the length of time of any outages and any subsequent disruption. Any potential safety impacts would also be considered during utility relocation.

The specifics surrounding utility relocations would be confirmed during the detailed design.

3.6 Property acquisition

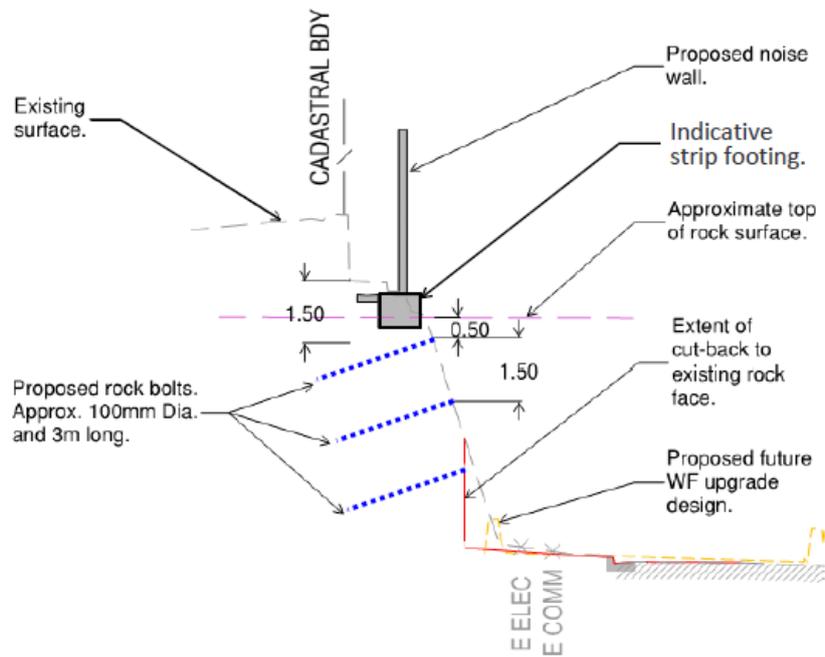
Subsurface acquisition may be needed from four properties, 3 Matthew Lane (and Council land between the property and the freeway) and 170, 172 and 174 Chandos Street, to install rock bolts to support the cutting. Rock bolts may also need installing for the section of the cutting at St. Thomas' Rest Park, which is owned by Roads and Maritime, but maintained North Sydney Council.

The need for any substratum acquisition would be confirmed during the detailed design, and where needed, Roads and Maritime would contact the affected property owners. Figure 3-7 shows a cross section of the potential subsurface acquisition at two locations along the cutting, representative of those private properties affected. The subsurface acquisition process is described in the following fact sheet:

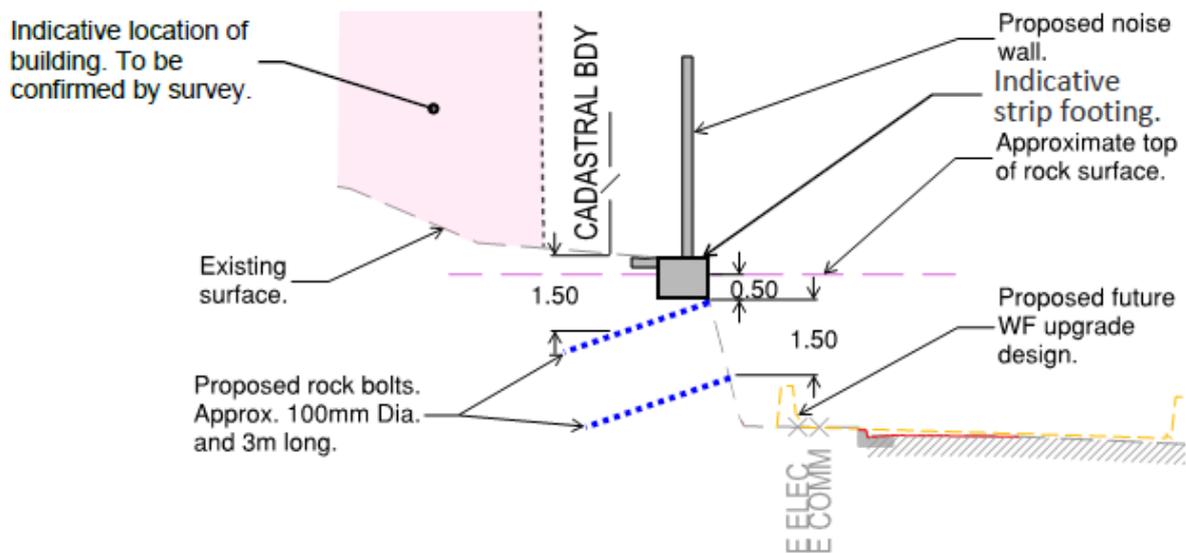
www.rms.nsw.gov.au/documents/projects/factsheet-property-acquisition-of-subsurface-lands.pdf

The acquisition would be made under powers afforded to Roads and Maritime under the *Roads Act 1993* following the processes in the *Land Acquisition (Just Terms Compensation) Act 1991*. This would be supported by the specific subsurface acquisition provisions in the Land Acquisition Information Guide (Roads and Maritime, 2014). Figure 3-8 shows the subsurface property acquisition plan.

As described in the factsheet and discussed in chapter 5, Roads and Maritime would consult with affected property owners as the proposal's design progresses. Safeguards would be put in place to ensure there would be no property damage on installing the rock bolts, as described in chapter 7.



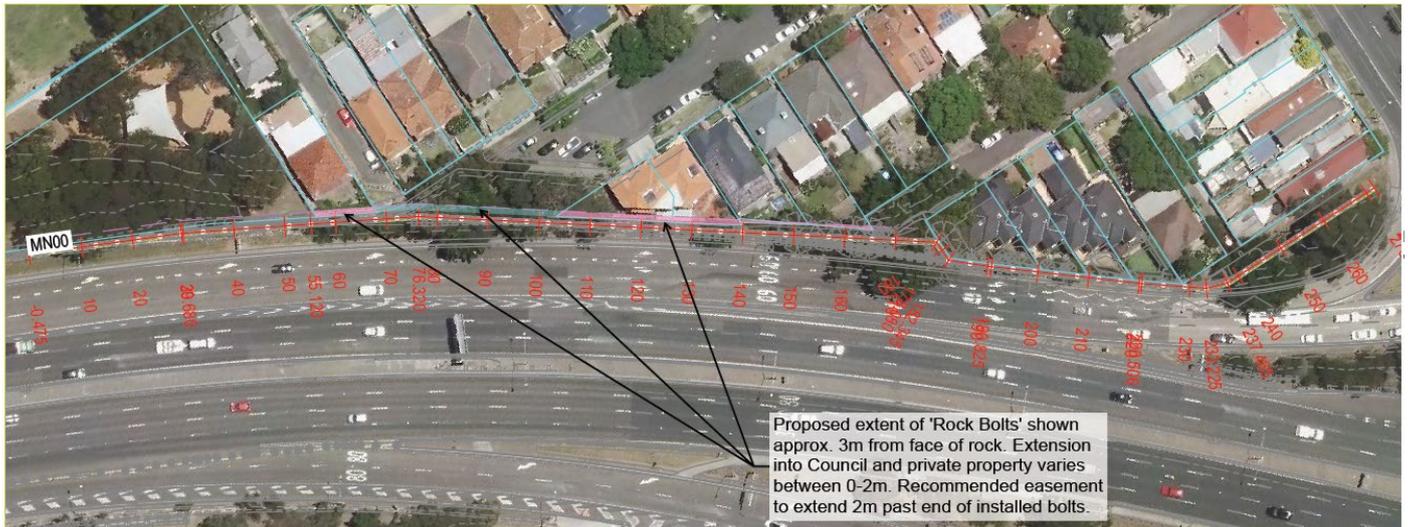
Typical Indicative Rock Bolt Arrangement
Cross Section - Chainage 50



Typical Indicative Rock Bolt Arrangement
Cross Section - Chainage 120

Source: Arup

Figure 3-7: Cross section showing examples of rock bolt locations



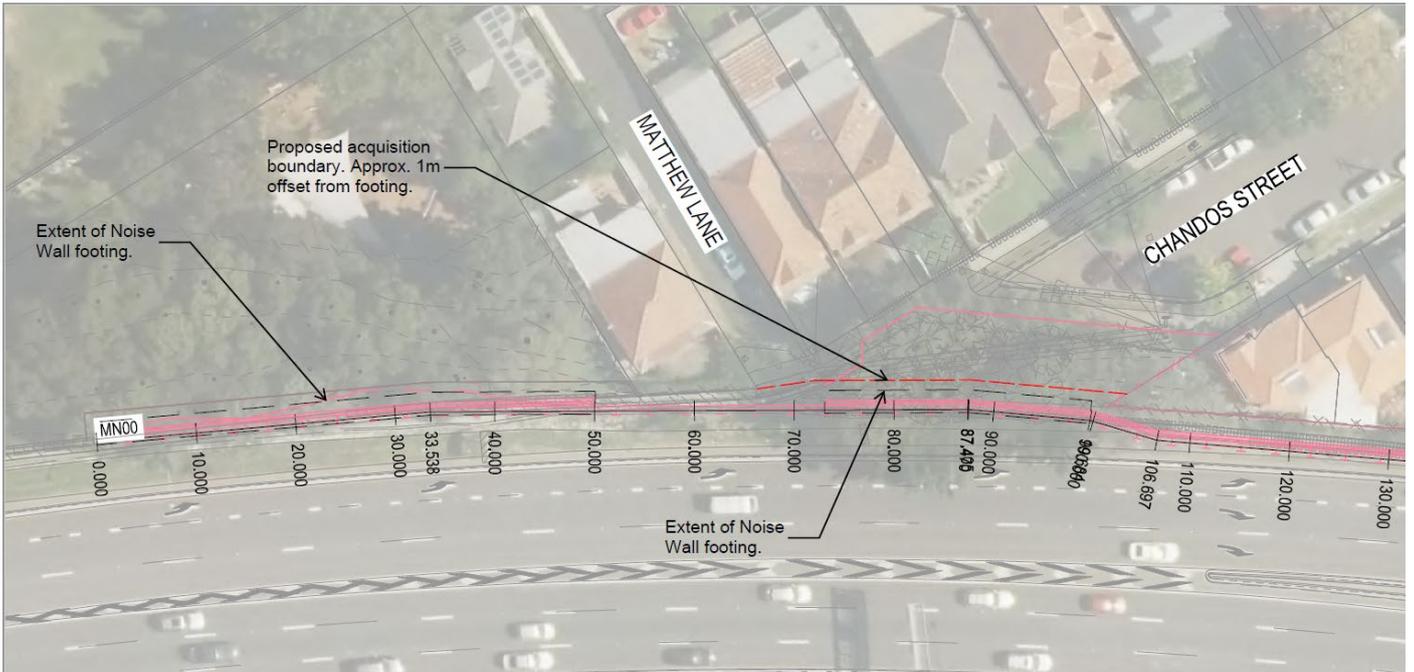
Source: Arup

Figure 3-8: Subsurface property acquisition plan

Surface acquisition is required of land owned or maintained by North Sydney Council to accommodate the footings of the noise wall.

Land at the end of Chandos Street is owned by North Sydney Council. A small portion of this land, as shown in Figure 3-9, needs to be acquired by Roads and Maritime through Compulsory Acquisition to accommodate the strip footing of the noise wall at this location. Under the *Roads Act 1993*, Roads and Maritime can access this land to carry out the works, however a permanent acquisition of North Sydney Council owned land is required once the footing is installed. As above, the acquisition would be made under powers afforded to Roads and Maritime under the *Roads Act 1993* following the processes in the *Land Acquisition (Just Terms Compensation) Act 1991*.

The land adjacent to Matthew Lane and the Warringah Freeway in the corner of St Thomas' Rest Park forms Lot 1 DP774511 and is owned by Roads and Maritime. Government Gazette No.153 14-10-1988 placed this lot under the care, control and management of North Sydney Council. Part of the noise wall footing would be located below the surface of this parcel of land, however the actual noise wall would be located in the Warringah Freeway corridor. It is proposed to enter into an agreement with North Sydney Council to facilitate construction of the noise wall footing. The park would be reinstated up to the boundary of the lot and landscaping would be agreed with Council.



Source: Arup

Figure 3-9: Acquisition of North Sydney Council Land

4. Statutory and planning framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP permits development on “any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent”.

As the proposal is for road infrastructure facilities, and is to be carried out by Roads and Maritime, it can be determined under division 5.1 of the EP&A Act. Development consent from Council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by State Environmental Planning Policy (Coastal Management), State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Development) 2005.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in chapter 5 of this REF.

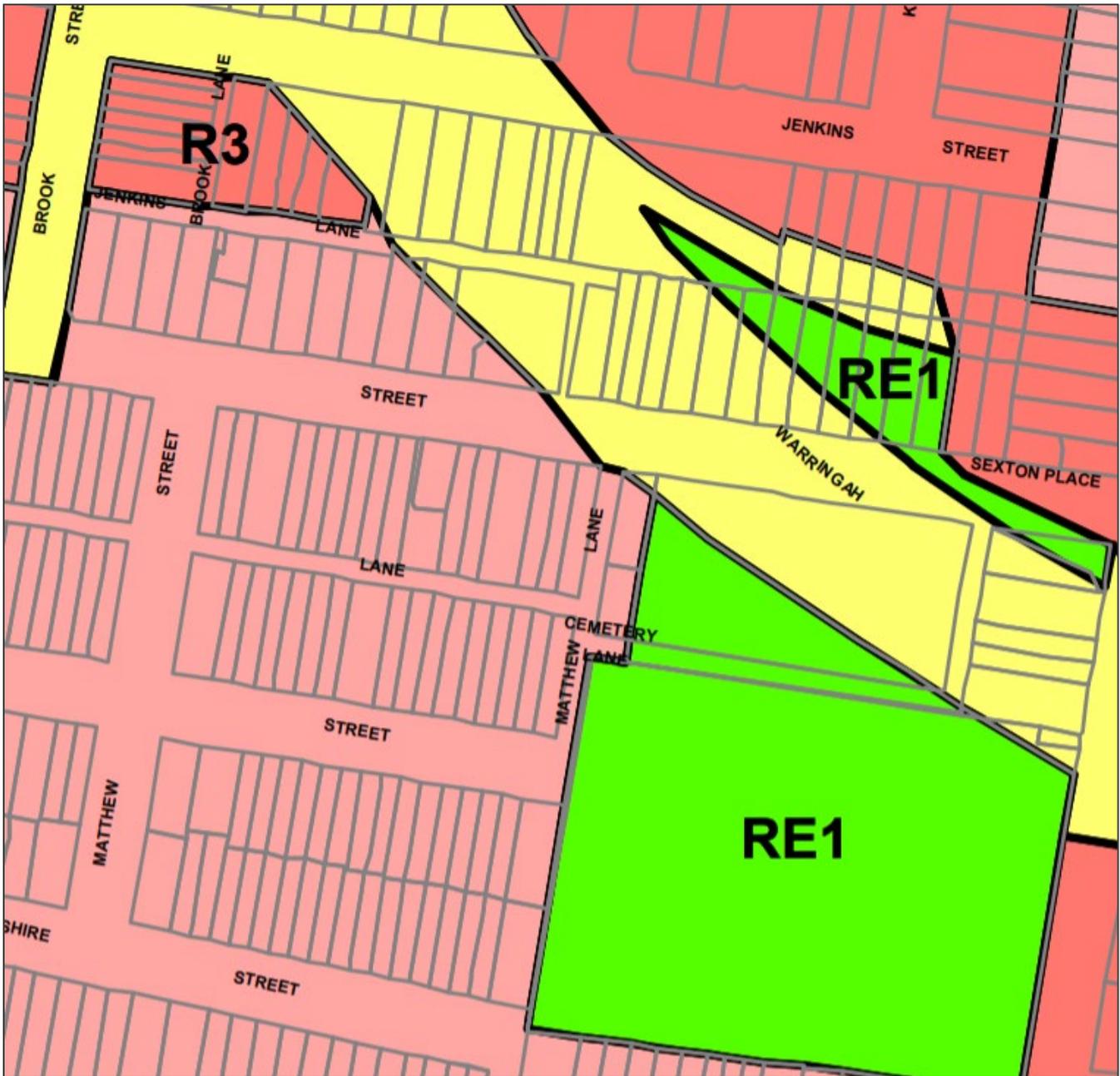
4.1.2 Local Environmental Plans

The proposal footprint is located within the North Sydney Council local government area (LGA). Local development control, land use zoning and planning in the LGA is governed under the respective local environmental plan (LEP) and supporting development controls plans (DCPs).

Given that clause 94 of the ISEPP applies to the proposal, the local policies and development control provisions of North Sydney Council do not apply. However, they are relevant in identifying potential land use impacts and planning policy conflicts, as recognised in the NAP. The proposal footprint is located on land zoned for road infrastructure development, while the local area includes zoned residential and recreational land. Table 4-1 describes the policies covering these land zones and the proposal's consistency with the objectives of these land uses.

Table 4-1: Relevant North Sydney Council LEP local planning objectives and land use zoning policies

Objective	Proposal consistency
<p>SP2 infrastructure (yellow on the map below) Applies to the Warringah Freeway</p>	
<ul style="list-style-type: none"> • Provide infrastructure and related uses • Prevent development that is not compatible with or that may detract from the provision of infrastructure. 	<p>The proposal would involve the upgrade of existing transport infrastructure, the form and function of which is compatible with the provisions defined by this zone.</p>
<p>R2 low density residential (pink on the map below) Applies to the residential housing to the south of Jenkins Lane including Chandos Street</p>	
<p>R3 medium-density residential (red on the map below) Applies to the residential housing on the northern side of Jenkins Lane</p>	
<p>R2: low-density</p> <ul style="list-style-type: none"> • Provide low-density housing • Enable other land uses that support day-to-day residential needs • Promote desired future low-density residential urban character and a high amenity level. <p>R3: medium-density</p> <ul style="list-style-type: none"> • Provide a variety of housing types • Enable other land uses that support day-to-day residential needs • Encourage medium-density housing if it does not compromise the amenity of the surrounding area 	<p>The proposal would impact on residents that overlook or back onto the Warringah Freeway, however this would be the context of an area where the local amenity is already impacted by road traffic. Importantly, the proposal would not impact on the area's residential use or function; however, people are likely to subjectively respond to the wall's introduction in terms of the noise improvements and reduced views of the freeway, compared to the loss of wider views across North Sydney.</p>
<p>RE1 public recreation (green on the map below) Applies to St Thomas' RestPark</p>	
<ul style="list-style-type: none"> • Enable land to be used for public open space or recreational purposes • Provide a range of recreational settings and activities, compatible land uses and protect and enhance the natural environment • Ensure development is secondary and complements/enhances public use and access. 	<p>The introduction of the noise wall would impact on recreational users of the cemetery; however, this would be in the context of an area where the amenity is already impacted by the Warringah Freeway. It would not impact on the cemetery's primary function; however, people are likely to subjectively respond to the wall's introduction in terms of the noise improvements and reduced views of the freeway compared to the loss of wider views across North Sydney. The retention of vegetation alongside and behind the noise wall would help screen and reduce the wall's visual impact within the setting of St. Thomas' Rest Park.</p>



Source: North Sydney Council

Figure 4-1: Land zoning in the study area

4.2 Other relevant NSW legislation

Table 4-2 lists the NSW legislation relevant to the proposal or the land on which the proposal would be built.

Table 4-2: Other relevant NSW legislation

Legislation and application	Relevance to the proposal and further requirements
<p><i>Heritage Act 1977</i></p> <p>Provides for the protection and conservation of buildings, works, archaeological relics and places of heritage value through their listing on various State and local registers. It makes it an offence to harm any non-Aboriginal heritage values without permission.</p>	<p>The proposal would have no significant impact on items of local or State heritage value (refer to section 6.3) and is unlikely to potentially impact on undiscovered archaeology given the disturbed nature of the local area. Approval for the proposal under the <i>Heritage Act 1977</i> is therefore not needed. Nonetheless, precaution would be adopted through implementing a procedure to prevent any damage to any unexpected finds (refer to section 6.3.4) consistent with the due-diligence provisions of this Act. The St. Thomas' Rest Park, Holtermann Estate Conservation Area and the barn outbuilding at a property on Atchison Street are locally-listed heritage items afforded protection and control under the North Sydney Council LEP (refer to section 4.1.2). As such, their heritage protection is covered under the local planning policy.</p>
<p><i>Roads Act 1993</i></p> <p>Provides for the construction and maintenance of public roads.</p>	<p>The proposal would require work on the Warringah Freeway and Brook Street, and on land at the end of Chandos Street owned by North Sydney Council. Accordingly, a licence would be obtained from the Transport Management Centre and North Sydney Council to occupy the road corridor, carry out associated work, and introduce traffic management controls. The occupancy licences would be sought for specific construction activities and it would allow Roads and Maritime to occupy specific areas of the Warringah Freeway, namely the Brook Street off ramp, and Brook Street at approved times providing certain conditions are met. Roads and Maritime would prepare a risk assessment of the activities it intends to carry out under occupancy. These would be translated into separate traffic control and management plans that would be submitted on applying for the road occupancy licence. The control and management plans would be prepared in accordance with the requirements of the Road Occupancy Manual (Transport Management Centre, 2015).</p>
<p><i>Contaminated Land Management Act 1997</i></p> <p>Establishes a process for investigating and remediating land where it presents a human health or environmental risk. It includes a duty to report contamination.</p>	<p>This Act requires Roads and Maritime and its contractors to notify the Environment Protection Authority (EPA) where constructions activities have contaminated land or unexpected existing ground contamination is discovered onsite. Section 6.7 discusses this further and describes the precautionary standard safeguards that would be adopted to reduce the potential of causing contamination and managing worker and public safety and exposure risk in the event of an unexpected contamination find.</p>
<p><i>Protection of the Environment Operations Act 1997</i></p> <p>Focuses on environmental protection, provisions for the reduction of water, noise and air pollution and the storage, treatment and disposal of waste. It introduces licencing provisions for scheduled activities that are of a nature and</p>	<p>Roads and Maritime would not need to obtain an environmental protection licence for this proposal as it does not involve a scheduled activity. Specifically, it would not involve the construction of more than one kilometre of freeway or the excavation of more than 30,000 tonnes of material.</p> <p>The Act still requires Roads and Maritime and its contractors to notify the EPA and the supporting authorities when a pollution incident occurs that causes or threatens material environmental harm either</p>

Legislation and application	Relevance to the proposal and further requirements
<p>scale that have a potential to cause environmental pollution. A key objective is to licence certain (scheduled) activities to ensure they are carried out in a responsible manner to provide environmental protection.</p>	<p>during construction or operation. In accordance with the intent of the Act, pollution prevention and waste controls are proposed to manage constructing the proposal (refer to section 7). The safeguards are aligned with the waste hierarchy of avoidance, recovery and recycling over disposal as defined under the <i>Waste Avoidance and Resource Recovery Act 2001</i>.</p>
<p><i>Biosecurity Act 2015</i></p> <p>Provides for the control of noxious weeds and other plant and pathogen species. It places a responsibility on land owners to control, remove and eradicate noxious weeds</p>	<p>A detailed biodiversity survey has not been carried out at this stage of the assessment, however vegetation species identified as part of the arboricultural survey are not classed as priority weeds/weeds of national significance (WONS).</p> <p>Roads and Maritime would need to carry out pre-clearance surveys to understand if any priority weeds or WONS are present, and safeguards would be introduced to manage and prevent their spread as described in section 6.4.4.</p>
<p><i>Biodiversity Conservation Act 2016</i></p> <p>Includes provisions to maintain a healthy, productive, and resilient environment for the community, now and in the future consistent with the principles of ecologically sustainable development (ESD). It does this by introducing a regulatory framework for assessing and offsetting any lost biodiversity values to development.</p>	<p>This Act requires that a test of significance (five-part test) is carried out if there is the potential for the proposal to have a significant impact on any threatened species, population or ecological community protected under the Act. Additional approval is needed if there is confirmed to be a likely significant impact.</p> <p>The only locally-recorded threatened species with a moderate-to-high potential of occurring within the proposal footprint is the grey-headed flying fox, which is listed as vulnerable under the Act. Despite this, the proposal footprint contains no primary foraging habitat or hibernacula. As such, it is concluded that there would be no significant ecological impact on this species' values within the meaning and definition of this Act.</p>

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and chapter 6 of the REF.

A referral is not required for proposed road activities that may affect nationally listed threatened species, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted to Roads and Maritime under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these biodiversity matters are also considered as part of chapter 6 of the REF and Appendix A.

Findings – matters of national environmental significance

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of the Environment and Energy under the EPBC Act.

