

Nelson Bay Road Upgrade, Williamtown to Bobs Farm Section 1

Review of Environmental Factors

Transport for New South Wales | May 2021



Nelson Bay Road Upgrade, Williamstown to Bobs Farm Section 1

Review of Environmental Factors

Transport for New South Wales | May 2021

Prepared by SMEC Australia Pty Ltd and Transport for New South Wales
Transport for New South Wales Publication Number 20.432.

Copyright: The concepts and information contained in this document are the property of Transport for New South Wales. Use or copying of this document in whole or in part without the written permission of Transport for New South Wales constitutes an infringement of copyright.



Member of the Surbana Jurong Group

Document controls

Approval and authorisation

Title	Nelson Bay Road Upgrade, Williamtown to Bobs Farm Section 1 review of environmental factors
Accepted on behalf of NSW Transport for New South Wales by:	Kate Hagan Project Development Manager
Signed:	
Dated:	13/05/2021

Executive summary

The proposal

Transport for New South Wales (Transport for NSW) proposes to upgrade Nelson Bay Road between Salt Ash and Bobs Farm (the proposal). Transport for NSW have titled this part of the upgrade Section 1. The proposal would be delivered as early works for the broader Nelson Bay Road upgrade project between Williamstown and Bobs Farm.

The proposal would involve building about one kilometre of dual carriageway, 900 metres east of Marsh Road at Salt Ash to 1.9 kilometres east of Marsh Road at Bobs Farm.

Key features of the proposal include:

- One kilometre dual carriageway with a 100 kilometre speed limit, 3.5 metre wide travel lanes, 2.5 metre wide shoulders, median separation barrier or line marked separation zone
- Two retaining walls:
 - Type 1 cut retaining wall spans from about Chainage 30240 to Chainage 30290 (50 metres) long with a maximum retaining wall height of about 6 metres at chainage 30250.
 - Type 2 (fill) spans from about Chainage 30290 to Chainage 30346 (56 metres long) with a maximum retaining wall height of about 2.3 metres at Chainage 30320.
- Installation of audio tactile line marking at western extent of upgrade
- Utility relocations: electricity, water and telecommunications
- Fauna fence on the southern side of the duplication.

Subject to funding construction of Section would be expected to commence in 2022 and would take around 18 months to complete. The proposal is expected to cost \$24 million to construct.

Need for the proposal

Section 1 is being delivered as early duplication works for the broader Williamstown to Bobs Farm project and is necessary to achieve the broader Williamstown to Bobs Farm upgrade. The consequences of deferral of Nelson Bay Road Section 1 project would lead to an inability to achieve the primary objectives of the broader project. Specific consequences arising from a deferral of the proposal include:

- Increased crash risk along the project length, from ongoing traffic growth from forecast population growth in the region
- Increased local congestion along this section of Nelson Bay Road
- Impact on the staged delivery of the broader Williamstown to Bobs Farm project.
- Increasing crash risk along the corridor increasing (forecast) traffic volumes.

Proposal objectives

The objectives of the proposal are to:

- Reduce peak period traffic congestion
- Improve road safety of all road users
- Enable the delivery of for the broader Nelson Bay Road upgrade project.

The development criteria for the proposal include:

- Improve safety and connectivity for road users
- Provide for safe construction while minimising impact on road users

- Minimise impact on utilities
- Best fits with existing and future planning
- Minimise changes to visual and landscape character
- Minimise direct impacts to adjacent rural residential properties, Worimi National Park and Worimi LALC lands
- Minimise traffic disruption during construction
- Minimise impacts on biodiversity
- Minimise impacts on Aboriginal heritage.

Options considered

There were six options considered:

- Option 1
 - A 100km/hr posted speed design with a 6.0 metre raised median, 2.5 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 2
 - A 100km/hr posted speed design with a 4.0 metre median with wire rope safety barriers (WRSB), 2.5 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 3
 - A 100km/hr posted speed design with a 2.6 metre median with vertical concrete barrier (VCB), 2.5 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 4
 - A 100km/hr posted speed design with a 2.6 metre median with VCB, 2.5 metre shoulders, 1.0 metre verge, overlay of existing westbound carriageway with widening for additional westbound lane and widening on northern side for new eastbound lanes.
- Option 5
 - An 80km/hr posted speed design with a 1.6 metre median with VCB, 2.0 metre shoulders, 1.0m verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 6
 - Do nothing: Do not upgrade the existing road.

The preferred design option is Option 3 as it avoids impacts to the Worimi National Park and Worimi Local Aboriginal Land Council lands. This option provides best value as it has reduced constructability issues, minimises impacts to existing utilities and removes the need for property acquisition or property adjustment.

Statutory and planning framework

The State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure projects throughout NSW. Under clause 94 of ISEPP, development works for a road or road infrastructure facility, undertaken by or on behalf of a public authority are permitted without consent. The proposal is categorised as development for a road and is being carried out by or on behalf of Transport for NSW, a public authority. Transport for NSW is the determining authority for the proposal.

The proposal is not State significant infrastructure or State significant development and can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposal is located within the Port Stephens local government area and is predominantly located within the road corridor on land zoned SP2 Infrastructure. Part 2 Division 1 Consultation of the ISEPP includes provisions for public authorities to consult with local councils and other public entities prior to the commencement of

certain types of development. Port Stephens Council have been consulted and had no objection to the proposal.

This review of environmental factors (REF) fulfils Transport for NSW's obligation under section 5.5 of the EP&A Act 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.

Community and stakeholder consultation

In November 2019, Roads and Maritime (now Transport for NSW) prepared the *Nelson Bay Road duplication: Williamtown to Bobs Farm – Project development and concept design Community and stakeholder engagement plan* (Roads and Maritime, 2019). This plan describes the communication and consultation approach and activities for the proposal to keep key stakeholders and the community informed during the work.

Transport for NSW consulted with the community on the route alignment options for the Williamtown to Bobs Farm (W2BF) proposed upgrade over a three week period from 20 September 2019 to 11 October 2019. Community members were encouraged to provide their feedback and leave comments via mail, email, online feedback form or phone contact with the project team. Transport for NSW also directly consulted a number of key stakeholders via individual meetings.

Transport for NSW has subsequently published a Community Consultation Report, which summarises community feedback and our responses about the route options. Following a review of the comments, Transport have decided to investigate alternative route options for the upgrade that were suggested by the community and stakeholders during the consultation period. Transport is planning to further consult with the community about the alternative route options in late 2020. It is noted that the proposal is not affected by consultation on route alignment options as the alignment for Section 1 has already been determined.

In July 2020, Transport for NSW undertook additional and targeted consultation with residents at the western extent of the proposal. The targeted consultation comprised corresponding directly with four residents adjacent to the proposal with an invitation to make contact with Transport for NSW and/or comment on the Section 1 upgrade. One resident responded citing that the existing wire rope safety barrier (WRSB) and 100 kilometre per hour speed limit of the proposed dual carriageway would increase the risk of vehicle accident when entering or exiting their property. Transport for NSW undertook a review and determined that removal of WRSB may result in a crash increase and that the existing 80 km/h speed limit is deemed to be appropriate and in accordance with current Speed Zone Guidelines (Roads and Maritime, 2011). Transport for NSW noted that the respondent's driveway is outside of the proposal's limit of works and that there will be no changes to their driveway as a result of the project.

In accordance with State Environmental Planning Policy (Infrastructure), Transport for NSW has consulted with Port Stephens Council and National Parks and Wildlife Service (NPWS). Port Stephens Council responded by email on 23 December 2019 and stated that they had reviewed the location and can that the proposal will not have any impact on Council owned infrastructure. A meeting was held with NPWS in August 2020. Transport for NSW explained the project upgrade in more detail and clarified why the median could not be extended further to the west. NPWS initially thought there were four lanes in this location (two in each direction). Transport for NSW clarified that there were only two lanes in this location (one lane in each direction), and that left only signage will be installed. NPWS were satisfied with the response.

The project would include proposed safety improvements involving installing audio-tactile line marking (ATLM) or 'rumble strips' on the edge line of the new road. Three properties that are within 200 metres of the proposed ATLM were invited to comment on the installation. Four additional properties that are within 500 metres of the ATLM were provided with information about the proposal. Transport for NSW have undertaken noise modelling of the potential impact of the ATLM on seven properties within 500 metres of the proposal and the assessment has indicated that there would be no noise impacts experienced at nearby residences.

Aboriginal community consultation is an integral part of the assessment of Aboriginal cultural heritage significance. Consultation was carried out in accordance with the Transport for NSW Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011).

Transport for NSW will continue to consult with Aboriginal community, affected residents, stakeholders and community during the development of the proposal.

Environmental impacts

Biodiversity

A Biodiversity Assessment Report (BAR) was prepared for the proposal. The BAR identified key impacts on biodiversity associated with the proposal would involve the direct removal of 2.27 ha of native vegetation and associated habitat including:

- Clearing of 0.11 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales which is listed as Endangered under the Biodiversity Conservation Act 2016 (BC Act). North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest).
- Clearing of one threatened flora species, Sand Doubletail orchid (*Diuris arenaria*), listed as Endangered under the BC Act. 18 Sand Doubletail individual orchids were recorded in the proposal area and all would be cleared by the project.

Assessments of impact significance were conducted for all threatened species and ecological communities considered likely to be affected by the proposal. These impact assessments determined that the proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats. These impact assessments determined that the proposal is unlikely to have a significant impact on threatened species, populations, ecological communities or their habitats so a Species Impact Statement (SIS) is not required under the BC Act. The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. Matters of National Environmental Significance (MNES) include threatened flora, fauna and communities, a referral of the proposal for consideration as a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is not required.

An additional mitigation measure (fauna exclusion fencing on the southern boundary) would be implemented to address potential impacts on wildlife movement for less-mobile fauna including Koala (*Phascolarctos cinereus*) and Spotted-tailed Quoll (*Dasyurus maculatus maculatus*). The implementation of the recommended mitigation measure means it is unlikely that residual impact of the proposal would result in a significant impact to biodiversity within the locality.

Transport for NSW's policy requires biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) would be provided for impacts that exceed predetermined thresholds. The policy, *Guidelines for Biodiversity Offsets* (Roads and Maritime 2016), indicates that the following offsets would be required by the proposal given residual impacts associated with the development footprint exceed the predetermined thresholds as specified in the guideline:

- 5.88 ha of habitat for EPBC Act listed species including Spotted-tailed Quoll, Grey-headed Flying-fox, New Holland Mouse and Large-eared Pied Bat
- 5.88 ha of habitat for BC Act listed species credit species including Squirrel Glider and Brush-tailed Phascogale
- 54 *Diuris arenaria* (Sand Doubletail) individuals.

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

A Biodiversity Offset Strategy would be developed to identify biodiversity credits and/or supplementary measures for these entities.

Aboriginal heritage

The Aboriginal Cultural Heritage Assessment Report (ACHAR) notes impacts would be contained within the existing road corridor and would impact all areas within the clearing boundary. The proposal would partially impact upon Aboriginal site OFOC1 (AHIMS 38-4-1600). OFOC1 is a very low density and low integrity shell scatter located within a highly disturbed context, consisting of four shell fragments moved from their original depositional context as a result of disturbance. Authorised unmitigated partial impacts to OFOC1 within the boundary of the study area have previously occurred in accordance with AHIP 11332343 for installation of an Optus fibre optic cable. Therefore, any remanent material associated with OFOC1 to be impacted by the proposal is assessed as negligible. Aboriginal objects have the potential to occur within the study area, however if present they are likely to be of very low density in highly disturbed locations removed from their original depositional context.

During the Cultural Values Assessment (CVA) process, nominated knowledge holders and Registered Aboriginal Parties (RAPs) advised the cultural landscape that the Williamstown to Bobs Farm Section 1 study area is within an area that is rich in cultural value and includes significant resource areas, Story or Dreaming Tracks, ceremonial grounds, corroboree grounds, burial places, pathways and pathway markers, and traditional and historical living places. The Section 1 upgrade proposal area lies within the zone of traditional patterns of movement between Tilligerry Creek and the beach front and between Tomaree and Fullerton Cove. These patterns of movement were associated with resource collection, community gatherings and ceremonial activities and hold significance to Aboriginal knowledge holders as an important element of the cultural landscape. The CVA also notes that within the Section 1 proposal area there are 18 Sand Doubletail orchid (*Diuris arenaria*) that have been identified as culturally significant by the RAPs and would be cleared by the proposal. Orchids were utilised as a traditional food source and hold cultural value for that association. Sand Doubletail orchid has medium significance to the local Aboriginal community for its use as a food source. The CVA notes the removal of the 18 orchids by the proposal does not significantly impact cultural use of orchids in the broader area. No other locationally specific sites of intangible cultural significance within the Section 1 area were identified during the cultural values assessment process.

Noise and vibration

The proposal is located within a rural environment with receivers typically classified as residential dwellings on small acreages. (Note there were no non-residential receivers identified within the study area.) Individual residential receivers located within 600 metres of the proposal site (refer Figure 6-6) and ancillary site A (refer Figure 6-7) were identified as per the Noise Criteria Guideline (NCG) (Roads and Maritime 2015). The existing noise levels are representative of the ambient noise environment of properties along an arterial or major road. The noise levels are controlled throughout each monitoring period by passing road traffic. The noise levels are lower during the evening and night periods with levels representative of reduce traffic. Observations on-site identified the surrounding locality typical of a rural environment, with traffic noise the dominant audible noise source.

Construction activities would typically be completed during standard construction hours, with only asphalt paving works to be completed during Out of Hours (OOH) periods (evening and night) for tie-in works and asphaltting style activities. For works completed during standard construction hours, noise levels are predicted to exceed the Noise Management Level (NML) at receiver location R1 during corridor clearing activities only (refer Figure 6-6). Noise levels during all other construction scenarios are predicted to remain below the standard construction hours NML at all receiver locations.

For asphalt paving works completed during OOH periods (evening and night), noise levels are predicted to exceed the relevant NMLs at receiver locations R1 to R5 and R8 to R10. Following implementation of standard mitigation measures, noise levels are predicted to remain 'noticeable' at receivers R1, R2 and R8 and 'clearly audible' at receiver R1, hence Additional Mitigation Measures (AMM) are required to be

implemented at these locations. Sleep disturbance screening criterion has the potential to be exceeded at receivers R1 to R4 and R8 to R10 during OOH (night) asphaltting works, however, the implementation of reasonable and feasible mitigation measures would significantly reduce received noise levels.

Potential noise impacts were assessed for a potential ancillary site 1.8 kilometres to the east of the of the proposal area. The results of the analysis indicated that no residential receivers are anticipated to be impacted by the establishment or operation of the ancillary site during standard construction hours.

An assessment of operational traffic noise was completed to determine future road noise levels associated with the Section 1 duplication of Nelson Bay Road for existing residential receivers in the vicinity of the proposal site. The results of the assessment indicated that future road noise levels at the nearest existing residential receivers would increase by less than 1.5dBA compared with current levels and ameliorative measures (architectural treatment) are not required.

ATLM are proposed to be installed along the centre median on the approach to the new dual carriageway. The closest residence to the ATML is identified as 2998 Nelson Bay Road (R1) about 40m from the start of the ATLM. The results of the ATLM assessment demonstrate that for the closest residence, the predicted maximum noise level of 57dBA would remain below the relevant criteria of 65dB LAmax by about 8dBA. It is expected that no impacts above the maximum noise level criterion would be experienced at any of the nearby residences.

A Construction Noise and Vibration Management Plan would be prepared to reduce and manage construction impacts.

Soil and water

The proposal would be constructed within the existing road corridor. It is estimated that the total area of land disturbed by the proposal would be about 52,830 square metres which includes the existing road alignment which is about 15,330 square metres (refer Table 6-43). Construction would be staged so the area of disturbance is restricted to the particular construction phase and allows for progressive site rehabilitation. Road construction would involve earthworks including removal of topsoil and unsuitable material, modification to existing cut and fill batters, and site restoration of areas disturbed by construction. An ancillary site would be required to assist in the construction of the proposal and would be predominantly used for material stockpiling, office accommodation and ancillary sites.

A Soil and Water Management Plan would be prepared and implemented to reduce and manage impacts.

Landscape character and visual

The proposal would be within the existing road corridor. All zones and viewpoints have a similar landscape character comprised of vegetated forest aligning the existing road corridor. With the exception of a short stretch impacted by the construction of the cut retaining wall, impact is limited to removal of trees and groundcover, inclusion of a median barrier, fauna exclusion fence and widening of the road. Although there is an electrical easement within close proximity to the north of the proposed works, a sufficient vegetation buffer would be retained to ensure this is not seen. The greatest landscape character and visual impact would be where the fill retaining wall is proposed, however the impact would be reduced with the implementation of the mitigation measures which include rehabilitating disturbed areas with indigenous plants and appropriate treatment to the face of the retaining wall to compliment the surrounding landscape. Overall, the proposal would have a low impact on the site's landscape character and visual amenity.

Detailed Landscape Drawings and Specifications would be prepared for the proposal and implemented during the relevant construction stage.

Traffic and transport

It is expected there would be a moderate impact on traffic and network performance during construction. Road user delay is based on the detailed construction staging strategy and requirements for traffic control. The proposed construction staging of the proposal would reduce impact on through traffic and road user delay. Generally, one lane in each direction would be provided on Nelson Bay Road during construction of the proposal. The impact to traffic is due to the reduction in speed limits through the work site. For the duration of the construction phase when the construction site is active and workers are undertaking activities behind construction barriers next to live traffic, the posted speed limit would generally be reduced to 60 kilometres per hour. There may be isolated times when workers are operating immediately adjacent live traffic without temporary traffic barriers when the posted speed limit is reduced to 40 kilometres per hour. During earthworks and pavement widening phases only one lane would be provided with one direction of travel permitted and traffic control in place. The locations where this arrangement is applied would be staged to limit the length under construction at any one time in order to reduce the impact on traffic using Nelson Bay Road. Where possible, the most disruptive work would be undertaken as night work.

It is expected that up to 80 heavy vehicle movements would occur during the peak construction period on a typical working day. Where possible heavy machinery would be transported to and from the site mainly during off-peak hours to minimize road user delays due to turning movements. Light vehicles and small plant are estimated at 60 movements per day.

A Communication Plan and a Traffic Management Plan would be prepared and implemented to reduce and manage impacts.

Justification and conclusion

This section of Nelson Bay Road at Salt Ash and Bobs Farm is a two lane road with narrow shoulders and a known crash history. The proposal is recommended as it would best address the objective to upgrade the road at this location (Section 1) on Nelson Bay Road. It would also be the most cost effective option. The proposal would result in some adverse impacts to the environment, road users and the community, however the safeguards and mitigation measures provided in this REF would mitigate these expected impacts.

The proposal is justified because it would improve road safety and meet future traffic needs.

Internet

The documents are available as pdf files on the Transport for NSW website at:

<https://www.rms.nsw.gov.au/projects/nelson-bay-road/nelson-bay-road-williamtown-to-bobs-farm-section-1.html>

Copies by request

Printed and electronic copies are available by contacting Kate Hagan 0439 607 972 noting that there may be a charge for hard copies, CD or USB.

What happens next?

If the proposal is determined to proceed, Transport for NSW will continue to consult with the community and stakeholders prior to and during construction.

Contents

Executive summary	i
Contents	viii
1. Introduction	1
1.1 Proposal identification.....	1
1.2 Purpose of the report.....	4
2. Need and options considered	5
2.1 Strategic need for the proposal.....	5
2.2 Existing infrastructure.....	6
2.3 Proposal objectives and development criteria.....	7
2.4 Alternatives and options considered.....	7
2.5 Preferred option.....	9
2.6 Design refinements.....	9
3. Description of the proposal	11
3.1 The proposal.....	11
3.2 Design.....	15
3.3 Ancillary site and stockpiling.....	26
3.4 Public utility adjustment.....	28
3.5 Property acquisition and leases.....	29
4. Statutory and planning framework	32
4.1 Environmental Planning and Assessment Act 1979.....	32
4.2 Other relevant NSW legislation.....	34
4.3 Commonwealth legislation.....	35
4.4 Confirmation of statutory position.....	36
5. Consultation	37
5.1 Consultation strategy.....	37
5.2 Community involvement.....	37
5.3 Aboriginal community involvement.....	40
5.4 ISEPP consultation.....	42
5.5 Government agency and stakeholder involvement.....	43
5.6 Ongoing or future consultation.....	44
6. Environmental assessment	46
6.1 Biodiversity.....	47
6.2 Aboriginal cultural heritage.....	69
6.3 Noise and vibration.....	79
6.4 Landscape character and visual.....	93
6.5 Soil and water.....	103
6.6 Traffic and transport.....	110
6.7 Air Quality.....	117
6.8 Waste and contamination.....	122
6.9 Non-Aboriginal heritage.....	127
6.10 Socio-economic, property and land use.....	131

6.11 Cumulative impacts.....	136
7. Environmental management.....	138
7.1 Environmental management plans (or system)	138
7.2 Summary of safeguards and management measures	139
7.3 Licensing and approvals	158
8. Conclusion.....	159
8.1 Justification.....	159
8.2 Objects of the EP&A Act.....	160
8.3 Conclusion.....	162
9. Certification.....	163
10. References.....	164

Tables

Table 3-1 Road design criteria.....	15
Table 3-2 Construction activities, plant and equipment.....	19
Table 3-3 Required materials.....	25
Table 3-4 Heavy vehicle movements during major aspects of construction	28
Table 5-1 Consultation methodology	37
Table 5-2 Summary of issues raised.....	39
Table 5-3 Summary of PACHCI.....	40
Table 5-4 Issues raised through Aboriginal community consultation.....	41
Table 5-5 Issues raised through ISEPP consultation	42
Table 5-6 Williamtown to Bobs Farm issues raised through stakeholder consultation.....	44
Table 6-1 Database searches.....	48
Table 6-2 Threatened flora habitat assessment and surveys results.....	50
Table 6-3 Plant community types.....	51
Table 6-4 Priority weeds of concern.....	53
Table 6-5 Threatened or migratory fauna recorded in the study area.....	53
Table 6-6 Threatened fauna assessment and surveys results	57
Table 6-7 Impacts on native vegetation	61
Table 6-8 Key threatening processes associated with native vegetation removal	61
Table 6-9 Impacts on threatened flora	62
Table 6-10 Impacts on threatened fauna and fauna habitat	62
Table 6-11 Key threatening processes associated with the removal of fauna habitat features	63
Table 6-12 Biodiversity safeguards and management measures.....	64
Table 6-13 AHIMS extensive search results	70
Table 6-14 Effective survey coverage summary	71
Table 6-15 Landform survey coverage summary	71
Table 6-16 Survey results summary	71
Table 6-17 Summary of significance.....	74
Table 6-18 Summary of significant cultural values	75
Table 6-19 Aboriginal cultural heritage safeguards and management measures	76

Table 6-20 Residential receiver locations	80
Table 6-21 Existing background noise level at nearest sensitive receiver	80
Table 6-22 Existing traffic flows	81
Table 6-23 ICNG Residential Management Levels	84
Table 6-24 Ancillary site establishment and operation	85
Table 6-25 Early works activities	86
Table 6-26 Construction scenario noise results	87
Table 6-27 Predicted road traffic noise levels	88
Table 6-28 Noise and vibration safeguards and mitigation measures	89
Table 6-29 Additional mitigation measures	90
Table 6-30 Landscape character and visual impact matrix	93
Table 6-31 Landscape and visual safeguards and management measures	102
Table 6-32 Summary of registered groundwater bores	104
Table 6-33 Soil and water safeguards and mitigation measures	109
Table 6-34 Daily traffic volumes (all vehicles) on Nelson Bay Road, east of Marsh Road 2018/2019	111
Table 6-35 Daily heavy vehicle average traffic volumes on Nelson Bay Road, east of Marsh Road 2019	111
Table 6-36 Crashes on Nelson Bay Road, east of Marsh Road 2013-2018	111
Table 6-37 Forecast weekday traffic volumes (all vehicles)	112
Table 6-38 Road user delay summary	113
Table 6-39 Traffic and transport safeguards and management measures	114
Table 6-40 Air quality safeguard and management measures	121
Table 6-41 Target wastes for reuse	122
Table 6-42 Contaminated sites within the vicinity of the proposal and ancillary areas	123
Table 6-43 Waste materials	124
Table 6-44 Waste and contamination safeguards and management measures	125
Table 6-45 Listed heritage items in the vicinity of the proposal area	127
Table 6-46 Non-Aboriginal safeguard and management measures	130
Table 6-47 Population statistics of the proposal area (ABS, 2016)	131
Table 6-48 Property accesses	132
Table 6-49 Socio-economic, property and land use safeguards and management measures	134
Table 6-50 Summary of potential cumulative impacts	137
Table 6-51 Cumulative impacts safeguards and management measures	137
Table 7-1 Summary of safeguards and management measures	139
Table 7-2 Summary of licensing and approvals required	158
Table 8-1 Objects of the EP&A Act	160

Figures

Figure 1-1 Location of the proposal	2
Figure 1-2 Proposal area	3
Figure 3-1 Key features of the proposal	12
Figure 3-2 Typical section for carriageway	13
Figure 3-3 Typical Section for Retaining Walls	14
Figure 3-4 Retaining wall – MW01 Type 1 (cut)	17

x

Figure 3-5 Retaining wall – MW01 Type 2 (fill)	18
Figure 3-6 Clearing boundary	24
Figure 3-7 Ancillary site location	30
Figure 3-8 Location of utilities	31
Figure 4-1 Land use zoning	33
Figure 6-1 Plant community types	54
Figure 6-2 Plant community types	55
Figure 6-3 Threatened flora and ecological communities	56
Figure 6-4 Threatened fauna and hollow-bearing trees.....	60
Figure 6-5 Survey coverage and results	73
Figure 6-6 Residential receiver locations	82
Figure 6-7 Residential receiver locations	83
Figure 6-8 Landscape Character Zones	94
Figure 6-9 Viewpoint locations along Nelson Bay Road.....	95
Figure 6-10 Typical roadside vegetation at LCZ 1.....	96
Figure 6-11 Typical roadside vegetation at LCZ 2.....	96
Figure 6-12 View east along Nelson Bay Road and view into roadside vegetation	97
Figure 6-13 Viewpoint 1.....	98
Figure 6-14 Viewpoint 2.....	99
Figure 6-15 Viewpoint 3.....	99
Figure 6-16 Viewpoint 4.....	100
Figure 6-17 Groundwater bores and spear locations near the proposal and ancillary site.....	106
Figure 6-18 Acid sulfate soil locations - proposal area and ancillary site.....	107
Figure 6-19 Traffic count locations.....	110
Figure 6-20 Location of crashes for Nelson Bay Road (Section 1).....	111
Figure 6-21 Port Stephens bus networks routes	112
Figure 6-22 Air Quality Index rating and Pollution concentration.....	117
Figure 6-23 Daily RAQI values recorded at Lower Hunter monitoring station (DECCNSW, 2020a)	118
Figure 6-24 PM2.5 levels recorded at the Stockton monitoring station (DECCNSW, 2020b)	119
Figure 6-25 PM10 levels recorded at the Stockton monitoring station (DECCNSW, 2020b)	119
Figure 6-26 Non-Aboriginal heritage sites adjacent to the proposal area and ancillary site.....	129

Appendices

Appendix A	Consideration of clause 228(2) factors and matters of national environmental significance and Commonwealth land
Appendix B	Statutory consultation checklists
Appendix C	Biodiversity Assessment
Appendix D	Aboriginal Cultural Heritage Assessment
Appendix E	Aboriginal Cultural Values Assessment
Appendix F	Noise and Vibration Assessment
Appendix G	Urban Design and Landscape Character and Visual Impact Assessment

1. Introduction

1.1 Proposal identification

Transport for New South Wales proposes to upgrade Nelson Bay Road at Salt Ash (the proposal) to a dual carriageway. The proposal would involve building about one kilometre length of dual carriageway from 900 metres east of Marsh Road at Salt Ash to 1.9 kilometres east of Marsh Road at Bobs Farm. The proposal is required to:

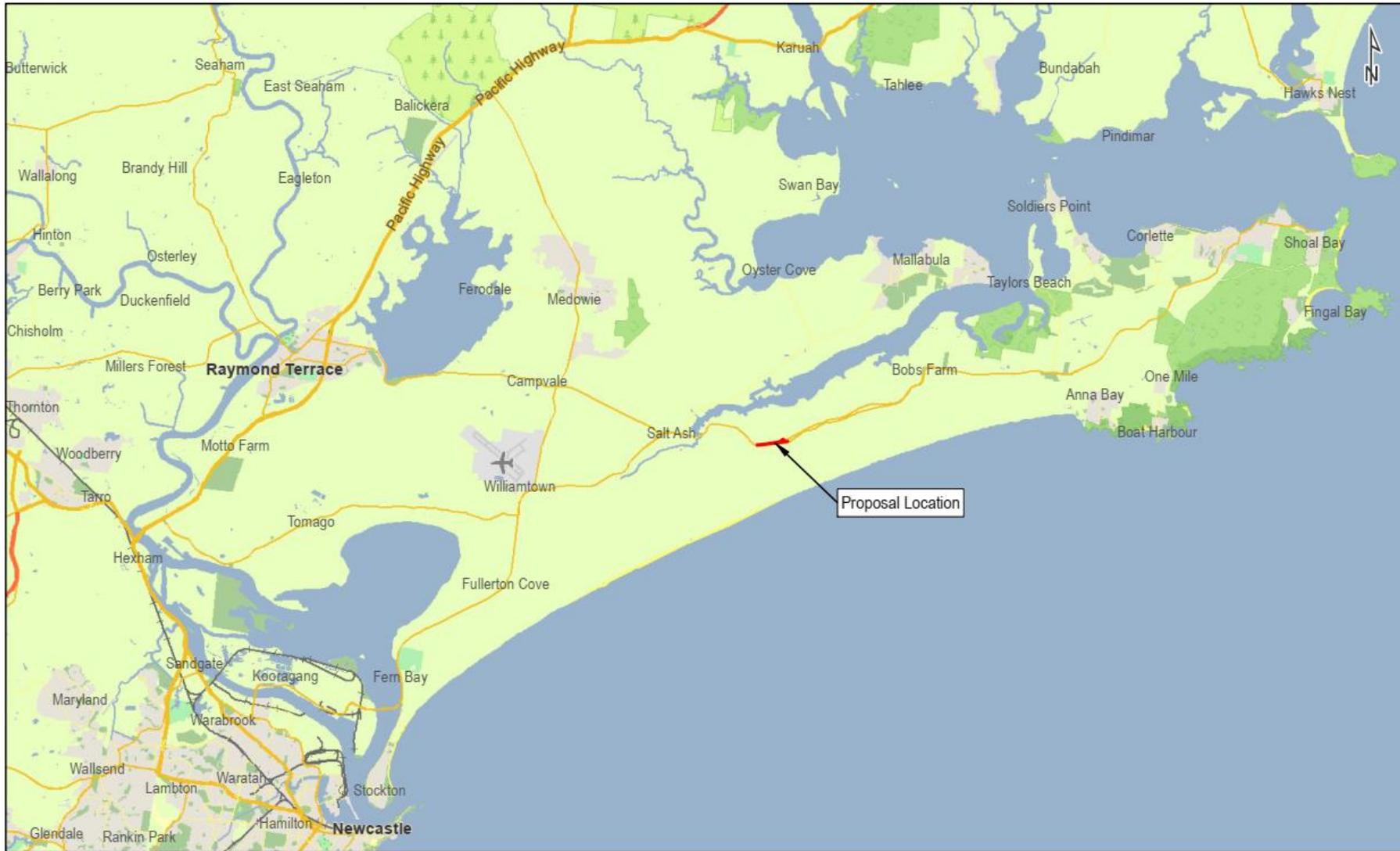
- Reduce local traffic congestion
- Improve road safety of all road users
- Enable the delivery of the broader Nelson Bay Road upgrade project.

The eastern extent the proposal would tie in with the Anna Bay to Bob's Farm duplication that was completed in 2015. 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.

One ancillary site has been identified about 1.5 kilometres east of the proposal area for use during construction.

Key features of the proposal include:

- One kilometre dual carriageway with a 100 kilometre speed limit, 3.5 metre wide travel lanes, 2.5 metre wide shoulders, median separation barrier or line marked separation zone
- Two retaining walls:
 - Type 1 cut retaining wall spans from about Chainage 30240 to Chainage 30290 (50 metres) long with a maximum retaining wall height of about 6 metres at chainage 30250.
 - Type 2 (fill) spans from about Chainage 30290 to Chainage 30346 (56 metres long) with a maximum retaining wall height of about 2.3 metres at Chainage 30320.
- Installation of audio tactile line marking at western extent of upgrade
- Utility relocations: electricity, water and telecommunications
- Fauna fence on the southern side of the duplication.



 Proposal area boundary

Nelson Bay Road Upgrade Section 1 30012877

Location of the proposal Fig. 1-1

Roadnet MDS 2019, Imagery © Department of Finance, Services & Innovation 2018

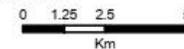


Figure 1-1 Location of the proposal



 Proposal area boundary

Nelson Bay Road Upgrade Section 1 30012877

Overview of the proposal Fig. 1-2

Roadnet MDS 2019, Imagery © Department of Finance, Services & Innovation 2018

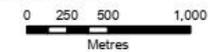


Figure 1-2 Proposal area

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared on behalf of Transport for NSW. For the purposes of these works, Transport for NSW 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) (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) (Appendix A).

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

- Section 5.5 of the EP&A Act including that Transport for NSW 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 strategic assessment approval granted by the Federal Government under the EPBC Act in September 2015, with respect to the impacts of Transport for NSW's road activities on nationally listed threatened species, ecological communities and migratory species.

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

2.1 Strategic need for the proposal

Nelson Bay Road is classified Transport for NSW as a class 4R road corridor with fringe urban and rural characteristics with class 6 routes of the highest strategic importance and class 1 routes of the lowest strategic importance. Functionally the Nelson Bay Road corridor:

- Provides connectivity between Newcastle and Port Stephens for business, tourism and leisure
- Provides access to and from Newcastle Airport and the Williamstown RAAF Base and links these destinations with Newcastle and national key transport routes including the Pacific Highway
- Supports sand mining activities along the Stockton Bight dune system and port related industries located on Kooragang Island and industrial areas at Tomago
- Enables access to Port Stephens as a popular tourism destination, which experiences seasonal peaks especially during summer holiday periods
- Provides access to the Stockton sand dunes and adjacent national parks
- Connects communities between Newcastle, Medowie, Raymond Terrace, Nelson Bay, Lemon Tree Passage and surrounding suburbs.

Section 1 is being delivered as early duplication works for the broader Williamstown to Bobs Farm project and is necessary to achieve the broader Williamstown to Bobs Farm upgrade. The consequences of deferral of Nelson Bay Road Section 1 project would lead to an inability to achieve the primary objectives of the broader project. Specific consequences arising from a deferral of the proposal include:

- Increased crash risk along the project length, from ongoing traffic growth from forecast population growth in the region.
- Increased local congestion along this section of Nelson Bay Road.
- Impact on the staged delivery of the broader Williamstown to Bobs Farm project.

2.1.1 NSW State Priorities: Making It Happen

NSW State Priorities: Making it Happen (State Priorities) (NSW Government, 2017a) replaces *NSW 2021: A plan to make NSW Number One*. It sets out the Premier's 12 priorities and 18 state priorities, which include:

- Building Infrastructure – improving road travel reliability
- Safer Communities – reducing road fatalities.

This proposal fits under the state priority of 'Building Infrastructure' to address increasing demand on infrastructure with an estimated 30 per cent more car trips expected during the next 15 years; and creating liveable communities where the need for smart, connected and resilient infrastructure has been identified. This proposal provides increased capacity on an important east-west road connection, to support future freight demand and reduce travel times for all road users.

Further, the proposal supports the need to improve road safety outcomes for all road users and create 'Safer Communities' by upgrading intersections, providing wider clear zones, and shoulders.

2.1.2 NSW Future Transport Strategy 2056

The *NSW Future Transport Strategy 2056* (Transport for NSW, March 2018) (Future Transport) is an update of the *NSW Long Term Transport Master Plan* (Transport for NSW, 2012a). Future Transport sets the 40-year vision, directions and outcomes framework for customer mobility in NSW, which will guide transport investment over the longer term.

A key aim of Future Transport is to provide essential access for regional NSW. The proposed upgrade of Nelson Bay Road has been planned to address issues such as asset condition, road safety, traffic efficiency and freight access. The proposal addresses this by improving the following:

- Carriageway widths
- Road conditions
- Road safety.

2.1.3 NSW State Infrastructure Strategy 2018-2038

The NSW Government recently updated the *NSW State Infrastructure Strategy 2018–2038* (Infrastructure NSW, 2018) which identifies and prioritises the delivery of critical public infrastructure to deliver the highest economic, employment and liveability benefits to the people of NSW. The investments recommended in the NSW State Infrastructure Strategy are focused around three critical priorities with the proposal sitting under the priority of '*ensuring a competitive and connected regional economy*'.

2.1.4 NSW Road Safety Strategy

The *NSW Road Safety Strategy 2012 - 2021* (Transport for NSW, 2012b) sets the direction of road safety in NSW for the next 10 years. NSW is committed to reducing fatalities with at least a 30 per cent reduction. Safety is the NSW Government's number one priority and these improvements on Nelson Bay Road would help reduce crash rates in this area while also easing congestion.

2.1.5 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* (Department of Planning and Environment, 2016) was prepared to complement Future Transport and manage the long term growth within the Hunter Region, and associated land use changes. The Hunter Region has the largest regional population and employment levels in NSW. Further. The proposal supports the *Hunter Regional Plan's* goals and directions including:

- Goal 1: The leading regional economy in Australia
 - Direction 6: Grow the economy of Mid Coast and Port Stephens.
 - Direction 7: Develop advanced manufacturing, defence and aerospace hubs
- Goal 3: Thriving communities
 - Direction 17: Create healthy built environments through good design.

2.2 Existing infrastructure

The existing Nelson Bay Road within the proposal area is about one kilometre in length and consists of a single travel lane in each direction. Existing lane widths are about 3.5 metres, with shoulders of 1.5 metre or less. The existing posted speed limit is 80 kilometres per hour in each direction. On the southern side of the Nelson Bay Road within the proposal area are two gated tracks providing access into Worimi National Park

and one sign posted bus stop. On the northern side of the Nelson Bay Road are two tracks providing access to the Ausgrid power line easement and one sign posted bus stop. At the eastern extent of the proposal area is an Ausgrid power pole and stay pole within the median that support a number of powerlines. In addition, there are Ausgrid power poles to the north and south of Nelson Bay Road within the proposal area of that support a number of powerlines that traverse the proposal area in north south direction.

Within the road reserve are the following underground utilities:

- Water – Hunter Water Corporation
- Telecommunications – Telstra
- Telecommunications – Optus.

There are no residences, street lights, intersections, footpaths or formal cycle lanes within the proposal area.

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal include:

- Reduce peak period traffic congestion
- Improve road safety of all road users

2.3.2 Development criteria

The development criteria for the proposal include:

- Improve safety and connectivity for road users
- Provide for safe construction while minimising impact on road users
- Minimise impact on utilities
- Best fits with existing and future planning
- Minimise changes to visual and landscape character
- Minimise direct impacts to adjacent rural residential properties
- Minimise direct impacts to Worimi National Park and Worimi LALC lands
- Minimise traffic disruption during construction
- Minimise impacts on biodiversity
- Minimise impacts on Aboriginal heritage.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

The methodology used to select the preferred option involved assessing each option against the proposal objectives, road safety, funding allocations, constructability, durability, maintenance demands and road

user delay. The selection of the preferred option was then determined through discussion between the design team and Transport for NSW.

2.4.2 Identified options

There were six options considered:

- Option 1
 - A 100km/hr posted speed design with a 6.0 metre raised median, 2.5 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 2
 - A 100km/hr posted speed design with a 4.0 metre median with wire rope safety barriers (WRSB), 2.5 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 3
 - A 100km/hr posted speed design with a 2.6 metre median with vertical concrete barrier (VCB), 2.5 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 4
 - A 100km/hr posted speed design with a 2.6 metre median with VCB, 2.5 metre shoulders, 1.0 metre verge, overlay of existing westbound carriageway with widening for additional westbound lane and widening on northern side for new eastbound lanes.
- Option 5
 - An 80km/hr posted speed design with a 1.6 metre median with VCB, 2.0 metre shoulders, 1.0 metre verge, overlay and cross fall correction of existing pavement and widening on northern side.
- Option 6
 - Do nothing: Do not upgrade the existing road.

2.4.3 Analysis of options

The criteria used to analyse the options were cost, safety, road user impacts, constructability and minimising environmental impacts as follows:

- Option 1: this alternative option did not proceed as it would impact property on northern side of carriageway
- Option 2: this alternative option did not proceed due to it being in close proximity to property on northern side of carriageway (2.5 metre from verge) and batters encroaching over the Worimi LACL boundary in isolated locations so this option did not satisfy the design criteria
- Option 3: (preferred option) the preferred option has close proximity to property on northern side of carriageway (3.9 metres from verge) however retaining walls will prevent batters encroaching beyond the road reserve boundary
- Option 4: this alternative option was not proceeded due to full pavement construction required on both sides of carriageway with verge 7.5 metres from property boundary on northern side
- Option 5: this alternative option was not proceeded due to the close proximity to property on northern side of carriageway (5.4 metres from verge) and batters encroaching over the boundary in an isolated location
- Option 6 (do nothing): was considered unacceptable as it does not address the proposal objectives.

2.5 Preferred option

Option 3 was the preferred option as it:

- Avoids impact to Worimi National Park
- Avoids impact on Worimi Local Aboriginal Land Council (LALC) lands (compared to wider median options)
- Achieves 100km/hr posted speed
- Widening predominantly on one-side to reduce constructability issues (compared to widening both sides)
- Remove the need for property acquisition or property adjustment
- Minimise impacts to utilities.

2.6 Design refinements

The proposal has been subject to a number of design refinements during the development of the proposal. Below is a summary of the major design refinements.

2.6.1 Strategic design

The strategic design was developed by Transport for NSW.

2.6.2 Concept design (20 per cent)

The following changes in design and strategy have been made during concept design.

- Bus Bay
 - Port Stephens Coaches has confirmed to Transport for NSW that the existing bus bays would not need to be maintained during construction so would be decommissioned, and would not be required when the proposal is operational so would not be reinstated
- Tie-in Pavement
 - The existing pavement widths at the tie ins are narrower than in the middle section of the proposal. Constructing in-situ stabilised pavement on these areas would require temporary pavement to allow two lanes of traffic to operate. By changing the pavement type to full depth AC these tie ins can be constructed a lot faster and prevent temporary pavement.

2.6.3 Concept design (100 per cent)

The following changes in design and strategy have been made during concept design since the 20% concept design submission.

- Alignment
 - Horizontal curve at Ch30860 on MC00 has been tightened to a radius of 438 metre to move the road away from the property boundary
 - The western limit of works was extended about west due to an issue with the survey. The design now ties into Nelson Bay Road about 125 metres west of previous limit of works
- Cross section:

- Cross section modified to provide a consistent offset for the safety barrier on the eastbound carriageway for areas with and without SO gutter. This has led to a shoulder width of three metres that includes the SO gutter where it is required
- Batter sloped flattened on the westbound carriageway to prevent the need to install safety barrier
- Retaining Walls
 - Retaining wall optioneering was completed during design development, L-shaped concrete reinforced walls were agreed for both cut (RW01) and fill (RW02) retaining walls

2.6.4 Detail design (100 per cent)

The following changes in design and strategy have been made during detailed design since the submission of 100% concept design:

- Median barrier installation
 - During detailed design development, direction was provided by Transport for NSW to use double sided Type F barrier in median instead of a vertical concrete barrier (VCB)
- Drainage
 - Removal of pavement interface drains and trench drain pipe where it cannot outfall, as per direction from Transport for NSW.
- Surplus earthworks material
 - Verge widening / batters flattened and landscape mounds introduced where possible on the project to remove surplus earthworks from the project.
- Fencing
 - Fauna fencing introduced to section of southern side of the project to prevent fauna crossings where median barrier is present.
- Pavement
 - Updated pavement design and approval form provided by Transport for NSW, incorporated into profiles, plans and details.
- Retaining walls
 - Safety barrier transitions updated
- Clearing boundary
 - Clearing boundary extents agreed with Transport for NSW and documented in drawing submission
- Property accesses
 - National Parks and Wildlife Services accesses on the southern side of the project now modelled in the design with 10:1 grade.
 - Closure of access track within road reserve at eastern extent of proposal adjacent to Worimi LALC property.
- Western limit of works
 - Tie-in amended to match existing pavement extents
 - Westbound carriageway pavement width reduced to remove redundant pavement works
- Pavement markings
 - Audio Tactile Line Marking to be installed for eastbound approach to median barrier within project extents
 - Chevrons removed from extended shoulder areas.

3. Description of the proposal

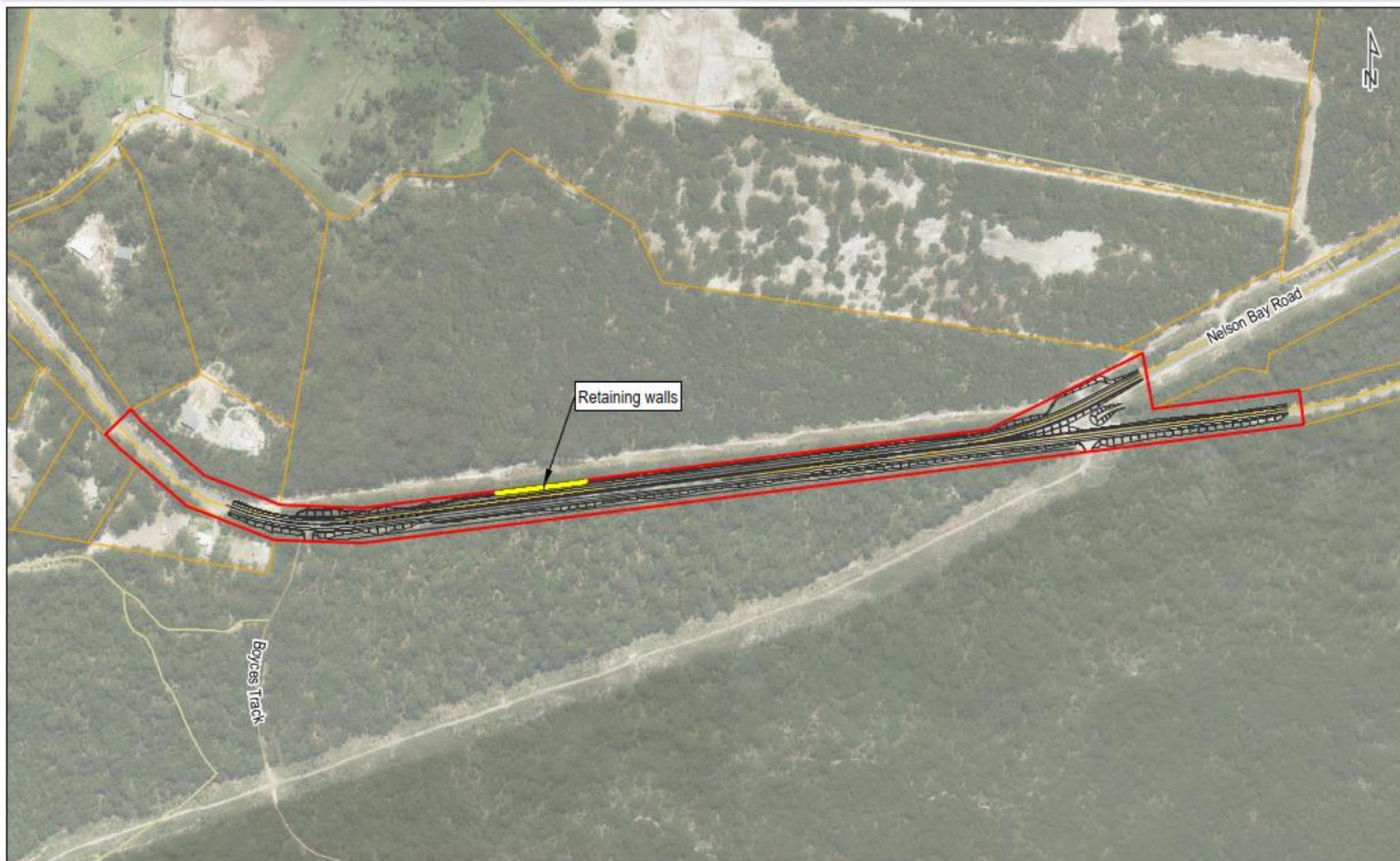
3.1 The proposal

Transport for NSW proposes to construct about one kilometre of dual carriageway from about 900 metres east of Marsh Road to 1.9 kilometres east of Marsh Road at Bobs Farm. Key features of the proposal (refer Figure 3-1) would include:

- One kilometre dual carriageway with a 100 kilometre speed limit, 3.5 metre wide travel lanes, 2.5 metre wide shoulders, median separation barrier or line marked separation zone
- Two retaining walls:
 - Type 1 cut retaining wall spans from about Chainage 30240 to Chainage 30290 (50 metres) long with a maximum retaining wall height of about 6 metres at chainage 30250.
 - Type 2 (fill) spans from about Chainage 30290 to Chainage 30346 (56 metres long) with a maximum retaining wall height of about 2.3 metres at Chainage 30320.
- Installation of audio tactile line marking at western extent of upgrade
- Utility relocations: electricity, water and telecommunications
- Fauna fence on the southern side of the duplication.
- Utility relocations.

Typical cross sections of the dual carriageway and retaining walls are shown in Figure 3-2 and Figure 3-3.

Subject to funding construction of Section would be expected to commence in 2022 and would take around 18 months to complete.