Findings – nationally listed biodiversity matters (where the strategic assessment applies)

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Section 7 of the REF describes the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposal is therefore permissible without consent. The proposal is not state significant infrastructure or state significant development. It can therefore be determined under division 5.1 of the EP&A Act.

Roads and Maritime is the determining authority for the proposal. This REF fulfils Roads and Maritime's obligation under section 5.5 of the EP&A Act including to "examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity".

5. Consultation

This chapter discusses the consultation carried out to date for the proposal and the consultation proposed in the future.

5.1 Consultation strategy

The proposal's communication and consultation strategy aims to describe the intention of consultation outcomes, the level of involvement and influence of proposal stakeholders, proposed consultation tools and engagement activities, and the relevance of consultation at each stage of the proposal lifecycle.

The specific objectives of the strategy are to:

- Effectively engage with residents and other people living or working locally
- Gather relevant information to help further inform the project team and influence design outcomes
- Manage local issues and concerns
- Ensure people are well informed about the proposal
- Provide people with effective mechanisms to contact the project team.

Roads and Maritime intends to use a balanced level of public participation to get the best outcome for the proposal. This involves:

- Informing the public by providing objective information to make them aware and help them understand the proposal, its impacts and the expected outcomes
- Obtaining public feedback to help inform the decision-making process and improve design outcomes
- Directly involving affected property owners to ensure their concerns are consistently understood and considered.

The strategy identifies stakeholders that may have a vested interest in, or be affected by, the proposal. These include, but are not limited to:

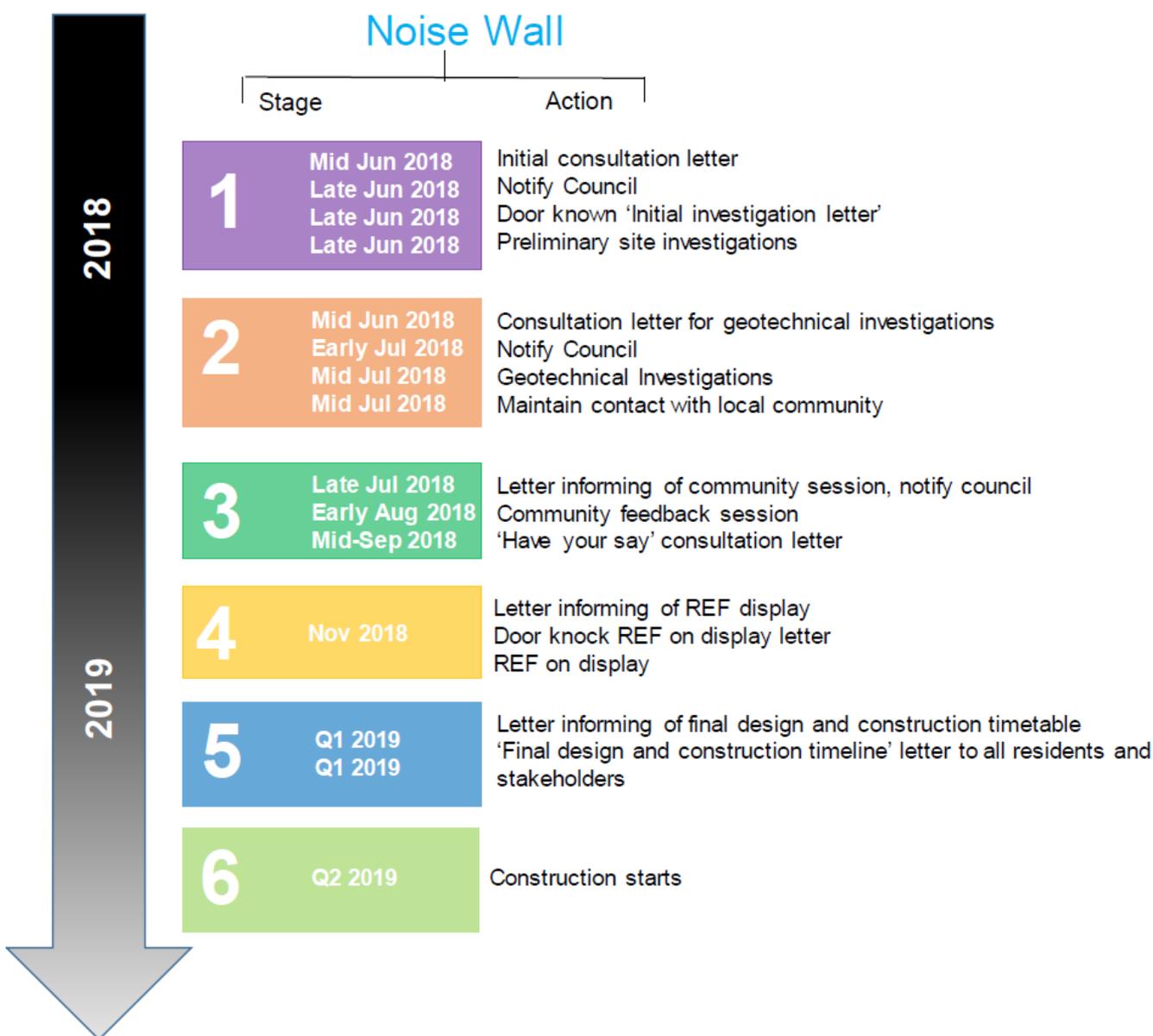
- Government agencies and the local council
- Residents
- Local community facilities
- Affected utility services
- Road users
- Emergency services
- The media.

Communication, consultation and engagement activities would take place throughout the life of the proposal to inform all relevant stakeholders of milestones, temporary traffic management controls, programmed noisy work activities and planned evening, weekend, public holiday and night work. The planned communication activities include:

- Providing access to information by:
 - Distributing collateral including notification letters, letterbox drops, and community updates
 - Releasing media updates and traffic alerts
 - Providing briefing notes to the local Member of Parliament on communications strategy

- Providing Council with collateral including notification letters and community updates
- Providing a business hours community information phone number and project email address.
- Obtaining feedback:
 - Via the community information phone number and email address
 - By holding community meetings and information sessions
 - By displaying the REF and seeking submissions
- Direct involvement:
 - Via one-on-one meetings and holding participatory information sessions
 - By meeting with directly affected property owners.

Figure 5-1 shows how the strategy would be implemented over the six stages of the proposal's lifecycle.



Source: Roads and Maritime: as adapted

Figure 5-1: Stages of the communication and consultation strategy

5.2 Community involvement

Appendix E includes a proposal community engagement report developed by Roads and Maritime. It includes all the consultation carried out to date and the feedback received. This is summarised below.

As shown in Figure 5-1, the first and second stage of community involvement and participation occurred in June and July 2018, through Roads and Maritime consulting with affected and benefited property owners in the area local to the proposal footprint to inform them of the intentions of installing a noise wall and the planned site investigation work that would be taking place to inform the concept design.

This was followed in August 2018 by Roads and Maritime distributing a letter to 45 residents, businesses and other addresses in the local area seeking their feedback on the proposed design and inviting them to a community feedback session. The community feedback session was held on Wednesday 8 August 2018 at Crows Nest Centre, 2 Ernest Place Crows Nest. Nine residents from seven local properties attended the information session, which was used to talk about specific elements of the design of the wall and its planned construction. Further individual meetings were held with some of the immediately impacted residents next to the noise wall. A total of 26 people have raised comments with nine matters raised.

The following design changes were incorporated into the proposal because of community feedback:

- Retaining the existing property boundary wall at the end of Jenkins Lane instead of replacing this with the noise wall
- Including transparent panels for the top two metres of the noise wall at the end of Chandos Street to minimise overshadowing impacts (see Section 6.6)
- Changing the noise wall alignment to remove any need for at surface private property acquisition
- Revising and shortening the noise wall extent at the Brook Street interchange to help remove concerns regarding potential safety issues associated enclosing a publicly-accessible area
- Developing the urban design, treatment and finish of the noise wall to reflect community comments and feedback.

Table 5-1 summarises the feedback received from the community that remains relevant and will continue to be considered during detailed design. Any further community feedback received following display of the REF will be captured in the submissions report (refer to section 5.6).

Table 5-1: Summary of issues raised by the community

Group	Issue raised	Response/where addressed in REF
Community	The intended construction start-date and duration	As described in section 3.3.2, construction is expected to start in early 2019 and last for eight to ten months.
	Tree removal	Roads and Maritime continues to consult with affected stakeholders to discuss tree/vegetation removal. At the community sessions, stakeholders were shown the visualisations that include the replanting once matured which are included in Appendix D. The reception was typically positive. Section 0 assesses the impact of vegetation removal. Following the September 2018 community consultation, the design was changed to avoid the loss of two mature Sydney blue gums at the Brook Street interchange, which hold amenity value locally.

Group	Issue raised	Response/where addressed in REF
	Safety concerns	Following the design amendments discussed above, the only safety comments received from the community related to the use of the informal access (the drainage channel) between Matthew Lane and St. Thomas' Rest Park. Residents suggested that the introduction of the noise wall in this area could create safety issues. Options available to mitigate this impact are to introduce lighting or to close off this access with a fence. The latter was discussed however the community decided that they would prefer the access to stay open.
	Construction impacts	Concerns were raised regarding noise and safety impacts during construction and loss of established trees and gardens. These impacts are assessed in chapter 6 of this REF and safeguard measures recommended to minimise impacts where feasible and reasonable.
	St. Thomas' Rest Park	The main concerns were the overshadowing impact in the park, the fact that there is limited green space in the area, and that this should not be impacted with a noise wall. Graffiti of the wall was also a raised concern. The impact to St. Thomas' rest Park has been assessed throughout chapter 6 of the REF. Planting would occur in front of the noise wall at St. Thomas' Rest Park to improve screening. The noise wall would also be treated with anti-graffiti surface treatment.
Residents – directly affected property owners	The need for precondition surveys to be carried out before and after construction	Section 6.1 assesses potential vibration impacts when building the proposal. Safeguard measures are included in this REF that recommend precondition surveys be carried out at those properties where subsurface property acquisition may be needed as well as those properties within the safe working distance buffers for the various vibratory equipment that may be used on site.
	Option for a noise wall on the Brook Street viaduct instead of next to exit ramp	Roads and Maritime continues to investigate the option for a noise wall to be installed on the Brook Street viaduct rather than next to properties, however this has not been considered as part of this proposal. It is generally considered the closer the noise wall to the property the greater the benefit provided and therefore the proposal is likely to generate greater benefits.
	Height of the noise wall	Feedback was received to investigate the possibility of a wall measuring higher than 4.5 metres. As discussed in chapter 2, this has been assessed but found to be unfeasible due to visual impact and overshadowing impacts as well as the ability to build a higher noise wall on top of the existing cutting.

As discussed in section 3.3.2, feedback was sought regarding the night work construction schedule. 'Have your say' Letters were distributed to 4,381 residents in September 2018. Two alternative proposals were provided during this round of community consultation:

- Night works up to five nights a week for a five-month period from March 2019
- Night works up to four nights a week for a six-month period from March 2019.

The received feedback indicated that eight people supported the five nights a week for a shorter duration project and one person supported four nights a week. Two submissions were received which indicated that they were not in favour of night works at all. No responses were received from the remainder of the residents contacted. Although Roads and Maritime did not receive a meaningful response from the wider community, Roads and Maritime has decided to proceed with working up to five nights a week to shorten the construction impacts accounting for the preference of the local community closest to the proposal.

As far as practical, noise impacts would be minimised in accordance with the Roads and Maritime Services Construction Noise and Vibration Guideline (CNVG, Roads and Maritime Services 2016) and safeguards are listed in section 0 of this REF.

5.3 Aboriginal community involvement

Aboriginal heritage impacts have been considered under the first stage of the four-stage Procedure for Aboriginal Heritage Cultural Heritage Consultation and Investigation (Roads and Maritime, 2011). The initial assessment confirmed there to be no Aboriginal objects, places, landscape features or values within the local area and negligible potential for encountering any associated archaeology within the proposal footprint as described in section 6.7. As such, there was no need to consult with the local Aboriginal land council.

5.4 ISEPP consultation

Roads and Maritime needs to notify the local Council and various other Government agencies in circumstances where a proposal has the potential to impact on assets or environmental values managed by these authorities. In the case of this proposal no such assets would be affected. Despite the need to install the noise wall about 50 metres from the designated area of St. Thomas' Rest Park and 180 metres for the barn outbuilding of a property on Atchison Street, both of which are locally listed heritage items, and next to the Holtermann Estate Conservation Area, it was concluded that this would have no direct material impact on associated heritage values (refer to section 6.3). While introducing the noise wall would visually impact receivers in the Conservation Area and affect the relationship between both the conservation area, St. Thomas' Rest Park, and the Warringah Freeway, it would introduce amenity improvement by reducing noise levels.

In addition, the need for light vehicles to temporarily access St. Thomas' Rest Park during the construction phase is not considered to have a direct material impact on the park's associated heritage values and specific safeguard measures are proposed to minimise impacts where possible.

On this basis, it was concluded that the net impact would be minor due to the balance of the beneficial amenity improvements removing the need to consult under the ISEPP. Furthermore, urban design and landscape treatments for the back face of the wall would be developed to reduce the visual impact of the wall further.

While there was deemed no need to issue notification on heritage matters in accordance with the ISEPP, Roads and Maritime has actively engaged and sought feedback from North Sydney Council on various occasions as described in section 5.5.

5.5 Government agency and stakeholder involvement

As the proposal progresses there will be detailed consultation with external stakeholders. This section outlines the interests of key external parties and the proposed mechanisms for accommodating their needs,

requirements and concerns. The Government agencies and stakeholders that have been consulted about the proposal include:

- North Sydney Council
- Affected utility and service providers
- Key transport agencies (Transport Management Centre, Transport for NSW).

No specific issues have been raised by key Government agencies or stakeholders that have influenced the design or the assessment required as part of this REF.

A meeting was held with North Sydney Council on 24 August 2018 to brief them on the proposal. Road and Maritime has also requested information from North Sydney Council to inform the design including:

- Vehicle access through St Thomas' Rest Park
- Council drainage plans in the area
- Any agreements in place between residents and North Sydney Council's Streets Alive program which maintains areas of public space
- Any fencing drawings at the end of Chandos Street.

Roads and Maritime would provide a copy of the REF to Council to review during the display period. Consultation with North Sydney Council would also continue throughout the detailed design and construction phase, as required.

A utilities search has identified a Telstra telecommunications microcell on one of the light poles that needs to be relocated with the light pole.

Consultation with Telstra has been ongoing since July 2018. Meetings were held between Roads and Maritime and Telstra in which its main concern was to ensure adequate clearance between the microcell and the proposed noise wall. This has been accounted for within the design with cabling for the microcell being relocated from Brook Street and the verge of the Warringah Freeway to Chandos Street, where it would be reconnected once the light pole is moved.

No other utility or service providers have been identified as being affected by the proposal.

Roads and Maritime met with the Transport Management Centre to discuss closing one lane of the Brook Street off ramp. While this was agreed, the main concern was any increase to traffic queue length on the ramp during the afternoon peak. Existing surveys show that there is enough capacity on the Brook Street off ramp however Roads and Maritime has scheduled further traffic queue length surveys for late October 2018 to address these concerns.

5.6 Ongoing or future consultation

Roads and Maritime will continue to seek feedback from the local community, North Sydney Council, relevant agencies, residents, and other key stakeholders as the design progresses and into the construction phase. Another community feedback session is proposed in November 2018 to discuss the final design of the noise wall and to allow further discussion and engagement with the community.

5.6.1 Display of the REF

The display of this REF provides an opportunity for the community and key stakeholders to comment and feedback on the proposal. The display of the REF along with the proposal was announced by issuing a community update to residents, businesses and key community facilities locally. Over the REF display

period, Roads and Maritime is continuing to meet with key stakeholders and affected property owners; a process that will continue during the proposal's detailed design.

The REF is being displayed for comment on the project website and at:

- North Sydney Council, 200 Miller Street Sydney

Submissions would be accepted during display of the REF and Roads and Maritime would consider and provide responses in a corresponding submissions report.

6. Environmental assessment

This section provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines Is an EIS required? as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000 and the Roads and Related Facilities EIS Guideline (DUAP 1996). The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Noise and vibration

This section describes the proposal's noise and vibration impacts by summarising a supporting technical report provided in Appendix C.

6.1.1 Methodology

The proposal has the potential to affect the community due to noise and vibration during construction. The following methodology has been implemented to assess the impacts. For construction noise impacts from the proposed activity, the Roads and Maritime Construction Noise Estimator was used. The following tasks were performed during the assessment:

- Identification of appropriate background noise levels
- Identification of the noise management level (NML)
- Identification of receivers and noise catchment areas (NCAs)
- Identification of the noise and vibration impacts
- Identification of feasible and reasonable additional mitigation measures

For construction impacts, a quantitative noise assessment in accordance with the Interim Construction Noise Guideline (ICNG, DECC, 2009) and the Roads and Maritime Construction Noise and Vibration Guidelines (Roads and Maritime 2016) was undertaken. Noise impacts have been estimated for construction works being undertaken during the night as this is the conservative/worst case scenario.

The Construction Noise Estimator was used to derive NML for the proposed work from monitored background noise levels. Common receivers were grouped into four NCAs to complete the construction noise assessment. The NCAs are areas that are affected by the same works and are located at similar distance from the noise generation activity. This assists with the assessment, consultation or notifications required.

Construction noise and vibration assessment

The assessment reviewed how the proposed activities, methods and scheduling described in chapter 3 would affect receivers sensitive to construction noise and vibration. Based on the duration of work, and number of affected receivers, a quantitative assessment was completed in accordance with the CNVG. These guidelines suggest noise management measures based on the length of the work, number of people affected, and the time the work would take place. The concept of safe working distances was used to assess construction vibration impacts as described in section 6.1.3.

Construction noise and vibration sources

Table 8.8 of Appendix C outlines the noise levels (sound power levels) for the major pieces of plant and equipment likely to be used during construction. It was determined that the equipment required to build the noise wall would likely have a maximum noise level of 68 dB(A) $L_{Aeq (15min)}$ across the construction footprint. This noise level was used to assess the likely construction impacts under the worst-case scenario of carrying out these activities out of hours.

An assessment of the establishment and operation of the construction compound was also carried out due to its proximity to residential properties on Metcalfe Street. It was assumed that the compound would need to operate at night in accordance with the program in section 3.3.2.

Operational noise assessment

Detailed noise modelling was used to confirm the change in noise level at properties located behind the noise wall. The model was verified and calibrated using the measured road traffic noise levels at Metcalfe Street, and traffic flow monitoring available for the Warringah Freeway and Brook Street off ramp. Section 5.1 of Appendix C shows that the noise model was found to validate well, and therefore a reasonable level of confidence can be placed in the ability to model and predict if the noise reduction from carrying out the proposal.

6.1.2 Existing environment

Sensitive receivers

Residential receivers

All residential properties within identified NCAs are considered sensitive to construction noise. Properties up to 50 metres from the proposal footprint were considered sensitive to construction vibration in accordance with the safe working distances described in section 6.1.3. As shown in Figure 6-1, the local area mainly comprises residential property.

Non-residential receivers

The recreational area of St. Thomas' Rest Park, which includes a children's playground, is also sensitive to road traffic noise. Road traffic noise levels would be greatest in those sections of the park closest to the Warringah Freeway.

Ambient noise levels

Ambient noise levels were monitored at Donnelly Road in Crows Nest in September 2017. This location was considered representative of properties sensitive to construction noise and vibration resulting from the construction of the proposal. Table 6-1 details the monitoring location and this is shown on Figure 6-1 as well as the surrounding land uses.



Source: Arup

Figure 6-1: Measurement location for ambient noise and local land use

Table 6-1: Noise monitoring location

Description	Measurement location address	Minimum distance to the proposal
Noise monitor located in the rear yard. Representative of receivers close to the western verge of the Warringah Freeway	Donnelly Road, Crows Nest	190 metres north west of the proposal

The measured ambient noise levels were used to establish construction NMLs in accordance with the guidelines. These NMLs form the criteria that the proposal’s noise construction impacts were assessed against (refer to section 6.1.3).

Road traffic noise levels were monitored on Metcalfe Street in Crows Nest in December 2010 to verify the modelling used to determine the effectiveness of installing the noise wall.

Table 6-2 summarises the monitored ambient noise levels representative of the local area surrounding the proposal.

Table 6-2: Ambient noise levels

Noise monitoring location	Noise levels (RBL ¹ , dB(A))		
	Day ²	Evening ²	Night ²
Donnelly Road	58	56	38

Note 1: rating background level. The overall single-figure background level representing each assessment period (day, evening, night) as defined under the NPI.

Note 2: day: 7am to 6pm, evening, 6pm to 10pm and night 10pm to 7am. Sunday the day period starts at 8am.

Note 3: 30 dB: whisper, 40 dB: computer, 50 dB: light traffic/refrigerator, 60 dB: conversation/air conditioning unit, 70 dB: shower/dishwasher

The monitoring confirmed that road traffic is the main ambient noise source locally, with noise levels being considerably lower at night as the traffic volumes on the Warringah Freeway decrease.

Road traffic noise levels

Table 6-3 summarises the road traffic noise levels measured at Metcalfe Street in December 2010. Noise levels were measured one metre from the façade of the property in accordance with the requirements for measuring traffic noise levels. The measured data were used to verify the noise model.

Table 6-3: Measured road traffic noise levels in 2010

Noise monitoring location	Road traffic noise levels	
	Day (L _{Aeq} , 15 hr)	Night (L _{Aeq} , 9hr)
Metcalfe Street	65	61

6.1.3 Criteria

This section describes the criteria used to assess the proposal's noise and vibration impacts.

Construction noise

Based on the duration of the work and number of affected receivers, a quantitative assessment was carried out in accordance with the ICNG was completed. Table 6-4 sets out the NMLs for residential receivers and how they are applied. The monitored ambient noise level (rating background level, RBL) was used to determine the NMLs.

Table 6-4: NMLs at residential receivers

Time of Day	Management Level (L _{Aeq} (15 min))*	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L _{Aeq} (15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details

Time of Day	Management Level (L_{Aeq} (15 min))*	How to apply
	Highly noise affected 75dB(A)	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining, or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:</p> <ul style="list-style-type: none"> • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	<p>A strong justification should typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the affected noise level.</p> <p>Where all feasible and reasonable practise have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.</p> <p>For guidance on negotiating agreements see section 7.2.2 of the ICNG.</p>

Where construction noise levels are greater than the NMLs, as described in Table 6-4 above, the receiver would be considered 'noise affected'. Where noise levels are more than 75dB(A) the receiver would be 'highly noise affected'. For non-residential receivers fixed threshold limits are set that should not be exceeded typically when the receiver is being used.

Table 6-5 provides the construction NMLs relevant to this assessment. It should be noted that as the assessment has only considered construction activities outside of standard hours, to be representative of a worst-case scenario, the night period NMLs have been applied. The scale of exceedance of the NMLs determines the level of safeguard measures to be implemented during construction.

Table 6-5: Construction noise criteria

Sensitive receiver type	Noise management level L_{Aeq} 15 min dB(A)		
	Day ¹	Evening ¹	Night ¹
Residential receivers	58 + 10 = 68	56 + 5 = 61	38 + 5 = 43
Active recreation areas <i>St. Thomas' Rest Park</i> ²	65	65	65

Note 1: day period 1: Monday to Friday 7am to 6pm and Saturday 8am to 1pm. Day period 2: Saturday 7am to 8am, 1pm to 6pm and Sunday/public holidays: 8am to 6pm. Evening: 6pm to 10pm. Night: 10pm to 7am (Monday to Saturday) and 10pm to 8am (Sunday).

Note 2: NML only apply when in use, assumed to be during the day and evening

Sleep disturbance

Given the proposed night work, an assessment of potential sleep disturbance was considered. Table 6-6 describes the sleep disturbance assessment levels. They are based on maximum noise levels (L_{Amax}) as this represents the highest noise level at any point at night whereas NMLs represent an average noise level over a 15-minute period between 10pm and 7am, which may not be significantly affected by a single loud event at night.

Table 6-6: $L_{A1,1min}$ (or L_{Amax}) Sleep disturbance assessment levels

Receiver location	External screening level ($L_{A90, 15min} + 15$)	Awakening reaction level (L_{Amax})
All residential receivers	53dB(A)	65dB(A)

Vibration generating activities

The guidelines identify safe working distances beyond which the use of vibration-generating equipment would have no amenity (human comfort) impact on people living locally nor would it potentially cause cosmetic non-structural building damage. Cosmetic damage is typically described as hairline cracks or the separation of partition walls from load-bearing walls.

The safe work distance to minimise cosmetic building damage for residential and light commercial buildings and human disturbance is 50 metres depending on the equipment being used (refer to Table 8.16 in Appendix C). At distances greater than 50 metres, there is a very low risk of structural damage or adverse response from the public due to construction work.

Operational

While operation of the proposal would not generate noise, the effectiveness of the proposal in reducing road traffic noise was assessed to the NAP criteria. These criteria are:

- Day (7am – 10pm) – 65 dB(A)
- Night (10pm – 7am) – 60 dB(A).

Where road traffic noise is reduced below these criteria a receiver is effectively treated. Conversely, if the noise wall does not reduce road traffic noise to within the NAP criteria, that receiver is eligible for additional at-property treatment measures.

6.1.4 Potential impacts

Construction

Section 3.3.2 discusses the proposed working hours including the planned night work. The ICNG states that justification should be provided for work to take place outside of standard working hours.

Where permitted and it is safe to do so, work would be carried out within normal standard hours using traffic management controls on the off ramp. However, for certain activities additional lane closures would be needed to provide a safe working environment. This work would be carried out at night to minimise traffic disruption on the Warringah Freeway and Brook Street off ramp. Carrying out work at night also helps reduce the construction programme.

Roads and Maritime's Construction Noise Estimator was used to assess noise impacts during night work. To provide a conservative assessment, precaution was adopted where the impact of the noisiest work-

related activity (ie noise wall construction) was assessed, despite this activity only taking place for a short period of time at night (before midnight). Noise impacts for establishing and operating the construction compound at night were also considered. Table 6-5 provides the ambient noise levels and NMLs.

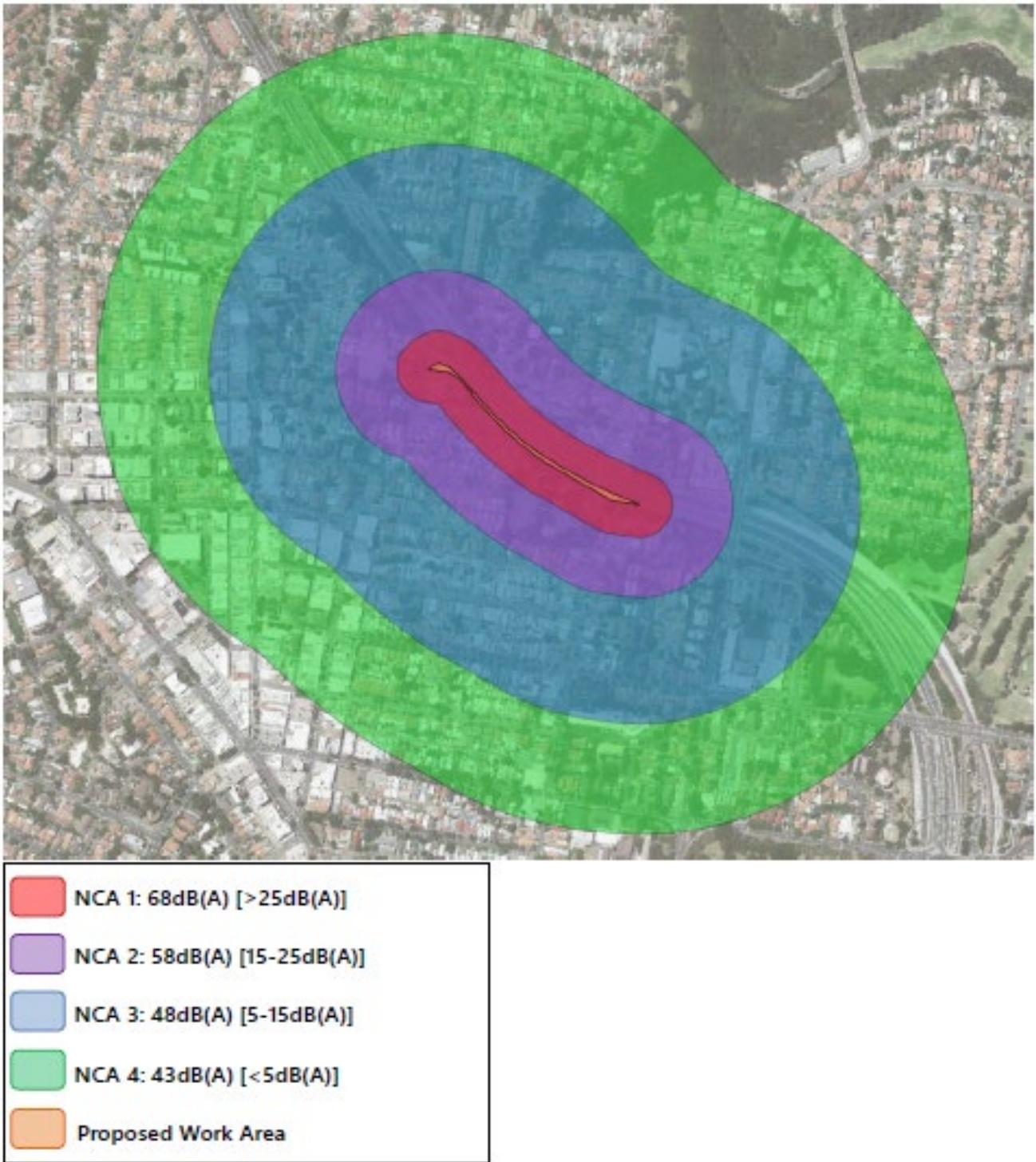
The assessment predicts that at worst:

- Night time NML exceedances would occur up to 400 metres from the construction footprint shown by the NCA boundaries in Figure 6-2 and Figure 6-3
- Sleep disturbance may occur up to 140 metres from the construction footprint as shown in Figure 6-4 and Figure 6-5.

It should be noted that the above assessment accounts for there being no temporary noise management restrictions or controls in place that are proven to be effective in reducing construction noise impacts. These would be supplemented by working under specified management controls that restricting any particularly noisy work to before midnight where practical.

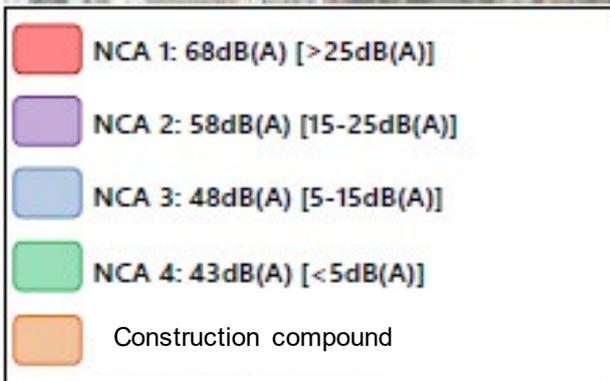
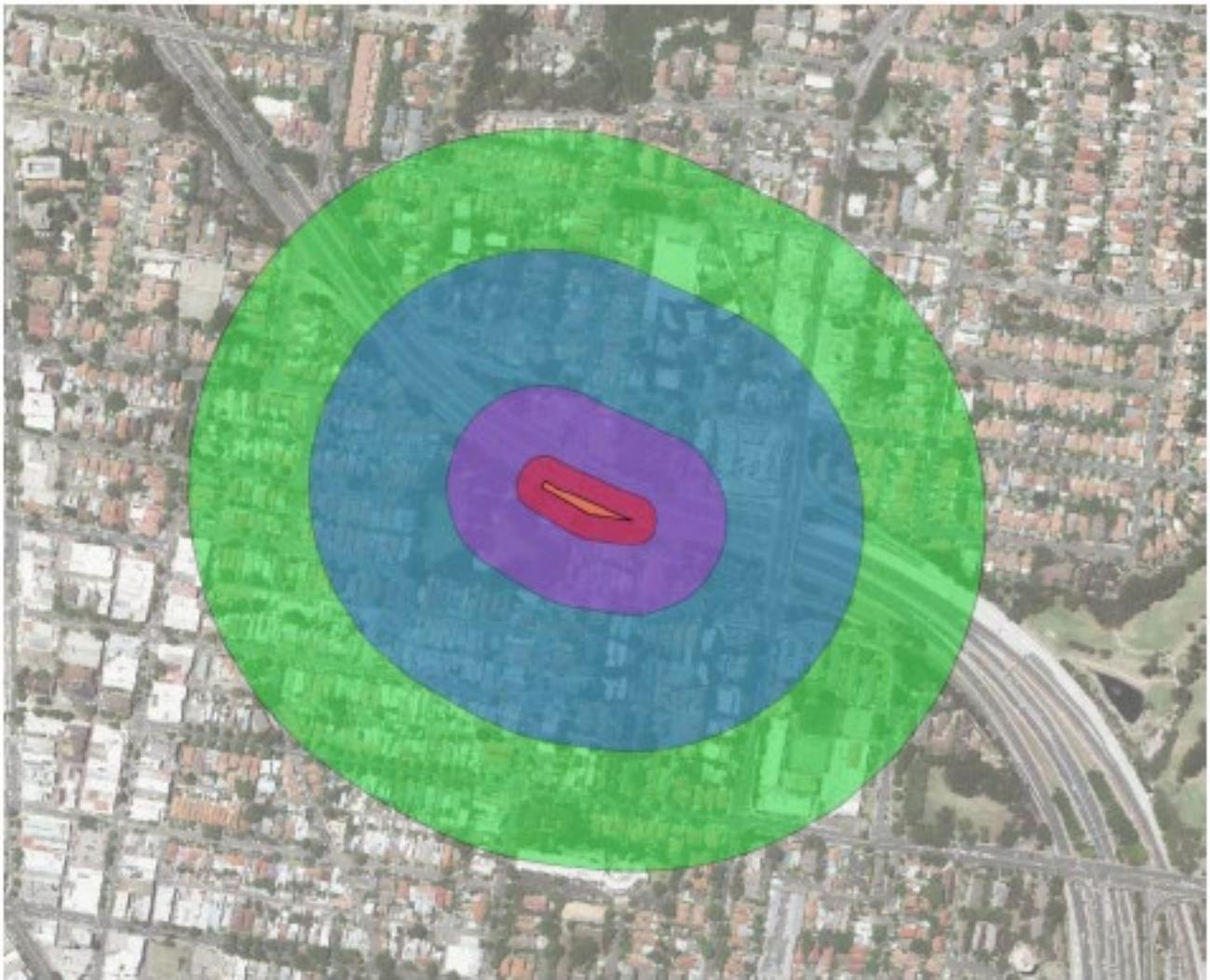
As described in the Construction Noise and Vibration Guideline (CNVG, Roads and Maritime, 2016), for long duration projects it is justified to increase the number of evening and nights worked to provide Duration Respite by completing the project more quickly. Detailed construction planning has identified that up to five consecutive nights of construction work would be needed over a 20-week period so the overall duration of construction of the proposal can be considered as providing Duration Respite.

While these measures would reduce noise, some exceedance of the NML is likely to remain. A feasible and reasonable approach towards additional noise management measures is therefore needed for each NCA based on the level of impact as discussed in section 0.



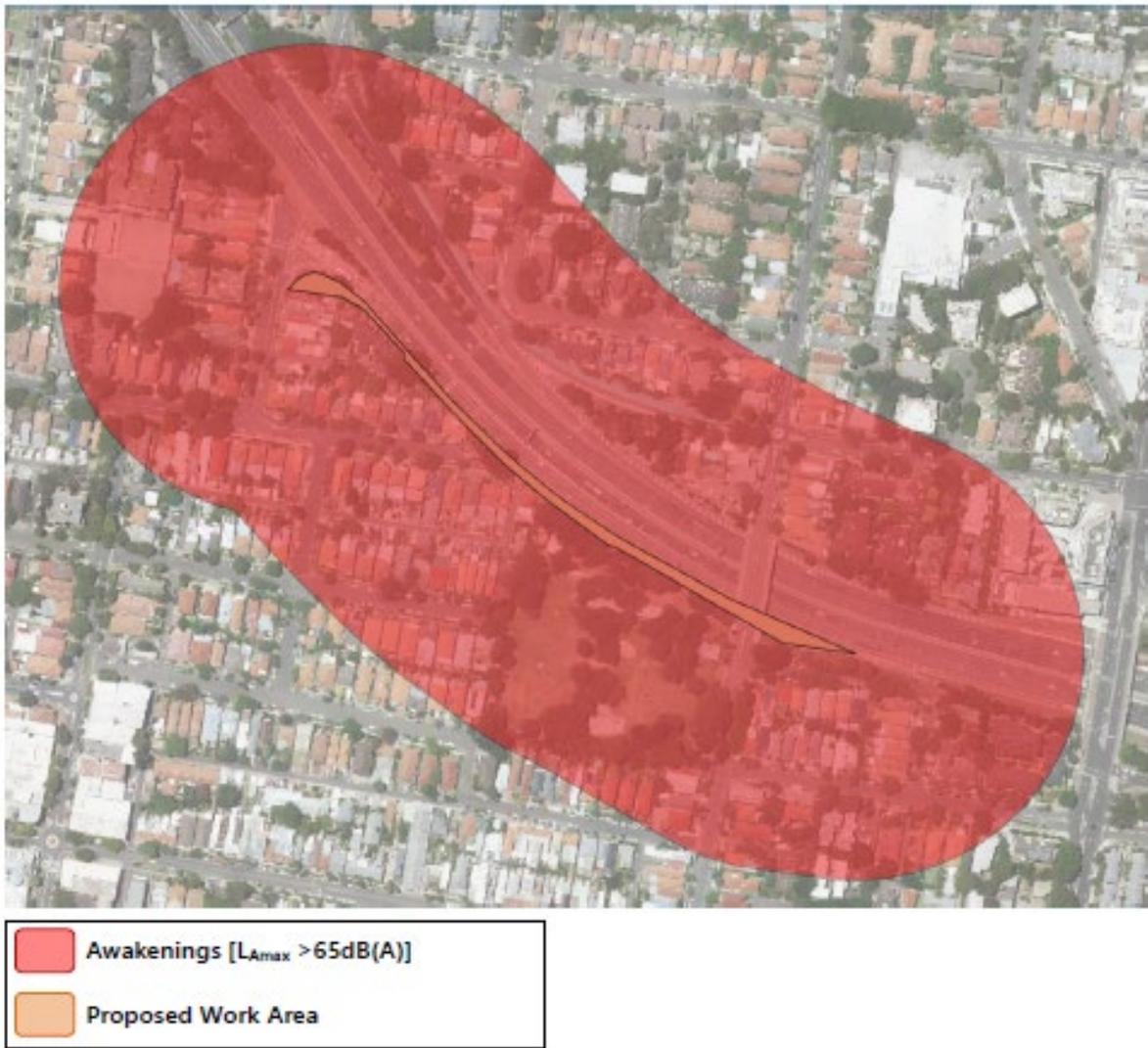
Source: Renzo Tonin

Figure 6-2: Predicted $L_{Aeq (15min)}$ construction noise levels generated by building the proposed noise wall which exceed the night-time NML



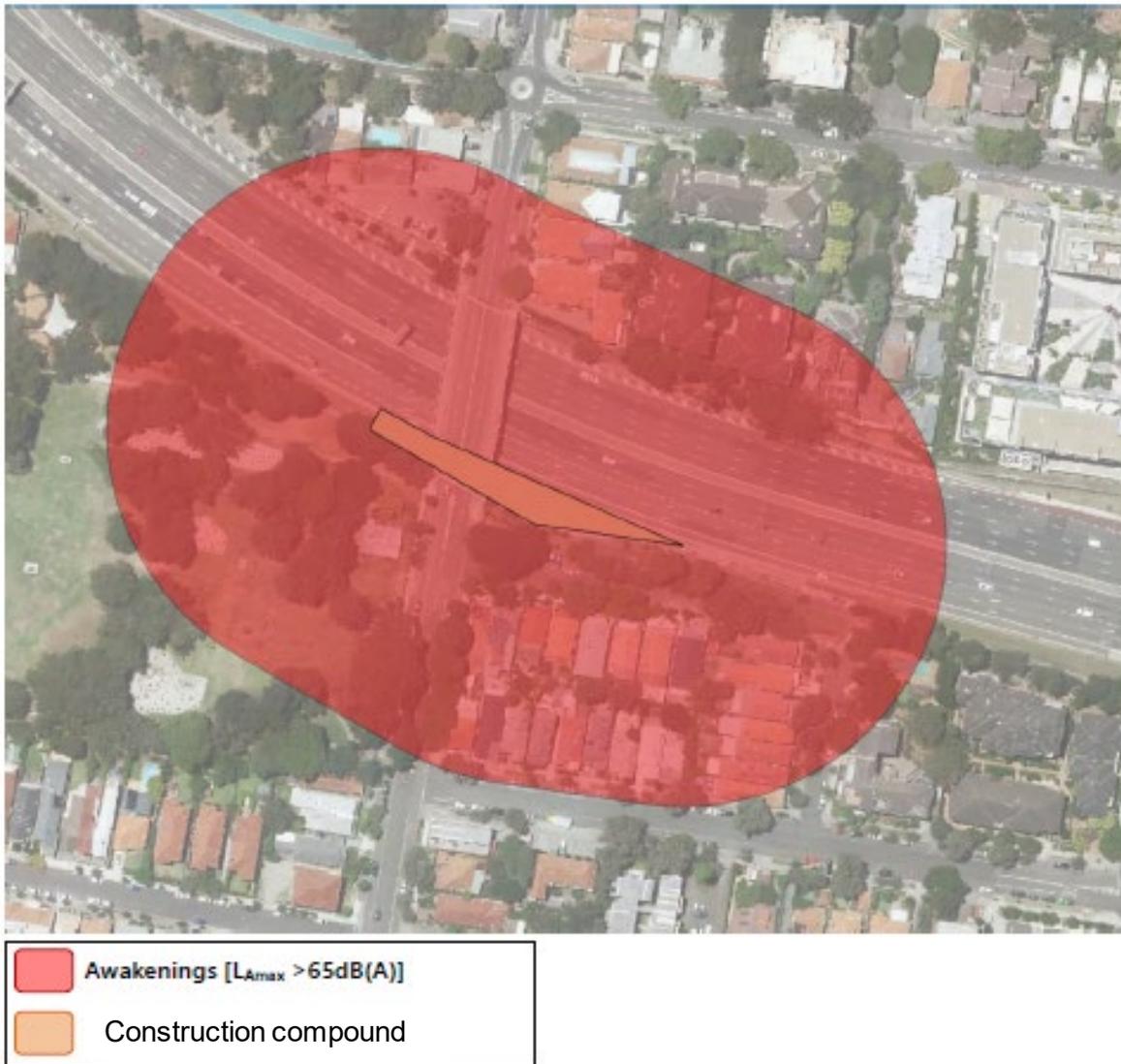
Source: Renzo Tonin

Figure 6-3: Predicted $L_{Aeq (15min)}$ construction noise levels generated by the construction compound which exceed the night-time NML



Source: Renzo Tonin

Figure 6-4: Areas with the potential to be impacted by sleep disturbance due to construction work associated with building the proposal



Source: Renzo Tonin

Figure 6-5: Areas with the potential to be impacted by sleep disturbance due to activities carried out at the construction compound

Vibration generating activities

Vibration generating equipment would be used onsite. This equipment would include hydraulic hammers for rock cutting and excavation work, a pile boring rig, and potentially a drilling rig if rock bolts are needed (refer to section 3.3.3). This equipment would be used during bulk earthworks and noise wall construction activities. These major activities requiring the use of vibration-generating equipment would take place periodically over about three months.

Based on the activities and equipment listed in section 3.3 there are predicted to be several instances when people living close by would be affected by construction vibration. The assessment does not account for individual plant selection, which will be the major factor in mitigating risk.

The assessment showed that about 14 buildings within 15 metres of the work area would be at a medium risk of structural damage and a high risk human disturbance. This assessment has been carried out with no safeguards in place. Section 0 describes the management measures to minimise the predicted residual vibration impacts.

Operation

The proposal would not alter the type or number of vehicles on the road, and would not change the alignment of the road. Accordingly, there would be no operational traffic noise impacts due to the proposal.

The purpose of the proposed noise wall is to reduce operational impacts from the Warringah Freeway to residents of Matthew Lane, Chandos Street, Jenkins Lane and part of Brook Street.

The modelling predicts that 12 properties receive an insertion loss benefit of greater than 5 dB with the noise level at 13 properties achieving the NAP criteria following construction of the proposed noise wall. Further at-property treatment would be considered for the other 23 properties eligible under the NAP. Roads and Maritime would engage with affected property owners to discuss options for at-property treatment measures during the detailed design process. Some of these properties are located within the Holtermann Estate Conservation Area (refer to section 6.3) and therefore the form and type of treatment would need to be sensitive to the area's heritage value.

Appendix C also includes results for a design which does not include the three-metre-high section of wall to the north of the existing property boundary wall. This does not change the number of properties which would meet the NAP criteria or the number of properties requiring further at-property treatment (as shown in Figure 6-6).



Figure 6-6 Properties eligible for at-property treatment

6.1.5 Safeguards and management measures

Construction Noise

As described in the Construction Noise and Vibration Guideline (CNVG, Roads and Maritime, 2016), for long duration projects it is justified to increase the number of evening and nights worked to provide Duration Respite by completing the project more quickly.

Detailed construction planning has identified that up to five consecutive nights of construction work would be needed over a 20-week period so the overall duration of construction of the proposal can be considered as providing Duration Respite.

Appendix C of the CNVG detail the management measures that are to be applied where exceedances of the NMLs remain after all appropriate standard management measures (shown in Table 6-10) have been applied. Table 6-7 lists the additional management measures considered to be feasible and reasonable for each NCA.

Table 6-7: Additional management measures for NCAs

NCA	NML dB(A)	Predicted Noise Levels dB(A)	Recommended additional management measures
NCA 1	43	68	<ul style="list-style-type: none"> Letterbox drop notification for all NCAs Alternate accommodation may be offered to residents in NCA 1 and would be reviewed in response to receiving a complaint Duration respite - increasing night works to shorten the overall construction programme as discussed above.
NCA 2		58	
NCA 3		48	
NCA 4		43	

Localised temporary acoustic hoardings/screens would be installed near high noise-generating activities where feasible and reasonable. Hoardings/screens would be located as close to the noise source as possible, and would be of an appropriate height as structurally feasible to minimise noise emissions.

Table 6-8 shows the specific mitigation options for the noisiest activities identified in the assessment. All options will be considered at the time of writing in a noise and vibration management plan (NVMP) and implemented accordingly.

Table 6-8: Specific mitigation options being investigated

Activity	Timing and duration*	Mitigation options
Corridor clearing	Early in program. One or two night shifts.	<ul style="list-style-type: none"> Work during standard hours to be maximised Mulching to be carried out during day where possible Respite periods during shift
Bulk earthworks	Early in program – about 10 to 15 nights.	<ul style="list-style-type: none"> Alternate rock breaking methods could be implemented depending on ground conditions Multiple machines may increase noise but decrease duration

Activity	Timing and duration*	Mitigation options
		<ul style="list-style-type: none"> • Respite periods during shift • Alternative accommodation
Noise Wall Construction	Large of portion of overall program although noisy activities will mostly be carried out during standard working hours. Possible night works include piling and lifting operations (about 60 nights in total)	<ul style="list-style-type: none"> • Consolidate lift nights to reduce durations • Multiple piling rigs may increase noise but reduce duration • Respite periods during shift • Alternative accommodation

*Duration would be determined by several factors including, but not limited to: ground conditions, weather, traffic control, and plant selection

Construction vibration

Due to the need to use vibration-generating equipment within the 50 metres of people and property (refer to section 6.1.3), the guidelines identify the need to develop safe working distances once the vibration levels of each plant item onsite are measured, and before they are regularly used onsite. Table 6-9 would be used to guide selection of plant.

Table 6-9: Recommended minimum working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance	
		Cosmetic damage	Human response
Excavators	< 30 tonne (travelling/digging)	10 metres	15 metres
Grader	≤ 20 tonne	2 metres (nominal)	10 metres
Loaders	-	-	5 metres
Small hydraulic hammers	300 kg (5-12 tonne excavator)	2 metres	7 metres
Medium hydraulic hammers	900 kg (12-18 tonne excavator)	7 metres	23 metres
Large hydraulic hammers	1600 kg (18-34 tonne excavator)	22 metres	73 metres
Jackhammer	Hand held	1 metre (nominal)	2 metres
Pile boring	≤ 800mm	-	10 metres

The guidelines detail the management measures to be applied where there is still predicted to be human comfort impacts. In this case, letterbox drop notification would be provided for all affected receivers. All potentially impacted receivers would also be informed of the nature and duration of vibration-generating work and the expected vibration levels. They would also be given contact details for enquiries and complaints.

Safeguards and management measures

Table 6-10 lists the measures that would be implemented to safeguard against and manage the proposal's predicted noise and vibration impacts.