- Proposal area boundary
- Detailed design 100%
- Property boundary
- Retaining wall

Nelson Bay Road Upgrade Section 1 30012877

Key features of the proposal **Fig. 3-1**

Roadnet MDS 2019, MetroMap Imagery (20191025) © Aerometrex Pty Ltd



Figure 3-1 Key features of the proposal

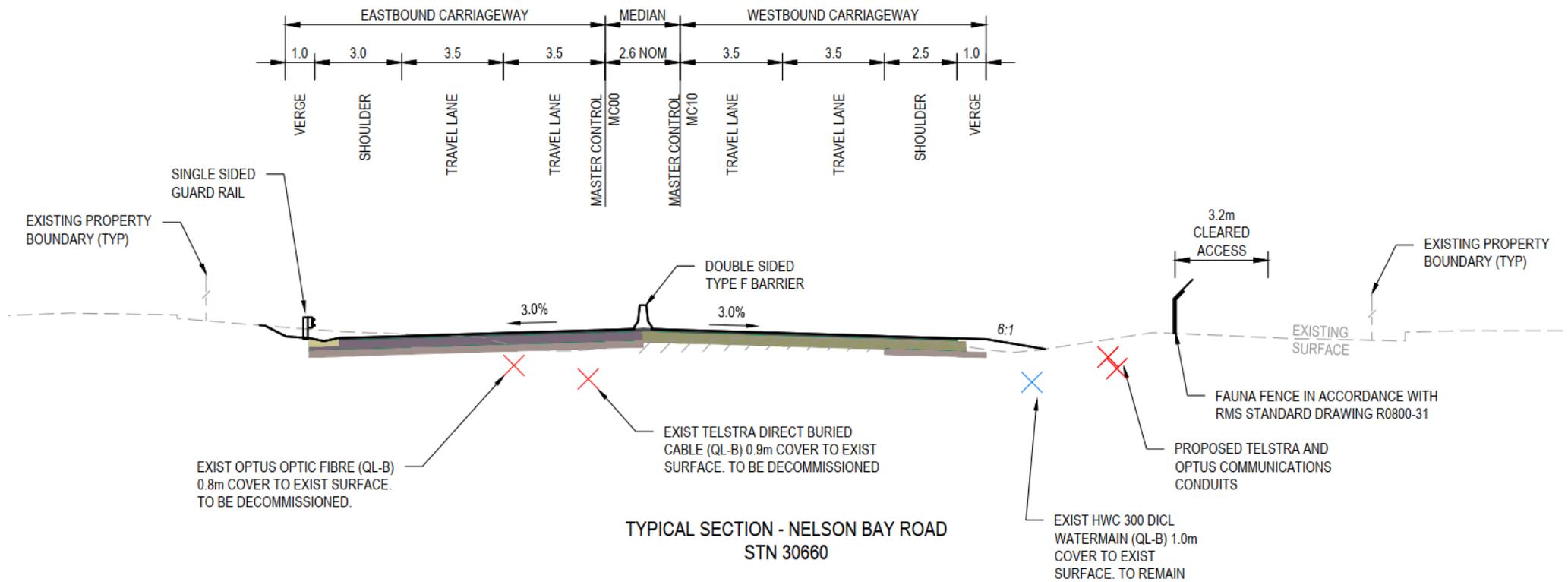


Figure 3-2 Typical section for carriageway

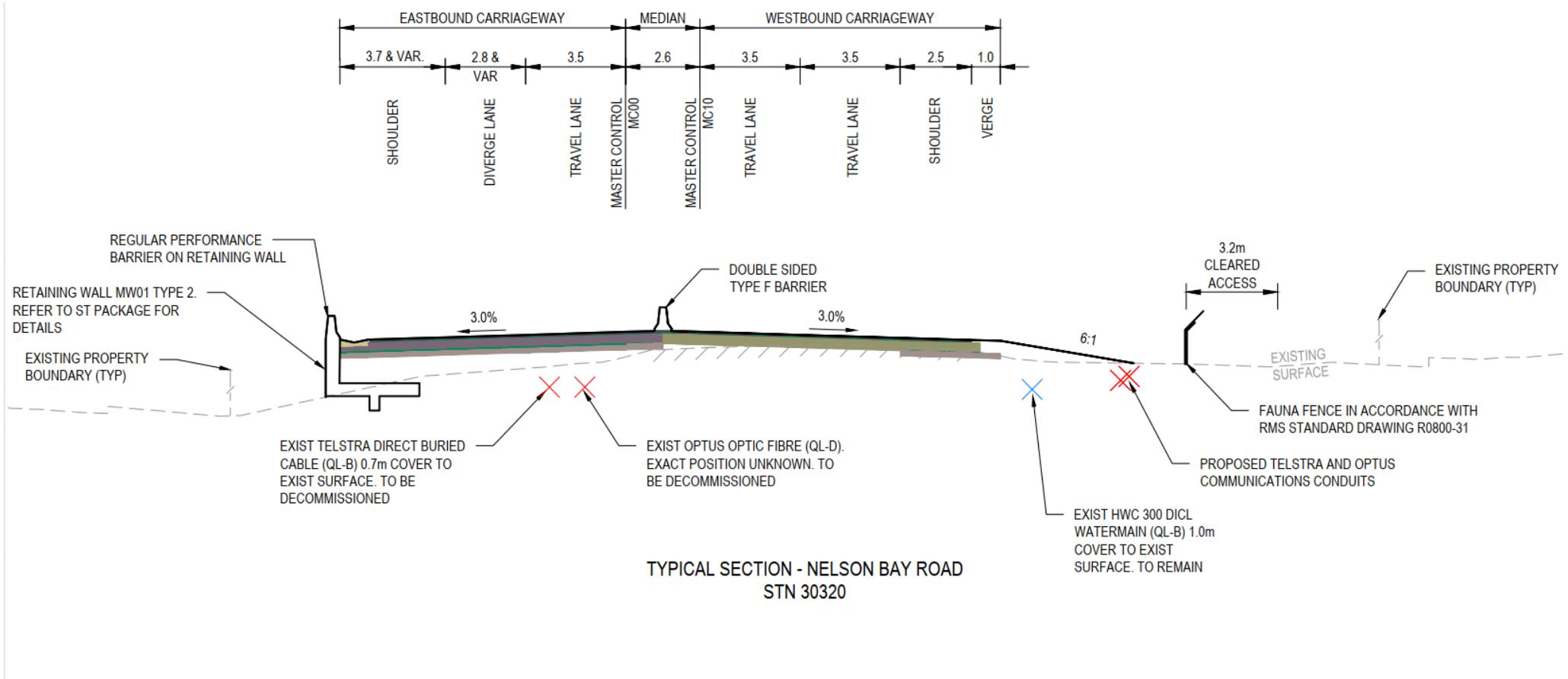


Figure 3-3 Typical Section for Retaining Walls

3.2 Design

3.2.1 Design criteria

The road has been designed in accordance with Austroads guidelines and associated Transport for NSW supplements. The design criteria developed for the proposal are summarised in Table 3-1 .

Table 3-1 Road design criteria

Criteria	Requirement
Design Vehicle	25m B-Double – Main Rd to Main Rd 19m Semi trailer – Main Rd to Secondary Rd 12.5m Single unit – Main Rd to Local Rd
Checking Vehicle	30m Super B Double – Main Rd to Main Rd 25m B-Double – Main Rd to Secondary Rd 19m Semi trailer – Main Rd to Local Rd
Lane widths	3.5 m
Median width (with safety barrier)	2.6 m
Shoulder width – Near side	2.5 m
Shoulder width – Off side	1.0 m
Verge	1.0 m

There are no existing drainage structures within the proposal extents. All surface flows infiltrate the subgrade through the permeable ground materials and then is conveyed through the site through the sandy subgrade.

It is not proposed to provide any piped drainage structures or transverse drainage structures for the proposal.

3.2.2 Engineering constraints

The key engineering constraints considered in the concept design include:

- Road design and alignment
 - Keeping the new road within the existing road reserve
 - Meeting the requirements of the proposed pavement design. This is contingent on the depth of the existing pavement for reuse
- Traffic management
- Construction staging
- Site access constraints, including ancillary site
- Maintenance requirements and access
- Property boundary constraints and the influence on construction activities
- Impact and relocation of public utilities

- Median and roadside barriers
- Retaining wall form and function
- Earthworks balance/ surplus material
- Environmental constraints:
 - Impacts on biodiversity
 - Impacts on Aboriginal Cultural Heritage
 - Impacts on noise and vibration impacts at nearby receivers associated with construction and operation.

3.2.3 Major design features

Major design feature – retaining wall design

MW01 Type 1 (cut) spans from about Chainage 30240 to Chainage 30290 (50m long) with a maximum retaining wall height of about 6 metres at chainage 30250 (refer Figure 3-4 *Error! Reference source not found.*). There are two subtypes of retaining wall, Type 1A for heights between 3.5 metres to 5.8 metres and Type 1B for heights from 1 metre to 3.5 metres. A perspective view of MW01 Type 1 taken from the 3D civil model is shown in *Error! Reference source not found.*.

MW01 Type 2 (fill) spans from about Chainage 30290 to Chainage 30346 (56 metres long) with a maximum retaining wall height of about 2.3 metres at Chainage 30320 (refer Figure 3-5). There are three subtypes of retaining wall, Type 2A is for heights between 1.3 metres to 2.3 metres, Type 2B is for retained heights from 500mm to 1.3 metres and Type 2C is the transitions between the type 1B and 2B profile. A perspective view of MW01 Type 2 taken from the 3D civil model is shown in Figure 3-5.

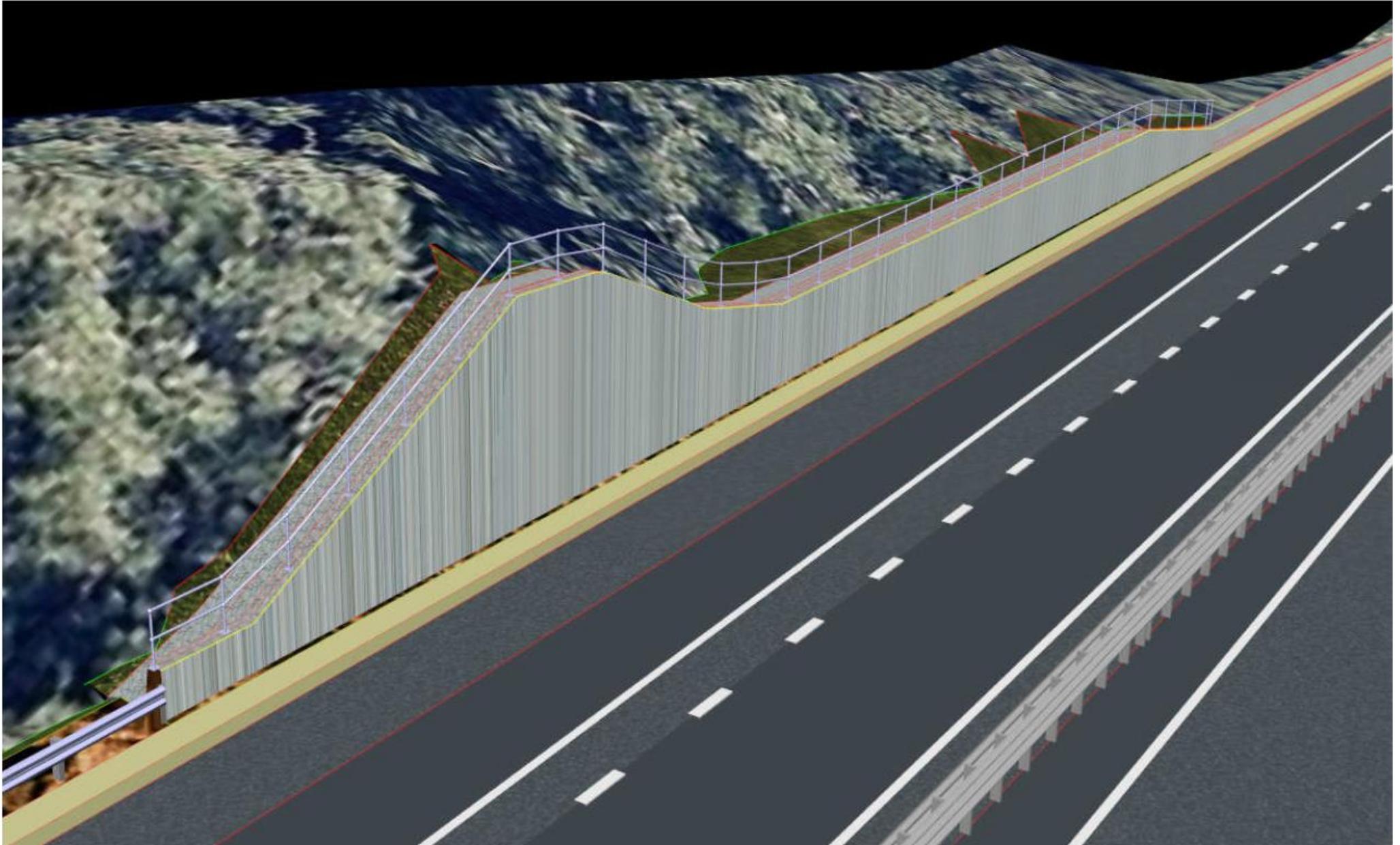


Figure 3-4 Retaining wall – MW01 Type 1 (cut)

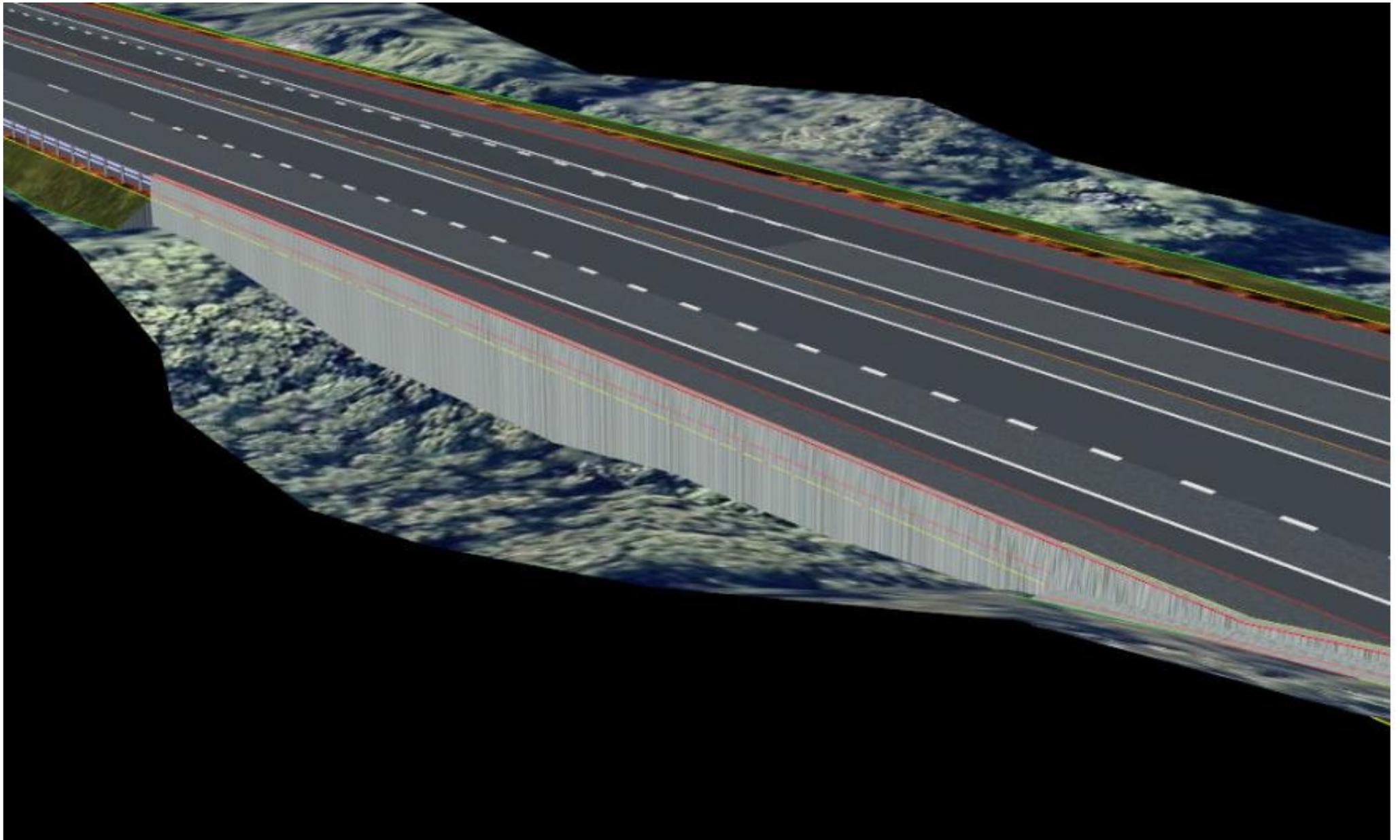


Figure 3-5 Retaining wall – MW01 Type 2 (fill)

3.2.4 Work methodology, plant and equipment

Details of the proposed Preconstruction and construction activities are provided in Table 3-2. It has been assumed that during each construction stage, plant and equipment such as vibrating and static rollers and excavators would be kept on site in designated areas.

Table 3-2 Construction activities, plant and equipment

Component	Typical activities	Typical plant, equipment and materials
Preconstruction	Notify residents and other relevant stakeholders	
Site establishment	<ul style="list-style-type: none"> • Delineation of the construction areas • Installation of initial environmental safeguards including site sediment and erosion controls and pollution management measures • Establishment of construction site facilities and access • Additional surveys and geotechnical investigations as required • Installation of temporary traffic controls and line marking. 	<ul style="list-style-type: none"> • Fences, portable sheds, portable toilets, road base and fuel storage tanks • Trucks, cranes, excavators, elevated work platform vehicle, backhoes and trenchers and small equipment
Survey	<ul style="list-style-type: none"> • Vehicle access • Minor vegetation trimming • Peg or marker installation. 	<ul style="list-style-type: none"> • Four-wheel drive vehicle, chainsaw
Site preparation	<ul style="list-style-type: none"> • Vegetation clearing and grubbing. • Processing of green waste into mulch for use in erosion and sediment controls and/or stabilisation of disturbed areas • Stripping and stockpiling of topsoil for reuse. • Removal of contaminated soil or hazardous waste material (if encountered). 	<ul style="list-style-type: none"> • Trucks, bulldozers, scrapers, graders, excavators, backhoes, mulcher and small equipment.
Relocation / protection of services	<ul style="list-style-type: none"> • Relocation or protection of services • Relocation of communications infrastructure to the southern side of Nelson Bay Rd • Protection of existing water infrastructure as required • Relocation of watermain clear of the proposed works on westbound carriageway at eastern extents of the proposal. 	<ul style="list-style-type: none"> • Trucks, cranes, excavators, boring machine, elevated work platform vehicle, backhoes and trenchers and small equipment.
Earthworks	<ul style="list-style-type: none"> • Removal and stockpiling of spoil and unsuitable material • Earthworks, including movement of materials along the alignment. • Spoil would be reused on site. Where this is not possible, unsuitable spoil would be disposed of to a licensed facility, property 	<ul style="list-style-type: none"> • Trucks, bulldozers, excavators, scrapers, graders, water carts, compactors, rollers, rock crushing equipment, and elevated work platform vehicle

Component	Typical activities	Typical plant, equipment and materials
	with approval to accept such material or on another Transport for NSW project.	<ul style="list-style-type: none"> Materials include site-won and imported earth and rock material.
Earthworks	<ul style="list-style-type: none"> Maintenance of construction erosion and sediment control measures e.g. diversion drains and temporary sedimentation sumps. 	<ul style="list-style-type: none"> Excavators, trucks, trenching equipment, small equipment
Pavements	<ul style="list-style-type: none"> Construction of road layers including sub-base, base and surfacing layer as well as sub-surface drainage. 	<ul style="list-style-type: none"> Graders, backhoes, trucks, water carts, vibratory compactors, trenching equipment, bitumen sprayers, material transfer vehicle, asphalt pavers, vibratory rollers and rubber-tyre rollers. Materials include road base and subbase material, subsoil pipes, concrete, lime, asphalt, bitumen and bitumen emulsion
Other work	<ul style="list-style-type: none"> Installation of retaining walls Installation of guardrail Installation of fauna fencing Installation of median safety barrier Temporary lighting, fencing and roadside furniture Progressive restoration of disturbed areas by means of stabilisation using measures such as revegetation, geofabric, soil binders, jute matting and the like Landscaping Line marking, raised road markers, sign posting. Removal or temporary relocation of signage (PSC, TfNSW, Port Stephens Buses) 	<ul style="list-style-type: none"> Trucks, fencing and barrier materials, truck mounted blowers, landscaping materials, cranes, line markers and small equipment. Materials include concrete, steel, geotextile, granular filter material, topsoil, seed mix, water, and signage faces, paint, raised pavement markers
Finishing work	<ul style="list-style-type: none"> Removal of temporary work Decommission, restoration and landscaping of temporary sites Site clean-up and disposal of all surplus waste materials. 	<ul style="list-style-type: none"> Trucks, excavators, backhoes, cranes, hand tools

3.2.5 Construction staging

A draft construction staging strategy has been prepared for the proposal. The stages below are indicative only with the draft construction staging strategy finalised prior to commencement of construction. The draft construction staging strategy proposes the following staging:

- Stage 1: Offline construction of pavement widening along the eastbound carriageway
- Stage 2: Offline construction of westbound shoulder widening and existing pavement rehabilitation
- Stage 3: Online tie in works at the project extents with contra flow / alternate flow in operation.

Stage 1

Stage 1 involves the construction of new pavement to the north of the existing carriageway. Travel lanes are shifted south to provide a 1.5m shoulder along the westbound travel lane while maximising the space available for offline construction. Key features of the staging traffic arrangement include:

- 3.2 metre travel lanes
- 1.5 metre shoulders
- 1.1 metre clear width between the back of shoulder and excavation edge for safety barrier installation

Key construction activities to occur during stage 1 include:

- Clearing and grubbing to suit new pavement extents
- Relocation of communications and water utilities
- Closure of existing bus stops within the works zone
- Construction of temporary U-turn facility for construction vehicles to the east of the works zone
- Closure of existing access along eastbound carriageway at CH. 30940
- Construction of retaining wall MW01 near CH. 30280
- Construction of new pavement for the proposed eastbound carriageway
- Construction of temporary pavement near CH. 30160 to cater for traffic switch for Stage 2 works

Stage 2

Stage 2 involves rehabilitation of the existing pavement and shoulder widening along the westbound carriageway. Travel lanes are shifted onto the newly constructed pavement built in stage 1 to allow stage 2 works to be completed offline. Key features of the staging traffic arrangement include:

- 3.2 metre travel lanes
- 1.5 metre shoulders
- 1.1 metre clear width between the back of shoulder and excavation edge for safety barrier installation

Key construction activities to occur during stage 2 include:

- Protection of existing watermain as required
- Rehabilitation of existing pavement
- Construction of shoulder widening
- Construction of AC layers to FSL over pavement rehabilitation and shoulder widening
- Construction of temporary pavement near CH. 30160 to cater for traffic switch for Stage 2 works

Stage 3

Stage 3 consists of tie-in works at each end of the project along with construction of the final wearing course and installation of roadside furniture, line marking and signage. Traffic utilises the future offside travel lanes in each direction for travel through the works zone. Key traffic staging arrangements include:

- 3.5m Travel Lanes located in the offside travel lane of the final arrangement
- Offside shoulders matching the width of the final arrangement
- Nominal 9.6m clearance between travel lanes through the final dual carriageway pavement area

To maximise offline construction, the eastern tie-in works has been split into two substages namely stage 3A and 3B. Stage 3A involves construction of the westbound carriageway tie-in with the existing eastbound carriageway utilised to carry both directions of traffic past the stage 3A works area. While Stage 3B will involve construction of the eastbound tie-in with the westbound carriageway utilised to carry both directions of traffic past the Stage 3B works area. About 2 kilometres east of the works area the travel lanes will divert onto their respective carriageways via a temporary crossover near the existing U-turn facility. The crossover geometry must be designed to satisfy a design speed of 60km/h and maintain access to the existing U-Turn facility. Contraflow travel lanes and shoulders will match the existing carriageway dimensions. Temporary line marking and signage will be required through the contraflow areas in order to restrict overtaking.

- Key construction activities to occur during stage 3 include:
- Tie-in works at western end of project under alternate flow conditions
- Tie-in works at eastern end of project under contraflow conditions
- Relocation of existing watermain along westbound carriageway clear of proposed works (Stage 3A)
- Construction of final wearing course
- Installation of roadside furniture, line marking and signage
- Landscaping works.

3.2.6 Construction hours and duration

Construction of the proposal is expected to take up to about 18 months to complete.

It is anticipated that construction of the proposal would be carried out both during and outside of standard working hours. Most work would be carried out during standard working hours. Work is also likely to be required outside standard working hours to minimise traffic impacts during traffic peaks.

Standard working hours are:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday: no work.

Proposed extended working hours are:

- Monday to Friday: 6am to 7am to 6pm to 8pm
- Saturday: 7am to 8am, 1pm to 6pm
- Sundays: 7am to 6pm
- Public Holidays: no work.

Proposed night works hours are:

- Monday to Friday: 8pm to 6am.
- Weekends: 8pm to 6am.

3.2.7 Clearing and earthworks

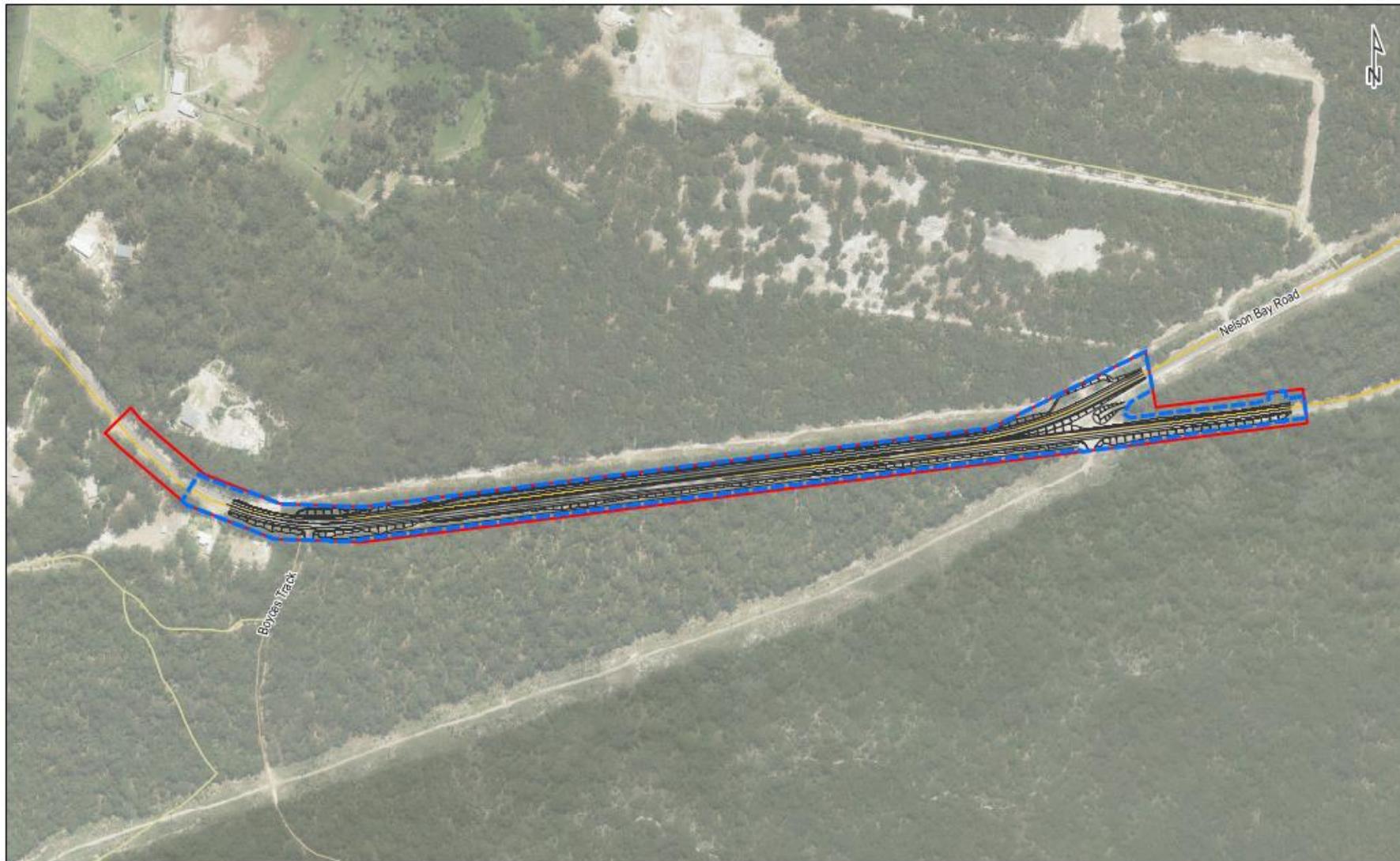
About 2.27 hectares of native vegetation would require removal by the proposal. To minimise the impact on any sensitive areas, unless specific clearing is necessary, all of the remaining clearing will be constrained to the minimal extents possible to allow for the safe construction of the proposal. It is noted that clearing would include trees located on the proposal's clearing boundary or where removal is required in order to construct the proposal safely or prevent a traffic hazard (refer Figure 3-6). Larger trees may be required to be removed within 1 metre outside of the northern boundary adjacent to the retaining wall where likely to create a safety risk to road users. It is expected that vegetation clearing would generate about 1,200 cubic metres of green-waste (refer Table 6-43).