Table 6-10: Noise and vibration management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the Interim Construction Noise Guideline (ICNG, DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. 	Contractor	Detailed design/pre-construction	NV1 Section 4.6 of QA G36 <i>Environment Protection</i>
Noise	<p>Where reasonable and feasible, work would be carried out during standard work hours:</p> <ul style="list-style-type: none"> • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • No construction on Sundays or Public Holidays <p>To minimise disruption to traffic and potential safety risks to construction personnel and road users it would be necessary to carry out some work outside these daytime hours. Proposed night work construction hours would be:</p> <ul style="list-style-type: none"> • 8pm to 5am Sunday to Friday 	Contractor	Detailed design/pre-construction	NV2
Noise	<p>Any variations to the standard construction hours would follow the approach in CNVG including consultation with the affected local community.</p>	Contractor	Pre-construction/construction	NV3

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise	<p>All sensitive receivers likely to be affected would be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification would provide details of:</p> <ul style="list-style-type: none"> • The proposal • The construction period and construction hours • Contact information for project community staff • Complaint and incident reporting • How to obtain further information. 	Contractor	Pre-construction	NV4
Noise and vibration	All personnel working on site would receive training to ensure awareness of requirements of the NVMP. Site-specific training will be given to personnel when working near sensitive receivers.	Contractor	Pre-construction	NV5
Vibration	Attended vibration monitoring or vibration trials would be carried out when the proposed work is within safe work distances to ensure that the levels remain below corresponding criteria.	Contractor	Pre-construction/ construction	NV6
Vibration	Building condition surveys would be carried out before starting the work. The exact buildings to be surveyed would be identified once detailed construction planning has occurred and during the preparation of the NVMP.	Contractor	Pre-construction/ construction	NV7
Noise	<p>The following controls would be included in the NVMP:</p> <ul style="list-style-type: none"> • Where practical, the layout and positioning of noise-producing plant and activities at each work site would be optimised to minimise noise emission levels • Where practical, equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate noise control equipment and be in good working order. 	Contractor	Construction	NV8

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> • Non-beeper reversing movement alarms would be used such as broadband (non-tonal) alarms or ambient noise-sensing alarms. Work sites would also be designed to reduce the need for reversing, potentially minimising the use of reversing beepers. • Vehicles, plant and equipment would be regularly inspected and maintained to avoid increased noise levels from rattling hatches, loose fittings etc • All vehicles, plant and equipment would be shut off when not in use. • Resilient damping material would be fitted on bin trucks to minimise noise impacts from loading materials. • Where feasible and reasonable, localised temporary acoustic hoardings/screens would be installed near high noise-generating activities. Hoardings/screens would be located as close to the noise source as possible, and would be an appropriate height as structurally feasible to minimise noise emissions 			
Noise	Consistent with any specific requirements of the approved NVMP a noise monitoring program would be implemented during construction to assess effective implementation of noise and vibration safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements.	Contractor	Construction	NV9
Noise	After considering the outcomes and recommendations arising from the noise monitoring program, and any other relevant information that becomes available during construction, appropriate measures would be implemented to address identified deficiencies or undertake actions needed to address noise and vibration impacts. If necessary, the NVMP would be reviewed and updated to include any additional measures.	Contractor	Construction	NV10

Impact	Environmental safeguards	Responsibility	Timing	Reference
Vibration	The required locations for using vibration generating equipment would be reviewed during construction planning when more-specific information is available.	Contractor	Construction	NV11

6.2 Landscape character and visual impact

This section describes the proposal’s landscape character and visual impacts by summarising a supporting technical report provided in Appendix D.

6.2.1 Methodology

The assessment was carried out in accordance with the Environmental Impact Assessment Guideline for Landscape Character and Visual Impact Assessment Practice Note (EIA-N04, Roads and Maritime, 2013) accounting for the principles set out in Beyond the Pavement (Roads and Maritime, 2010) and R271: The Design and Construction of Noise Walls (Roads and Maritime, 2017). It involved a desktop analysis and site visit. The assessment focussed on the temporary landscape character and visual amenity impacts during construction and the long-term visual impacts on selected viewpoints due to changes in the landscape from removal of vegetation and introducing the noise wall. Section 6.6 separately considers the overshadowing impacts on adjacent properties.

Appendix D includes the standard impact rating matrix used in the impact assessment as taken from the Guidelines for Landscape Character and Visual Impact Assessment. It describes a six-point scale that is used to rate impacts from negligible to major.

6.2.2 Existing environment

Regional landscape context

The proposal is located within an urban landscape setting characterised by its low-rise dense built form dominated by a mixture of residential housing styles, types and periods, which in part, offer limited cohesion and reflect the way the local suburbs have developed and evolved. In contrast, elements of the area’s land use patterns have been preserved. These provide reference to the area’s cultural history, most notably in the form of the locally-heritage-listed St. Thomas’ Rest Park, the barn outbuilding of a property on Atchison Crescent, and the Holtermann Estate Conservation Area (refer to section 6.3).

The barn outbuilding of the property on Atchison Crescent is not considered to contribute to the landscape character of the area impacted by the proposal, and therefore it has not been included in the assessment of landscape character or visual amenity.

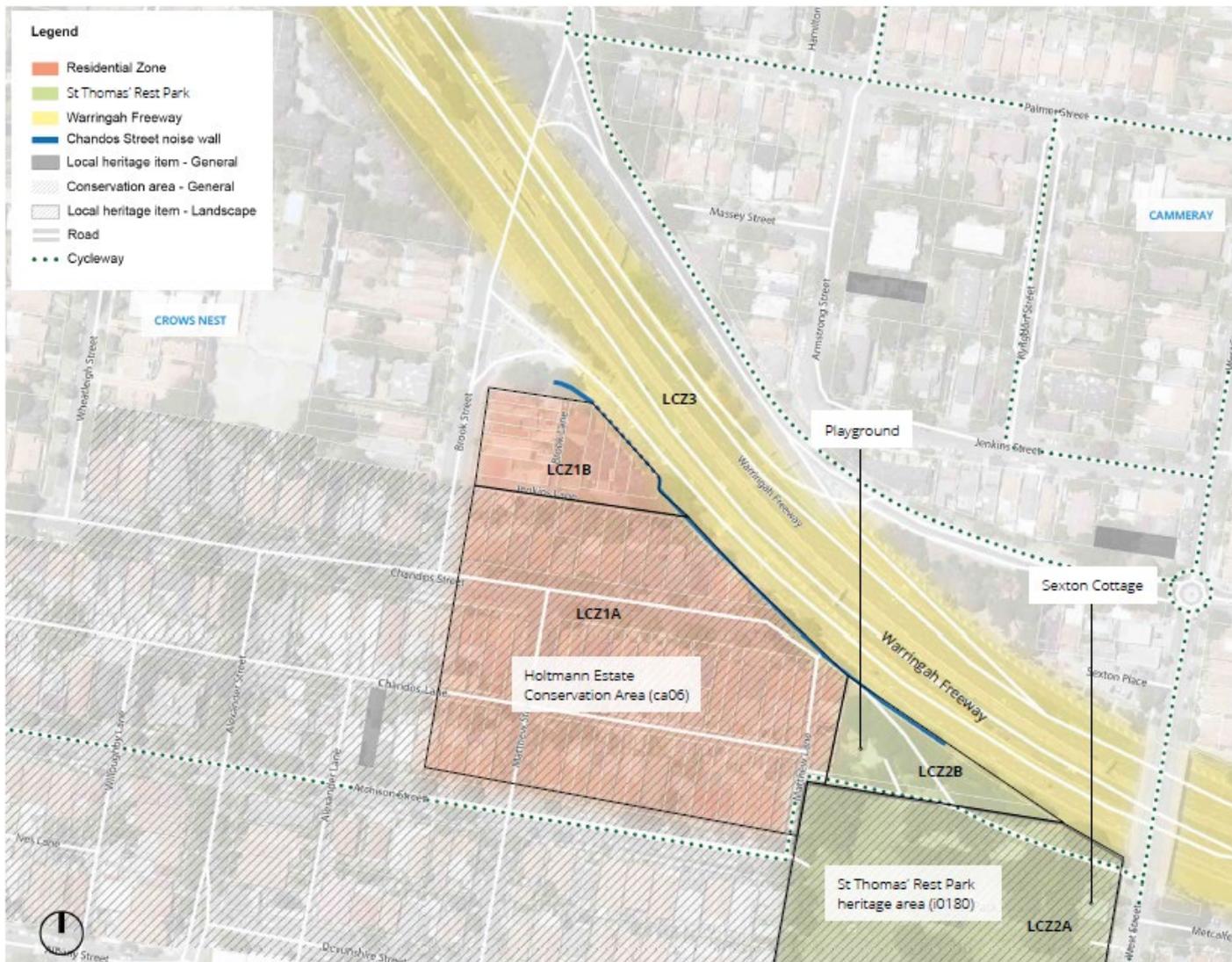
Landscape character continuity between suburbs has further been impacted by the construction of the Warringah Freeway. This forms a physical and visual barrier that severs relationships between Crows Nest and Naremburn to the west and Cammeray to the east. However, as a feature, the freeway corridor is self-contained either in sandstone cutting or by using amenity planting and street trees. It therefore retains its own distinct character, while reducing its influence on adjacent land uses and streetscapes except for those located next to the freeway. The exposed sandstone cuttings also form a recognisable feature and reference point within the landscape setting of the freeway.

Landscape Character

To characterise the differences in the landscape, it was divided into three distinct zones that have recognisable components and patterns. Table 6-11 describes each zone, its characteristics and its sensitivity to change. Figure 6-7 shows the location of each of the three landscape character zone (LCZ).

Table 6-11: Landscape character zones

Zone	Zone	Land use characteristics	Sensitivity to change
LCZ1A	<i>Residential properties</i> next to the proposal that are in the Holtermann Estate Conservation Area.	<ul style="list-style-type: none"> Low to medium density residential development including established lawns and gardens that incorporate tree and shrub cover Located within the Holtermann Estate Conservation Area, which is designated for the historical development of land rather than the heritage value of the dwellings. 	<i>Moderate sensitivity:</i> despite the presence of the Holtermann Estate Conservation Area, properties are already exposed to a major road corridor reducing the zone's sensitivity to change.
LCZ1B	<i>Residential properties</i> located between the Brook Street off ramp, Brook Street and Jenkins Lane outside of the Conservation Area.	<ul style="list-style-type: none"> Low to medium density residential development including established lawns and gardens that incorporate tree and shrub cover. 	<i>Moderate sensitivity:</i> properties are already exposed to a major road corridor reducing the zone's sensitivity to change.
LCZ2A	<i>Open space</i> in the form of the local landscape-heritage-listed St. Thomas' Rest Park.	<ul style="list-style-type: none"> An important local cemetery including the remains of famous colonial identities, among which are several pioneers of the north shore. Accordingly, provides local heritage landscape value due to including components including Sexton's Cottage and the cemetery fence, noting that this is not the fence next to the Warringah Freeway Provides open space for recreational purposes with open turf lawn and dense tree planting. 	<i>High sensitivity:</i> the local heritage landscape listing and amenity value contribute to the zone's sensitivity to change.
LCZ2B	<i>Open space</i> covering the area to the north-west corner of St. Thomas' Rest Park, which is outside of the landscape heritage listing.	<ul style="list-style-type: none"> Provides open space for recreational purposes and includes a fenced children's playground. 	<i>Low sensitivity:</i> isolated from the main section of the park and the associated heritage landscape listing. Its setting is affected by its proximity to the Warringah Freeway and the few planted trees offer limited screening.
LCZ3	<i>Infrastructure</i> in the form of the Warringah Freeway road corridor.	<ul style="list-style-type: none"> Characterised by being one of Australia's widest road corridors that forms a key approach and gateway from and into the city centre. Comprises a built form framed by roadside vegetation and planted trees in sections. Exposed sandstone cuttings provide reference and context of the natural environment. 	<i>Low sensitivity:</i> the zone's sensitivity to change is reduced within the context of its function as a major arterial road.



Source: Arup

Figure 6-7: Landscape character zones

Visual Impact

The visual character of the area is defined by its topography, infrastructure, open space and built form. Importantly, the Warringah Freeway is visually contained using cuttings, existing property and amenity planting along this section. The introduction of a noise wall on a small relatively screened section of verge along the western side of the Warringah Freeway means the proposal's visual envelope (ie the area over which the noise wall is visible) would be restricted to a small area around the Brook Street intersection, residential property located next to the freeway, the St. Thomas' Rest Park, and existing road users.

Nine private and public viewpoints were selected to represent the above receivers. Table 6-12 describes the character of each viewpoint and Figure 6-8 shows their location.



Source: Arup

Figure 6-8: Representative viewpoints

Table 6-12: Visual receivers (viewpoints)

Viewpoint and location		Direction	Receiver representation and sensitivity	Existing view
VP1	St. Thomas' Rest Park: Sexton's Cottage (heritage-listed)	North-west	Recreational users: <i>high</i>	<ul style="list-style-type: none"> Views extend across the well vegetated park and include several historical remnants of the cemetery. Views to the north west, the proposal site, are screened by existing foreground vegetation.
VP2	St. Thomas' Rest Park: Playground	North-west	Recreational users: <i>moderate</i>	<ul style="list-style-type: none"> Views to the north west of the proposal site are screened by existing foreground vegetation. Where long distance views are available these extend across the Warringah freeway corridor in the foreground to residential development and a dense tree canopy beyond.

Viewpoint and location		Direction	Receiver representation and sensitivity	Existing view
VP3	Matthew Lane	North	Private residence: <i>moderate</i>	<ul style="list-style-type: none"> Views of the Warringah Freeway are currently screened by a timber fence however long-distance views are available above the fence.
VP4	Chandos Street: residential	North-east	Private residence: <i>moderate</i>	<ul style="list-style-type: none"> Views across the Warringah Freeway corridor to residential built form on the other side. Dwellings with a second storey generally have more elevated, far-reaching views.
VP5	Chandos Street	North	Motorist and pedestrians using Chandos Street: <i>moderate</i>	<ul style="list-style-type: none"> A scenic view corridor currently extends to the end of the street, framed by residential dwelling on both side, with the street ending in a screen of dense shrub and tree planting. This vegetation blocks more distant views to the Warringah Freeway.
VP6	Warringah Freeway	North-west	Road users: <i>low</i>	<ul style="list-style-type: none"> The existing view is dominated by large-scale road infrastructure and exposed sandstone walls of the cutting.
VP7	Jenkins Street	South-west	Private residence: <i>moderate</i>	<ul style="list-style-type: none"> Existing views south across the Warringah Freeway to residential built form and vegetation on the other side.
VP8	Jenkins Lane and Brook Lane	East	Private residence: <i>moderate</i>	<ul style="list-style-type: none"> Filtered views of the road corridor through foreground vegetation. In some locations, views are constrained by existing property boundary walls.
VP9	Brook Street	South-east	Private residence and pedestrians walking along the street: <i>moderate</i>	<ul style="list-style-type: none"> Existing views extend south east towards the Brook Street off ramp and a group of large mature trees next to the road.

6.2.3 Potential impacts

Construction

The introduction of construction equipment, such as work platforms and cranes along the road corridor, the temporary use of night lighting, the removal of vegetation, and general work activities would impact on the landscape character and visual amenity along the Warringah Freeway for both its users and adjacent residents. While any construction impacts would be temporary, the vegetation removal would have a longer-term impact carrying forward into the operational phase as it would introduce new views over the freeway for the people living nearby.

Overall, any visual impacts relating to the construction compound and construction activities would be minor and temporary in nature, lasting intermittently over an eight to ten month period. The vegetation removal would affect the landscape character and its screening amenity value for adjacent residents, the impact of which is considered below as part of the operational assessment.

Operation

Landscape character

Table 6-13 summarises the proposal's impact on the three landscape character zones with more detail provided in Appendix D.

Table 6-13: Landscape character assessment

Zone	Description of changes to LCZ	Sensitivity	Magnitude	Impact
LCZ1A residential	The introduced noise wall would create a sizable structure along the boundary of this zone potentially leading to an increased sense of enclosure for some residents. The removal of existing vegetation would also increase exposure to the proposed built form of the noise wall and wider components of the Warringah Freeway.	Moderate	Moderate	Moderate
LCZ1B residential				
LCZ2A open space	There would be no change in landscape character of this zone given its distance from the proposal footprint and separation by existing screening vegetation within this area of the park.	High	Negligible	Negligible
LCZ2B open space	The introduced noise wall would create a sizable structure into the north-western corner of this section of the park. This would reduce views and increase the sense of enclosure in this location.	Low	Moderate	Moderate/Low
LCZ3 Warringah Freeway corridor	The existing built form in this zone already contains road infrastructure elements that would be replicated and reinforced under the proposal. In this sense, the proposal would have no material impact on the character of the zone. However, the vegetation clearance along the road corridor would remove some of the natural setting and character of the freeway resulting in a more urban character. Over time, the planned revegetation described in section 0 would establish and mature eventually replacing the lost value.	Low	Negligible	Negligible

The main impact on the area's landscape character would be along the interfacing boundary between the noise wall and the residential properties in LCZ1A and LCZ1B and St. Thomas' Rest Park (LCZ2B). The combination of landscape planting and an effective urban design strategy (refer to section 0) would mitigate against the above landscape character impacts. These measures are designed to integrate the noise wall into the existing character of the area. It is predicted that the noise wall's impact could be reduced to acceptable levels through effective design and landscape planting.

Visual Impact

Table 6-14 summarises the assessed visual impacts reported in detail in Appendix D.

Table 6-14: Visual impact ratings

ID	Viewpoint location	Type of receiver	Sensitivity	Magnitude	Impact rating
VP1	St. Thomas' Rest Park: Sexton's Cottage	Recreational users	High	Negligible	Negligible
VP2	St. Thomas' Rest Park: playground	Recreational users	Moderate	Moderate	Moderate
VP3	Matthew Lane	Private residence	Moderate	High	Moderate/high
VP4	Chandos Street	Private residence	Moderate	High	Moderate/high
VP5	Chandos Street	Motorists and pedestrians	Moderate	High	Moderate/high
VP6	Warringah Freeway	Road users	Low	Low	Low
VP7	Jenkins Street	Private residence	Moderate	Low	Low/moderate
VP8	Jenkins Lane and Brook Lane	Private residence	Moderate	High	Moderate/High
VP9	Brook Street	Private residence and pedestrians	Moderate	Moderate	Moderate

Four viewpoints (VP3, VP4, VP5 and VP8) are predicted to experience a moderate/high adverse visual impact due to the introduction of a noise wall either along or close to property boundaries. It also accounts for the loss of the views at the end of Chandos Street.

There is predicted to be a moderate adverse visual impact for three of the viewpoints (VP2 and VP9) due to introduction of the noise wall, removal of screening vegetation, and therefore, increased views of the Warringah Freeway.

It is noted that some receivers may consider the introduction of the noise wall as providing a beneficial impact by blocking the view of the road corridor, however this has not been assessed to ensure a worst-case scenario is considered.

Low-to-moderate impacts are predicted from the eastern side of the Warringah Freeway as the introduction of the noise wall would introduce a new, but distant, built form into the viewscape. It should be noted that a noise wall is approved for sections of Jenkins Street on the eastern verge of the Warringah Freeway, which would block views of the Chandos Street noise wall (refer to section 6.8).

Low impacts are predicted for users of the Warringah Freeway as the noise wall would be similar in mass, scale and composition to the existing road infrastructure. A negligible impact is predicted for the area of the St. Thomas' Rest Park that is heritage listed due to its distance from the proposal, and intermediary vegetation screening views.

Screen planting proposed as part of the urban design strategy is likely to further reduce visual impacts over time once this has established and matured.

Figure 6-9 shows the future views for each viewpoint assessed with the proposed noise wall and established planting and vegetation in place.

Viewpoint 1



Viewpoint 2



Viewpoint 3



Viewpoint 4



Viewpoint 5



Viewpoint 6



Viewpoint 7



Viewpoint 8



Viewpoint 9



Source: Arup

Figure 6-9: Photomontages showing the future view at each viewpoint with the proposed noise wall built

6.2.4 Safeguards and management measures

Table 6-15 lists the measures that would be implemented to safeguard against and manage the proposal's predicted landscape character and visual impacts.

Table 6-15: Landscape character and visual impact safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	<p>An Urban Design Plan (UDP) would be prepared to support the final detailed project design and implemented as part of the CEMP. The UDP would present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan would include design treatments for:</p> <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Relocated and introduced fixtures such as lighting, fencing and signs • Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. <p>The UDP would be prepared in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> • Noise Wall Design Guidelines (RTA, 2006) • Landscape Guideline (RTA, 2008) • Beyond the Pavement (Roads and Maritime, 2014) 	Roads and Maritime project manager / Contractor	Detailed design/ pre-construction	LV1
Landscape character and visual impact	<p>The CEMP shall include measures and procedures to minimise visual impacts, including:</p> <ul style="list-style-type: none"> • The worksite is to be kept clean and tidy always • Appropriate storage of equipment, arrangements for the storage and removal of rubbish and waste material • On completion of work, all vehicles, material and refuse relating to the work would be removed 	Contractor	Pre-construction	LV2
Landscape	Detailed design solutions to minimise the	Roads and	Detailed	LV3

Impact	Environmental safeguards	Responsibility	Timing	Reference
character and visual impact	visual impacts of noise wall would be developed in consultation with property owners, residents and North Sydney Council.	Maritime project manager	design	
Landscape character and visual impact	The Landscape Management Plan would be refined to ensure cost effective and consistent management of landscape works will be developed in consultation with property owners and residents. The plan will be prepared in accordance with the Landscape Guideline.	Roads and Maritime project manager	Detailed design	LV4
Landscape character and visual impact	Landscaping is to be completed in accordance with the Landscaping and Urban Design Plan.	Contractor	Construction	LV5
Lighting impacts	Temporary site lighting will be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting.	Contractor	Pre-construction/ construction	LV6

6.3 Non-Aboriginal heritage

This section describes the proposal's non-Aboriginal heritage impacts.

6.3.1 Methodology

Commonwealth, state, local and agency database and register searches were carried out in June 2018 to confirm the presence of non-Aboriginal heritage items and Conservation Areas within 200 metres of the proposal footprint. Archaeological potential was considered by reviewing the area's development history.

6.3.2 Existing environment

Historical context

Crows Nest was originally part of a land grant made to Edward Wollstonecraft in 1821. Wollstonecraft built a cottage on the land and replaced it with a house in 1850. Both properties were named Crows Nest giving rise to the suburb's name.

A key feature of the local area is the St. Thomas' Rest Park. This is on land donated to the Anglican Parish of St. Leonards in 1845 by Alexander Berry. The park was originally the cemetery of St. Thomas' Church. It was the first burial ground on Sydney's north shore.

The Warringah Freeway was built in stages between 1968 and 1992. It originally terminated at Chandos Street before being extended to Willoughby Road in 1978. On its extension, the Chandos Street ramps were moved back to Brook Street. Land availability constraints meant that residential and commercial property and various community infrastructure was resumed by the State Government to build the freeway. By association, this affected the area's historic land use patterns and heritage value. This has resulted in the current pattern of dispersed and isolated heritage value in the local area.

Listed heritage

There are three locally-listed heritage items within 200 metres of the proposal footprint as described in Table 6-16 and shown on Figure 6-10. By contrast, there is no listed Commonwealth or State heritage, or agency-registered heritage and conservation assets within or local to the proposal.

Table 6-16: Local heritage listings in the North Sydney LEP

Listing	Location in relation to the proposal	Significance
CA07: Holtermann Estate <i>Conservation Area</i>	The proposal footprint borders the Conservation Area at Chandos Street and Matthew Lane.	The Conservation Area demonstrates the typical subdivision processes that occurred in the north shore during the late nineteenth and early twentieth centuries. The scale and style of dwellings defines the area as a historic precinct. The Conservation Area is representative of historic development rather than a rare sample in north Sydney.
IO180: St. Thomas' Rest Park <i>Landscape listing</i>	25 metres south of the proposal footprint.	This remains an important local cemetery that contains the remains of many famous colonial identities, among which are several pioneers of the north shore. This location is important due to its association with early residents of Sydney.
IO140: barn <i>Outbuilding at Atchison Street</i>	170 metres south west of the proposal footprint	Rare survival of a utilitarian outbuilding in a suburban environment.



Source: Arup

Figure 6-10: Local heritage listings in the North Sydney LEP

Archaeological potential

The extent of cutting depth close to the proposal footprint and the disturbance caused when constructing the Warringah Freeway is likely to have destroyed any subsurface archaeology.