MI Engineers has calculated the following based on 100% detailed design (MI Engineers 2020):

- General earthworks (cut/fill): 12,290 cubic metres
- 5,041 cubic metres of non-contaminated spoil (other than topsoil) being disposed of offsite
- Unsuitable material (type not specified) is calculated at 990 cubic metres.

(It is noted that the 100 per cent detailed design was used to calculate earthwork volumes and that a bulking factor was not applied.) The following is noted in relation to earthworks:

- Values calculated are surface to surface data
- Quantities calculated have been adjusted for pavement boxing
- Volumes assumed that the cut material can be used for UZF material.



- Proposal area boundary
- Clearing boundary
- Detailed design 100%

Nelson Bay Road Upgrade Section 1 30012877
Proposal area and clearing boundary **Fig. 3-6**
Roadnet MDS 2019, MetroMap Imagery © Aerometrex Pty Ltd

0 50 100
Metres

Figure 3-6 Clearing boundary

3.2.8 Source and quantity of materials

Construction of the proposal would require various materials and pre-cast elements (refer Table 3-3).

Table 3-3 Required materials

Type	Estimate of quantity*
Unbound pavement	1,544m ³
Spray binder	31,528l
Spray cutter oil	3,153l
Aggregate (10mm precoated)	67m ³
Aggregate (7mm precoated)	111m ³
Gravel - SMZ	5,642m ³
Dense grade asphalt	47,180m ³
Topsoiling and hydromulching	8,2500m ²
Concrete	500m ³
Steel reinforcement	65 tonnes
Quicklime	1588m ³
Guide posts	20 each
Guardrail	1,635m
Terminals	4 each
Single and double sided rail barriers	4 each
Thermoplastic Pavement Marking Material	4,772m
Raised pavement markers	580 each
Retroreflective Raised Pavement Markers	445 each
Chevrons	328m ²
Signposts	23 each
100 mm dia Corrugated Perforated Plastic Drainage Pipe	2,894m
Aggregate Filter Material	110m ³
No Fines Concrete	300m ³
Geotextile	4,300m ²
Steep Batter Outlet	4 each
Flat Batter Outlet	8 each
Fencing	900m

Construction of the proposal would require various materials and pre-cast elements including, but not limited to, the following:

- General fill (of varying quality) for use in earthworks
- Road materials, including verge material and road base and sub-base
- Aggregate for use in concrete, asphalt and rip-rap scour protection
- Sand for use as backfill around pipes and for asphalt and concrete
- Cement for concrete production
- Concrete for retaining walls, rigid barrier systems and miscellaneous works kerbs and gutters, v-drains, headwall outlets, safety barrier and signage post footings.
- Plastic, including perforated and non-perforated PVC plastic pipes for subsurface drainage
- Steel for use in reinforcement of structures, guard rail safety barriers, and maintenance handrail
- Wood for use in formwork and other temporary structures
- Signage and other road furniture
- Geotextiles and geofabrics
- Fencing
- Cables and posts for safety barriers
- Erosion and sediment control materials including sediment fencing, geofabric and stormwater drain protection
- Utility materials
- Topsoil
- Water
- Soft landscaping materials (e.g. topsoil, mulch etc.).

3.3 Ancillary site and stockpiling

3.3.1 Ancillary site

The ancillary site (Ancillary site A) is about 1.8 kilometres east from the proposal within the median of Nelson Bay Road. It is between chainage 32647 and chainage 32800 and 3,800 square metres in size. The duration of the ancillary site would be up to two years to allow for early works, an 18 month construction period for the main work contract as well as time to construct and demobilise the ancillary site. Ancillary site hours of operation would be dependent on construction hours. Construction would generally be undertaken during standard hours, however some outside of standard hours and night works would be required. There would be occasions when the ancillary site is used when the construction site is non-operational, for example to accept delivery of materials. The proposed ancillary site (refer Figure 3-7) has been selected as it meets the following criteria:

- Are within or adjacent to the road reserve
- Ready access to the road network
- Access to local power supply
- Minimise impacts to traffic using Nelson Bay Road
- Provide sufficient area for the storage of raw materials
- No clearing of native vegetation for the establishment and operation of stockpile/compound sites

- Not located on flood prone areas
- Minimise noise impacts on sensitive receivers
- No impacts to Aboriginal heritage.

Activities at the ancillary site include (but not limited to):

- Offices
- Amenities
- Storage of materials including fuels and chemicals
- Storage of plant and equipment, light and heavy vehicle parking.

3.3.2 Traffic management and access

Construction staging would be managed to minimise impacts on traffic. During the construction of the earthworks and pavement widening phases, two lanes would generally be provided in order to reduce the impact on traffic using Nelson Bay Road. Isolated single lane closures are anticipated at night during which time, traffic would be managed under contraflow conditions.

During construction of the proposal when the temporary safety barrier is in place the posted speed limit would be 60 kilometres per hour. Some construction activities would require the removal of the safety barrier in which case the posted speed limit would be dropped to 40 kilometres per hour. When the worksite is not active the 60 kilometres per hour speed limit would be maintained.

During construction of the proposal, the dates and details of lane closures would be determined and included in a communications strategy. This communications strategy along with relative material such as community updates would be made available to the public in the lead up to any scheduled full or partial road closures.

Heavy vehicle movements would be required for the construction of the proposal. These would mainly be associated with transport of construction machinery and equipment, and the import and movement of road construction material.

Table 3-4 below outlines the indicative heavy vehicle movements during major aspects of the construction phase of each stage of the proposal.

Table 3-4 Heavy vehicle movements during major aspects of construction

Construction activity	Anticipated duration	Heavy vehicles per day (average)
<p>Earthworks</p> <ul style="list-style-type: none"> Removal and stockpiling of spoil and unsuitable material Earthworks, including movement of materials along the alignment from cutting to fill embankment areas 	<ul style="list-style-type: none"> The earthworks and road surface work would be completed progressively to suit the proposed construction staging Cut material associated with the wider road formation would be removed and moved to fill embankment locations or stockpiled The remainder of the cut material would be disposed of to a licensed facility, property with approval to accept such material or on another Transport for NSW project Heavy vehicles would make use of the off-line sections of the alignment, which would alleviate traffic numbers along the Nelson Bay Road during construction 	30
<p>Road surface</p> <ul style="list-style-type: none"> Construction of road layers including sub-base, base and surfacing layers as well as sub-surface drainage. 	<p>The road construction would occur progressively in stages during the 12 months following the completion of the corresponding earthworks, during the second half of the construction timeframe</p>	30

It is estimated about 80 heavy vehicles would be required to access the site daily during the busiest construction phases. Further light vehicle movements would be required on site for other components of construction and includes the movement of workers and small plant which would be estimated at 100 movements per day. Emergency access would be provided through the work site at all times.

3.3.3 Stockpiles

Stockpiles would be required for the duration of construction. This could include general fill from cuttings, road base constituents, asphalt millings, stripped topsoil, mulch, pre-cast concrete components and excess spoil unsuitable for use on the proposal. Stockpiling activities would be undertaken at the ancillary site discussed in Section 3.3.1 and shown in Figure 3-7.

In addition, it is expected that stockpiling of smaller amounts of materials would be undertaken within the work sites at various locations which would be nominated on the project's erosion and sediment control plans. If additional ancillary sites are required these would be subject to further environmental assessment.

3.4 Public utility adjustment

There are a number of utilities present (refer Figure 3-8) in the proposal area as identified by Dial Before You Dig (DBYD) inquiry and fieldwork survey, however only a limited length of these utilities are expected to be impacted by the construction work. The utilities present within the proposal area are:

- Electrical: Ausgrid

- Water: Hunter Water Corporation
- Telecommunications: Telstra
- Telecommunications: Optus.

Consultation with the public utility authorities has been carried out as part of the development of the detailed design to identify and locate existing utilities and incorporate utility authority requirements for relocations and/or adjustments. Confirmation of the relocation of utilities and associated strategies has been carried out in consultation with utility authorities during detailed design.

It is proposed that communication assets (Optus optic fibre and Telstra copper) on the northern side of the proposal would be relocated to southern side. It is proposed to protect the Hunter Water potable watermain on southern side as necessary, and 180 metres of relocation for watermain required at the eastern extent of the project on the westbound carriageway.

3.5 Property acquisition and leases

The proposal does not require any property acquisition. Leases may be required for additional ancillary sites not located within the road reserve. One change to access is required at the private property access to electrical easement on the northern side of the Eastbound carriageway at eastern project extents. This access has been removed as part of the project due to restricted sight distance to approaching eastbound vehicles. An alternate access for this entrance is located about 185 metres to the north on Nelson Bay Road. This alternate access has a widened unsealed shoulder available for entering vehicles providing safer access. This change in access has been agreed with Ausgrid.



- Proposal area boundary
- Site compound

Nelson Bay Road Upgrade Section 1 30012877

Ancillary site location Fig. 3-7

Roadnet MDS 2019, Imagery: © Department of Customer Service 2020

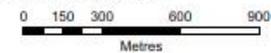


Figure 3-7 Ancillary site location



- | | | | | |
|---|------------------------|---|---|---------------------|
|  | Proposal area boundary | Utilities |  | Electrical Pole |
|  | Detailed design 100% |  |  | Water Hydrant |
| | |  | | Electrical Overhead |
| | |  | | Water |

Nelson Bay Road Upgrade Section 1 30012877

Existing Utilities **Fig. 3-8**

Roadnet MDS 2019, MetroMap Imagery © Aerometrex Pty Ltd



Figure 3-8 Location of utilities

4. Statutory and planning framework

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 a road and is to be carried out by Transport for NSW or on behalf of Transport for NSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. 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 require development consent or approval under State Environmental Planning Policy (Coastal Management) 2018, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (State Significant Precincts) 2005. The proposal does not occur on or affect land identified by any of the planning instruments listed in this paragraph.

Part 2 of 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

Port Stephens Local Environmental Plan

The Port Stephens Local Environment Plan 2013 (Port Stephens LEP) is the statutory planning document applying to all land within the Port Stephens LGA, with the exception of land under the provision of relevant State Environmental Planning Policies. The proposal is located within land classified as SP2 Infrastructure (Classified Road) (refer Figure 4-1). Land immediately to the south of the proposal area is classified as E1 National Parks and Nature Reserves and to the North E3 Environmental Management

The objectives of Zone SP2 Infrastructure are to provide for infrastructure and related uses; and prevent development which is not compatible with or which may detract from the provision of infrastructure. The proposal has been identified in the Port Stephens LEP as being permissible with consent within Zone SP2 Infrastructure, however as noted in Section 4.1.1, consent from Port Stephens Council is not required under the ISEPP.

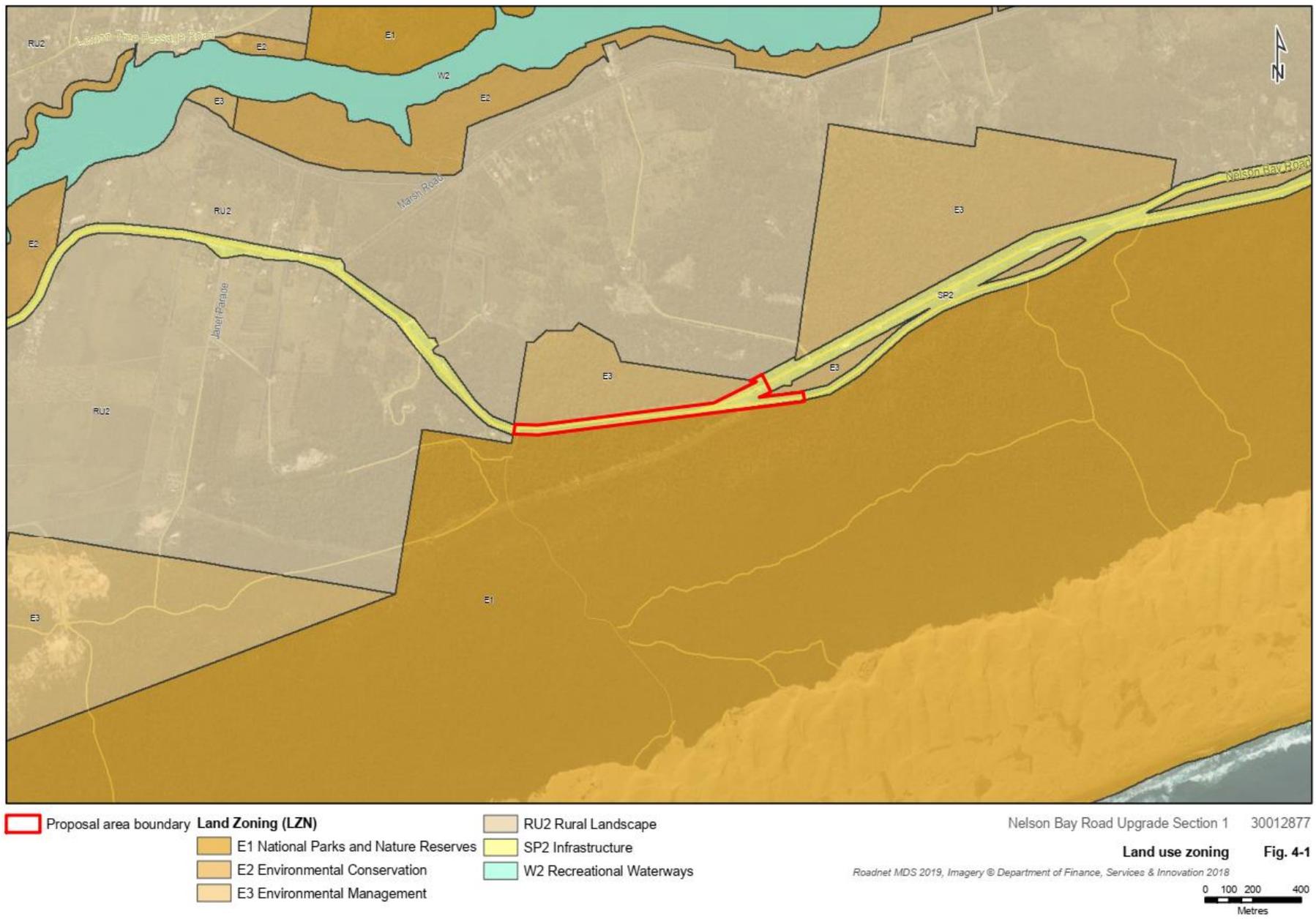


Figure 4-1 Land use zoning

4.2 Other relevant NSW legislation

4.2.1 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the primary statute for management of Aboriginal cultural heritage in New South Wales. Items of Aboriginal heritage (Aboriginal objects) or Aboriginal places (declared under section 84) are protected and regulated under the NPW Act.

Under the Act, an Aboriginal object is defined as 'any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains'. As such, Aboriginal objects are confined to physical evidence and are commonly referred to as Aboriginal sites.

Aboriginal objects are protected under section 86 of the Act. It is an offence to harm or desecrate an Aboriginal object, either knowingly (section 86(1)) or unknowingly (section 86(2)). There are offences and penalties relating to the harm to, or desecration of, an Aboriginal object or declared Aboriginal place. Harm includes to destroy, deface, damage or move.

Aboriginal heritage is considered further in chapter 6 of the REF.

4.2.2 Protection of the Environment Operations Act 1997

The Environment Protection Authority (EPA) is the responsible agency for the administration of the *Protection of the Environment Operations Act 1997* (POEO Act) in relation to air, noise, water, pollution and waste management. Under clause 48(1), an Environment Protection Licence (EPL) is required for scheduled activities as defined by Schedule 1 of the Act.

In accordance with Clause 35 (2) (b) (iii) (Road construction) of Schedule 1, if the proposal is a continuous length of 5 kilometres then 'road construction' clause would be triggered and the proposal would be classified as a scheduled activity under the Act (Schedule 1, Part 1(35)). Should the proposal trigger the requirement for an EPL, the EPL would be sought prior to the commencement of work. As the proposal less than 5 kilometres in length an EPL is not required.

4.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) and its supporting regulations commenced on 25 August 2017. The BC Act repeals the *Threatened Species Conservation Act 1995* (TSC Act) along with other natural resource management legislation, including sections of the NPW Act. The BC Act sets out the environmental impact assessment framework for threatened species and ecological communities for Division 5.1 activities (amongst other types of development). Under the BC Act, if threatened species, populations, ecological communities or their habitat may be impacted by the proposal, an assessment of significance of the impact must be undertaken, in accordance with Part 7 of the BC Act and Part 5 of the EP&A Act. The BC Act also lists key threatening processes (KTPs), which are matters that threaten the survival or evolutionary development of a species, population or ecological community. A biodiversity assessment was carried out to assess the impact of the proposal on threatened flora, fauna and ecological communities (refer Appendix D).

Biodiversity is considered further in chapter 6 of the REF.

4.2.4 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the protection and conservation of NSW's environmental heritage. Under the Act, an item is defined as a place, building, work, relic, moveable object or precinct and a relic is defined as any deposit, artefact, object or material evidence which:

- Relates to the settlement of the area which comprises NSW, not being Aboriginal settlement
- Is of State or local heritage significance.

State significant items are listed on the NSW State Heritage Register (SHR) are given protection under the Heritage Act against activities which may damage or affect its heritage significance. There are no items listed on the SHR within the proposal area.

Section 139 requires an excavation permit to disturb or excavate any land knowing or having reasonable cause to suspect the disturbance or excavation would or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed. A permit is also required to disturb or excavate any land on which the person has discovered or exposed a relic. As there are no heritage items within the proposal area listed on either the NSW State Heritage Register or the Port Stephens Council LEP a s.139 permit is not required for the proposal.

Non-Aboriginal heritage is considered further in chapter 6 of the REF.

4.2.5 Biosecurity Act 2015

The Biosecurity Act 2015 repeals the Noxious Weeds Act 1993 and provides for a coordinated approach to the removal and control of scheduled noxious weeds across the NSW. It repealed ten acts including the *Noxious Weeds Act 1993*, from 1 July 2017.

No permits or approvals are required under this Act, but it is the responsibility of Transport for NSW to provide for the removal and proper disposal of any listed weeds found within the proposal site. The proposal area falls within the boundary administered under *Hunter Regional Strategic Weed Management Plan 2017-2022* (Local Land Services Hunter, 2017). Three priority weed species listed for the Hunter were identified in the proposal area.

Noxious weeds are considered further in chapter 6 of the REF.

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. 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 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 C.

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. Chapter 6 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 ISEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

Transport for NSW is the determining authority for the proposal. This REF fulfils Transport for NSW'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 duplication Nelson Bay Road between Williamstown and Bobs Farm, recent consultation undertaken for the proposal, and any additional consultation proposed for the future.

5.1 Consultation strategy

In November 2019, Roads and Maritime (now Transport for NSW) prepared the *Nelson Bay Road duplication: Williamstown to Bobs Farm – Project development and concept design Community and stakeholder engagement plan* (Roads and Maritime, 2019). This plan describes the communication and consultation approach and activities for the proposal to keep key stakeholders and the community informed during the work.

The communication and engagement objectives include:

- Explain the need for the duplication of Nelson Bay Road including the key features and benefits. The key features and benefits would be confirmed once the strategic business cases have been approved.
- Identify key stakeholders and build and maintain relationships throughout the development and delivery of the upgrades.
- Provide an opportunity for the community to contribute to identifying and prioritising capacity improvements and other work along Nelson Bay Road including road safety initiatives, potential road realignments, intersection upgrades and asset management work.
- Provide an opportunity for the community and stakeholders to understand future freight demands and the role of higher productivity vehicles on the Nelson Bay Road corridor.
- Inform the community of the investment priorities along Nelson Bay Road and project delivery time frames.
- Manage community expectations about the extent of work on Nelson Bay Road when the work would be delivered and the proposed delivery model.

5.2 Community involvement

Transport for NSW consulted with the community on the route alignment options for the W2BF proposal over a three week period from 20 September 2019 to 11 October 2019. It is noted that this consultation was in relation to the broader NBR upgrade program and route alignment options. Community members were encouraged to provide their feedback and leave comments via mail, email, online feedback form or phone contact with the project team. Transport for NSW also directly consulted a number of key stakeholders via individual meetings. The key consultation tools are listed below in Table 5-1 .

Table 5-1 Consultation methodology

Consultation medium	Outcome
W2BF Have your say – Route alignment options project update (September 2019)	<ul style="list-style-type: none">• 4900 Have your say project updates were hand delivered to letter boxes in Williamstown, Salt Ash and Bobs Farm in mid-September 2019.
Facebook advertisement	<ul style="list-style-type: none">• A paid Facebook advertisement was uploaded to the Roads and Maritime Facebook page and shared by Kate Washington, MP.

Consultation medium	Outcome
Media release	<ul style="list-style-type: none"> • A media release covering the project was issued by Transport for NSW. It was subsequently published by the <i>Port Stephens Examiner</i> and the <i>Tanilba Bay Newsletter</i>.
Email notifications	<ul style="list-style-type: none"> • Direct emails were sent from Transport for NSW staff to key stakeholders including: <ul style="list-style-type: none"> – Williamstown per-and-poly-fluoro alkyl substances (PFAS) Working Group – two service stations affected by the proposal – Williamstown RAAF Base Commander and Infrastructure Management group – Worimi Local Aboriginal Land Council (LALC) – Newcastle Airport – staff, contractors and businesses – Williamstown RAAF Base – staff – contractors and businesses – Hunter Freight Group – Port Stephens Council – Kate Washington Member of Parliament (NSW)
Newspaper advertisement	<ul style="list-style-type: none"> • An advertisement covering the project was published in the <i>Port Stephens Examiner</i> on 26 September 2019.
Consultation with key stakeholders	<ul style="list-style-type: none"> • Transport for NSW staff attended meetings and consulted with key stakeholders including: <ul style="list-style-type: none"> – Hunter Water – Worimi LALC – NSW Department of Premier and Cabinet – Port Stephens Council – Port Stephens Buses – Williamstown RAAF Base – A small number of property owners upon request.

Transport for NSW contacted potentially affected property owners and businesses who had not responded to the initial opportunity to provide comment on the proposed route alignment options by direct mail. The closing date for the consultation report was extended to 2 December 2019 to give property and business owners the opportunity to respond.

Comments on the proposed W2BF closed on Friday 11 October 2019, with 98 submissions received about a range of issues. Late submissions about the proposal were accepted until Monday 2 December 2019. Some submissions included multiple comments and raised multiple issues. There was both positive and negative support for each of the route alignment options. Key concerns raised included:

- Loss of property and/or property functionality (including farming operations)
- Financial loss as a result of the upgrade
- Minimising construction traffic
- Safer alignment and construction environment
- Potential for flooding and drainage issues.

In March 2020 Transport for NSW prepared the *Nelson Bay Road Upgrade - Williamstown to Bobs Farm Community Consultation Report*. Table 5-2 notes issues raised that directly or potentially relate to Section 1 and where they are addressed in the REF.

Table 5-2 Summary of issues raised

Issue category	Issue/ potential issue	Response / where addressed in REF
Community	<ul style="list-style-type: none"> Insufficient time/detail provided to community 	Chapter 5.2 Community involvement
	<ul style="list-style-type: none"> Upgrade is essential for the community 	Chapter 2 Need and options considered
Environment	<ul style="list-style-type: none"> Concern about the SA2BF route alignment option A (online) interfering with frog habitat 	Chapter 6.1 Biodiversity
	<ul style="list-style-type: none"> Concern about the SA2BF route alignment option A (online) creating a bushfire risk 	It is not evident how Section 1 would increase bushfire risk in the area
	<ul style="list-style-type: none"> Concern about the SA2BF route alignment option A (online) creating more litter 	It is not evident how Section 1 would increase litter in the area
	<ul style="list-style-type: none"> Concern about the route alignment option A (online) creating more noise and other impacts for residents 	Chapter 6.3 Noise and vibration
Traffic	<ul style="list-style-type: none"> Comment that dual carriageway between Nelson Bay and Williamstown would create better traffic flow 	Chapter 6.6 Traffic and transport
	<ul style="list-style-type: none"> Comment that route alignment option A (online) would reduce traffic congestion 	Chapter 2.3 Proposal objectives and development criteria
Construction staging	<ul style="list-style-type: none"> Request to schedule the SA2BF section first for construction 	Chapter 3.1 The proposal

In July 2020, Transport for NSW undertook additional and targeted consultation with residents at the western extent of the proposal. The targeted consultation comprised corresponding directly with four residents adjacent to the proposal with an invitation to make contact with Transport for NSW and/or comment on the Section 1 upgrade. One resident responded citing that the existing wire rope safety barrier (WRSB) and 100 kilometre per hour speed limit of the proposed dual carriageway would increase the risk of vehicle accident when entering or exiting their property. Transport for NSW undertook a review and determined that removal of WRSB may result in a crash increase and that the existing 80 km/h speed limit is deemed to be appropriate and in accordance with current Speed Zone Guidelines (Roads and Maritime, 2011). Transport for NSW noted that the respondent's driveway is outside of the proposal's limit of works and that there would be no changes to their driveway as a result of the project.