6.3.3 Potential impacts

Construction

There are no heritage items or conservation values within the construction footprint. As discussed in section 3.3.6, small vehicles may need to access St. Thomas' Rest Park during construction to assist with lifting the noise wall panels into place. Vehicles would access the park via the existing gate on West Street and travel to the north-west corner of the park. The construction vehicles are likely to be similar in size and type to those used to maintain the park and providing standard management controls are put in place when vehicles track across the area then impacts can be adequately managed.

As an extension of the discussion in section 6.2.3, the proposed impact on the area's landscape character and visual amenity would extend to temporarily affecting the conservation setting and values associated with the Holtermann Estate, which borders the proposal. The proposed vegetation loss would remove a key amenity and visual buffer alongside the Conservation Area, temporarily introducing new views of the freeway. This would have most impact for properties in the Conservation Area along Chandos Street. Conversely, the barn and core heritage values of St. Thomas' Rest Park are separate and removed from the construction footprint removing the potential for any indirect impacts.

Operation

The introduction of a 4.5-metre-high noise wall along the common boundary of part of the Conservation Area would introduce a modern structure that would be inconsistent with the area's heritage character and values. Despite this, its introduction is not considered to contribute to an incremental loss of the Conservation Area's heritage significance. Equally, the introduction of the wall would reduce noise levels within those areas of the Conservation Area closest to the proposal. This would provide benefit by indirectly improving the setting and amenity value from within sections of the Conservation Area. A similar benefit would be experienced by users at the St. Thomas' Rest Park where noise levels are expected to decrease because of the introduction of the proposed noise wall.

Under the proposal, architectural treatment is proposed at multiple properties within the Conservation Area. While the specific treatment measures would be defined during detailed design, they may include altering building façades, changing the window-type, sealing windows, providing mechanical ventilation, or introducing localised screening. Depending on the nature and scale of these changes, they may introduce elements into the Conservation Area that do not reinforce its character and value.

6.3.4 Safeguards and management measures

Table 6-17 lists the measures that would be implemented to safeguard against and manage the proposal's predicted non-Aboriginal heritage impacts.

Table 6-17: Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	The Standard Management Procedure: Unexpected Heritage Items (Roads and Maritime, 2015) would be followed if any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work would only recommence once the requirements of that procedure have been satisfied.	Contractor	Detailed design/ pre-construction	NAH1 Section 4.10 of QA G36 <i>Environment Protection</i>
Conservation Area	The at-property treatment measures would be designed to be consistent with the specific development control objectives for Conservation Area outlined in the North Sydney Council LEP.	Roads and Maritime project manager	Detailed design	NAH2
Conservation Area	The UDP and LMP would be developed to minimise the visual impact of the inside of the noise wall along the common boundary of the Holtermann Estate Conservation Area and the St. Thomas' Rest Park.	Roads and Maritime project manager	Detailed design	NAH3
St. Thomas' Rest Park	The tracking of vehicles would be carefully monitored to avoid any structural collision to the form and fabric of Sexton's Cottage, the gravestones and the cemetery fence Vehicle access in St. Thomas' Rest Park would follow the route shown in Figure 3-5.and a spotter would be used to monitor progress. This indicative access route would be confirmed and refined (where required) onsite before moving equipment through the park to avoid any impact on the form and fabric of the heritage value.	Contractor	Pre-Construction	NAH4
St. Thomas' Rest Park	Before tracking vehicles and equipment through St. Thomas' Rest Park, heavy duty track mats would be laid down along the access path.	Contractor	Construction	NAH5

6.4 Biodiversity

This section describes the proposal's biodiversity impacts. It also describes the proposal's impact on trees in the area by summarising a supporting arboricultural report provided in Appendix F.

6.4.1 Methodology

Commonwealth and state database searches were carried out in July 2018 to confirm the presence of protected threatened biodiversity values within 10 kilometres of the proposal footprint. This information, in combination with local habitat characteristics and vegetation types, was used to confirm the ecological potential within the proposal footprint. Appendix G includes the biodiversity search results.

The arboricultural assessment in Appendix F determined the existing amenity value of the trees within the construction footprint. Tree health, condition and amenity value was surveyed, and an assessment was carried out in accordance with the Institute of Australia Consulting Arboriculturalists (IACA) Significance of a Tree, Assessment Ratings System (STARS).

The occurrence of noxious weeds within the local government area was confirmed by referring to Council-records, Weed Wise (NSW Department of Primary Industries, NSW DPI, 2017) and Weeds of National Significance (Department of Planning and Environment, 2017).

6.4.2 Existing environment

Vegetation and habitat

The proposal is in an urbanised area next to a major road. The ecological community within and surrounding the proposal can be classified as a 'miscellaneous ecosystem' of planted street trees and exotic vegetation. It comprises various mixes of native and exotic species introduced to provide amenity value within the St. Thomas' Rest Park and the urban environment of Crows Nest. Most of the proposal footprint is located within a vegetated amenity buffer alongside the Warringah Freeway. It provides limited ecological or habitat value other than to hardy and tolerant endemic species such as small terrestrial and arboreal mammals, microchiropteran bats, reptiles and nesting birds. This is supported by its isolation from any other key important habitat values in the area.

Protected biodiversity

While 109 Commonwealth-protected and 141 State-protected species were identified within 10 kilometres of the proposal (refer to

Table 6-18), none are considered likely to occur local to the proposal due to its isolation and limited habitat value. The only exception is the grey-headed flying fox *Pteropus poliocephalus*, listed as vulnerable under the BC Act. This species has a large range over the Sydney metropolitan area and may shelter or forage occasionally in the area. However, there is better-quality habitat for the grey-headed flying fox within comfortable range such as the wider St. Thomas' Rest Park, meaning that it would not rely on the habitat of the proposal footprint for its survival.

Table 6-18: Statutorily protected biodiversity within 10 kilometres of the proposal

Commonwealth/state listed	Species summary
Commonwealth-protected biodiversity (EPBC Act)	<ul style="list-style-type: none"> • 37 vulnerable species • 26 endangered species • Seven critically endangered species • 39 migratory species
State-protected biodiversity (BC Act)	<ul style="list-style-type: none"> • 81 vulnerable species • 51 endangered species • Seven critically endangered species • Two presumed extinct

Tree species

There are 32 trees within the construction footprint including:

- One willow bottle brush *Callistemon salignus*
- Three Sydney blue gum *Eucalyptus saligna*
- One wattle *Acacia sp.*
- Two nettle tree *Celtis sinensis*
- 11 sheoaks *Allocasuatina littoralis*
- Two Chinese banyan *Ficus macrocarpa*
- Two grey gums *Eucalyptus Punctata*
- Six tallowwood *Eucalyptus microcorys*
- Three spotted gum *Corymbia maculate*
- One jacaranda *Jacaranda mimosifolia*.

All are assessed to be in fair to good health and condition. Two trees were identified as being of high retention value for amenity purposes, as shown in Figure 6-11, with the remaining trees of either medium to low retention value. None are protected under the BC Act or EPBC Act. It is likely that all these trees were planted when the Warringah Freeway was built to form part of the roadside amenity planting. While none of the trees hold specific floral or biodiversity value, four species (Sydney blue gum, grey gums, tallowwood, and spotted gum) can potentially contain tree hollows that provide habitat for birds and bats.



Source: Arup

Figure 6-11: Retention value of trees within the construction footprint

Biosecurity species

There is a moderate-to-high potential for weeds to occur within any road margin due to their distribution via passing vehicles. As of 2014, there were 129 declared and controlled noxious weeds in North Sydney. These records have not been updated to respond to the *Biosecurity Act 2015*. Table 6-19 summarises each declared weed's classification under the redacted *Noxious Weed Act 1993*.

Table 6-19: Declared noxious weeds in North Sydney LGA

Classification and relevant control measure	Number within the LGA
Class 1: needs eradicating and the area kept weed-free	34
Class 2: needs to be fully and continuously suppressed	12
Class 3: cannot be spread	11
Class 4: cannot be spread	45
Class 5: managed through notification	27

Twenty-nine (29) of the above weeds are of national significance (WONS) as they are recognised as being particularly invasive at a national level.

As is common to urban areas, there is the potential for pest and vermin species to occur locally principally including European fox *Vulpes vulpes* and European rabbit *Oryctolagus cuniculus*.

6.4.3 Potential impacts

Construction

Vegetation loss

The proposal would result in the loss of localised vegetation (miscellaneous ecosystem) from the Warringah Freeway road margin. This would include the loss of 19 (59 per cent) of the recorded trees. While the impacted area contains no habitat features such as roots or rocky outcrops, certain species of the trees to be removed may include hollows, which may remove potential bird and microchiropteran bat habitat.

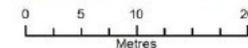
As these trees provide sub-optimal foraging habitat for the grey-headed flying fox no impacts on this species are expected.

Tree value loss

Figure 6-12 (Map 1 to 4) shows the scale of impact on each of the trees within the construction footprint. Nineteen (19) trees have been identified as experiencing a high impact and would be subject to major encroachment. Those trees identified as receiving a high impact because of the proposal cannot be sustainably retained, these are shown in red in Figure 6-12. All trees to be removed to deliver the proposal are identified as having a low-to-medium amenity value. As such, the arboricultural and amenity impact of their loss is limited and it could be easily mitigated through replanting. Thirteen (13) trees would not be impacted by the proposal and they would be retained. Two of these are identified as being of high amenity value.



- Legend**
- Noise Wall
 - Construction Footprint
 - Tree Protection Zones
- Tree Impacts**
- High Impact: >20%
 - No Impact: 0%



Datum/Projection:
GDA 1994 MGA Zone 56
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Imagery Captured: 2018-05-06 Prepared by: KR Date: 2018-10-26



Legend

- Noise Wall
- Construction Footprint
- Tree Protection Zones

Tree Impacts

- High Impact: >20%
- No Impact: 0%



0 5 10 20
Metres

Datum/Projection:
GDA 1994 MGA Zone 56

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Imagery Captured: 2018-05-06 Prepared by: KR Date: 2018-10-26



Legend

- Noise Wall
- Construction Footprint
- Tree Protection Zones

Tree Impacts

- High Impact: >20%
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0 5 10 20
Metres

Datum/Projection:
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Source: Eco logical

Figure 6-12: Impacts on trees close due to construction footprint of the proposal

Section 6.2 describes the associated landscape character and visual impacts of removing these trees, while section 6.3 describes their loss in terms of heritage-related impacts.

It is possible that some trees within St. Thomas' Rest Park would need to be pruned to allow vehicles to travel through the area to access the construction footprint.

Key threatening processes and other impacts

Any mobile species (eg birds and bats) affected by the proposal's construction would be able to temporarily move out of the affected area removing the risk of injury or death. Less mobile or nocturnal species, such as small terrestrial and arboreal mammals, microchiropteran bats, reptiles and nesting birds are likely to be most at risk during construction from injury or death.

One remaining residual impact would be for any echolocating bats to become disorientated immediately after the tree and vegetation removal along the road margin. However, bat species are generally adaptive and would find alternative routes. This would be assisted by the widespread presence of alternative structures to echolocate from in the local area. Any disorientation impacts would therefore be temporary and localised.

The proposal would involve various activities that may potentially impact on biodiversity values. Known as key threatening processes they include:

- Plant dieback and infection from moving and spreading materials containing pathogen species such as root-rot fungus
- Weed dispersal and invasion through vegetation clearance, earthworks, material importation and vehicle movement on and offsite
- Land clearance.

Other indirect impacts associated with the proposal that may occur during construction include:

- Edge effects leading to a wider loss in habitat value from reducing the vegetation buffer extent and replacing it with a noise wall. This may affect drainage characteristics and soil moisture content, overshadow adjacent habitat, lead to weed invasion, and/or result in the temporary introduction of, noise, vibration and artificial lighting
- Death and injury from equipment use and vehicle movement around the site
- Accidental spills affecting soil and habitat quality
- Attraction of pest-species onsite through poor site maintenance during construction.

In all cases these impacts would be minor in nature due to the limited ecological values impacted by the proposal. These impacts can also be largely avoided through implementing and maintaining standard safeguards during construction that are proven to be effective.

Operation

No direct operational impacts are expected once the noise wall is built. However, indirect overshadowing impacts are likely to affect habitat (re)growth. Section 6.6 shows the extent of overshadowing expected from the proposal. This would reduce light levels directly behind the noise wall, overshadowing the vegetated areas and habitats in St. Thomas' Rest Park and gardens to the rear of those properties alongside the noise wall. Landscape planting at the rear of the noise wall, proposed as part of the urban design strategy, would include species that are tolerant to limited or low light levels.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not needed. The proposal is also not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

6.4.4 Safeguards and management measures

Table 6-20 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-20: Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>A Flora and Fauna Management Plan (FFMP) would be prepared in accordance with Roads and Maritime's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to:</p> <ul style="list-style-type: none"> Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas Requirements set out in the Landscape Guideline (RTA, 2008) Pre-clearing survey requirements Procedures for unexpected threatened species finds and fauna handling Protocols to manage weeds and pathogens. 	Contractor	Detailed design/ pre-construction	B1 Section 4.8 of QA G36 <i>Environment Protection</i>
Biodiversity	All personnel working on site would receive training to ensure awareness of the requirements of the FFMP and relevant statutory responsibilities. Site-specific training would be given to personnel when working near areas of identified biodiversity value that are to be protected.	Contractor	Pre-construction/ construction	B2
Tree loss	An arborist would carry out a pre-construction check of the site to confirm that all preserved trees are clearly and effectively marked and suitable protection zones are in place to prevent any impact on the canopy or root zones.	Contractor	Pre-construction/ construction	B3
Hollow-bearing trees	Pre-clearance checks would be carried out for those tree species identified as potentially hollow-bearing that would be removed as part of the proposal to ensure these are not being used as habitat for bats and birds. If bat and	Contractor	Pre-construction/ construction	B4

Impact	Environmental safeguards	Responsibility	Timing	Reference
	bird species are discovered then they would be relocated in accordance with Guide 9: fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011). If needed nest boxes would be installed to replace the lost tree hollows as per Guide 8 of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011).			
Tree loss	Tree removal or pruning would be carried out by a qualified specialist in accordance with AS4970: 2009: Protection of Trees on Development Sites (Standards Australia, 2009) and AS4373:2007: Pruning of Amenity Trees and WorkCover Amenity Tree Industry Code of Practice 1998.	Contractor	Construction	B5
Biodiversity	Consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects, and any specific requirements of the approved FFMP, an unexpected finds procedure would be implemented if a threatened species or ecological community that had not been identified and assessed by the REF are unexpectedly encountered during the construction process.	Contractor	Construction	B6
Weeds and pathogens	Declared noxious weeds and potential pests and pathogens would be managed according to requirements under the <i>Biosecurity Act 2015</i> and Guide 6 (Weed Management) of the Roads and Maritime Services Biodiversity Guidelines 2011 and Guide 7: pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011). Topsoil from the site that contains or potentially contains weed species or propagules would: <ul style="list-style-type: none"> • Not be reused for future rehabilitation or revegetation works • Be removed from the construction site and disposed of at an appropriately licensed facility Until removal occurs, topsoil would be stockpiled in cleared or disturbed areas and managed in accordance with the RTA Stockpile Site Management Guideline.	Contractor	Construction	B7

6.5 Traffic and transport

This section describes the proposal's traffic, transport and access impacts.

6.5.1 Methodology

Potential impacts were assessed due to the need to close a lane of the Brook Street off ramp during construction while introducing various traffic management controls and pedestrian access restrictions during certain periods in the local area.

6.5.2 Existing environment

About 10 per cent of the 170,000 vehicles that travel along the Warringah Freeway (at Brook Street Interchange) everyday (17,500 vehicles) exit at Brook Street. The freeway is maintained by Roads and Maritime Services with operations managed by the Transport Management Centre..

The three-lane Brook Street off ramp extends back from the intersection about 315 metres. It operates with a 60 km/h posted speed limit.

Brook Street is a regional road with a current traffic volume of 30,000 vehicles per day.. It provides the main access for residents living on Jenkins Lane and Chandos Street if travelling from the Warringah Freeway. On-street parking is available outside of peak periods.

There are no bus stops or other public transport provisions local to the proposal. The nearest bus stops are located on Willoughby Road about 360 metres west of the proposal.

The nearest cycle provisions are through St. Thomas' Rest Park, that connect into on-road provisions on Aitchison Street (100 metres south of the proposal) and West Street (190 metres south east of the proposal). Cycling is not permitted on this section of the Warringah Freeway.

Footpaths are provided throughout the recreational and residential areas close to the proposal. They principally provide access from residential areas to Crows Nest's commercial centre. Footpaths from St. Thomas' Rest Park provide access to the West Street overbridge and therefore provide the ability to walk from Crows Nest to Cammeray.

6.5.3 Potential impacts

Construction

Over the eight to ten month construction period there would be a small amount of additional traffic accessing and leaving the area, typically about 20 vehicles every shift comprising 10 heavy-vehicles and 10 light-vehicles on average. These vehicles would deliver equipment and remove waste, travelling between the site and a waste management facility via the Warringah Freeway. Additional vehicle movements would be minimal compared to existing traffic movement on the Warringah Freeway and the Brook Street off ramp.

Occasional larger semi-rigid trucks would be used to deliver large prefabricated materials such as the noise wall panels, steel pile reinforcement cages and steel posts. They would arrive onsite under traffic management controls and with occupancy of one lane of the Brook Street off ramp.

During closure of the inside lane of the Brook Street off ramp, connectivity to turn left at Brook Street interchange would be maintained.

Closure of one lane would increase the traffic queue length during peak periods, however it is expected that the queue could be contained within the Brook Street off ramp and would not cause any obstruction or delays for the main carriageway of the Warringah Freeway. Therefore, the closure is not considered to have a material impact on the capacity of the off ramp. Roads and Maritime is carrying out further traffic queue length surveys in late October 2018 to confirm the capacity of the off ramp during peak periods and ensure that closing one lane of the Brook Street off ramp throughout the construction phase is appropriate.

There may also be occasions when additional lanes would need to be temporarily closed on the off ramp, to complete rock cutting, piling and other noise wall construction activities. This specialist work, and associated additional lane closures, would be programmed to be carried out when there would be less traffic on the road including school holidays, weekends and at night. The road occupancy licence would outline when any lane closures would be permitted and what other traffic management controls would need to be introduced when working in the Warringah Freeway corridor at specific times and days. Traffic diversions or full closures of the off ramp may be required. Detour routes via the Willoughby Road Exit Ramp onto Willoughby Road will be utilised in this instance.

Traffic management controls are likely to be needed on Brook Street to allow relocation of utilities from the verge of the Warringah Freeway to Brook Street/Chandos Street. Traffic management controls would also be in place to assist vehicles entering and exiting the construction site and construction compound. These controls are not likely to affect local parking.

Due to space constraints at the construction compound, it is likely that some light vehicles and small pieces of plant and equipment may need to be temporarily parked on the local streets near the proposal footprint during any given work shift. The construction phase would require a work zone at the end of Chandos Street for construction access and would also result in the removal of about five car park spaces at the end of Chandos Street. A work zone is also required at the end of Jenkins Lane.

There is demand in the local area for on-street parking from people working in Crows Nest. This has been recognised by Roads and Maritime and as a result, opportunities to park light construction vehicles on the site or to the south east of the construction footprint on West Street will be reviewed with the contractor to relieve demand close to the proposal.

While vehicles would need to access St. Thomas' Rest Park during construction, this would not affect pedestrian or cycling movement through the park and no diversions would be needed.

During construction, there may be the need to restrict access to informal footpaths used by the local community to move between Chandos Street, Matthew Lane and St. Thomas' Rest Park.

Operation

There would be no direct operational traffic and transport impacts. While building the noise wall would not remove the private property access from Brook Street to Jenkins Lane, it would enclose it close to the property at Jenkins Lane. This may make it less attractive due to the perceived security issues of walking down an enclosed space. These residents would still be able to access their properties alongside the Warringah Freeway behind the wall and from Brook Street to Brook Lane. The design has been refined to change the alignment of the wall to open-up this area as much as possible. In addition, as raised in community consultation (refer to chapter 5), there are perceived security issues associated with the informal access path from Chandos Street and Matthew Lane through to St. Thomas' Rest Park. Historically, this has been used by the public despite it not being an official path. During operation of the noise wall this would remain open but members of the public may choose not to use this route due to the safety concerns. A designated access is provided about 50 metres north off Matthew Lane therefore where the public choose not to use the informal access path, access to St. Thomas' Rest Park would not be restricted by the proposal.

6.5.4 Safeguards and management measures

Table 6-21 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-21: Traffic and access safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and Access	<p>A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in accordance with the Roads and Maritime Traffic Control at Work Sites Manual (RTA, 2010) and QA Specification G10 Control of Traffic (RTA, 2008). The TMP would include:</p> <ul style="list-style-type: none"> • Confirmed haulage routes • Confirmed temporary traffic management provisions • Measures to maintain access to local roads and properties • Site-specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms • Work zones required in Chandos Street and Jenkins Lane • Stipulated parking restrictions. 	Contractor	Detailed design/ pre-construction	<p>TT1</p> <p>Section 4.8 of QA G36 <i>Environment Protection</i></p>

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	Consultation would be carried out with potentially affected residences before starting and during work in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008). Consultation would include but not limited to door knocks, newsletters or letter box drops providing information on the proposed work, the need to park on local roads, working hours and a contact name and number for more information or to register complaints.	Roads and Maritime project manager	Detailed design/pre-construction	TT2
Access	Requirements for any changes to local access arrangements would be confirmed during detailed design in consultation with the local road authority and any affected landowners.	Roads and Maritime project manager	Detailed design	TT3
Access	Disruptions to property access and traffic would be notified to landowners at least five days in accordance with the relevant community consultation processes outlined in the TMP.	Contractor	Construction	TT4
Pedestrian and cyclists	Pedestrian and cyclist access would be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Contractor	Construction	TT5

6.6 Socio-economic, property and land use

This section describes the proposal's socio-economic, property and land use impacts.

6.6.1 Methodology

A basic level of assessment was carried, as described in the corresponding environmental impact assessment practice note (EIA-N05, Roads and Maritime, 2013), to determine the socio-economic, property and land-use impacts that are predicted to occur from building the noise wall. The assessment also considered amenity impacts such as noise, local access and visual amenity. This section also includes the assessment of overshadowing for those properties immediately next to the proposed noise wall. The assessment used a 3D model of the local area and built form to understand how the introduced noise wall would overshadow adjacent properties. The assessment considered likely impacts on both the shortest and longest days of the year (21 June and 22 December respectively). The assessment has been carried out to determine existing overshadowing, the situation with a solid noise wall, and the situation (based on the current design) with transparent panels for the top two metres of the noise wall at the end of Chandos Street.

The diagrams presented below show the cumulative number of hours of sunlight per day. In addition, overshadowing at 9am, 12 noon and 3pm for the shortest and longest day as well as the spring and autumn equinox (23 September and 20 March respectively) is shown at the most-affected properties.

Appendix D provides further detail on the assessment method.

6.6.2 Existing environment

Socio-economic context

The proposal is in the North Sydney LGA. About 68,000 people were living in the LGA at the time of the 2016 census, with this number estimated to have increased to around 73,000 in 2017 (Australian Bureau of Statistics, 2018). The local demographic helps define the area's community cohesion and values. It also assists in profiling how adaptable the community is likely to be to the change. Accordingly, as of 2016, the demographic of the local community was as follows.

- Slightly more females lived in the area
- The average age was consistent with the state and national average of about 36
- About 60 per cent of people living in the area were couples without children
- About 40 per cent of the adult population was married, while about 45 per cent had never married, with the remainder either divorced, separated or widowed. The proportion of people married was about 10 per cent less than the state and national average
- About 55 per cent of the resident population were born in Australia (14 per cent less than the state average), followed by England (seven per cent), New Zealand (three per cent) then China, Japan and South Africa (about two per cent each)
- About 72 per cent of the population spoke only English at home. The most common other languages were Cantonese, Mandarin, Japanese, Spanish and French
- The average weekly rent was about \$500
- The median weekly household income was about \$2,200 which was about \$1,00 above the state and national average
- About 30 per cent of people travelled to work by car (25 per cent less than the state average) followed by bus (16 per cent) and train (13 per cent), with about 12 per cent of people walking to work. There was a much higher proportion of public transport use and walking to work than the state and national average
- The main occupations of the people in the area were professionals (44 per cent), managers (20 per cent) and clerical and administrative workers (14 per cent)
- About four per cent of people were unemployed which is about two per cent below the state and national average.

The demographic of the area demonstrates people to be affluent, mobile, and reliant on public transport use to travel to and from work. The demographic is typical of a community that is actively engaged and can mobilise in response to changes that would affect them as a collective of individuals. This has been confirmed through the consultation response from the community described in chapter 5.