The proposal would include safety improvements involving installing audio-tactile line marking (ATLM) or 'rumble strips' on the edge line of the new road. Three properties that are within 200 metres of the proposed ATLM were invited to comment on the on the proposed safety improvements. Four additional

properties that are within 500 metres of the ATLM were provided with information on the proposed safety improvements.

5.3 Aboriginal community involvement

5.3.1 Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Aboriginal community consultation is an integral part of the assessment of Aboriginal cultural heritage significance. Consultation was carried out in accordance with the Transport for NSW Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime, 2011) (PACHCI). Consultation to identify interested local Aboriginal parties was carried out by Transport for NSW (Table 5-3).

The Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010c) were used for the project. The process of consultation with Aboriginal stakeholders for the project has been undertaken and managed by Transport for NSW. Thirteen Aboriginal parties registered their interest in the project and are referred to as registered Aboriginal parties (RAPs). RAPs were invited to provide cultural information about the study area, provided with Stage 2 archaeological assessment and the draft Aboriginal Cultural Heritage Assessment Report (ACHAR) and cultural values methods for review, and kept updated about the project via an Aboriginal Focus Group (AFG) consultation meeting, letters, and emails. EMM, Transport for NSW and Waters Consultancy consulted with the RAPs in formulating appropriate management measures for the Aboriginal cultural heritage values identified during by the ACHA and Cultural Values Assessment (CVA) (Waters Consultancy 2020) which are located in the appendices (refer Appendix D and Appendix E respectively).

Table 5-3 Summary of PACHCI

Stage	Description	Relevant consultation activities
Stage 1	Initial Transport for NSW assessment	<ul style="list-style-type: none"> Aboriginal Heritage Information Management System (AHIMS) search Review by Transport for NSW Aboriginal Cultural Heritage Team.
Stage 2	Site survey and further assessment	<ul style="list-style-type: none"> Identification of key Aboriginal stakeholders Site survey with archaeologist.
Stage 3	Formal consultation and preparation of an Aboriginal cultural heritage assessment report (ACHAR)	<ul style="list-style-type: none"> ACHAR provided to Registered Aboriginal Parties (RAP) for comment. ACHAR updated to address comments and provided to RAPs as final report.

Table 5-4 Issues raised through Aboriginal community consultation

Group	Issue	Response / where addressed in REF
Worimi Local Aboriginal Land Council (LALC)	No objection to closure of informal access within road reserve at eastern extent of the proposal	<ul style="list-style-type: none"> • NA
Worimi LALC	The survey area was along Nelson Bay Road in Bobs Farm, to the north is a small pocket of bushland landlocked by Ausgrid powerline and the road, and to the south is NPW Worimi National Park in which freshwater areas are located.	<ul style="list-style-type: none"> • NA
Worimi LALC	Around 70-75% of the area was covered due to heavy ground cover and vegetation making visibility poor.	<ul style="list-style-type: none"> • REF S.6.2 and Table 6-14 and Appendix D
Worimi LALC	Worimi LALC identified that the survey area contained significant cultural landscape features related to a Smooth-bark Apple eucalyptus (<i>Angophora costata</i>) which is a woman's tree in Worimi culture. The tree featured two limbs identified as having been manipulated to make a circle of limbs as a marker for fresh water and woman's learning area. This with the fact on the opposite side of the road is freshwater areas still utilised today by Worimi women for teaching and medicines is quite significant.	<ul style="list-style-type: none"> • REF Table 6-16, Appendix D and Appendix E
Worimi LALC	Other features may be present within the area due to the presence of freshwater areas and plants including small herbs and paperbarks (<i>Melaleuca</i>) with high medicinal purposes.	<ul style="list-style-type: none"> • Appendix D
Worimi LALC	<ul style="list-style-type: none"> • Natural resources used by Aboriginal people that are, or would have been, within the study area include: • Smooth-bark Apple eucalyptus (<i>Angophora costata</i>): a Worimi women's tree used for a marking tree (circle fused limbs), bark was used as a purple dye for paint, and bark could be boiled and ingested for stomach ailments. • Basket Grass (<i>Lomandara longfolia</i>) used for basket weaving, rope making, and the ends of the leaflet used for hydration. • Dianella (<i>Dianella caerulea</i>) edible fruit which can be used for dye and the leaflet can be used to create a 'snake whistle' in Worimi culture which causes a vibration in the air which draws snakes towards the whistler. • Paperbark (<i>Melaleuca sp.</i>) bark and leaves used for medicinal purposes as it contains antiseptic characteristics and can be used to form a paste to cover wounds or skin infections or boiled and ingested for congestion relief, sore throat or headache, and bark also used for bedding and shelter. 	<ul style="list-style-type: none"> • Appendix D
Worimi LALC	In response to potential impacts from the proposal Worimi LALC identified the Smooth-bark Apple eucalyptus possible women's tree, and the freshwater areas to the south of the study area.	<ul style="list-style-type: none"> • Appendix D

Group	Issue	Response / where addressed in REF
Worimi LALC, Aboriginal knowledge holders	Sand Doubletail orchid (<i>Diuris arenaria</i>) that have been identified as culturally significant by the RAPs and knowledge holders. Orchids were utilised as a traditional food source and hold cultural value for that association. This orchid has <u>medium significance</u> to the local Aboriginal community for its use as a food source.	<ul style="list-style-type: none"> REF Table 6-16, Appendix D and Appendix E

5.3.2 Cultural Values Assessment

Transport for NSW received advice from Aboriginal stakeholders that the proposal area lies within the zone of traditional patterns of movement between Tilligerry Creek and the beach front, and between Tomaree and Fullerton Cove. These patterns of movement were associated with resource collection, community gatherings and ceremonial activities and hold significance as an important element of the cultural landscape. In accordance with PACHCI, Transport for NSW undertook an assessment of Aboriginal cultural values for the proposal area (Waters Consultancy, August 2020) (refer Appendix E). Cultural values were sourced from interviews with Aboriginal knowledge holders and a desktop review of available information.

On 4 March 2020 Transport for NSW sent an email to all register Aboriginal parties (RAPs) that included the proposed cultural values assessment methodology for review and comment 3 April. As the proposed Aboriginal Focus Group (AFG) meeting for 24 March could not go ahead due to Covid-19 restrictions the comment period was extended to 17 April 2020. On 8 April 2020, an AFG meeting was held via Zoom at which the draft methodology was discussed, and a verbal invitation was given for the nomination cultural knowledge holders. On 9 April 2020, a copy of the AFG presentation with an email remainder of review dates was sent to all RAPs. A full copy of the AFG presentation and the minutes of the meeting were provided to RAPs on 15 April 2020. Telephone or email contact was made with the RAPs in the two weeks following the AFG to request the nomination of cultural knowledge holders. As a result of these processes thirteen individuals were nominated as cultural knowledge holders.

5.3.3 Ongoing consultation

Transport for NSW would undertake ongoing consultation with RAPS and Aboriginal knowledge holders for the duration of the project with regards to Aboriginal heritage aspects including impacts to the Sand Doubletail orchid (*Diuris arenaria*).

5.4 ISEPP consultation

Port Stephens Council and the NSW National Parks and Wildlife Service have been consulted about the proposal as per the requirements of clause 13 and clause 16 (2) of ISEPP respectively. Appendix B contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered. Issues that have been raised as a result of this consultation are outlined below in Table 5-5.

Table 5-5 Issues raised through ISEPP consultation

Agency	Response / Issue	Issue / where addressed in REF
Port Stephens Council	<ul style="list-style-type: none"> Port Stephens Council replied by email and advised that the proposal would not have any impact on Council owned infrastructure. 	<ul style="list-style-type: none"> N/A

Agency	Response / Issue	Issue / where addressed in REF
	<ul style="list-style-type: none"> Transport for NSW consulted with PSC on 9 October 2020 on the requirement to relocate the PSC gateway sign. PSC had no objection to its proposed relocation. 	<ul style="list-style-type: none"> N/A
National Parks and Wildlife Service	<ul style="list-style-type: none"> NPWS only require two access points into the Worimi Conservation Lands at Boyces Trail entry and powerline easement entry NPWS requested the safety barrier extend further west to prevent staff turning right onto the dual carriageway from the Boyces Trail entry for safety NPWS have noted that surplus material may be reused on NPWS estate subject to further discussion 	<ul style="list-style-type: none"> Access will be maintained Transport for NSW advised the median barrier could not be extended past Boyces Trail due to restricted road cross-section width. NPWS accepted the current design at Boyce's Track. REF S.3.2.7 and S.6.8

5.5 Government agency and stakeholder involvement

Various government agencies and stakeholders have been consulted about the Williamstown to Bobs Farm package of work, including:

- Federal government
 - Department of Environment
 - Department Infrastructure & Regional Development
 - Williamstown RAAF Air Base Executive Officer.
- State government
 - Transport for New South Wales
 - Office of Environment and Heritage
 - Department of Planning & Environment
 - NSW Environment Protection Authority
 - NSW National Parks and Wildlife Service
 - Department of Premier and Cabinet.
- Local government
 - Port Stephens Council
 - Newcastle Council.
- Utility providers
 - Electrical: Ausgrid
 - Water: Hunter Water Corporation
 - Telecommunications: Telstra
 - Telecommunications: Optus.

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in Table 5-6.

Table 5-6 Williamtown to Bobs Farm issues raised through stakeholder consultation

Agency	Issue raised	Response / where addressed in REF
Elected government representatives	<ul style="list-style-type: none"> Managing stakeholder expectations about the extent of work that can be delivered within the funding provided 	<ul style="list-style-type: none"> N/A
Emergency services	<ul style="list-style-type: none"> Temporary and long term access arrangements 	<ul style="list-style-type: none"> S.6.6 Traffic and Transport considers access through site for emergency vehicles
Hunter water	<ul style="list-style-type: none"> Impact on Hunter Water land holdings 	<ul style="list-style-type: none"> N/A
RAAF and Newcastle Airport	<ul style="list-style-type: none"> Project alignment with RAAF and Newcastle Airport priorities 	<ul style="list-style-type: none"> N/A
Ausgrid	<ul style="list-style-type: none"> Appears that all of the Ausgrid assets will be clear of the proposed road works, to be confirmed by Transport for NSW and during the design phases Inserted some pole locations that should be made highlighted for safety concerns for plant and equipment movements If an Ausgrid asset is required to be relocated due to the proposed road works, those works are deemed “Contestable Works” and must be carried out by suitably qualified Accredited Service Providers (ASPs). 	<ul style="list-style-type: none"> N/A

5.6 Ongoing or future consultation

The Nelson Bay Road duplication: Williamtown to Bobs Farm – Project development and concept design Community and stakeholder engagement plan (Roads and Maritime, 2019) identifies a number of activities to be carried out as part of the community engagement for concept design and REF. Outcomes from this engagement phase were then reported back to the local community and stakeholders. This was done via a project notification, targeted letters and targeted emails. After the determination of the REF, community engagement tools and techniques would include some or all of the following:

- Briefings by the Transport for NSW
- Project media announcements
- Project notifications and project updates for nearby residents, businesses and stakeholders
- Door-knocking nearby residents and businesses
- Meetings and briefings for stakeholders, interest groups, businesses and residents
- Letters, emails and targeted correspondence
- Project updates on the Transport for NSW website: www.rms.nsw.gov.au/projects.

Other consultation activities that would be carried out include the following:

- Consultation with key stakeholders to help in managing impacts during construction
- Follow-up meetings to discuss access arrangements with directly affected landholders
- On-going meetings with PSC, utility providers, nearby landowners, emergency services and community stakeholders, as required
- Ongoing updates of the project website as required

6. Environmental assessment

This section of the REF 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? (DUAP 1995/1996) 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 Biodiversity

6.1.1 Methodology

A biodiversity assessment was prepared (*Nelson Bay Road Duplication: Williamstown to Bobs Farm Section 1 Biodiversity Assessment Report*) (BAR) (WSP 2020) to assess the potential impact of the proposal on threatened flora, fauna and ecological communities and to meet the requirements of the EP&A Act. The Biodiversity Assessment findings are provided in Appendix C and summarised below.

The aim of this background research was to identify threatened flora and fauna species, populations and ecological communities, Commonwealth listed Migratory species or critical habitat which has been recorded previously or is predicted to occur in the locality. This allowed for known habitat characteristics of threatened biodiversity to be compared with those present within the study area to determine the likelihood of occurrence of each species or populations. These results informed the identification of appropriate field survey effort and the groups likely to occur.

Literature review and database assessment

Previous studies, reports and documentation relevant to the proposed Nelson Bay Road Section 1 Upgrade were reviewed to provide information useful for informing the BAR. This included a review of:

- Nelson Bay Road: Williamstown to Bob's Farm – Preliminary environmental investigation' (Roads and Maritime, 2019)
- Nelson Bay Road Duplication: Williamstown to Bob's Farm – Preliminary biodiversity investigation (WSP, 2019).
- Local broad-scale vegetation mapping of the study area:
 - Greater Hunter Native Vegetation Mapping V4.0 (Sivertsen & Roff, et.al 2011)
 - Hunter, Central and Lower North Coast Vegetation Classification and Mapping (Somerville, 2009)
 - Vegetation Survey, Classification and Mapping – Lower Hunter and Central Coast Region (Lower Hunter and
 - Central Coast Regional Environmental Management Strategy, 2003, Parsons Brinckerhoff, 2013).
- Port Stephens Council Comprehensive Koala Management Plan of Management (Port Stephens Council, 2002)
- Saving our Species Report: Managing koala populations for the future: constituent populations of the Central ARKS Port Stephens sub-area (Biolink Ecological Consultants, 2018)
- Koala Habitat Planning Map (Land Use Planning Sustainable Planning Group, 2007)
- Summary of Koala Data for Port Stephens LGA (Port Stephens Council, 2019)

Biodiversity Assessment Method

Plot and transect surveys were carried out in accordance with the Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a). At each plot and transect survey location, dedicated 20 minute searches were conducted for threatened species assessed as having a moderate or high likelihood of occurrence within each vegetation type sampled. The number of plots completed for each identified vegetation zone and the location of each transect/plot identified (refer Appendix C).

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the study area were obtained from a range of databases (refer Table 6-1).

Table 6-1 Database searches

Database	Date Accessed	Search Area
Department of Environment and Energy's Protected Matters Search Tool	<ul style="list-style-type: none"> • 29 August 2019 • Updated 28 January 2020 	10 km area centred on the middle point of the proposed footprint
BioNet Atlas of NSW Wildlife	<ul style="list-style-type: none"> • 29 August 2019 • Updated 28 January 2020 	10 km area centred on midpoint of proposed footprint
NSW Flora Online	<ul style="list-style-type: none"> • 28 January 2020 	Port Stephens LGA
NSW Department of Primary Industries (Fishing and Aquaculture) spatial data	<ul style="list-style-type: none"> • 28 January 2020 	10 km area centred on midpoint of proposed footprint
Coastal SEPP search NSW DPIE	<ul style="list-style-type: none"> • 28 January 2020 	10 km area centred on midpoint of proposed footprint
Critical habitat register		
NSW Areas of Outstanding Biodiversity Value Register	<ul style="list-style-type: none"> • 29 August 2019 • Updated 28 January 2020 	10 km from proposal site
Commonwealth Critical Habitat register	<ul style="list-style-type: none"> • 29 August 2019 • Updated 28 January 2020 	10 km area centred on midpoint of proposed footprint
DPI Critical Habitat Register	<ul style="list-style-type: none"> • 29 August 2019 • Updated 28 January 2020 	10 km area centred on midpoint of proposed footprint
Bureau of Meteorology's (BoM) Atlas of Groundwater Dependent Ecosystems	<ul style="list-style-type: none"> • 29 August 2019 • Updated 28 January 2020 	10 km area centred on midpoint of proposed footprint

Habitat assessment

A habitat assessment was completed to assess the likelihood of occurrence of each threatened species, population and community (threatened biodiversity) identified with the potential to occur in the study area. All threatened biodiversity identified during background research were considered. The habitat assessment was utilised to inform the identification of appropriate targeted surveys and was revisited after the surveys were completed based on the habitat components identified in the study area. The assessment was based on the habitat profile for the species and other habitat information in the Threatened Species Profile Database (DPIE, 2020). The assessment also included consideration of the dates and locations of nearby records and information about species populations in the locality. Refer Appendix C for the full likelihood of occurrence assessments.

Field survey

Field validation (ground-truthing) of this existing mapping within the proposal area was completed to confirm the vegetation structure, dominant canopy species, native diversity, underlying geology, condition and presence of threatened ecological communities. This was based on the completion of random

meanders, rapid data points and drive by assessments. The field survey aimed to ground-truth the results of the background research and habitat assessment. All threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence. Targeted flora surveys were completed by conducting spot lighting, call playback diurnal bird surveys, koala spot assessments, remote cameras, Elliot trapping, Anabat detectors (two deployed) and opportunistic sightings.

Five vegetation integrity plots, as described in the Biodiversity Assessment Methodology (BAM) (Office of Environment & Heritage, 2017a), were completed across all vegetation types recorded. Exceptions to this were if the vegetation polygon were too small or if no access was available. Information collected during the survey was used to determine the Plant Community Type (PCT) for each vegetation type recorded as detailed in the BioNet Vegetation Classification System (Office of Environment Energy and Science, 2020c) and whether vegetation within the study area aligned to any state or commonwealth listed ecological communities.

Field surveys of the study area were carried out over the following periods:

- 15-16 April 2019 (flora, fauna)
- 20, 22-23, 30 August 2019 (flora)
- 11, 24 September 2019 (flora, fauna)
- 20-23, 30 August 2019 (flora)
- 20, 23-24 30 August 2019 (fauna)
- 18 November 2019 (flora, fauna)
- 17 January 2020 (fauna).

Fauna habitat assessments were undertaken to assess the likelihood of threatened species of animal (species known or predicted to occur within the locality from the literature and database review) occurring within the study area. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species is likely to occur within the study area. Fauna habitat characteristics assessed were:

- Structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources
- Presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles
- Presence of the ground cover vegetation, leaf litter, rock outcrops and fallen timber and potential to provide protection for ground-dwelling mammals, reptiles and amphibians
- Presence of waterways (ephemeral or permanent) and water bodies.

6.1.2 Existing environment

The proposal is located in the Port Stephens LGA and falls within North Coast Bioregion / Karuah Manning Subregion. Vegetation within the study area forms part of a large remnant patch which provides connectivity to the north-east and south-west. Wildlife connectivity to the north and south is hindered by barriers associated with Nelson Bay Road, transmission easements and rural/urban developments. The southern portion of the study area forms part of the Worimi National Park. The BAR considered landscape features to determine the following:

- Proposal area does not contain any areas of geological significance or areas of outstanding biodiversity.
- No rivers, streams or important wetlands occur within the study area.

Threatened flora species

The desktop assessment identified 29 listed threatened flora species listed under the Biodiversity Conservation Act 2016 (BC Act) as being known or predicted to occur in the locality of the study area. Of these 17 were considered to have a moderate or high likelihood of occurrence based on the habitat available within the study area (refer Appendix C). These species became candidates for detailed targeted surveys. Targeted threatened flora surveys have been completed for all but candidate species. Table 6-2 below outlines candidate species, their conservation status, potential occurrence and whether they are likely to be affected by the proposal. Each species affected is considered further with respect to Section 5A and Matters of National Environmental Significance (MNES) under Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) significance assessments (refer Appendix C).

Table 6-2 Threatened flora habitat assessment and surveys results

Scientific name	Common Name	Status		Potential occurrence	Serious and irreversible impact entity?	Affected species?
		BC Act	EPBC Act			
<i>Angophora inopina</i>	Charmhaven Apple	V	V	Moderate	No	No, surveyed
<i>Asperula asthenes</i>	Trailing Woodruff	V	V	Moderate	No	No, surveyed
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	Moderate	No	No, surveyed
<i>Corybas dowlingii</i>		E ¹		Moderate	No	No, surveyed
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Moderate	No	No, surveyed
<i>Diuris arenaria</i>		E		Recorded	Yes	No, surveyed
<i>Diuris praecox</i>	Rough Double Tail	V	V	Moderate	No	No, surveyed
<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V	V	Moderate	No	No, surveyed
<i>Eucalyptus parramattensis subsp. decadens</i>		V	V	Recorded	No	No, surveyed
<i>Grevillea parviflora subsp. parviflora</i>	Small-flower Grevillea	V	V	Moderate	No	No, surveyed
<i>Lindernia alsinoides</i>	Noah's False Chickweed	E		Moderate	Yes	No, surveyed
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Moderate	No	No, surveyed
<i>Melaleuca groveana</i>	Groves Paperbark	V	-	Moderate	No	No, surveyed
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Moderate	No	No, surveyed
<i>Prostanthera densa</i>	Villous Mint-bush	V	V	Moderate	No	No, surveyed

Scientific name	Common Name	Status		Potential occurrence	Serious and irreversible impact entity?	Affected species?
		BC Act	EPBC Act			
<i>Pterostylis Chaetophora</i>		V	-	Moderate	No	No, surveyed
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	Moderate	No	No, surveyed

Notes:

- 1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.
- 2) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

Sand Doubletail (*Diuris arenaria*)

Sand Doubletail (*Diuris arenaria*) is listed as an Endangered species and a SAll entity (serious and irreversible impacts of development) under the BC Act. A population of 18 *Diuris arenaria* individuals were recorded within the proposal area during targeted seasonal surveys. The species occurred along the Nelson Bay Road verge in good and regrowth condition patches of PCT 1646 Smooth-barked Apple – Blackbutt – Old Man Banksia Woodland.

Plant community types

Two native plant community types (PCT) (refer Figure 6-1) was recorded within the study area being:

- PCT 1646: Smooth-Barked Apple – Blackbutt- Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast
- PCT 1717: Broad-leaved Paperbark – Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast (moderate condition and regrowth).

A summary of the vegetation types recorded within the study area and proposal area are outlined in, Figure 6-1 and Figure 6-2.

Table 6-3 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) study area	Area (ha) impacted
PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Moderate	Yes – Swamp Sclerophyll Forest (Endangered – BC Act)	0.20	0.11
PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Good	No	15.64	1.76
	Moderate		0.24	0.09
	Regrowth		4.84	0.31
Total extent of native vegetation			20.92	2.27
Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation	n/a	No	3.93	2.98
Miscellaneous ecosystem – urban/exotic plantings	n/a	No	0.03	0.03

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) study area	Area (ha) impacted
Total extent of non-native vegetation			3.96	3.01
Total native and non-native vegetation			24.88	5.28

PCT 1646

This vegetation type occupies most of the study area and is dominated by a canopy of *Angophora costata* (Smooth-barked Apple), *Eucalyptus pilularis* (Blackbutt) and *Banksia serrata* (Old Man Banksia) This community forms part of the NSW Dry Sclerophyll Forests (Shrubby sub-formation) and associated Coastal Dune Dry Sclerophyll Forests vegetation class (Office of Environment Energy and Science, 2020c). Although PCT 1646 does not align with any threatened ecological community listed under either the Biodiversity Conservation Act 2016 (BC Act) or the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) it does provide habitat for a threatened orchid species, *Diuris arenaria* (refer Appendix C). This species was recorded within the higher quality patches of PCT 1646 within the study area.

PCT 1717

Floristic composition and dominance is consistent with PCT 1717 i.e. canopy dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany); sub-canopy and shrub layer was dominated by juvenile *Melaleuca quinquenervia* (Broad-leaved Paperbark) and ground stratum consisted of *Lomandra longifolia* (Spiny-headed Mat-rush), *Imperata cylindrica* (Blady Grass) and *Dianella caerulea var. producta* (Blue-flax Lily).

The study area is located on the coastal floodplain associated with Tilligery Creek. The structure is that of an open forest and is low lying. This PCT occurs on sandy loams in the eastern portion of the study area and the western portion of this PCT (Janet Parade) occurs on Humic Grey Soils

Based on floristic, geographic and geological characteristics, this vegetation type is considered consistent with the scientific description and distribution information outlined for PCT 1717 within BioNet Vegetation Classification (Office of Environment Energy and Science, 2020c). This vegetation type is consistent with the Swamp Sclerophyll Forest on Coastal Floodplains threatened ecological community listed as Endangered under the BC Act.

Threatened species

Although PCT 1646 does not align with any threatened ecological community listed under either the BC Act or the EPBC Act it does provide habitat for an orchid species, *Diuris arenaria* which is listed as endangered under the BC Act. This species was recorded within the proposal area's western extent and to the south in Worimi National Park where higher quality patches of PCT 1646 exist.

Groundwater dependent ecosystems

PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest and PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland vegetation communities are highly to moderately likely to be groundwater dependent ecosystems (GDEs) which are reliant on surface expressions of groundwater or on subsurface groundwater in the study area (BoM, 2018). PCTs identified within the study area are likely to be classified as terrestrial GDE or "Vadophytic vegetation" (refer Figure 6-1 and Figure 6-3). No groundwater aquifer, cave systems or wetlands were identified within the study area from the field surveys or desktop assessment.

Weeds

59 exotic species were recorded with three are listed as Priority Weeds under the NSW Biosecurity Act 2015 (Biosecurity Act) for the Greater Hunter Local Land Service region (refer Table 6-4). These three exotic species are also listed Weeds of National Significance (WONs). Under the Biosecurity Act, land managers are required to follow the regional and non-regional duties which have been allocated to each Priority Weed.

Table 6-4 Priority weeds of concern

Scientific name	Common name	Priority weed duty	WONS
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> *	Bitou Bush	Prohibition on dealings Must not be imported into the State or sold	Yes
<i>Lantana camara</i> *	Lantana		Yes
<i>Senecio madagascariensis</i> *	Fireweed		Yes

Fauna recorded

Sixty-two fauna were recorded during field surveys, which included 46 birds, 13 mammals, three reptiles (Appendix A of the BAR). Of the recorded fauna, seven are listed as threatened or migratory under either the BC Act or EPBC Act (refer Table 6-5).

Table 6-5 Threatened or migratory fauna recorded in the study area

Scientific name	Common name	BC Act	EPBC Act
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M
<i>Hirundapus caudacutus</i>	White-throated Needle-tail	-	V,M
<i>Micronomus norfolkensis</i>	Eastern Freetail Bat	V	-
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M

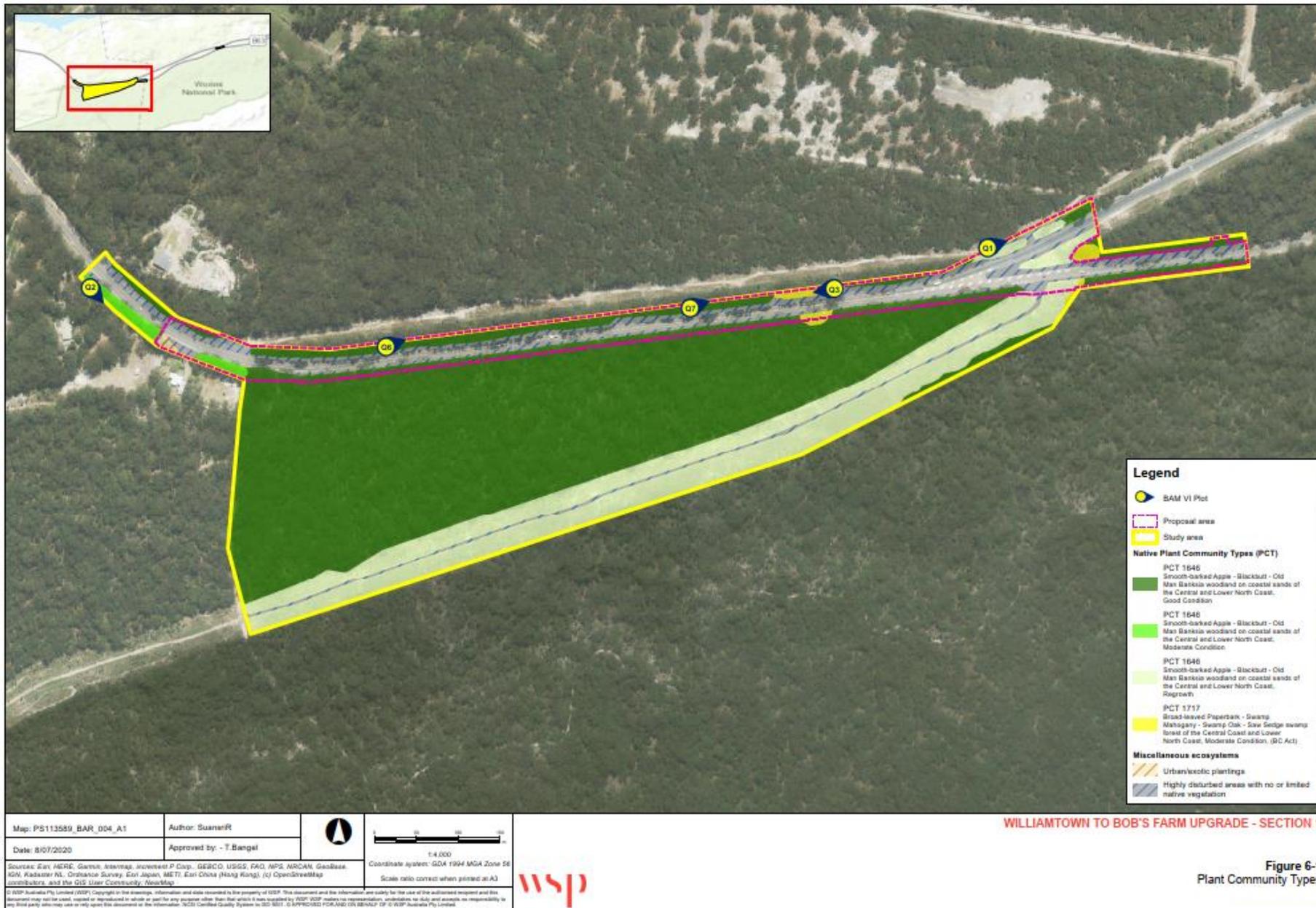
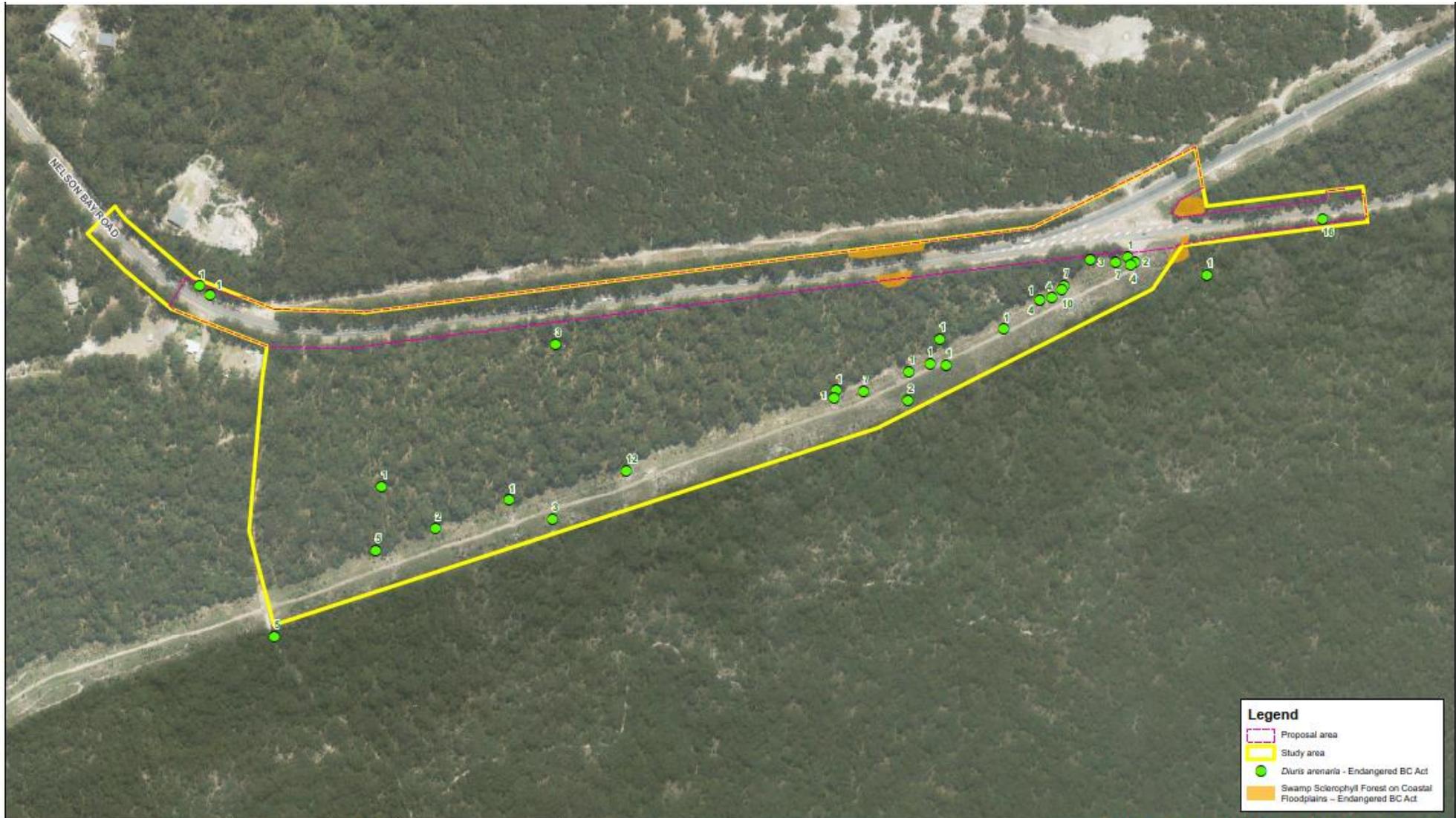


Figure 6-1 Plant community types



Figure 6-2 Plant community types



Legend

- Proposal area
- Study area
- *Duris arenaria* - Endangered BC Act
- Swamp Sclerophyll Forest on Coastal Floodplains - Endangered BC Act

Map: PS113589_BAR_005_A1	Author: SuansinR	 1:4,000 Coordinate system: GDA 1994 MGA Zone 58 Scale ratio correct when printed at A3
Date: 8/07/2020	Approved by: - T. Bangel	

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, Geobase, IGN, Kantamir NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community - NearMap

© WSP Australia Pty Limited (WSP). Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorized recipient and the recipient may not be copied, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, guarantee or warranty as to the accuracy or completeness of any data and accepts no responsibility or liability arising from any use or reliance upon this document or the information. MCSI Certified Quality System to ISO 9001. 8 APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 6-3
Threatened flora species and ecological communities

Figure 6-3 Threatened flora and ecological communities

Threatened fauna species

The desktop assessment identified 64 BC Act threatened fauna as being known or predicted to occur in the locality of the study area with 25 of these considered to have a moderate to a high likelihood to occur based on the habitat available within the study area. These species became candidate species for detailed targeted fauna surveys. Table 6-6 outlines candidate species, their conservation status, potential occurrence and whether they are likely to be affected by the proposal. Each species affected is considered further with respect to Section 5A and MNES significance assessments (refer Appendix C).

Table 6-6 Threatened fauna assessment and surveys results

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act	EPBC Act			
Birds						
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V	-	Moderate	No	Yes
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Recorded	No	Yes
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo	V	-	Moderate	No	Yes
<i>Circus assimilis</i>	Spotted Harrier	V	-	Moderate	No	Yes
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper	V	-	Moderate	No	Yes
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Recorded	No	Yes
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M	Recorded	No	No
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Moderate	No	Yes
<i>Lophoictinia isura</i>	Square-tailed Kite	V		Moderate	No	Yes
<i>Petroica boodang</i>	Scarlet Robin	V	-	Moderate	No	Yes
<i>Ninox strenua</i>	Powerful Owl	V	-	Moderate	No	Yes
<i>Tyto novaehollandiae</i>	Masked Owl (southern mainland)	V	-	Moderate	No	Yes
Mammals						
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Moderate	No	Yes
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Moderate	Yes – breeding habitat only	Yes – no SAIL entity will be impacted

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act	EPBC Act			
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Moderate	No	Yes
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-	Recorded	Yes – breeding habitat only	Yes – no SAI entity will be impacted
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	Moderate	Yes – breeding habitat only	Yes – no SAI entity will be impacted
<i>Mormopterus (Micronomus) norfolkensis</i>	Eastern Freetail Bat	V	-	Recorded	No	Yes
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	High	No	Yes
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	High	No	Yes
<i>Phascolarctos cinereus</i>	Koala	V	V	Moderate	No	Yes – no important habitat is likely to be impacted
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	High	No	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	Moderate	No	Yes
<i>Scoteanax rueppellii</i>	Greater Broad nosed Bat	V		Moderate	No	Yes
<i>Vespadelus troungtoni</i>	Eastern Cave Bat	V	-	Moderate	Yes – breeding habitat only	Yes – no SAI entity will be impacted

It is noted:

- 1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act
- 2) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act

Wildlife connectivity corridors

Wildlife corridors are generally links of native vegetation that join two or more areas of similar habitat and are critical for sustaining ecological processes, for example provision of animal movement and the maintenance of viable populations. (Department of Environment, 2016).

Due to the existing Nelson Bay Road, associated north and south power easements as well as clearing for residential development at the western end, wildlife corridors in association with the study area are subject to fragmentation. Whilst these barriers are not impassable, they may already limit regular fauna movement.

Due to large patches of continuous vegetation occurring on either side of the study area and the existing road being single lane in both directions, fauna species (especially larger and more mobile species) may still cross the study area. The extent of contiguous vegetation associated with Worimi National Park to the south of the study area, suggests that the study area is not likely to act as a key wildlife corridor in isolation.

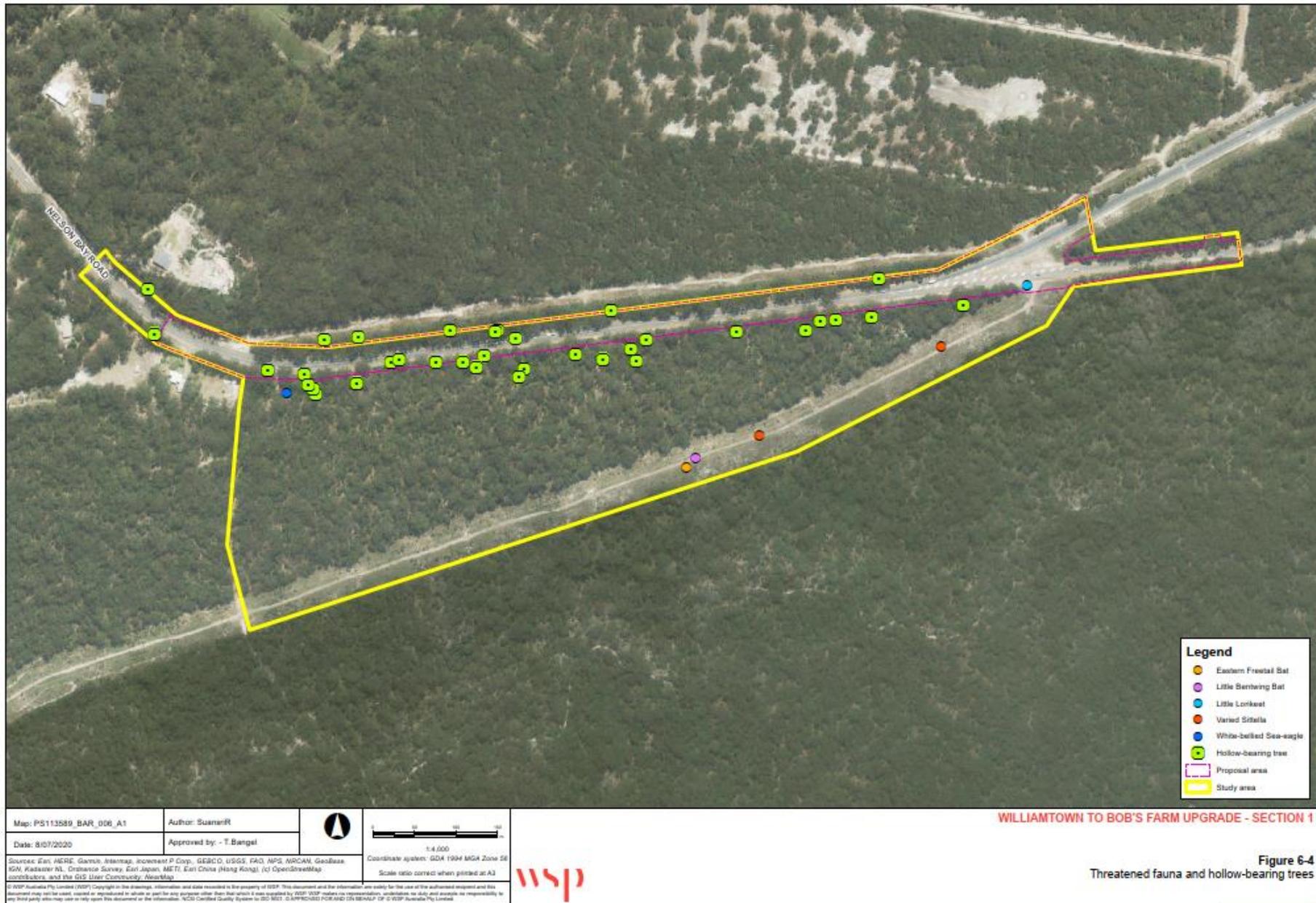


Figure 6-4 Threatened fauna and hollow-bearing trees

6.1.3 Potential impacts

Construction

Removal of native vegetation

About 2.27 hectares of native vegetation would be cleared by the proposal (refer Figure 3-6). This impact is based on the removal of all vegetation from within the clearing boundary, representing a worst-case scenario. A breakdown of approximate native vegetation removal of each PCT and vegetation zone is provided below in Table 6-7 .

Table 6-7 Impacts on native vegetation

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region	Proposal area (Ha)
PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Moderate	E	-	68%	0.11
PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast – Good condition	Good	-	-	45%	1.76
	Moderate			71%	0.09
	Regrowth				0.31
Total native vegetation impacted					2.27

It is noted

1)Based on the VIS classification database

2) Area to be cleared based on ground-truthed vegetation mapping within the study area.

Key threatening processes associated with the removal of native vegetation are listed in Table 6-8.

Table 6-8 Key threatening processes associated with native vegetation removal

Key threatened process	BC Act	EPBC Act	Impact of the proposal
Clearing of native vegetation	✓	Not listed	The proposal will contribute to this process through the clearing of 2.27 hectares of native vegetation
Land clearance	Not listed	✓	

Removal of threatened flora

There would be direct impacts on one threatened flora species, Sand Doubletail orchid (*Diuris arenaria*), listed as Endangered under the BC Act. 18 Sand Doubletail individual orchids were recorded in the proposal area that all 18 individuals and would be cleared by the project. These individuals recorded form part of a larger substantial local population which extends from the study area through Worimi National Park, Worimi Conservation Area to a biodiversity offset area located about 2 km south west of the study area. A large area of this population is conserved under the Saving Our Species program whilst other areas of the population are protected within Worimi National park and a biodiversity offset area which has been established for another project in the locality. A breakdown of the direct impacts to threatened flora species and their habitats is provided in Table 6-9.

Table 6-9 Impacts on threatened flora

Species	Potential occurrence	Impacted by proposal?	Impact (ha/ individuals)
<i>Diuris arenaria</i> (Sand Doubletail)	Recorded	Yes – individuals recorded within good and regrowth condition PCT 1646	18 individuals (2.07 ha of suitable habitat)

Removal of threatened fauna habitat

The direct impacts of the proposal on threatened fauna habitat has been estimated based on a worst-case scenario (i.e. removal of all vegetation within the proposal area). A breakdown of the direct impacts on threatened fauna species is provided in Table 6-10 .

Table 6-10 Impacts on threatened fauna and fauna habitat

Species	Potential occurrence	Impacted by proposal	Impact (ha)
Dusky Woodswallow (<i>Artamus cyanopterus</i>)	Moderate	Yes	2.27
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	Recorded	Yes	2.27
Scarlet Robin (<i>Petroica boodang</i>)	Moderate	Yes	2.27
Gang-Gang Cockatoo (<i>Callocephalon fimbriatum</i>)	Moderate	Yes	2.27
Powerful Owl (<i>Ninox strenua</i>)	Moderate	Yes	2.27
Masked Owl (<i>Tyto novaehollandiae</i>)	Moderate	Yes	2.27
Little Eagle (<i>Hieraaetus morphnoides</i>)	Moderate	Yes	2.27
Square-tailed Kite (<i>Lophoictinia isura</i>)	Moderate	Yes	2.27
Spotted Harrier (<i>Circus assimilis</i>)	Moderate	Yes	2.27
Little Lorikeet (<i>Glossopsitta pusilla</i>)	Recorded	Yes	2.27
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	High	Yes	2.27
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	Moderate	Yes	2.27
Little Bent-wing Bat (<i>Miniopterus australis</i>)	Recorded	Yes	2.27
Large Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	Moderate	Yes	2.27
Eastern Cave Bat (<i>Vespadelus troughtoni</i>)	Moderate	Yes	2.27
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	Moderate	Yes	2.27
Eastern Coastal Freetail Bat (<i>Micronomus norfolkensis</i>)	Recorded	Yes	2.27
Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>)	Moderate	Yes	2.27

Species	Potential occurrence	Impacted by proposal	Impact (ha)
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	Moderate	Yes	2.27
Squirrel Glider (<i>Petaurus norfolcensis</i>)	Moderate	Yes	2.27
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	Moderate	Yes	2.27
Koala (<i>Phascolarctos cinereus</i>)	Moderate	Yes	2.27
Spotted-tailed Quoll (<i>Dasyurus maculatus maculatus</i>)	Moderate	Yes	2.27
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	Moderate	Yes	2.27

Key threatening processes associated with removal of key fauna habitat features are identified in Table 6-11 below.

Table 6-11 Key threatening processes associated with the removal of fauna habitat features

Key threatened process	BC Act	EPBC Act	Impact of the proposal
Loss of hollow-bearing tree	✓	Not listed	About 16 hollow-bearing trees will require removal.
Removal of dead wood and dead trees	✓	Not listed	Dead wood on the ground which is scattered through the study area would likely require removal.

Fauna injury and mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed.

If trenches are dug deep and steep sided, entrapment of wildlife is a possibility. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

Operation

Fauna injury and mortality

There is a chance of fauna mortality during the operational phase of the proposal through vehicle collision. Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike.

With the proposal expanding an existing road the risk of vehicle strike has potential to incrementally increase, particularly for less mobile mammal species such as the Koala and Spotted-tailed Quoll. The main impacts associated with this would include:

- Potential long-term decrease in the size of a local population via mortality from vehicle strike

- Increase in existing road barrier (both in width of carriageway and installation of concrete median) which may trap or increase the length of time an animal would need to spend on the road to cross thereby leading to an increase in chance of a collision with a vehicle.

The significance of such an impact cannot be predicted as there is no definitive data available, however potential impacts would endeavour to be reduced through the implementation of mitigation measures detailed in Section 6.1.4.

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 *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

6.1.4 Safeguards and management measures

Table 6-12 Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity impacts	<p>A Flora and Fauna Management Plan will be prepared in accordance with Transport for NSW's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (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 <i>Landscape Guideline</i> (RTA, 2008) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Procedures addressing relevant matters specified in the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens. 	Contractor	Preconstruction Construction	Section 4.8 QA G36 <i>Environment Protection</i>
Removal of native vegetation	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Contractor	Preconstruction	Appendix C

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	Contractor	Preconstruction Construction	Appendix C
	Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal footprint	Contractor	Construction	Appendix C
	Any removal of trees adjacent to the proposal boundary that are likely to create a safety risk to road users requires written approval from Transport for NSW and consultation with relevant land owners.	Contractor	Preconstruction	Clause 88 of the Roads Act 1993
Removal of threatened plants	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal footprint.	Contractor	Construction	Appendix C
	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing</i>	Contractor	Construction	Appendix C

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<i>biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).			
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal footprint.	Contractor	Construction	Appendix C
Removal of threatened species habitat and habitat features	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	Contractor	Construction	Appendix C
	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
Injury and mortality of fauna and fragmentation of identified habitat corridors	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal footprint.	Contractor	Construction	Appendix C

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>Road-kill and connectivity impacts will be minimised for Koalas and other less-mobile fauna species via:</p> <ul style="list-style-type: none"> • Installation of fauna exclusion fencing along the southern side of Nelson Bay Road in areas of likely occurrence (about just west of Boyces Trail east to the Easement Trail). • Fauna exclusion fencing site location selection and design specifics to be assessed by a suitably qualified person. • Installation of 'Koala Warning Signs' or 'Injured Native Wildlife Signs' in areas of potential wildlife conflict areas or crossing points. • Implement regular slashing of roadside vegetation in clear zones to minimise the height of ground cover in potential conflict areas or crossing point. 	Contractor	Construction	Appendix C
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011). Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
Invasion and spread of pests	Pest species will be managed within the proposal site.	Contractor	Construction	Appendix C
Invasion and spread of pathogens and disease	Implement hygiene procedures for the use of vehicles and the importation of materials to the proposal footprint in accordance with <i>Guide 7: Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011). Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the</i>	Contractor	Construction	Appendix C

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).			
Changes to hydrology and impacts to groundwater dependant ecosystems	Construction to be completed in accordance with 'Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction, Sydney' (Blue Book) (Department of Environment and Climate Change, 2008).	Contractor	Construction	Appendix C

6.1.5 Biodiversity offsets

The Transport for NSW biodiversity offsets policy would be provided for impacts that exceed predetermined Thresholds (or where offsets are not reasonable or feasible, supplementary measures). The Transport for NSW *Guidelines for Biodiversity Offsets* (November 2016) indicates that the following offsets would be required by the proposal given residual impacts associated with the development footprint exceed the predetermined thresholds as specified in the guideline:

- 5.88 ha of habitat for EPBC Act listed species including Spotted-tailed Quoll, Grey-headed Flying-fox, New Holland Mouse and Large-eared Pied Bat
- 5.88 ha of habitat for BC Act listed species credit species including Squirrel Glider and Brush-tailed Phascogale
- 54 *Diuris arenaria* (Sand Doubletail) individuals.

A Biodiversity Offset Strategy would be developed to identify biodiversity credits and/or supplementary measures for those entities impacted.

6.2 Aboriginal cultural heritage

6.2.1 Methodology

Cultural heritage assessment

The Transport for NSW *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime, 2011) defines a four stage process for investigating potential impacts to Aboriginal cultural heritage as a result of Transport for NSW activities. These Transport for NSW activities includes road planning, development, construction and maintenance. The PACHCI includes a process for community consultation to ensure that the role, function, view and beliefs of Aboriginal people are considered and respected in the assessment process.