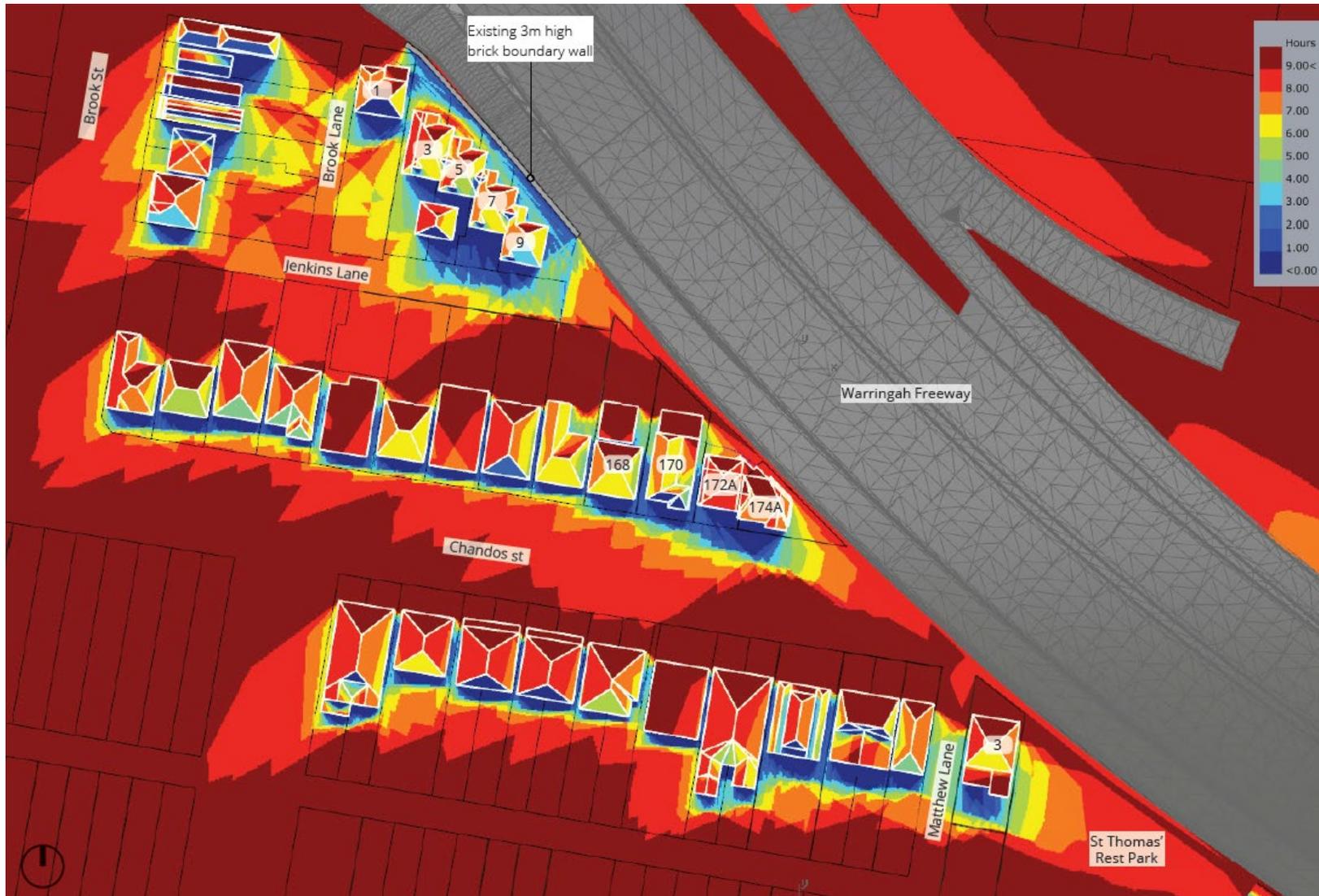
Property and land use

The proposal is in a low-rise dense built environment mainly comprising residential property and road infrastructure. St. Thomas' Rest Park provides urban amenity and recreational use, while it also includes a fenced children's playground. The commercial area of Crows Nest is about 360 metres south west of the proposal.

The surface proposal footprint is located within land zoned SP2: Infrastructure (classified road) under the North Sydney LEP. It is located on land owned by Roads and Maritime. No surface acquisition would be needed to construct the wall.

Figure 6-13 shows the number of sunlight hours the local area currently receives on the shortest day (21 June). As shown, the existing natural and built form blocks light and reduces the number of sunlight hours received in certain areas on the shortest day. Specifically, the blue shading represents areas that receive less than three hours of sunlight on the shortest day whereas red shading represents areas that receive the most sunlight hours on the shortest day. Typically, shadows are cast on the southside in the wake of the properties. Also, the existing property boundary wall at the end of Jenkins Lane overshadows the gardens, however the north-facing facades of these properties still receive between three-to-six hours of sunlight on the shortest day.

Figure 6-14 shows the number of sunlight hours on the longest day (22 December). There is a limited overshadowing impact on the properties on the longest day with most locations receiving more than six hours of sunlight.



Source: Arup

Figure 6-13: Existing overshadowing environment on the shortest day



Source: Arup

Figure 6-14: Existing overshadowing environment on the longest day

6.6.3 Potential impacts

Construction

The amenity of residents and users of St. Thomas' Rest Park and playground would be temporarily affected during construction through increased noise levels and visual impacts as described in section 6.1 and section 6.2. These impacts would also include loss of amenity at night due to the use of site and security lighting and the potential for sleep disturbance. Further is the potential for amenity impacts through the need to use vibration-generating equipment close to residential properties and the potential for generating dust onsite through the earthworks and rock cutting.

The nature of the proposal is such that the above impacts would be periodic and would be limited in frequency and duration. Minor work associated with the relocation of utilities also has the potential to generate amenity impacts for residents of Chandos Street. All impacts can be effectively managed and safeguarded against by implementing standard safeguards as described in chapter 7.

Fencing would need removing in St. Thomas' Rest Park through to Chandos Street however the noise wall would replace this. This fencing does not form part of the heritage listing and is of limited amenity value.

The removal of roadside verge vegetation to accommodate the proposal would increase visibility of the Warringah Freeway. This would adversely affect people's views, however as described in section 6.2, the urban design and landscape planting strategy both serve to minimise any adverse impacts.

While there is a proposal to close one of the three lanes on the Brook Street off ramp it is considered that this would not affect users due to the sufficient capacity of the remaining lanes to support existing traffic volumes. Local road, pedestrian and cyclist access would also be maintained throughout however some access restrictions may be required for the informal footpath used to travel between Chandos Street, Matthew Lane and St. Thomas' rest park.

Operation

Introducing the noise wall would benefit residential and recreational amenity in the area by reducing ambient noise. It is also understood that the local community are generally supportive of the noise wall as confirmed through the initial consultation (refer to chapter 5).

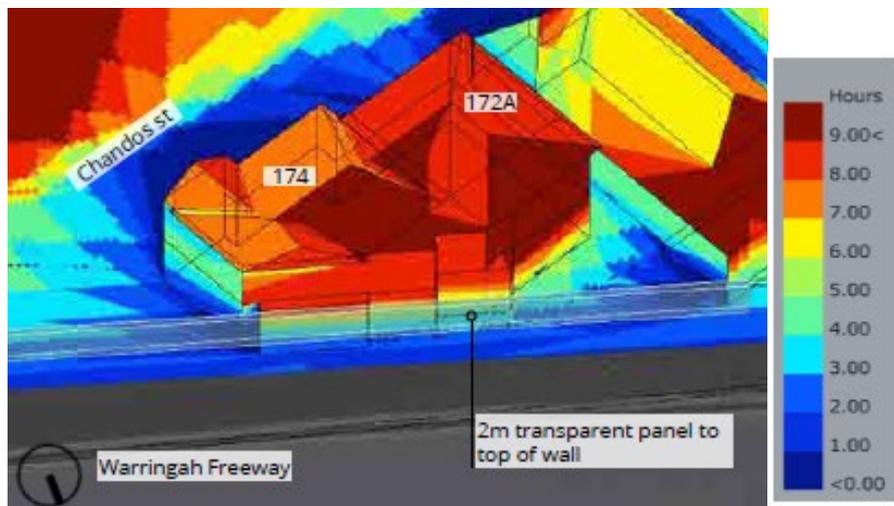
No access or land use changes are needed to deliver the proposal. The proposed acquisition of land (refer to section 3.6) would be carried out equitably in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*, the supporting NSW Government Land Acquisition Reform 2016 and the Land Acquisition Guide (Roads and Maritime, 2014).

The proposed noise wall would result in overshadowing for properties and open space immediately next to the wall. Section 4 of Appendix D contains the full assessment of overshadowing impacts. This shows that the increase in overshadowing during the longest day is minimal. A solid noise wall would result in increased overshadowing to the ground floor of properties on Chandos Street (see Figure 4O of Appendix D). The inclusion of transparent panels reduces overshadowing to the ground floor of properties on Chandos Street (see Figure 4P of Appendix D).

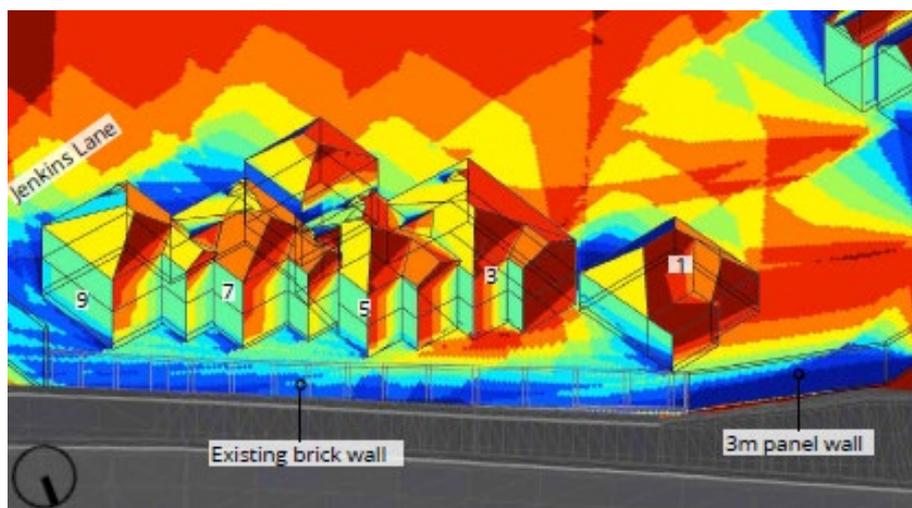
Figure 6-16 and Figure 6-17 show the number of sunlight hours on the shortest day with a solid noise wall in place and for a noise wall with transparent panels for the top two metres of the wall at the end of Chandos Street (current design). Overshadowing impacts affect the same properties discussed for the longest day, however impacts are greater during the shortest day with reduced sunlight hours as a result of the proposed noise wall. In summary, the proposal would overshadow the areas directly behind the noise wall including the north-western corner of St. Thomas' Rest Park, the garden of a property on Matthew Lane, and the open area close to the Brook Lane, where less than two hours of sunlight are predicted on the shortest day. During the longest day, these areas receive more than four hours of sunlight with the

proposed noise wall in place. This is compared to the current situation where these areas receive between one and nine hours of sunlight on the shortest day (refer to Figure 6-13).

The inclusion of transparent panels reduces overshadowing impacts to the ground floor of properties on Chandos Street. Figure 6-15 shows the details of predicted sunlight hours on the shortest day at these properties based on the current design of the proposal with transparent panels included.



Chandos Street

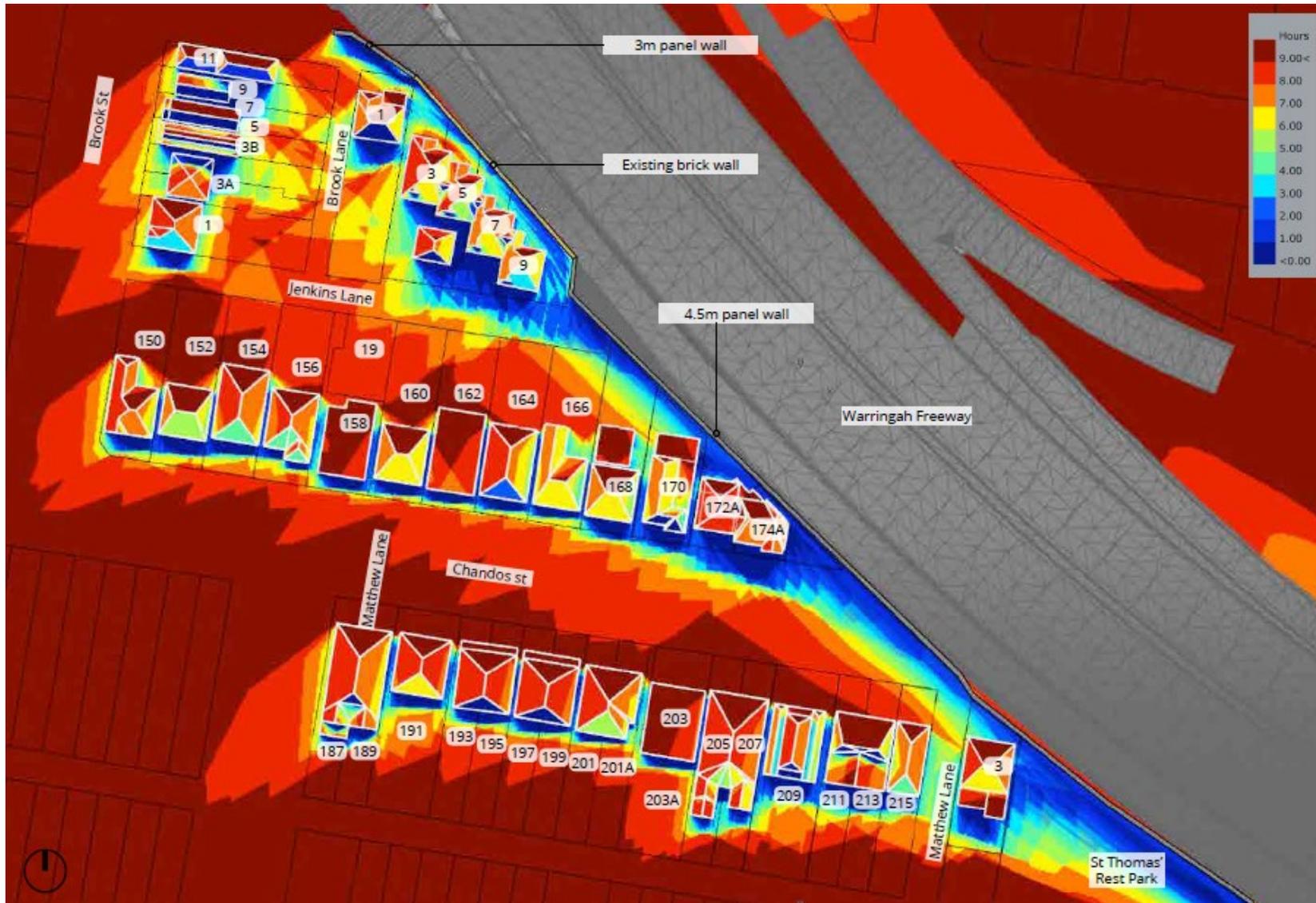


Jenkins Lane

Source: Arup

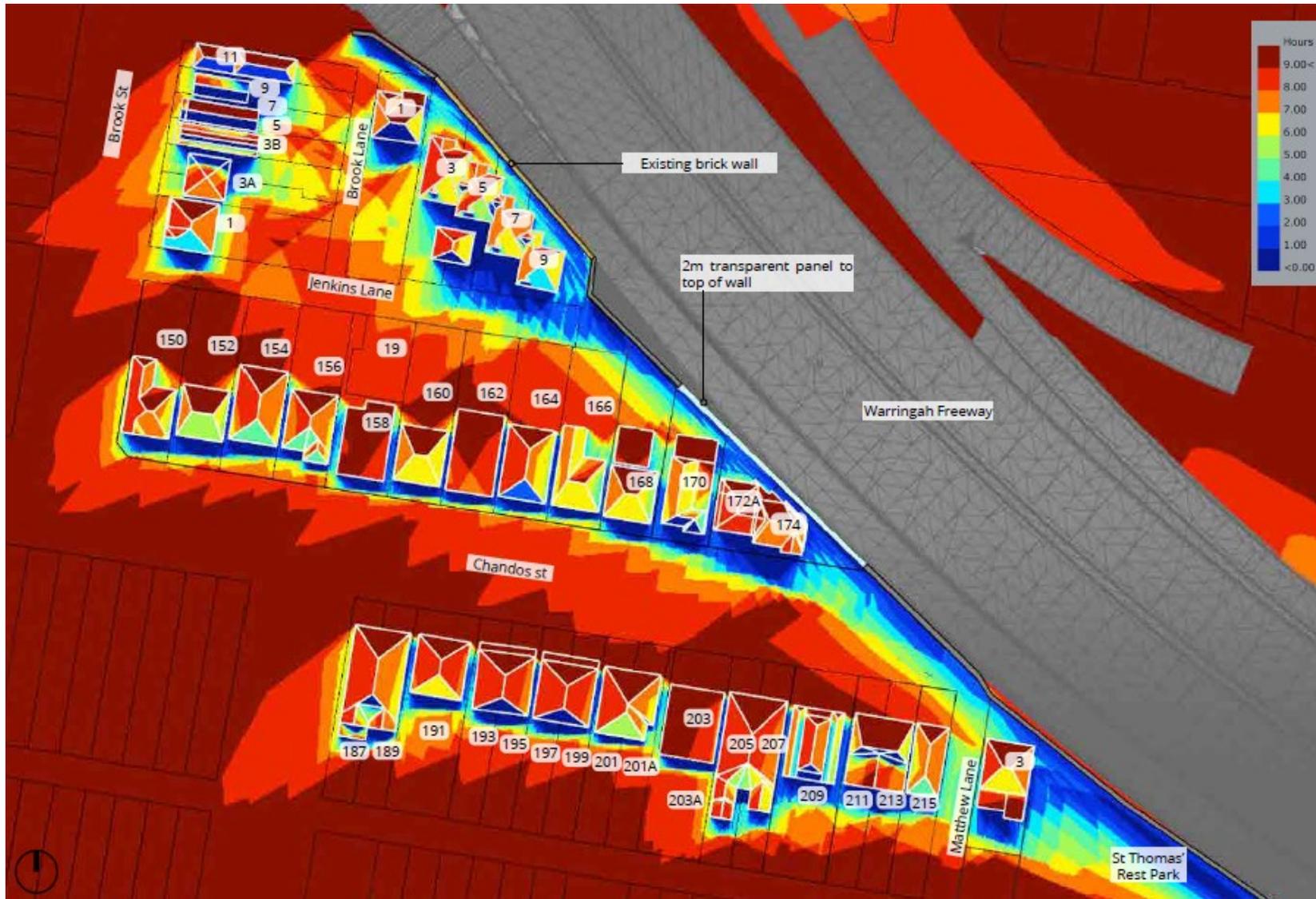
Figure 6-15: Sunlight hours at the facades of properties on Chandos Street and Jenkins Lane on the shortest day

Figure 6-18 shows the shadows cast by the proposed noise wall at 9am, 12 noon and 3pm at properties on Chandos Street. Shadowing is provided for the shortest and longest day as well as the autumn and spring equinox. This shows that the longest shadows are cast, and therefore overshadowing impacts are greatest, during the morning due to the noise wall blocking sunlight from the east. Overshadowing of the property facades is likely to occur for all hours shown during the shortest day and during the morning on the autumn equinox. No overshadowing of property facades is predicted during either the spring equinox or longest day.



Source: Arup

Figure 6-16: Aerial view of overshadowing with a solid noise wall



Source: Arup

Figure 6-17: Aerial view of overshadowing with the noise wall with transparent panels

AUTUMN EQUINOX - SOLID WALL



AUTUMN EQUINOX - TRANSPARENT PANELS



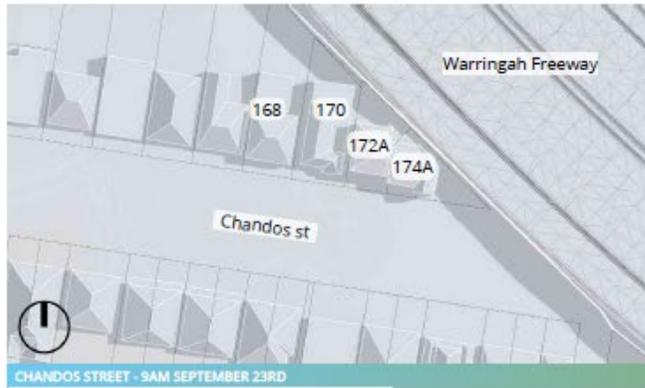
WINTER SOLSTICE - SOLID WALL



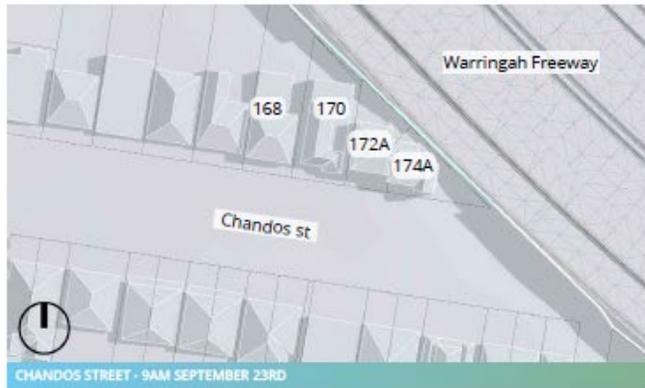
WINTER SOLSTICE - TRANSPARENT PANELS



SPRING EQUINOX - SOLID WALL



SPRING EQUINOX - TRANSPARENT PANELS



SUMMER SOLSTICE - SOLID WALL



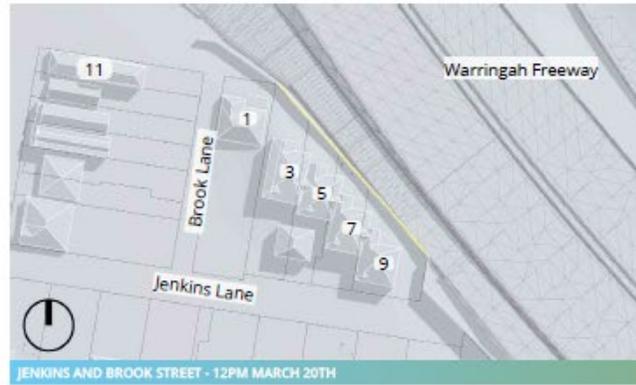
SUMMER SOLSTICE - TRANSPARENT PANELS



Source: Arup

Figure 6-18: Shadows cast by the proposed noise wall at 9am, 12 noon and 3pm for each of the days assessed for properties at Chandos Street

AUTUMN EQUINOX - SOLID WALL



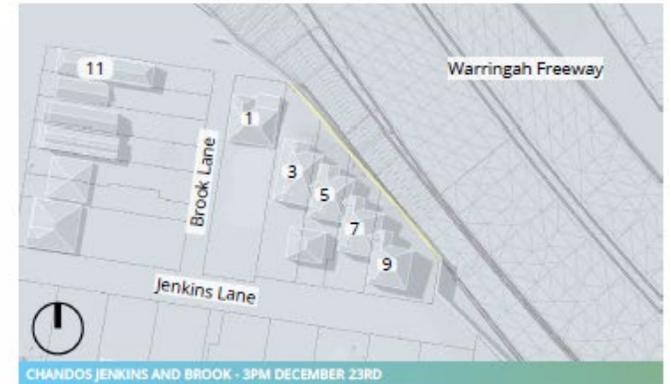
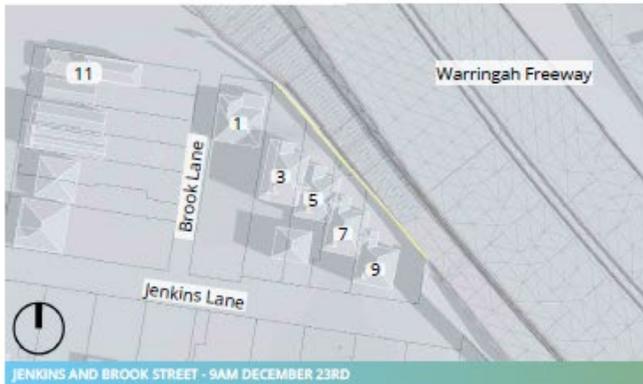
WINTER SOLSTICE - SOLID WALL



SPRING EQUINOX - SOLID WALL



SUMMER SOLSTICE - SOLID WALL



Source: Arup

Figure 6-19: Shadows cast by the proposed noise wall at 9am, 12 noon and 3pm for each of the days assessed for properties at Jenkins Lane and Brook Street

Figure 6-19 shows the shadows cast at the same three hours but at properties on Jenkins Lane and Brook Street. Again, the longest shadows are cast, and therefore overshadowing impacts are greatest, during the morning due to noise wall blocking sunlight from the east. Overshadowing of property facades on Jenkins Lane are likely during the morning of the autumn equinox and shortest day.