The archaeological assessment for the proposal was prepared in accordance with PACHCI (Roads and Maritime 2011). The assessment included archaeological survey of the study area conducted on 8 May 2019 with support of Worimi Local Aboriginal Lands Council (LALC) representatives. The Aboriginal Cultural Heritage Assessment Report (ACHAR) (EMM, 2020) has been completed in accordance with the following requirements:

- Stage 2 and Stage 3 of the PACHCI (Roads and Maritime 2011)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010b)
- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (DECCW 2011)
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (ACHCRs) (DECCW 2010c).

The archaeological survey and data collection methods followed Section 2.2 of the Code of Practice (DECCW 2010b), which sets out the required recording methods. The survey team comprised five people each with a survey coverage width of between five and 10 metres. The study area was divided into three survey units to aid description and recording. The survey strategy was to cover the entire study area with a focus on ground surface exposures. The survey effort was recorded using the Australian Soil and Land Survey Field Book (CSIRO 2009) as a guide and using a hand-held non-differential GPS unit (MGA94 Zone 56) with photographs to identify landscape context. The methodology for identifying and recording Aboriginal sites is in accordance with the Code of Practice (DECCW 2010b), with any sites identified to be recorded using a hand-held non-differential GPS unit (MGA94 Zone 56).

Cultural values assessment

Aboriginal cultural values assessment has been undertaken through consultation with knowledge holders as identified by the registered Aboriginal parties, regarding historical and cultural values within the study area. Archival research was undertaken of national, state and local institutions to provide the historical and ethnographic context for the assessment. An analysis of the ethnographic literature and historical record was undertaken to provide a contextual understanding to allow for the interpretation and assessment of the cultural information.

Consultation with Aboriginal knowledge holders was a key component to the assessment of Aboriginal cultural heritage values. As stated in the guidelines produced by the International Council on Monuments and Sites (ICOMOS) on the application of the Burra Charter to Indigenous heritage:

Indigenous people are the relevant knowledge-holders for places of Indigenous cultural significance. Their traditional knowledge and experience must be appropriately used and valued in the assessment of places. Advice may need to be sought on who are the relevant knowledge holders.

The assessment of Aboriginal cultural heritage values was undertaken collaboratively with the Aboriginal community and identified Aboriginal knowledge holders. This is consistent with the guidelines for the assessment of Aboriginal cultural heritage produced by the Office of Environment & Heritage (OEH).

6.2.2 Existing environment

Database searches

A search of the AHIMS database was carried out on 23 April 2019 over a four kilometre by three kilometre area centered on the study area. The search area was sufficient to define the pattern of previously recorded Aboriginal sites in the landscape surrounding the study area. The AHIMS searches identified 13 registered sites (refer Table 6-13) in proximity to the study area (refer Figure 6-5).

Table 6-13 AHIMS extensive search results

Site Type	Representation (%)
Shell middens	92
<10 shell fragments	23
20-50 shell fragments	15
Small scatter (number of shell pieces not specified)	54
Isolated find (stone) artefact)	8

Shell middens represent the dominate site type for the area. No stone artefacts were identified in association with any shell material registered as middens and several site descriptions comment that the shell material maybe naturally occurring. One isolated stone artefact is registered 150 metres south of the study area (AHIMS 38-4-0782). Aboriginal site “Nelson Bay Road #2” has duplicated registrations in AHIMS (AHIMS-4-0403/AHIMS 38-4-1065). One midden site “OFOC1” (AHIMS 38-4-1600), falls within the study area boundary located on an unsealed easement for the overhead powerline north of the Nelson Bay Road.

Aboriginal context

The study area is located within the inter barrier depression of the coastal dunes systems. It has freshwater estuarine resources available to its north and coastal resources to its south, as well as swales and freshwater swamps within the inter barrier depression. This area is therefore within an environmental setting which served as an important source of plant and animal resources known to have been utilized by Aboriginal peoples in the past, and this practice continues into the present. However, high levels of disturbance within the study area have had a deleterious impact upon them material traces of past Aboriginal land use and has likely removed any significant traceable archaeological material.

Land use and disturbance

European agricultural practices have occurred throughout much of the locality and present land uses include agriculture, horse and cattle grazing, hobby farms, low density housing as well as recreational and industrial businesses. The study area has been subject to a moderate to high level of disturbance associated with construction and vegetation clearance of Nelson Bay Road. Underground utilities are present within the road corridor (northern and southern sides) so the ground has been subject to disturbance. This includes the installation of an Optus fibre optic cable in the vicinity of an Aboriginal Heritage Information Management System (AHIMS) listed site (OFOC1). The Optus project was subject to an Aboriginal Heritage Impact Permit (AHIP) and the work carried out in accordance with the AHIP.

Predictive model

Aboriginal objects have potential to occur within the study area, however if present they are likely to be of very low density in highly disturbed locations removed from their original dispositional context. The predicted location of Aboriginal objects within highly disturbed context such as the study area cannot be scientifically modelled, however it is noted that all Aboriginal objects are protected under Part 6 of the NPW Act.

Survey coverage evaluation

The survey area was divided into three survey units (SU) to aid description and recording (refer Figure 6-5). Effective coverage is calculated in Table 6-14. The survey was primarily effective to identify the extent of disturbance within the study area. Landforms within the area survey have been described as modified, undulating low dunes due to the level of disturbance evident (refer Table 6-15). The survey effort results are summarised in Table 6-16.

Table 6-14 Effective survey coverage summary

SU	Landform	Length (m)	Width (m)	Area (m2)	Visibility	Exposure	Effective coverage (m2)	Effective coverage (%)
SU1	Modified, undulating low to moderate dunes	2,486	25	62,150	20%	10%	1,243	2
SU2	Modified, undulating low to moderate dunes	305	25	7,625	40%	<5%	152.5	2
SU3	Modified, undulating low to moderate dunes	1,423	25	35,575	15%	<5%	266.8	0.7

Note: Pedestrian survey coverage illustrates the coverage of only one of five survey participants. Due to the density of vegetation along the northern margin of SU1 survey coverage was at times outside of the study area boundary.

Table 6-15 Landform survey coverage summary

Landform	Area (m2)	Area effectively surveyed (m2)	Area effectively surveyed (%)	Number of sites	Number of artefacts or features
Modified, undulating low dunes	105,350	1,662.3	1.6	0	0

Table 6-16 Survey results summary

Name	Description	Location (GDA94 Zone 56)
SU1 POI 1	Four shell fragments located 13 metres north of the edge of pavement for Nelson Bay Road, at the junction of two unsealed tracks, likely associated with AHIMS site 38-4-1600.	401933E 6371270N
SU1 POI 2	Two shell fragments located 25 metres north of the study area boundary on an unsealed track within the powerline easement.	401777E 6371239N
SU1 POI 3	A Smooth-bark Apple eucalyptus located nine metres north of the study area boundary. The tree features two fused branches which form a loop-	401511E 6371189N

Name	Description	Location (GDA94 Zone 56)
	type feature about five metres above the ground surface. Worimi LALC identified the tree as a possible women's place marker.	
SU2 POI 1	Two shell fragments located about two metres from the edge of pavement within the median at the beginning of the existing Nelson Bay duplication in the east of the study area	401925E 6371235N
SU3 POI 1	One shell fragment located on the road verge towards the eastern end of the study area.	402124E 6371233N

Summary of archaeological significance assessment

A significance assessment is made up of four significance criteria that attempt to define why a site is important. These include research potential, rarity and representativeness, integrity and educational potential. Each of these values were assessment and an overall significance has been assigned based on the average across the values. The significance assessment ultimately informs the management of sites and places. Table 6-17 summarises the significance assessment for the Aboriginal site in the proposal area. The assessment provided in Table 6-17 was previously impacted in accordance with AHIP 1132343 as a result of the Optus fibre optic cable installation. As a result, OFOC1 (AHIMS 38-4-1600) is now listed on AHIMS as partially destroyed.

Table 6-17 Summary of significance

Name/AHIMS ID	Research potential	Rarity and representativeness	Integrity	Educational potential	Overall archaeological significance rates
OFOC1/38-4-1600	Low	Low	Low	Low	Low

Cultural Values

During the CVA process, Registered Aboriginal Parties (RAPs) advised the cultural landscape that the Williamtown to Bobs Farm Section 1 study area is within an area that is rich in cultural value and includes significant resource areas, Story or Dreaming Tracks, ceremonial grounds, corroboree grounds, burial places, pathways and pathway markers, and traditional and historical living places. The Section 1 upgrade proposal area lies within the zone of traditional patterns of movement between Tilligerry Creek and the beach front and between Tomaree and Fullerton Cove (refer Table 6-18). These patterns of movement were associated with resource collection, community gatherings and ceremonial activities and hold significance to Aboriginal knowledge holders as an important element of the cultural landscape.

The CVA also notes that within the Section 1 proposal area there are 18 Sand Doubletail orchid (*Diuris arenaria*) that have been identified as culturally significant by the RAPs (refer Table 6-18). Orchids were utilised as a traditional food source and hold cultural value for that association. This orchid has medium significance to the local Aboriginal community for its use as a food source. No other locationally specific sites of intangible cultural significance within the Section 1 area were identified during the cultural values assessment process.

6.2.3 Potential impacts

Construction

Construction would be contained within the existing road corridor and would impact all areas within the clearing boundary (refer Figure 3-6). The proposal would partially impact upon Aboriginal site OFOC1 (AHIMS 38-4-1600). OFOC1 is a very low density and low integrity shell scatter located within a highly disturbed context, consisting of four shell fragments moved from their original depositional context as a result of disturbance. Authorised unmitigated partial impacts to OFOC1 within the boundary of the study area have previously occurred in accordance with AHIP 11332343 for installation of an Optus fibre optic cable. Therefore, any remanent material associated with OFOC1 to be impacted by the proposal is assessed as negligible. Aboriginal objects have the potential to occur within the study area, however if present they are likely to be of very low density in highly disturbed locations removed from their original depositional context.

The ACHAR notes that two large diameter trees are situated about 0.30 metres outside of the road corridor cadastral boundary and that up to <50% of each tree canopy overhangs the road corridor. Sheet piling

would cut and/or remove a substantial portion of the root system of both trees which would potentially destabilise the trees and create a safety hazard and a risk they could fall into the road corridor. Transport for NSW propose to remove both trees at ground level with the stump left in place so as to avoid any ground disturbance. Neither tree has been identified by the archaeological assessment as having archaeological or cultural value.

The CVA notes that knowledge holders and the RAPs have concerns regarding the impact of works on the ecosystems of the project corridor and beyond. Knowledge of country includes knowledge of landforms, waterways, plants, and animals and the ways in which these all come together to form specific local ecosystems. These elements all hold cultural value for their links to cultural activities, including resource gathering, and to the cultural stories that act to preserve and transmit cultural knowledge. Table 6-18 summarises the impacts identified by the CVA.

Table 6-18 Summary of significant cultural values

Item	Description	Cultural Significance	Impact Yes/No
West-East Movement Corridor	A movement corridor running from Tilligerry Creek to the beach front.	This movement corridor has High Significance to the local Aboriginal community as the patterns of movement hold cultural value for their association with resource use, community gatherings and ceremonial cycles.	Yes
North-South Movement Corridor	A movement corridor running from Tomaree south to Fullerton Cove.	This movement corridor has High Significance to the local Aboriginal community as the patterns of movement that occurred across this zone hold cultural value for their association with resource use, community gatherings and ceremonial cycles.	Yes
Diuris arenaria Orchid	An endangered orchid species that is present in the study area.	The Diuris are a genus of the orchid family <i>Orchidaceae</i> and are endemic to Australia. Orchids were utilised as a traditional food source and hold cultural value for that association. This orchid has Medium Significance to the local Aboriginal community for its use as a food source.	Yes

Operation

The proposal is not anticipated to impact of any items of Aboriginal heritage or cultural values in the operational phase.

6.2.4 Safeguards and management measures

Table 6-19 Aboriginal cultural heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	<p>The <i>Standard Management Procedure – Unexpected Heritage Items</i> (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. Work will only re-start once the requirements of that Procedure have been satisfied.</p> <p>If there is a confirmed discovery of archaeological Aboriginal human remains it is recommended that consultation occur with the identified knowledge holders in relation to: the development of a Management Plan for proposed works in the relevant area; cultural ceremonies in relation to the human remains and the site of their occurrence; and, repatriation of the human remains.</p>	Transport for NSW	Construction	<p>Section 4.9 QA G36 Environment Protection</p> <p>CVA (refer Appendix E)</p>
Aboriginal heritage	<p>An AHIP is required for proposed impacts to Aboriginal site OFOC1 (AHIMS 38-4-1600):</p> <ul style="list-style-type: none"> • An AHIP is proposed for 10 years to allow for the proposed development to be completed. • The AHIP should limited to the existing road corridor, inclusive of partial impacts to OFOC1 (AHIMS 38-4-1600). • The AHIP conditions should allow for unmitigated impacts to any unidentified Aboriginal objects (excluding human skeletal remains) within the proposed AHIP boundary. It is anticipated that any such objects are likely to be highly disturbed and of similarly low significance as the known OFOC1 (AHIMS 38-4-1600). • An Aboriginal Site Impact Recording Form (ASIRF) must be submitted to Heritage NSW and AHIMS to document impacts to the site in accordance with AHIP conditions. 	Transport for NSW Contractor	Preconstruction Construction	ACHAR (refer Appendix D)
Aboriginal heritage	<p>All land-disturbing activities must be confined to within the existing road corridor. Prior to commencement of construction activities, the perimeter of the proposal area should be fenced with high visibility curtilage to prevent inadvertent impacts outside of the area assessed including to the possible women's tree.</p>	Contractor	Construction	ACHAR (refer Appendix D)

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	<p>Completion of cultural heritage awareness training will be a requirement of the Construction Environmental Management Plan for all employees and contractors during project construction.</p> <p>An Aboriginal cultural heritage awareness training package should be delivered as part of the site induction for all contractor(s) and maintenance personnel involved in the construction works. The training package to be developed by a cultural heritage specialist in consultation with the RAPs and Knowledge Holders. The training package should at a minimum ensure awareness of the cultural significance of the project area, the requirements of the AHMP and relevant statutory responsibilities, and the identification of unexpected heritage items and appropriate management procedures.</p>	Contractor	Construction	<p>ACHAR (refer Appendix D)</p> <p>CVA (refer Appendix E)</p>
Aboriginal heritage	<p>In the event that known or suspected human skeletal remains are encountered within the study area, the immediate vicinity will be secured and the find reported to the environmental manager, the police and the state coroner on the same day of the find (as required for all human remains discoveries). Additionally:</p> <ul style="list-style-type: none"> • The environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material • If it is determined that the skeletal material is ancestral Aboriginal remains, Heritage NSW will be contacted for advice, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains and the site will be recorded in accordance with the • National Parks and Wildlife Act 1974 and Heritage NSW guidelines. 	Transport for NSW Contractor	Construction	ACHAR (refer Appendix D)
Aboriginal cultural values	<p>An Aboriginal Heritage Management Plan (AHMP) should be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). The AHMP should provide specific guidance on measures and controls to be undertaken to avoid and mitigate impacts on Aboriginal cultural heritage during construction. This</p>	Contractor	Preconstruction Construction	CVA (refer Appendix E)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	should include protection measures to be applied during construction, including but not limited to the recommendations set out in this table, as well as contractor training in general Aboriginal cultural heritage awareness and management of Aboriginal heritage values.			
Aboriginal cultural values	The AHMP should provide for an addition to the <i>Unexpected Heritage Items Procedure 2015</i> to require the notification of the identified knowledge holders within 48 hours of any discovery of potential archaeological Aboriginal skeletal remains during the proposed works.	Transport for NSW Contractor	As required	CVA (refer Appendix E)
Aboriginal cultural values	The development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist on the cultural values and historical records relating to the cultural landscape of the Section 1 study area with a focus on the three values identified in Table 2. The report to be produced as a full colour booklet for distribution to local libraries and educational institutions. The content of the booklet to be developed in consultation with the RAPs and Knowledge Holders.	Transport for NSW Contractor	Preconstruction Construction	CVA (refer Appendix E)

6.3 Noise and vibration

A noise and vibration assessment (*Noise and Vibration Assessment Nelson Bay Road Upgrade Section 1*) (Muller Acoustic Consulting, 2020) was prepared to assess the potential construction and operation impacts of the proposal on adjacent sensitive receivers. The Noise and Vibration assessment is provided in Appendix F.

6.3.1 Methodology

The noise and vibration assessment (refer Appendix F) has been prepared in accordance with the following guidelines and criteria:

- Roads and Maritime Services (2016), Environmental Impact Assessment Procedure: Preparing an Operational Traffic and Construction Noise and Vibration assessment report
- Roads and Maritime Services (2016), Construction Noise and Vibration Guideline (CNVG)
- Roads and Maritime Services (2015), Noise Criteria Guideline (NCG)
- Roads and Maritime Services (2015), Noise Mitigation Guideline (NMG)
- Department of Environment and Climate Change (2009), Interim Construction Noise Guideline (ICNG)
- Environment Protection Authority (2017), NSW Noise Policy for Industry (NPI)
- AS IEC 61672.1-2019 Electroacoustics – Sound level meters – Specifications
- Australian Standard – AS 1055:2018 Acoustics- Description and measurement of environmental noise
- Australian Standard – AS 2436-2010 (R2016) Guide to Noise Control on Construction, Maintenance and Demolition Sites
- Department of Environment and Conservation (2006), Assessing Vibration: A Technical Guideline
- British Standard BS 7385: Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2.

To establish the existing background noise environment of the proposal area, unattended noise monitoring was conducted at one location identified as 2998 Nelson Bay Road, Salt Ash, NSW, which is the nearest residential receiver to the proposal site. The monitoring location (L1) is representative of the surrounding noise sensitive receivers to the proposal and is shown in Figure 6-6. The location was selected as it considered ambient noise sources which may influence the readings, existing barriers constructed in the locality, the proximity of assessment locations to the proposal and security requirements. Observations on-site identified the surrounding locality typical of a rural environment, with traffic noise the dominant audible noise source. Noise measurements were carried out using one Stantec Type 1, Svan 977 noise monitor from Tuesday 10 December 2019 to Thursday 19 December 2019. This period satisfies the minimum one-week period for baseline noise monitoring as per Fact Sheet A of the NPI. The results of unattended noise monitoring are provided in Appendix F.

In summary, the methodology for the noise and vibration assessment included the following:

- Identifying noise and vibration sensitive receivers and defining the study area
- Carrying out noise monitoring to determine the existing noise environment
- Establishing noise and vibration assessment criteria
- Prediction of construction and operational noise levels
- Assessing predicted noise and vibration levels against the relevant criteria to identify potential impacts
- Identify safeguards and management measures to be implemented to minimise impacts.

6.3.2 Existing environment

Sensitive receivers

The proposal is located within a rural environment with receivers typically classified as residential dwellings on small acreages. Individual residential receivers located within 600 metres of the proposal site were identified as per the NCG and shown in Table 6-20 and Figure 6-6.

Table 6-20 Residential receiver locations

Receiver	Address	Distance to proposal
R1	2998 Nelson Bay Road	135
R2	2984 Nelson Bay Road	270
R3	2972 Nelson Bay Road	380
R4	2942 Nelson Bay Road	490
R5	2977 Nelson Bay Road	420
R6	2941 Nelson Bay Road	515
R7	2938 Nelson Bay Road	710
R8	68 Marsh Street	520
R9	140 Marsh Street	600
R10	3121 Nelson Bay Road	670

Existing noise environment

To establish the existing noise environment of the proposal area, unattended noise monitoring was conducted at one located identified as 2998 Nelson Bay Road, Salt Ash which is the nearest residential receiver to the proposal site. The selected monitoring location is show below in Figure 6-6 and a summary of existing background noise is in Table 6-21. The monitored noise levels at L1 are representative of the ambient noise environment of properties along an arterial or major road. The noise levels are controlled throughout each monitoring period by passing road traffic. The noise levels are lower during the evening and night periods with levels representative of reduce traffic. Observations on-site identified the surrounding locality typical of a rural environment, with traffic noise the dominant audible noise source.

Table 6-21 Existing background noise level at nearest sensitive receiver

Sensitive receiver location	Measured background noise, RBL, dBA			Measure dB LAeq		
	Day 7am - 6pm	Evening 6pm - 10pm	Night 10pm - 7am	Day 7am - 6pm	Evening 6pm - 10pm	Night 10pm - 7am
R1	55	44	33	62	59	58

Existing traffic flows

Traffic data for existing traffic traveling along Nelson Bay Road was quantified using traffic counter by Matrix Traffic and Transport Data. The data was measured about 250 metres east of Marsh Road, Salt Ash between Friday 8 March 2019 and Thursday March 14 2019 for both eastbound and westbound traffic. The results of the traffic counts are presented in Table 6-22 .

Table 6-22 Existing traffic flows

Road	Days (07:00 to 22:00)			Night (22:00 to 07:00)		
	Volume	% Heavy Vehicles	Speed Limit	Volume	% Heavy Vehicles	Speed Limit
Nelson Bay Road Eastbound	8545	5	80	801	15	80
Nelson Bay Road Westbound	8228	5	80	1179	15	80

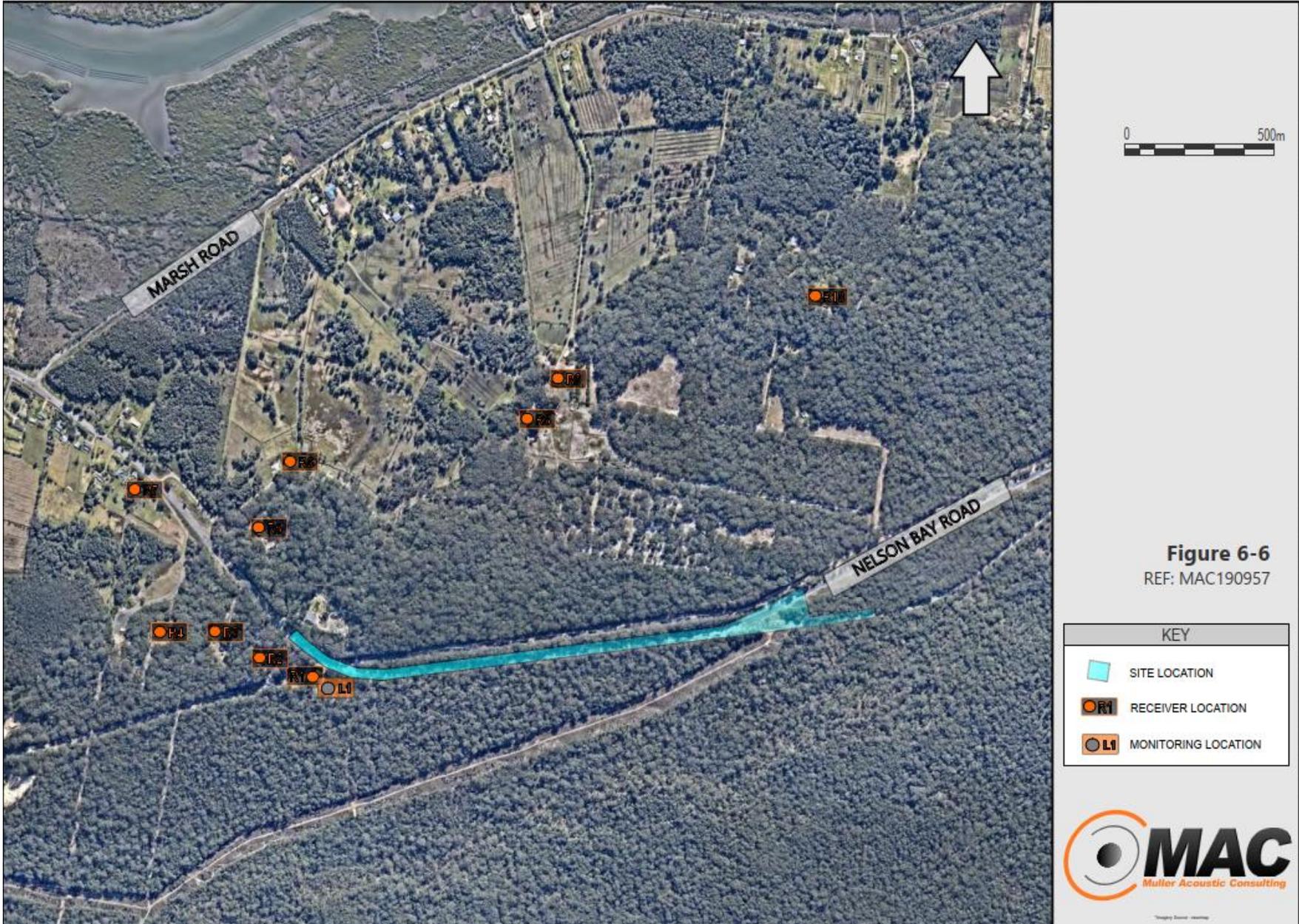


Figure 6-6 Residential receiver locations

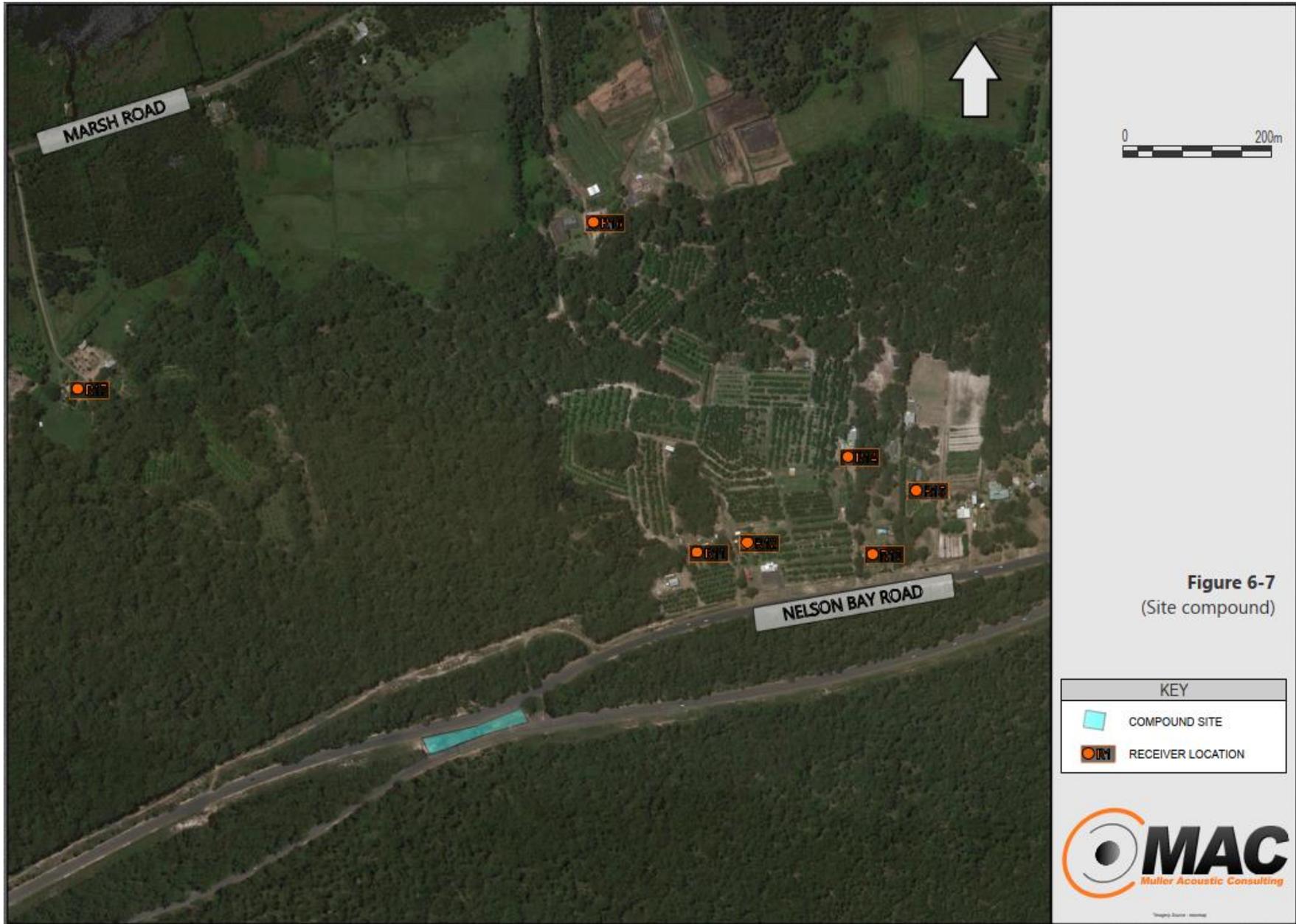


Figure 6-7
(Site compound)

KEY	
	COMPOUND SITE
	RECEIVER LOCATION



Figure 6-7 Residential receiver locations

6.3.3 Criteria

The ICNG is the principle guidance for the assessment and management of construction noise in NSW. The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction proposals with typical durations of more than three weeks
- Qualitative, which is suited to short term infrastructure maintenance (for proposals with a typical duration of less than three weeks).