As discussed in section 5.2, there are perceived safety concerns from the local community regarding the proposed noise wall enclosing areas used by the local community, especially the access between Brook Street and Jenkins Lane and the informal access between Matthew Lane/Chandos Street through to St. Thomas' Rest Park. It is acknowledged that there would be some enclosure of these spaces however there are alternative accesses to these properties on foot via Jenkins Lane and Matthew Lane respectively.

Despite the proposal requiring the removal of several trees and resulting in the introduction of a new built structure that would have a visual and overshadowing impact on certain receivers (refer to section 6.2 and the overshadowing impacts described above), the urban design, landscape planting strategy, and inclusion of transparent panels, all serve to reduce the proposal's impact.

6.6.4 Safeguards and management measures

Amenity impacts associated with noise and vibration, visual amenity, and traffic and access would be safeguarded against and managed using the measures outlined in section 0, section 6.2.4 and section 6.6.4 respectively. Additional safeguards to ensure adequate ongoing community engagement and consultation are described in Table 6-22.

Table 6-22: Socio-economic safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic	The community would be kept informed about the proposal through the measures outlined in the Communications Strategy for the proposal (as discussed in chapter 5).	Project Manager and consultation team	Pre-construction/ construction	SE1
Socio-economic	All acquisition of private property would be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> and the Land Acquisition Information Guide (Roads and Maritime, 2014).	Project Manager	Pre-construction/ construction	SE2
Socio-economic	Acquisition of a small parcel of land at the end of Chandos Street owned by North Sydney Council would be made under powers afforded to Roads and Maritime under the <i>Roads Act 1993</i> following the processes in the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Project Manager	Pre-construction/ construction	SE3
Socio-economic	Roads and Maritime would enter into an agreement with North Sydney Council to facilitate construction of the noise wall footing in the corner of the St Thomas' Rest Park, adjacent to Matthew Lane. On completion of the work, the park would be reinstated to the boundary of the lot, and landscaping would be agreed with North Sydney Council.	Project Manager	Pre-construction/ construction	SE4

6.7 Other impacts

This section describes the range of common and typical impacts associated with construction. Importantly, their impacts are minimal and can be safeguarded against and managed through adopting effective standard measures that are proven effective in mitigating impacts.

6.7.1 Existing environment and potential impacts

Table 6-23 summarises the other potential impacts associated with building the proposal.

Table 6-23: Other environmental aspects

Environmental factor	Existing environment	Potential impacts
Air Quality	<p>Local air quality is likely to be mainly affected by vehicle emissions from the Warringah Freeway. There are four registered pollutant sources within the local airshed (National Pollution Inventory, 2018) which are likely to contribute to overall local air quality in the area. The closest is the Royal North Shore Hospital, about 1.5 kilometres north west of the proposal footprint.</p> <p>During 2017, local air quality for Sydney's north shore was generally good by national standards (OEH, 2018). Last year, the associated health-based air quality standards were achieved except on less than 14 days over the year. Exceedances were due to extensive hazard reduction burning and widespread dust storms in late September.</p>	<p>Temporary amenity impacts from dust generation during vegetation clearance, earthworks, pile boring and material transportation. Construction vehicle and equipment emissions would also contribute to local air quality.</p> <p>Amenity impacts during construction would be temporary and localised, and would be minimised using standard dust suppressant measures to minimise the generation and spread of dust.</p> <p>Operation of the noise wall is unlikely to affect local air quality in the area.</p>

Environmental factor	Existing environment	Potential impacts
Greenhouse gas and climate change	<p>The existing climate in Sydney is characterised by warm summers and mild winters with rainfall throughout the year. Climate change generally refers to the warming temperatures and altered climate conditions associated with the increased concentration of greenhouse gases in the atmosphere. It is now accepted that the release of certain gases intensifies climate change. These gases are collectively referred to as 'greenhouse gases' and there are a number of industrial facilities locally that emit greenhouse gases. This is supplemented by existing road-traffic generated greenhouse gas emissions. Over time, it is expected that Sydney will experience more extreme weather because of greenhouse gas emissions and climate change. This will include stronger winds, heavier rainfall, and hotter temperatures.</p>	<p>Building the proposal would result in limited greenhouse gas emissions through material consumption, including embodied emissions, and the use of plants and equipment.</p> <p>Operationally, the proposal would not contribute to greenhouse gas emissions.</p> <p>A durable surface treatment on the noise wall has been proposed to protect against more frequent-extreme weather events in the future.</p>
Aboriginal heritage	<p>An Aboriginal Heritage Information Management Search (AHIMS) was conducted and there are no recorded sites or places within 200 metres of the proposal. The closest recorded places are 700 metres north-west of the proposal.</p>	<p>The PACHCI stage 1 assessment (as shown in Appendix H) concluded that the proposal is unlikely to have any impact on Aboriginal cultural heritage as no Aboriginal sites or places have been identified and the heritage potential of the construction and proposal footprints appears to have been severely reduced due to past disturbance. Consultation with the Aboriginal community is therefore not needed in accordance with the PACHCI guidelines. The only potential low risk is discovering, and impacting on, an unexpected find during construction for which standard safeguards are recommended.</p>
Ground contamination	<p>A search of the contaminated land register in June 2018 within 400 metres of the proposal confirmed there are no areas of contamination in the area. There are also no licensed activities under the <i>Protection of the Environment Operations Act 1997</i> within 400 metres of the proposal.</p>	<p>It is unlikely that contaminated land would be encountered during construction due to the lack of any identified contaminated sites. While there is a risk of accidental spills occurring during construction this can be effectively managed using standard safeguard and management measures.</p>

Environmental factor	Existing environment	Potential impacts
Soils and water quality	<p>GyMEA, Lambert and Blacktown soils underlie the proposal footprint. They all classify as Kandosol soils accounting for the sandstone nature of the area. There is an extremely low probability (one to five per cent) of acid sulfate soils in this area and the soils are not characteristically saline.</p> <p>Water quality in the area is likely to be affected by typical urban runoff.</p> <p>No contamination or pollutant sources have been identified within 400 metres of the proposal which could affect soil or water quality.</p>	<p>There is the potential for erosion, sedimentation and stormwater runoff from site resulting from the vegetation removal, rock cutting and earthworks. Such impacts are common to construction works, and their extent and impact under this proposal would be limited due to the scale and nature of the work. Providing the proposed standard safeguards are employed and maintained then impacts would be avoided and/or minimised.</p> <p>The proposal would have no operational impact on soil quality. The proposed swale drainage (refer to section 0) would be used to maintain water quality in the area.</p>
Hydrology and flooding	<p>The proposal area is in the Sydney Harbour and Parramatta River catchment. The rivers of the metropolitan rivers of North Sydney are relatively small. Flat Rock Creek is the closest surface water features. It is located about 390 metres north east of the proposal.</p> <p>The North Sydney LGA wide flood study carried out in 2016 showed that the proposal is unlikely to be significantly affected by flooding even in the probable maximum flood scenario. Low-level flooding <0.3 metres is predicted under the probable maximum flood scenario for localised sections of the roadside verge of the Warringah Freeway in the location of the proposal.</p>	<p>The verge of the Warringah Freeway below Matthew Lane could experience low-level flooding during an extreme weather events, however there is a low likelihood that such an event would occur during construction.</p> <p>The nature and duration of the proposal work is unlikely to result in increased flood risk in to the locality. Also, the inclusion of the drainage infrastructure in section 0 would be used to avoid localised flooding.</p>

Environmental factor	Existing environment	Potential impacts
Waste and Resource Use	<p>Waste management is driven by Roads and Maritime policy and State legislation and guidance that focusses on reducing resource consumption, minimising waste, and recovering and recycling materials. Section 3.3.4 describes the resources that would be used to build the proposal, and the intended waste management provisions. While the specifics of these would be defined during the detailed design, the key wastes generated during construction would be:</p> <ul style="list-style-type: none"> • Residual/surplus building material (concrete, fencing, scrap material) • Packing materials (pallets, crates, plastics) • Food waste and general site waste and litter • Wastewater from facilities, vehicle wash down and dust suppression • Residual chemical (oils, lubricants, waste fuels, batteries) • Green waste (trees and other vegetation). 	<p>The generation of waste would have the potential to impact the local environment if not correctly managed. Potential impacts would include:</p> <ul style="list-style-type: none"> • Ground contamination from spillages or runoff and waste transfer especially if there is stockpile mismanagement or poor waste storage • Amenity impacts from littering and potential increased attraction of vermin and pest species • Excessive waste being diverted to landfill. <p>However, by introducing standard waste management measures impacts could be adequately avoided and minimised.</p> <p>Maintenance of the noise wall would be carried out periodically as part of an existing maintenance contract. Small amounts of materials would be needed to maintain the wall, while small volumes of typical wastes would be generated. The maintenance work would be carried out under standing management provisions to ensure the responsible control and safe disposal of any generated waste.</p>

6.7.3 Safeguards and management measures

Table 6-24 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-24: Other safeguard and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	<p>The Construction Environmental Management Plan (CEMP) would include measures and procedures to minimise air pollution and odours, including:</p> <ul style="list-style-type: none"> • Care during loading and unloading of materials to avoid spills and windblown dust • Turn off machinery rather than left to idle when they are not in use • Maintain vehicles to manufacturer's standards • Employ measures such as watering or covering exposed areas to minimise or prevent air pollution and dust • Vehicles transporting waste of other materials are to be covered during transportation • Ensuring sewer diversion is a closed system and back up pumps are available 	Contractor	Pre-construction	AQ1
Greenhouse gas and climate change	<p>Specific measures would be outlined in the CEMP to ensure that construction minimises any potential impacts on or from climate change including:</p> <ul style="list-style-type: none"> • Energy efficiency and related carbon emissions would be considered during the development of construction methodologies, procurement of low carbon alternatives and the selection of efficient plant vehicles, and equipment. • Plant, vehicles and machinery must be operated efficiently in accordance with the manufacturers guidelines to ensure optimal performance and be switched off when not in use. <p>Procedures would be set out for the management of extreme events including flooding, heatwaves and bushfires.</p>	Contractor	Pre-construction/ construction	GH1

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal Heritage	The Standard Management Procedure - Unexpected Heritage Items will be followed if a known or potential Aboriginal object(s), including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work would only recommence once the requirements of that Procedure have been satisfied.	Contractor	Construction	AH1
Soil and water	A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction.	Contractor	Detailed design/pre-construction	SW1 Section 2.1 of QA G38 Soil and Water Management
Soil and water	A site-specific Erosion and Sediment Control Plan (ESCP) would be prepared and implemented as part of the SWMP. The Plan would include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design/pre-construction	SW2 Section 2.2 of QA G38 Soil and Water Management
Contaminated land	<p>If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. This may include but not be limited to:</p> <ul style="list-style-type: none"> • Diversion of surface runoff • Capture of any contaminated runoff • Temporary capping. <p>All other works that may impact on the contaminated area would cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.</p>	Contractor	Detailed design/pre-construction	SW3 Section 4.2 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas. The Spill Management Plan will address, but not necessarily be limited to: management of chemicals and potentially polluting materials; any bunding requirements; maintenance of plant and equipment; and emergency management, including notification, response and clean-up procedures.	Contractor	Pre-construction/ construction	SW4
Waste	<p>The CEMP will include specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriate handle and dispose of unavoidable waste. This will include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> • Measures to avoid and minimise waste associated with the project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. <p>The measures will be prepared taking in to account <i>Environmental Procedure – Management of Wastes on Roads and Maritime Services Land</i> and relevant <i>Roads and Maritime Waste Fact Sheets</i>.</p>	Contractor	Pre-construction	W1

6.8 Cumulative impacts

This section considers the cumulative impacts and benefits likely to arise from the combination of the construction and operation of the proposal with other developments in the nearby area. The cumulative assessment has been based on currently available information on likely other developments and therefore potential cumulative impacts of proposed future developments cannot be quantified.

6.8.1 Study area

The study area was defined by considering other projects in North Sydney that have the potential to contribute to cumulative impacts with the proposal. The proposal is expected to be built in 2019 to become operational in 2020.

6.8.2 Broader program of work

This proposal is being undertaken as part of the wider NAP. Noise treatment measures, such as noise walls or at-property architectural treatments, are chosen on a site-by-site basis based on eligibility under the NAP criteria. It is understood that several noise walls have been built within the North Sydney LGA to reduce amenity noise. Each wall is proposed to provide treatment to specific properties in a set location. It would therefore have no direct or indirect cumulative impact or benefit on the receivers affected by this proposal. It is acknowledged that installing noise walls alongside the Warringah Freeway under the NAP benefits both affected receivers and the wider community in these areas.

6.8.3 Other projects and developments

There are a range of other specific and precinct committed and approved developments in the area that have the potential to contribute to cumulative impacts with the proposal. The reported impacts in Table 6-25 are a summary of available information in the public domain.

Table 6-25: Projects currently under construction or proposed for the future

Project	Construction impacts	Operational impacts
<p>Western Harbour Tunnel and Beaches Link The Western Harbour Tunnel and Beaches Link is a NSW Government initiative to provide additional road network capacity across Sydney Harbour and to improve connectivity with Sydney's northern beaches. The Western Harbour Tunnel and Beaches Link program of works includes:</p> <ul style="list-style-type: none"> • The Western Harbour Tunnel and Warringah Freeway Upgrade project, comprising a new tolled motorway tunnel connection across Sydney Harbour, and the Warringah Freeway Upgrade to integrate the new motorway infrastructure with the existing road network and to connect to the Beaches Link and Gore Hill Freeway Connection • The Beaches Link and Gore Hill Freeway Connection, including a new tolled motorway tunnel connection from the Warringah Freeway to Balgowlah and Frenchs Forest, and upgrade and integration works to connect to the Gore Hill Freeway. <p><i>Location: Next to the proposal</i></p> <p><i>Schedule: Should the project be taken forward, construction is anticipated to start in 2021 and would likely take five-to-six years to complete.</i></p>	<ul style="list-style-type: none"> • Secretary's Environmental Assessment Requirements have been issued however an Environmental Impact Statement is yet to be published • Construction impacts are likely to be typical of any large infrastructure project including visual, noise and air quality amenity impacts, vegetation removal, construction traffic management measures and light spill from worksites • Construction work would be required on the Warringah Freeway. <p><i>Importantly, this program of work, if approved, would be constructed after this proposal. The noise wall would provide acoustic treatment for the construction of this project, and therefore there is expected to be a cumulative benefit.</i></p>	<p><i>While the operational impact from this proposal is currently unconfirmed, the introduction of a noise wall would help mitigate against any increase in operational noise. As such, there is expected to be a cumulative benefit.</i></p> <p><i>Any future environmental impact statement for the Western Harbour Tunnel and Beaches Link program of work would be required to assess the operational noise impacts associated with the program of works.</i></p>

Project	Construction impacts	Operational impacts
<p>Northern toll plaza precinct upgrade Removal of the redundant toll booths and toll office on the northern side of the Sydney Harbour Bridge</p> <p><i>Location: three kilometres south of the proposal</i></p> <p><i>Schedule: Currently unknown</i></p>	<p>Amenity related impacts associated with noise and vibration, local air quality and traffic and transport access are anticipated.</p> <p><i>This project would temporarily affect traffic flows southbound into the city. As the proposal would only locally affect northbound traffic leaving the Warringah Freeway at Brook Street there is not expected to be any cumulative impacts. For any people who regularly use the Brook Street interchange to travel to and from the city they may experience impact fatigue from having to travel through two traffic controlled areas however this proposal is not predicted to add to any journey time delay.</i></p>	<p>The scheme would result in a long-term traffic and transport benefit by removing the existing structure and upgrading the road surface. Removing the structures would also result in beneficial visual impacts.</p> <p><i>The proposal is unlikely to have any cumulative or combined impact or benefit with this proposal as the above visual benefits would not affect those receivers close to the noise wall proposal.</i></p>
<p>Jenkins Street/Armstrong Street Noise Wall Construction of a noise wall on the eastern verge of the Warringah Freeway opposite the proposal</p> <p><i>Location: 60 metres north east of the proposal</i></p> <p><i>Schedule: Investigation work is proposed for a noise wall on the north-east side of the freeway near Jenkins Street and the Amherst Street off Ramp at Cammeray. The construction program for the proposal is subject to community consultation.</i></p>	<p>Construction impacts consistent to those identified in this REF given the similar nature and location of the works.</p> <p><i>This proposal is not expected to be constructed at the same time as the Chandos Street noise wall.</i></p> <p><i>The separation of the two proposals on either side of the freeway would likely reduce the potential for any cumulative amenity impacts.</i></p>	<p>The scheme would reduce exposure for residents of Jenkins Street and Armstrong Street to road traffic noise from the Warringah Freeway.</p> <p><i>While Jenkins Street/Armstrong Street noise wall would not benefit the receivers next to this proposal, it would reduce road traffic noise for a greater proportion of the local community, providing a wider cumulative benefit.</i></p>

Project	Construction impacts	Operational impacts
<p>Various residential refurbishments or single property house builds in Crows Nest</p> <p>There are several local residential developments identified on the North Sydney Council website. These are limited to single residential properties and while approved, no specific information is available as to when work may be carried out.</p>	<ul style="list-style-type: none"> Construction impacts would be localised, amenity-related and small scale typically relating to noise, dust and general disruption. There may be additional non-residential traffic in the area possibly including occasional heavy vehicle deliveries. <p><i>While any individual developments are unlikely to have any widespread cumulative impact in combination with the proposal, if several developments are taking place at the same time in the local area this may cause added impacts for residents.</i></p>	<p>While the proposals include for the introduction of residents in the area, none are local to the proposal, and it will be the developer's responsibility to ensure they are not exposed to high levels of noise from existing road traffic.</p>

6.8.4 Potential impacts

Table 6-26 lists the potential cumulative impacts that have the potential to occur from the proposal being built and operating at the same time as other projects and development in the area. For those aspects not discussed in Table 6-26, no cumulative impacts are anticipated.

Table 6-26: Potential cumulative impacts of the proposal and other developments in the area

Environmental factor	Construction	Operation
Noise and vibration	<p>There is the potential for sensitive receivers affected by the proposal to be additively impacted by construction noise associated with building the Jenkins Street/Armstrong Street noise wall on the opposite verge of the Warringah Freeway. Even if there is no program or construction overlap, residents under both proposals may be impacted for longer than the eight to ten months needed to construct this proposal.</p>	<p>The NAP program and proposal to install noise walls alongside sections of the Warringah Freeway is predicted to offer wider cumulative benefit to more residents and sensitive receivers than benefited by this proposal. The proposal is expected to help reduce any construction and operational impacts from the future Western Harbour Tunnel and Beaches Link project.</p>

Environmental factor	Construction	Operation
	<p>While any individual development in the local area is unlikely to have any widespread cumulative noise impact in combination with the proposal, there is the potential for neighbouring properties to be affected by noise and vibration from these projects in combination with the proposal. The nature and scale of impact would depend on the proposal in question however these developments are likely to be built during standard work hours while the proposal would require out-of-hours work.</p>	
<p>Traffic and Transport</p>	<p>Road users of the Warringah Freeway (and specifically the Brook Street interchange) will be affected by traffic management controls implemented as part of the construction of the Jenkins Street/Armstrong Street noise wall as well as the northern toll plaza upgrade. Additional traffic controls may be introduced on the local roads to accommodate property (re)development in the area. At worst, people are likely to experience minor travel delays across more of their journeys than accounted for under the proposal.</p>	<p>No cumulative impact is anticipated from the operation of the proposal alongside other developments.</p>
<p>Socio-economic</p>	<p>The proposal in combination with other development is likely to result in wider cumulative amenity impacts for the local community. People may become fatigued in terms of overall amenity loss and from an overlap or sequential staging of construction.</p>	<p>No cumulative operational impacts are anticipated, however the proposal in combination with other developments would provide wider community benefit by reducing traffic noise exposure from the Warringah Freeway.</p>

6.8.5 Safeguards and management measures

Table 6-27 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-27: Safeguards and management measures for cumulative impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative impacts	Consultation would be carried out with other project teams within Roads and Maritime and Council for the other developments discussed to coordinate traffic management in the wider area, especially during peak periods.	Roads and Maritime	Pre-construction/ construction	C11
Cumulative impacts	All environmental management plans would be prepared to consider other developments in the area.	Contractor	Pre-construction	C12

7. Environmental management

This chapter describes how the design, construction and operation of the proposal would be managed to reduce its potential environmental impacts. A framework for managing potential impacts is provided along with a summary of site-specific environmental safeguards and a list of the licences and approvals needed before starting construction.

7.1 Environmental management plans

Several safeguards and management measures have been identified in the REF to minimise adverse environmental impacts, including social impacts, which could potentially arise because of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A construction environmental management plan (CEMP) would be prepared to describe the safeguards and management measures identified. The CEMP would provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP would be prepared prior to construction of the proposal and must be reviewed and certified by the Roads and Maritime Environment Officer prior to the commencement of any onsite works. The CEMP would be a working document, subject to ongoing change and updated as needed to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the: QA Specification G36 – Environmental Protection (Management System), QA Specification G40 – Clearing and Grubbing, QA Specification G10 – Traffic Management, QA Specification R178 – Vegetation, QA Specification R179 – Landscaping Planting, and QA Specification R271 – Design and Construction of Noise Walls.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7-1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared and submitted for review and endorsement of the Roads and Maritime Environment Manager prior to commencement of the activity.</p> <p>As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> • any requirements associated with statutory approvals • details of how the project will implement the identified safeguards outlined in the REF • issue-specific environmental management plans • roles and responsibilities • communication requirements • induction and training requirements • procedures for monitoring and evaluating environmental performance, and for corrective action • reporting requirements and record-keeping • procedures for emergency and incident management • procedures for audit and review. <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>	Contractor / Roads and Maritime project manager	Pre-construction / detailed design	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / Roads and Maritime project manager	Pre-construction	-
GEN3	General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include adjoining residential areas requiring particular noise and vibration management measures.	Contractor	Pre-construction / detailed design	-
Noise and vibration					
NV1	Noise and vibration	A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the Interim Construction Noise Guideline (ICNG, DECC, 2009) and identify: <ul style="list-style-type: none"> • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. 	Contractor	Detailed design/pre-construction	Section 4.6 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV2	Noise	<p>Where reasonable and feasible, work would be carried out during standard work hours:</p> <ul style="list-style-type: none"> • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • No construction on Sundays or Public Holidays. <p>To minimise disruption to traffic and potential safety risks to construction personnel and road users it would be necessary to carry out some work outside these daytime hours. Proposed night work construction hours would be:</p> <ul style="list-style-type: none"> • 8pm to 5am Sunday to Friday 	Contractor	Detailed design/pre-construction	-
NV3	Noise	Any variations to the standard construction hours would follow the approach in CNVG including consultation with the affected local community.	Contractor	Pre-construction/construction	-
NV4	Noise	<p>All sensitive receivers likely to be affected would be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification would provide details of:</p> <ul style="list-style-type: none"> • The proposal • The construction period and construction hours • Contact information for project community staff • Complaint and incident reporting <p>How to obtain further information.</p>	Contractor	Pre-construction	-
NV5	Noise and vibration	All personnel working on site would receive training to ensure awareness of requirements of the NVMP. Site-specific training will be given to personnel when working near sensitive receivers.	Contractor	Pre-construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV6	Vibration	Attended vibration monitoring or vibration trials would be carried out when the proposed work is within safe work distances to ensure that the levels remain below corresponding criteria.	Contractor	Pre-construction/ construction	-
NV7	Vibration	Building condition surveys would be carried out before starting the work. The exact buildings to be surveyed would be identified once detailed construction planning has occurred and during the preparation of the NVMP.	Contractor	Pre-construction/ construction	-
NV8	Noise	<p>The following controls would be included in the NVMP:</p> <ul style="list-style-type: none"> • Where practical, the layout and positioning of noise-producing plant and activities at each work site would be optimised to minimise noise emission levels • Where practical, equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate noise control equipment and be in good working order. • Where possible, non-beeper reversing movement alarms would be used such as broadband (non-tonal) alarms or ambient noise-sensing alarms. Work sites would also be designed to reduce the need for reversing, potentially minimising the use of reversing beepers. • Vehicles, plant and equipment would be regularly inspected and maintained to avoid increased noise levels from rattling hatches, loose fittings etc • All vehicles, plant and equipment would be shut off when not in use. • Resilient damping material would be fitted on bin trucks to minimise noise impacts from loading materials. 	Contractor	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Where feasible and reasonable, localised temporary acoustic hoardings/screens would be installed near high noise-generating activities. Hoardings/screens would be located as close to the noise source as possible, and would be an appropriate height as structurally feasible to minimise noise emissions			
NV9	Noise	Consistent with any specific requirements of the approved NVMP a noise monitoring program would be implemented during construction to assess effective implementation of noise and vibration safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements.	Contractor	Construction	-
NV10	Noise	After considering the outcomes and recommendations arising from the noise monitoring program, and any other relevant information that becomes available during construction, appropriate measures would be implemented to address identified deficiencies or undertake actions needed to address noise and vibration impacts. If necessary, the NVMP would be reviewed and updated to include any additional measures.	Contractor	Construction	-
NV11	Vibration	The required locations for using vibration generating equipment would be reviewed during construction planning when more-specific information is available.	Contractor	Construction	-
Landscape character and visual amenity					
LV1	Landscape character and visual impact	An Urban Design Plan (UDP) would be prepared to support the final detailed project design and implemented as part of the CEMP. The UDP would present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan would include design treatments for: <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Relocated and introduced fixtures such as lighting, fencing and signs 	Roads and Maritime project manager / Contractor	Detailed design/ pre-construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage Procedures for monitoring and maintaining landscaped or rehabilitated areas. <p>The UDP would be prepared in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> Noise Wall Design Guidelines (RTA, 2006) Landscape Guideline (RTA, 2008) Beyond the Pavement (Roads and Maritime, 2014) 			
LV2	Landscape character and visual impact	<p>The CEMP shall include measures and procedures to minimise visual impacts, including:</p> <ul style="list-style-type: none"> The worksite is to be kept clean and tidy at all times Appropriate storage of equipment, arrangements for the storage and removal of rubbish and waste material <p>On completion of work, all vehicles, material and refuse relating to the work would be removed</p>	Contractor	Pre-construction	-
LV3	Landscape character and visual impact	Detailed design solutions to minimise the visual impacts of noise wall would be developed in consultation with property owners, residents and North Sydney Council.	Roads and Maritime project manager	Detailed design	-
LV4	Landscape character and visual impact	The Landscape Management Plan would be refined to ensure cost effective and consistent management of landscape works will be developed in consultation with property owners and residents. The plan will be prepared in accordance with the Landscape Guideline.	Roads and Maritime project manager	Detailed design	-
LV5	Landscape character and visual impact	Landscaping is to be completed in accordance with the Landscaping and Urban Design Plan	Contractor	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
LV6	Lighting impacts	Temporary site lighting will be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting.	Contractor	Pre-construction/ construction	
Non-Aboriginal heritage					
NAH1	Non-Aboriginal heritage	The Standard Management Procedure: Unexpected Heritage Items (Roads and Maritime, 2015) would be followed if any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work would only recommence once the requirements of that procedure have been satisfied.	Contractor	Detailed design/ pre-construction	Section 4.10 of QA G36 <i>Environment Protection</i>
NAH2	Conservation Area	The at-property treatment measures would be designed to be consistent with the specific development control objectives for Conservation Area outlined in the North Sydney Council LEP.	Roads and Maritime project manager	Detailed design	-
NAH3	Conservation Area	The UDP and LMP would be developed to minimise the visual impact of the inside of the noise wall along the common boundary of the Holtermann Estate Conservation Area and the St. Thomas' Rest Park.	Roads and Maritime project manager	Detailed design	-
NAH4	St. Thomas' Rest Park	The tracking of vehicles would be carefully monitored to avoid any structural collision to the form and fabric of Sexton's Cottage, the gravestones and the cemetery fence Vehicle access in St. Thomas' Rest Park would follow the route shown in Figure 3-5 and a spotter would be used to monitor progress. This indicative access route would be confirmed and refined (where required) onsite before moving equipment through the park to avoid any impact on the form and fabric of the heritage value.	Contractor	Pre-Construction	-
NAH5	St. Thomas' Rest Park	Before tracking vehicles and equipment through St. Thomas' Rest Park, heavy duty track mats would be laid down along the access path.	Contractor	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity					
B1	Biodiversity	<p>A Flora and Fauna Management Plan (FFMP) would be prepared in accordance with Roads and Maritime's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to:</p> <ul style="list-style-type: none"> Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas Requirements set out in the Landscape Guideline (RTA, 2008) Pre-clearing survey requirements Procedures for unexpected threatened species finds and fauna handling <p>Protocols to manage weeds and pathogens.</p>	Contractor	Detailed design/ pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>
B2	Biodiversity	All personnel working on site would receive training to ensure awareness of the requirements of the FFMP and relevant statutory responsibilities. Site-specific training would be given to personnel when working near areas of identified biodiversity value that are to be protected.	Contractor	Pre-construction/ construction	-
B3	Tree loss	An arborist would carry out a pre-construction check of the site to confirm that all preserved trees are clearly and effectively marked and suitable protection zones are in place to prevent any impact on the canopy or root zones.	Contractor	Pre-construction/ construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B4	Hollow-bearing trees	Pre-clearance checks would be carried out for those tree species identified as potentially hollow-bearing that would be removed as part of the proposal to ensure these are not being used as habitat for bats and birds. If bat and bird species are discovered then they would be relocated in accordance with Guide 9: fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011). If needed nest boxes would be installed to replace the lost tree hollows as per Guide 8 of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011).	Contractor	Pre-construction/ construction	-
B5	Tree loss	Tree removal or pruning would be carried out by a qualified specialist in accordance with AS4970: 2009: Protection of Trees on Development Sites (Standards Australia, 2009) and AS4373:2007: Pruning of Amenity Trees and WorkCover Amenity Tree Industry Code of Practice 1998.	Contractor	Construction	-
B6	Biodiversity	Consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects, and any specific requirements of the approved FFMP, an unexpected finds procedure would be implemented if a threatened species or ecological community that had not been identified and assessed by the REF are unexpectedly encountered during the construction process.	Contractor	Construction	-
B7	Weeds and pathogens	Declared noxious weeds and potential pests and pathogens would be managed according to requirements under the <i>Biosecurity Act 2015</i> and Guide 6 (Weed Management) of the Roads and Maritime Services Biodiversity Guidelines 2011 and Guide 7: pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011). Topsoil from the site that contains or potentially contains weed species or propagules would:	Contractor	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Not be reused for future rehabilitation or revegetation works Be removed from the construction site and disposed of at an appropriately licensed facility <p>Until removal occurs, topsoil would be stockpiled in cleared or disturbed areas and managed in accordance with the RTA Stockpile Site Management Guideline.</p>			
Traffic and transport					
TT1	Traffic and Access	<p>A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in accordance with the Roads and Maritime Traffic Control at Work Sites Manual (RTA, 2010) and QA Specification G10 Control of Traffic (RTA, 2008). The TMP would include:</p> <ul style="list-style-type: none"> Confirmed haulage routes Confirmed temporary traffic management provisions Measures to maintain access to local roads and properties Site-specific traffic control measures (including signage) to manage and regulate traffic movement Measures to maintain pedestrian and cyclist access Requirements and methods to consult and inform the local community of impacts on the local road network Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads A response plan for any construction traffic incident Consideration of other developments that may be under construction to minimise traffic conflict and congestion that 	Contractor	Detailed design/ pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<p>may occur due to the cumulative increase in construction vehicle traffic</p> <ul style="list-style-type: none"> • Monitoring, review and amendment mechanisms • Work zones required in Chandos Street and Jenkins Lane • Stipulated parking restrictions. 			
TT2	Traffic and transport	<p>Consultation would be carried out with potentially affected residences before starting and during work in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008). Consultation would include but not limited to door knocks, newsletters or letter box drops providing information on the proposed work, the need to park on local roads, working hours and a contact name and number for more information or to register complaints.</p>	Roads and Maritime project manager	Detailed design/pre-construction	-
TT3	Access	<p>Requirements for any changes to local access arrangements would be confirmed during detailed design in consultation with the local road authority and any affected landowners.</p>	Roads and Maritime project manager	Detailed design	-
TT4	Access	<p>Disruptions to property access and traffic would be notified to landowners at least five days in accordance with the relevant community consultation processes outlined in the TMP.</p>	Contractor	Construction	-
TT5	Pedestrian and cyclists	<p>Pedestrian and cyclist access would be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.</p>	Contractor	Construction	-
Socio-economic					
SE1	Socio-economic	<p>The community would be kept informed about the proposal through the measures outlined in the Communications Strategy for the proposal (as discussed in chapter 5).</p>	Project Manager and consultation team	Pre-construction/ construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SE2	Socio-economic	All acquisition of private property would be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> and the Land Acquisition Information Guide (Roads and Maritime, 2014).	Project Manager	Pre-construction/ construction	-
SE3	Socio-economic	Acquisition of a small parcel of land at the end of Chandos Street owned by North Sydney Council would be made under powers afforded to Roads and Maritime under the <i>Roads Act 1993</i> following the processes in the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Project Manager	Pre-construction/ construction	
SE4	Socio-economic	Roads and Maritime would enter into an agreement with North Sydney Council to facilitate construction of the noise wall footing in the corner of the St Thomas' Rest Park, adjacent to Matthew Lane. On completion of the work, the park would be reinstated to the boundary of the lot, and landscaping would be agreed with North Sydney Council.	Project Manager	Pre-construction/ construction	
Other impacts					
AQ1	Air quality	<p>The Construction Environmental Management Plan (CEMP) would include measures and procedures to minimise air pollution and odours, including:</p> <ul style="list-style-type: none"> • Care during loading and unloading of materials to avoid spills and windblown dust • Turn off machinery rather than left to idle when they are not in use • Maintain vehicles to manufacturer's standards • Employ measures such as watering or covering exposed areas to minimise or prevent air pollution and dust • Vehicles transporting waste of other materials are to be covered during transportation 	Contractor	Pre-construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Ensuring sewer diversion is a closed system and back up pumps are available 			
GH1	Greenhouse gas and climate change	<p>Specific measures would be outlined in the CEMP to ensure that construction minimises any potential impacts on or from climate change including:</p> <ul style="list-style-type: none"> Energy efficiency and related carbon emissions would be considered during the development of construction methodologies, procurement of low carbon alternatives and the selection of efficient plant vehicles, and equipment. Plant, vehicles and machinery must be operated efficiently in accordance with the manufacturers guidelines to ensure optimal performance and be switched off when not in use. <p>Procedures would be set out for the management of extreme events including flooding, heatwaves and bushfires.</p>	Contractor	Pre-construction/ construction	-
AH1	Aboriginal Heritage	The Standard Management Procedure - Unexpected Heritage Items will be followed if a known or potential Aboriginal object(s), including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work would only recommence once the requirements of that Procedure have been satisfied.	Contractor	Construction	-
SW1	Soil and water	A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction.	Contractor	Detailed design/pre-construction	Section 2.1 of QA G38 Soil and Water Management
SW2	Soil and water	A site-specific Erosion and Sediment Control Plan (ESCP) would be prepared and implemented as part of the SWMP. The Plan	Contractor	Detailed design/pre-construction	Section 2.2 of QA G38

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		would include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.			Soil and Water Management
SW3	Contaminated land	<p>If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. This may include but not be limited to:</p> <ul style="list-style-type: none"> • Diversion of surface runoff • Capture of any contaminated runoff • Temporary capping. <p>all other works that may impact on the contaminated area would cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.</p>	Contractor	Detailed design/pre-construction	Section 4.2 of QA G36 Environment Protection
SW4	Soil and water	A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas. The Spill Management Plan will address, but not necessarily be limited to: management of chemicals and potentially polluting materials; any bunding requirements; maintenance of plant and equipment; and emergency management, including notification, response and clean-up procedures.	Contractor	Pre-construction/construction	-
W1	Waste	<p>The CEMP will include specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriate handle and dispose of unavoidable waste. This will include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> • Measures to avoid and minimise waste associated with the project 	Contractor	Pre-construction	Section 4.2 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. <p>The measures will be prepared taking in to account <i>Environmental Procedure – Management of Wastes on Roads and Maritime Services Land</i> and relevant <i>Roads and Maritime Waste Fact Sheets</i>.</p>			
Cumulative impacts					
C11	Cumulative impacts	Consultation would be carried out with other project teams within Roads and Maritime for the other developments discussed to coordinate traffic management in the wider area, especially during peak periods.	Roads and Maritime	Pre-construction/ construction	-
C12	Cumulative impacts	All environmental management plans would be prepared to consider other developments in the area.	Contractor	Pre-construction	-

7.3 Licensing and approvals

Table 7-2 lists the licences and approvals needed before starting construction onsite.

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
<i>Roads Act 1993</i>	<ul style="list-style-type: none"> • Licence from the Transport Management Centre to occupy one lane of the Brook Street off ramp of the Warringah Freeway during construction • Licence from North Sydney Council to occupy Brook Street and Chandos Street for part of the construction work. 	Prior to the start of the activity

8. Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ESD as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

8.1 Justification

The proposal has been progressed as properties on the western side of the Warringah Freeway have been identified as being eligible for treatment to reduce road traffic noise levels under the NAP. The aim of the proposal therefore is to reduce road traffic noise levels to meet the NAP criteria.

8.1.1 Social factors

The proposal is predicted to result in more than a 5 dB(A) reduction in road traffic noise for people living in the area. This is the level above which a noise wall is justified as being a reasonable treatment option as defined in the NMG. However, to achieve the NAP criteria at all affected properties, supplementary architectural treatment would be needed at about 23 properties. The proposal would also deliver community benefit to the wider community by reducing road traffic noise for users of St. Thomas' Rest Park, particularly the children's playground in the north-west corner of the park.

There are some unavoidable impacts from delivering the above benefits such as vegetation loss alongside the freeway, increased overshadowing, and the loss of views at some properties. These impacts have been minimised through an effective landscape planting strategy and urban design. The noise wall design was also refined to include transparent panel sections at the end of Chandos Street to reduce overshadowing impacts. Roads and Maritime is also committed to continuing its engagement and consultation with affected property owners as the design progresses to understand concerns and make any needed adjustments to further reduce the proposal's impacts.

Despite there being temporary amenity-related impacts during construction, these could be safeguarded against by adopting standard measures that are proven to be effective in avoiding and minimising impacts.

8.1.2 Biophysical factors

Despite the proposal resulting in vegetation and tree removal, this would only affect roadside amenity planting next to the Warringah Freeway, Brook Street off ramp and end of Chandos Street, which has limited ecological value. None of the impacted area is considered to have any material biodiversity value or include species, communities or habitat that is protected under State and Commonwealth legislation. The only exception is the potential for grey-headed flying fox, listed as vulnerable under the BC Act, to occasionally forage over the area. However, as there is better-quality habitat within comfortable range, such as the St. Thomas' Rest Park, it is concluded that the grey-headed flying fox is unlikely to rely on the impacted vegetation and trees for its survival. Importantly, the proposal would not impact on the form, function, survival or wider condition of the biophysical values of the local area. A replanting strategy as part of the urban design strategy of the proposal would reintroduce vegetation to the area.

8.1.3 Economic factors

The capital investment needed to build the proposal is likely to deliver local and regional economic benefit through the creation of construction jobs and purchase materials from local manufacturing and construction businesses. While there is unlikely to be any direct economic operational benefit, improving the amenity of the local area has the potential to make it more of an attractive place to live. It may also encourage more people to benefit from the amenity of the St. Thomas' Rest Park and local area. These benefits however would be hard to quantify.

8.1.4 Public interest

The proposal would be in the public interest as it contributes to a community-wide noise benefit despite local adverse impacts described in the REF. Safeguard measures would be used during construction to minimise any environmental and social impacts, while Roads and Maritime is committed to consulting with directly affected property owners as the design progresses.

8.2 Objects of the EP&A Act

Table 8-1 lists how the proposal responds to the objects of the EP&A Act.

Table 8-1: Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The Warringah Freeway is a heavily trafficked road, carrying about 170,000 vehicles per day (at the Brook Street Interchange). The proposal would provide community benefit by reducing noise levels for the people living locally, while reducing ambient noise levels in sections of the Holtermann Estate Conservation Area closest to the proposal and the St. Thomas' Rest Park. It therefore offers wider social and economic community welfare, including improved management of two amenity and conservation-valued assets. While building the proposal would result in vegetation loss, and it would introduce a new structure that would lead to some localised overshadowing, these impacts have been minimised through urban design and landscape planting. Roads and Maritime is also committed to consulting with directly affected property owners as the design progresses to understand concerns and make any needed adjustments to further reduce the proposal's impacts.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Refer to section 8.2.1.
1.3(c) To promote the orderly and economic use and development of land.	The proposal can be built and operated on public land without the need for surface property acquisition. As such, it provides an economic and orderly use of the existing road corridor to provide wider community development.

Object	Comment
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to this proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	Despite the proposal resulting in vegetation and tree removal, this would only affect roadside amenity planting, which has limited ecological value. None of the impacted area is considered to have any material biodiversity value or include species, communities or habitat that is protected under State and Commonwealth legislation. While vulnerable grey-headed flying fox has the potential to be present locally, the habitat of the area only provides low-value foraging habitat, with far better-quality habitat provided nearby. As such, there is predicted to be no ecological conservation loss or impact on threatened native plants, animals, communities or habitat.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal footprint has no heritage value or archaeological potential given the extensive disturbance that occurred in building the freeway. By including a noise wall, it would improve the amenity value of the Holtermann Estate Conservation Area and the St. Thomas' Rest Park.
1.3(g) To promote good design and amenity of the built environment.	The proposal has been designed to industry and Roads and Maritime standards and specifications to consider environmental, social and economic factors throughout the design process. It has been refined to include transparent panels to minimise overshadowing and amenity impacts. This would be supplemented by other urban design and landscape planting measures to reduce the noise wall's visual impact. Overall, the proposal has been design to the specifications in R271: The Design and Construction of Noise Walls, the Noise Wall Design Guidelines, and Beyond the Pavement, all of which specify requirements to promote good design and amenity of the built environment.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to this proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to this proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	<p>Roads and Maritime has consulted with the community and sought their participation through feedback, briefing sessions and direct consultation, before determining whether to build the proposal.</p> <p>Roads and Maritime is also committed to continuing its consultation in developing the proposal's design through to construction. Chapter 5 describes the detail of how the public has been, and how they will be involved, in the environmental planning and assessment process.</p>

8.2.1 The precautionary principle

To account for the subjectivity of professional judgment applied in environmental assessment and the inherent uncertainty of modelling predictions, the following precautionary measures have been adopted:

- Worst case assumptions have been made throughout the technical assessments. For example, the impact assessment assumed the impact external to property where all equipment would be used onsite at the same time, at its maximum output, at night, at the closest distance to nearby receivers. As such, the associated predicted amenity, noise and visual impacts were based on a worst-case scenario that would be exceptionally unlikely to occur. Nonetheless, precautionary safeguards were developed against this worst-case scenario assessment.
- Operational visual impacts were assessed before any replanting or vegetation treatments have established and matured. This ensures that the worst-case visual impact at any receiver were considered.
- Precautionary controls are included in the safeguards to provide additional protection in the event of uncertainty.
- There is a commitment to assess and verify elements of the proposal's design that are not fully understood or defined at this stage either during the detailed design or before work starts. For instance, there is a commitment to monitor vibration levels and set safe working distances onsite based on the final equipment selection.

8.2.2 Intergenerational equity

The proposal would provide immediate improvements for the people living and visiting the area in terms of noise reduction and amenity improvement. With appropriate maintenance, the proposal would continue to provide protection for residents and visitors into the future in response to changing traffic conditions on the Warringah Freeway. The urban design strategy for the proposal would also provide greater screening benefit into the future as planted vegetation matures.

8.2.3 Conservation of biological diversity and ecological integrity

While the proposal would result in vegetation removal and tree loss it would have no material impact on any threatened biota (refer to section 6.5). Also, the low ecological value of the impacted footprint means any lost biological diversity and ecological integrity could be effectively replaced through the planned landscape planting. Even if tree hollows are identified in any of the proposed trees (refer to section 6.5), replacement features can be installed such as nest boxes before construction to ensure there would be no ecological impact.

8.2.4 Improved valuation, pricing and incentive mechanisms

There are proposed incentive-based safeguard and management measures set out for the proposal to protect the environment, four key elements of which are to:

- Reduce the likelihood of routine pollution occurring while the proposal is being built and therefore the associated prosecution and fines associated with causing environmental harm
- Adopting safe work methods to reduce the likelihood of an accidental spillage or pollution event occurring during construction, again to prevent prosecutions and fines
- Ensuring there is an equitable and fair process for the compulsory purchase of land as set out under the *Land Acquisition (Just Terms Compensation) Act 1991*, the supporting NSW Government Land Acquisition Reform 2016 and the Land Acquisition Guide and Policy (Roads and Maritime, 2014)

- Using specifications, contract-terms and mechanisms to incentivise contractors to minimise their environmental impact and footprints when building the proposal to the extent as is feasible and reasonable. These include controls such as:
 - Using recycled and low-embodied energy materials where feasible and reasonable in their application to consider the lifecycle demand on natural resources and their conservation
 - Sourcing materials and dispose of waste locally to minimise transportation impacts. This is termed the ‘proximity principle’.

Roads and Maritime has also developed environmental assessment guidance to allow external parties to prepare its environmental assessment documentation. These external parties comprise specialists who are competent in environmental impact assessment and are experienced in identifying cost-effective safeguards and management measures based on a hierarchy of avoidance over mitigation. In addition, Roads and Maritime has its own in-house team of environmental specialist who review all environmental assessments to ensure the safeguards and management measures are cost-effective and achieve the proposal’s environmental goals and objectives along with Roads and Maritime’s organisational aims.

8.3 Conclusion

The proposal to install a noise wall along the western verge of the Warringah Freeway near the Brook Street interchange is subject to assessment under division 5.1 of the EP&A Act. The REF has examined been prepared to help Roads and Maritime “take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity”.

This has included consideration (where relevant) of conservation agreements and plans of management under the *National Parks and Wildlife Act 1974*, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats, and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

Several potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in permanent overshadowing impacts and the loss of views from various properties. It would also result in a range of temporary amenity-related construction impacts. Safeguards and management measures, as detailed in this REF, would ameliorate or minimise these expected impacts. The proposal would also provide a community benefit by reducing noise for people living behind the noise wall as well as for users of the St. Thomas’ Rest Park. On balance therefore, the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment and determination under division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Department of the Environment and Energy is not required.

9. Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.



Chris Fay, MSc., BSc., CEnvP (IA), C.WEM, C.Env

Technical Director

Arup

Date: November 2018

I have examined this review of environmental factors and accept it on behalf of Roads and Maritime Services.

Adam Price

Project Manager – Motorways

Roads and Maritime Services

Date: November 2018

10. References

- Australian Bureau of Statistics 2018, Census data 2016
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Terms and acronyms used in this REF

Term/acronym	Description
AHIMS	Aboriginal Heritage Information Management System
BC Act	<i>Biodiversity Conservation Act 2016</i> (NSW).
CEMP	Construction environmental management plan
CNVG	Construction Noise and Vibration Guidelines
CNVMP	Construction Noise and Vibration Management Plan
DCPs	Development Control Plan
DECCW	Department of Environment, Climate Change and Water <i>now</i> Environment Protection Authority
DUAP	Department of Urban Affairs and Planning <i>now</i> Department of Planning and Environment
EIA	Environmental impact assessment
ENMM	Environmental Noise Management Manual
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC	<i>Environment Protection Biodiversity Conservation Act 1999</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
ESD	Ecological Sustainable Development
FFMP	Flora and Fauna management plan
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
Heritage Act	<i>Heritage Act 1977</i> (NSW)
IACA	Institute of Australian Consulting Arboriculturists
ICNG	Interim Construction Noise Guidelines
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LAeq	Equivalent continuous sound pressure level
LAmx	Maximum sound pressure level

Term/acronym	Description
LCZ	Landscape character zone
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LEP	Local environmental plan
LGA	Local government area
LMP	Landscape management plan
MNES	Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> .
MNES	Matter of National Environmental Significance
NCA	Noise catchment area
NCG	Noise Criteria Guidelines
NMG	Noise Mitigation Guidelines
NML	Noise management level
NPI	National pollution inventory
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NSW	New South Wales
NVMP	Noise and vibration management plan
OEH	NSW Office of Environment and Heritage
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
QA Specifications	Specifications developed by Roads and Maritime Services for use with road work and bridge work contracts let by Roads and Maritime Services.
RBL	Rating background level
rms	Root mean square
RNP	Road Noise Policy
Roads and Maritime	NSW Roads and Maritime Services
ROL	Road Occupancy Licence
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SWMP	Soil and water management plan
TMP	Traffic management plan
UDP	Urban design plan
WONS	Weeds of National Significance