The noise and vibration study has adopted a quantitative approach and included identification of potentially affected receivers, description of activities involved in the proposal, derivation of the construction noise criteria, quantification of potential noise impacts at receivers, and provides management and mitigation recommendations.

Section 4 of the ICNG details the Noise Management Levels (MNL) for noise at noise receivers, and how they are applied (refer Table 6-23). The NMLs for residential receivers were derived from the existing background noise levels, or rating background level (RBL), with the relevant criteria applied in accordance with the ICNG for working during recommended standard hours and works outside these hours.

Table 6-23 ICNG Residential Management Levels

Time of day	NML LAeq (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 + 10db	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(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 also 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
	Highly noise affected 75dBA.	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: <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 strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community.

Time of day	NML LAeq (15 min)	How to apply
		For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC, 2009)

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction NML for noise assessment is the median of the RBL's.

6.3.4 Potential impacts

Ancillary site establishment and operation

Noise levels associated with the ancillary site establishment and operation have been predicted for receivers R11 to R17 (refer Table 6-24). The results of the assessment indicate that LAeq(15min) noise levels would remain below the standard and OOH1 NMLs at all receiver locations during the establishment and operation of the ancillary site (refer Figure 6-7). Predicted noise levels during OOH2 anticipated to be above the NML at receiver locations R11 to R15 during ancillary site establishment, and at receiver locations R11 and R12 during operation of the ancillary site.

Table 6-24 Ancillary site establishment and operation

Receiver	dB LAeq NML Standard / OOH1 / OOH2	Predicted dB LAeq Per Activity	
		Ancillary site establishment	Ancillary site operation
R11	65/49/38	45	43
R12		44	41
R13		41	38
R14		39	37
R15		40	36
R16		35	32
R17		35	32

Early works

The early works of the proposal would involve the following activities:

- Establishment of the ancillary site
- Site establishment works, including delineation of the construction areas, installation of initial
- Environmental safeguards, additional surveys, establishment of site facilities and access and installation of temporary traffic controls and line marking
- Site preparation through vegetation clearing and grubbing and stripping and stockpiling of topsoil for re-use
- Relocation of utilities/services.

Noise levels during standard construction hours are likely to marginally (+1dB) exceed the NML at receiver location R1 during corridor clearing works and approach the NML during the relocation of services (refer Table 6-25). A predicted exceedance occurs when corridor clearing works occur at the western limit of

works only. If early works activities are completed during OOH periods, noise emissions would likely be above the OOH1 (evening) and/or the OOH2 (night) NMLs at receiver locations R1 to R5 and R8 to R10 during each of the early works activities.

Table 6-25 Early works activities

Receiver	dB LAeq NML Standard/OOH1/OOH2	Predicted dB LAeq Per Activity		
		Site establishment	Corridor clearing	Relocation of services
R1	65/49/38	61	66	64
R2		55	58	51
R3		51	55	51
R4		42	46	42
R5		35	39	37
R6		32	36	<30
R7		<30	32	<30
R8		47	51	45
R9		45	49	43
R10		44	46	42

Construction activities

It is anticipated that the construction phase of the proposal would be completed in three stages:

- Stage 1: would involve the construction of the new eastbound carriageway and tie-in at the eastern limit of works. Construction activities would include primary earthworks to clear and stockpile spoil and unsuitable material along the carriageway alignment, installation of drainage structures and construction of road layers including sub-base, base and surfacing layer.
- Stage 2: would involve in-situ stabilisation of the existing pavement which would be built up to the final road surface level. During pavement stabilisation, the existing road surface would be profiled and a stabilisation binder added to the reclaimed material to form the new road sub-base prior to construction of the base and surfacing layer.
- Stage 3: would involve the construction or installation of the median barrier, the construction of the final wearing course, and the installation of road furniture.

Typical plant and equipment, along with the fleet sound power level for each of the activities during the construction stages are provided in Table 6-26 . It is anticipated that works would primarily be completed during standard construction hours with tie-in works (asphalt paving) with the existing carriageway would likely be completed during OOH periods to minimise impacts on traffic. Construction phase activities would typically occur during standard construction hours only. Night works may be required during short duration asphaltting type activities. Noise levels would approach the standard construction hours noise management level (NML) at receiver location R1 during primary earthworks, asphalt paving works and pavement stabilisation works when completed at the western limit of works (refer Table 6-26). For asphalt paving or pavement stabilisation works, including tie-in works completed during OOH work periods, levels above the NMLs are predicted at receiver locations R1, R2, R3 and R8 for OOH2 (night), and R1 to R5 and R8 to R10 for OOH1 (evening).

Table 6-26 Construction scenario noise results

Receiver	dB LAeq NML Standard OOH1 OOH2	Predicted dB LAeq Per Activity					
		Primary earthworks	Drainage works	Asphalt paving	Pavement stabilisation	Road furniture	Decommission site
R1	65/49/38	64	61	65	65	55	58
R2		57	55	59	59	49	51
R3		54	51	55	55	45	47
R4		45	42	46	46	36	39
R5		38	35	39	40	30	32
R6		35	32	36	36	<30	<30
R7		31	<30	32	32	<30	<30
R8		50	47	51	51	41	44
R9		48	45	49	49	39	42
R10		45	44	48	48	38	40

Construction traffic

A construction road noise levels assessment has been completed assuming a worse case of 80 workers on average per shift. Under the assessed construction road traffic conditions, it is anticipated that the road traffic noise would increase by up to 0.1dB LAeq (15hr) for the day period and up to 0.2dB LAeq(9hr) for the night period. Road traffic noise impacts from construction work employees are anticipated to be negligible when compared when compared against existing traffic volumes on Nelson Bay Road.

Operation

In accordance with the Procedure for Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2016), an assessment of road traffic noise has been carried out for the existing and future road alignment. The proposal is not expected to increase traffic volumes or change the traffic mix. Noise levels for existing and future traffic were quantified by direct calculation to each of the nearby sensitive receiver locations. These are noted to be the potentially most affected by road traffic noise from the proposal.

Table 3-1Table 6-27 presents the results of the road traffic noise assessment for each scenario. A comparison of the existing and future (i.e. post proposal) road traffic noise levels indicate that noise emissions are anticipated to increase by up to 1.5dBA at receiver locations along Marsh Road following the completion of the proposal. The noise level changes are therefore within the 2dBA increase criteria and ameliorative measures are not required.

Table 6-27 Predicted road traffic noise levels

Receiver	dB LAeq,15hr Daytime Noise Level			dB LAeq,9hr Night-time Noise Level		
	Existing	Future	Change, dB	Existing	Future	Change, dB
R1	62.8	63.1	0.3	55.6	55.9	0.3
R2	59.8	59.9	0.1	52.6	52.7	0.1
R3	58.3	58.3	0	51.2	51.2	0
R4	55.7	55.9	0.2	48.5	48.6	0.1
R5	58.3	58.4	0.1	51.1	51.1	0
R6	51.9	51.9	0	44.6	44.7	0.1
R7	68.6	68.6	0	61.4	61.4	0
R8	46.7	47.9	1.2	39.5	40.5	1.0
R9	45.7	47.0	1.3	38.5	39.5	1.0
R10	45.9	47.4	1.5	38.5	39.8	1.4

Note: Levels calculated to the most exposed façade, excludes dwelling structure and includes +2.5dB façade reflection and -1.7dB façade correction. Modelling calibrated in near field.

Audio Tactile Line Markings

Audio Tactile Line Markings (ATLM) are proposed to be installed along the centre median on the approach to the new dual carriageway. The closest residence to the ATML is identified as 2998 Nelson Bay Road (R1) about 40m from the start of the ATLM. The results of the ATLM assessment demonstrate that for the closest residence, the predicted maximum noise level of 57dBA would remain below the relevant criteria of 65dB LAmax by about 8dBA. It is expected that no impacts above the maximum noise level criterion would be experienced at any of the nearby residences.

6.3.5 Safeguards and management measures

Table 6-28 provides the safeguards and mitigation measures proposed to address potential impacts identified from noise and vibration during construction and operation of the proposal. Where exceedances are still expected to occur after standard mitigation measures have been applied, the Construction Noise and Vibration Guideline (Roads and Maritime, 2016) recommends the implementation of additional mitigation measures as shown in Table 6-29.

Table 6-28 Noise and vibration safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will 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, taking into account Beyond the Pavement: urban design policy, process and principles (Roads and Maritime, 2014). • 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. 	Contactor	Preconstruction Construction	Section 4.6 QA G36 Environment Protection
Noise and vibration	<p>All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least 5 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contactor	Construction	Section 3.7 QA G36 Environment Protection
Noise and vibration	Notification detailing work activities, dates and hours, impacts and mitigation	Contractor	Preconstruction Construction	Appendix F

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone numbers.</p> <p>Notification should be a minimum of five working days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required.</p>			
Site induction	<p>All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:</p> <ul style="list-style-type: none"> • All project specific and relevant standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures 	Contractor	Construction	Appendix F
Construction hours and scheduling	<p>Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and or vibration levels should be scheduled during less sensitive time periods</p>	Contractor	Construction	Noise assessment

Table 6-29 Additional mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Asphalt paving Day Out of Hours Residential Receiver R1	<ul style="list-style-type: none"> • V = Validation of predicted noise levels • N = Notification <ul style="list-style-type: none"> – Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification 	Contractor	Construction	Appendix F

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them</p> <ul style="list-style-type: none"> • R2 = Respite Period <ul style="list-style-type: none"> – Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month. • DR = Duration Respite <ul style="list-style-type: none"> – Respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. In this instance and where it can be strongly justified it may be beneficial to increase the number of evenings or nights worked through Negotiated Respite so that the proposal can be completed more quickly. – Pre-purchased movie tickets or a similar offer may also provide respite for the community while providing provision for additional out of hours work. This measure is determined on a proposal-by-proposal basis, and may not be applicable to all Transport for NSW proposals. – The receivers that should be liaised with to gain community support for Negotiated Respite include those where out of hours work exceed the NML. <p>Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Negotiated Respite.</p>			
<p>Asphalt paving Day Out of Hours Residential Receivers R2 and R8</p>	<p>Notifications (letterbox drop or equivalent) (N) Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation</p>	<p>Transport for NSW Contractor</p>	<p>Construction</p>	<p>Appendix F</p>

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them</p>			

6.4 Landscape character and visual

A landscape character and visual impact assessment was prepared for the proposed works (*Nelson Bay Road Duplication – Urban Design Report and Landscape Character and Visual Impact Assessment*) (Terras Landscape Architects, 2020). A summary of the findings of the landscape character and visual impact assessment (LCVIA) are provided in the following section. The LCVIA is provided in Appendix G of this REF.

6.4.1 Methodology

The assessment in this report is consistent with the following

- Urban Design Policy Beyond the Pavement (Roads and Maritime, 2018).
- The Guideline for Landscape Character and Visual Impact Assessment, Environment Impact Assessment Practice Note EIA-N04 (Roads and Maritime, 2018), referred to hereafter as the “Guideline”.

The Guideline is considered to relevant to this proposal, as the proposed works would be assessed and determined under Division 5.1 of the EP&A Act.

The Guideline provides for two discrete assessments, each equally important:

- Landscape character assessment – the assessment of impact on the aggregate of an area’s built natural and cultural character or sense of place – which helps determine the overall impact of a project on an area’s character and sense of place
- Visual impact assessment – the assessment of impact of views – which helps define the day to day visual effects of a projects on people’s view

The method to measure impact is based on the combination of sensitivity of the existing area of view to change and magnitude of the proposal on that area or view. Sensitivity and Magnitude are defined by the Guideline as:

- Sensitivity: the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed nature of change
- Magnitude: the physical scale of the project, how distant it is and the contrast it presents to the existing condition.

The combination of sensitivity and magnitude provide the rating of the landscape character impact for a project, or visual impact for individual viewpoints (Table 6-30 .

Table 6-30 Landscape character and visual impact matrix

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Source: Guideline for landscape and visual impact assessment (Roads and Maritime, 2018)

Landscape character impact assessment tasks

Landscape character zones (LCZ) have been established using information gathered from other technical inputs and attending a site visit. Generally, the existing landscape character is consistent along the road. Three separate LCZ have been identified which have been based on the proposals impact on the landscape character (refer Figure 6-8). These have been identified based on the site characteristics as well as the requirement of either a cut retaining wall, a fill retaining wall or no wall required at all. The LCZ are:

- LCZ 1 – Cut retaining wall
- LCZ 2 – Filling retaining wall
- LCZ 3 – No retaining wall

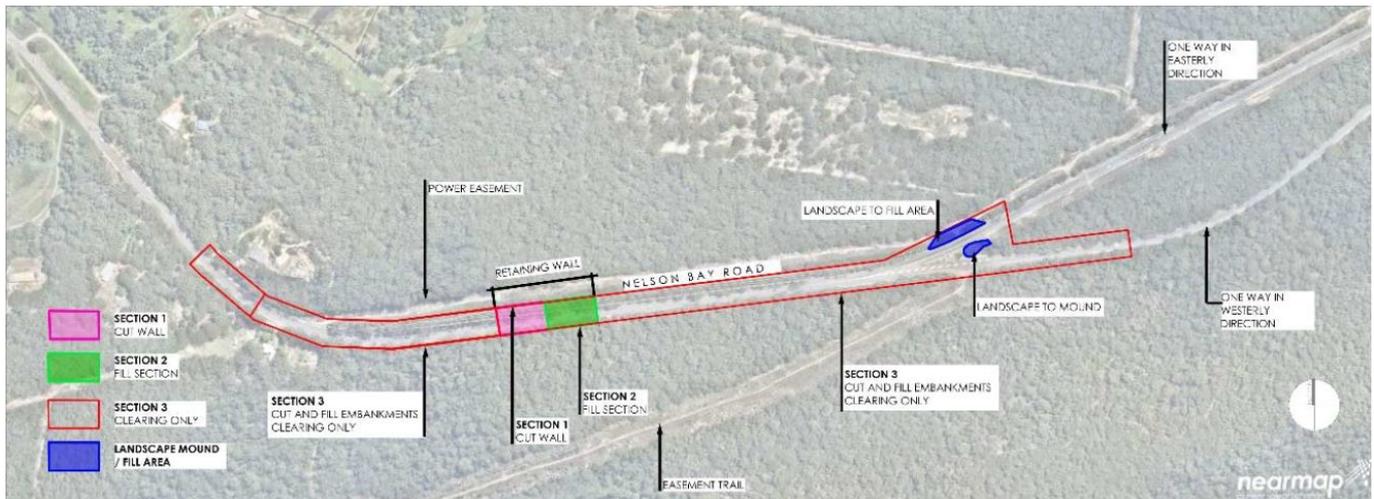


Figure 6-8 Landscape Character Zones

Visual impact assessment

The methodology applied involves systematically evaluating the visual environment relating to the proposal site and using value judgements based on community responses to scenery. This identifies aspects that are more objective (such as the physical setting, character and visibility of the proposal), from more subjective aspects, such as the compatibility of the proposal within the setting.

Visual data collection involves systematically evaluating the visual environment from relevant viewpoints through fieldwork to determine the actual potential for views to the site. Once a viewpoint has been identified, data is recorded both photographically and as detailed notes.

The selection of viewpoints has been based on locations where potential for views of the proposal would occur. Viewpoint 1 and 2 locations are shown in Figure 6-9. Viewpoint selection criteria include:

- Consideration of where views can be obtained from publicly frequented locations such as major traffic corridors
- Prominent look-outs or locations of high scenic value
- Where members of the local community may be affected.

The visual impact assessment work has been carried out following the below steps:

- Assess the visibility of the proposal. This includes a review of the existing visual environment/landscape setting of the locality.
- Identify key existing viewpoints and their sensitivity. This requires the preparation of a viewpoint analysis using a representative number of viewpoints located within a reasonable distance of the site located within its visual catchment.

- Assess visual impacts. A brief description of the proposal followed by an assessment of the likely impacts based on a composite of the sensitivity of the view and the magnitude of the proposal being a combination of scale, size and character having regard to the proximity of the viewer.

Due to local topography, existing vegetation and existing road alignment, the proposal would only have visual effect upon those areas within the site and generally only experienced by road users for a very short period of time as they drive through the location.



Figure 6-9 Viewpoint locations along Nelson Bay Road.

6.4.2 Existing environment

Landscape context

Nelson Bay Road 900 metres east of Marsh Road to 1.9 kilometres east of Marsh Road at Bobs Farm is a single carriageway. Generally, the landscape character can be defined as vegetated forest aligning a two lane road corridor which creates an enclosed woodland character for motorists using Nelson Bay Road.

Landscape character assessment

For the purposes of the landscape character assessment, the study area was divided into three zones which reflect the different landscapes in and around the proposal area. These LCZs are described below.

LCZ 1 – Cut retaining wall location

This section has been identified due to the requirement of a cut retaining wall. Existing site conditions in this section include dense vegetation exists on both side of the road with significant upslope batters located on the northern side of the road and is located on a crest in the road as show in Figure 6-10.



Figure 6-10 Typical roadside vegetation at LCZ 1

LCZ 2 – Filling retaining wall location

This section has been identified due to the requirement of a fill retaining wall. Existing site conditions including dense vegetation existing on both sides of the road with batter down from the northern side of the road and is located on a crest in the road as shown in Figure 6-11.



Figure 6-11 Typical roadside vegetation at LCZ 2

LCZ 3 – No retaining wall location

Existing site conditions in this section include dense vegetation existing on both sides of the road slight undulating topography on both sides on the road as shown in Figure 6-12.



Figure 6-12 View east along Nelson Bay Road and view into roadside vegetation

6.4.3 Potential impacts

Visual impact assessment

Viewpoint 1

This viewpoint has been taken from the western extents of the site. It looks east towards the retaining wall locations, which would be visible by road users as they pass between until they pass the walls themselves (refer Figure 6-13). Additional works visible from this location include vegetation clearing for the road widening and clear zones as well as the median barrier. The fauna fence and access track will also be visible until the new planting works establish.

The sensitivity is low to moderate given the existing vegetation located outside the proposal boundaries. The time in which the retaining wall would be seen by road users limits the sensitivity on this occasion due to the short period of exposures as traffic moves past. The magnitude is moderate to high due to the size of the retaining wall. The impact is moderate due to the cut into the existing batter, installation of a retaining wall and safety and median barriers at this location. In some points the wall can be up to five metres, however visual access to the wall would be minimal. The impact on westward traffic again be reduced due to traffic moving in the opposite direction.



Figure 6-13 Viewpoint 1

Viewpoint 2

This viewpoint has been taken from the point where the carriageways splits (refer Figure 6-14). It looks west towards the retaining wall locations, however due to the existing vegetation and crest in the road the retaining walls would not be visible. Works in this location would be limited to vegetation clearing for the road widening and the median barrier. The fauna fence and access track will also be visible until the new planting works establish.

The sensitivity is low to moderate given the minimal construction outside of the road widening and existing vegetation located outside the proposal boundaries. The magnitude is low as there are no built structures proposed in this zone, other than median barriers. Batters would be revegetated and existing established vegetation beyond the extent of works would remain the same. The impact is low due to the extent of existing vegetation and the fact that no built structures are required. Batters formed to accommodate the level of change would be revegetated with local species.

Visual impacts associated with the construction of the proposal are directly associated with general construction activities (such as earthworks and ancillary sites), presence of plant and equipment. These impacts would occur throughout the construction period. During construction, temporary lighting would be required at the ancillary site for night work.

Visual impacts during construction would be temporary in nature, and standard construction safeguards and management measures would be adopted to minimise these impacts.

No residents would be impacted due to their proximity to the proposal and the presence of existing vegetation.

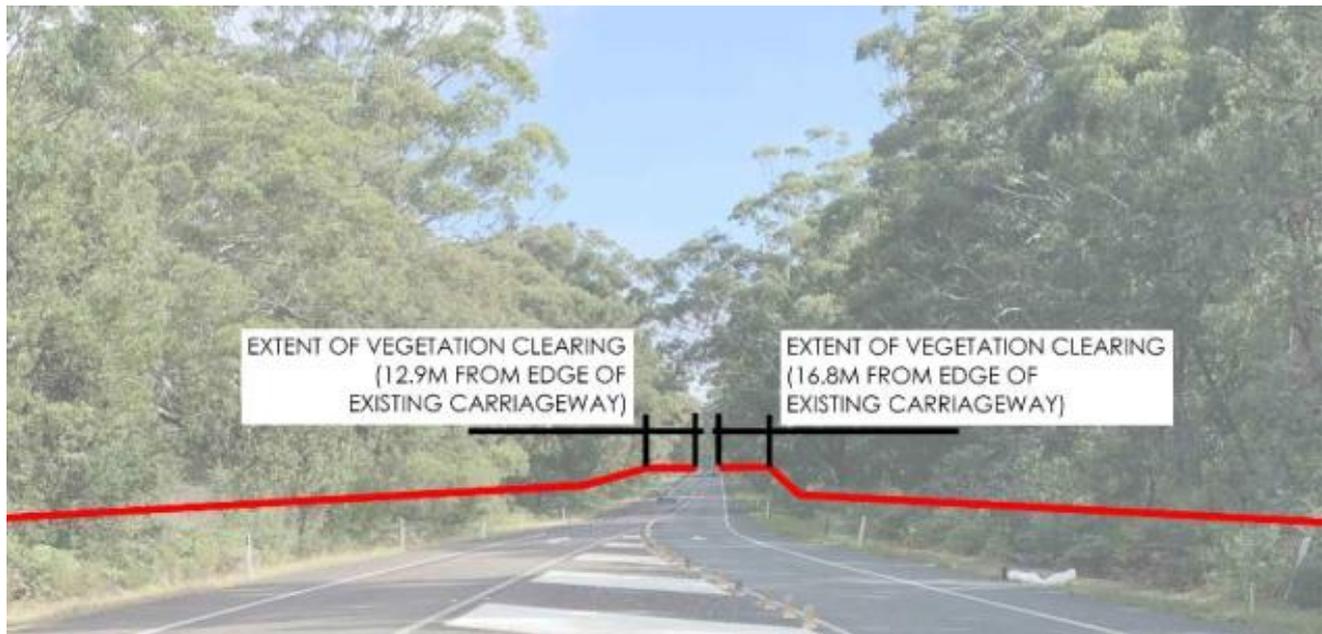


Figure 6-14 Viewpoint 2

Viewpoint 3

Viewpoint three has been taken from the western end of the proposal. This viewpoint looks south east towards the proposal however due to existing vegetation and curve in the road the retaining walls would not be visible. There are areas on the southern side of the road that would require clearing. Works in this location would be limited to vegetation clearing for the road widening and clear zones (refer Figure 6-15).

The sensitivity is moderate to high given the areas to be cleared are located outside of existing residences. The magnitude is low as there are not built structures proposed in this zone. Batters would be revegetated and existing established vegetation beyond the extent of works would remain. The impact is moderate due to the location of existing residences and the requirements for batters to be formed to accommodate the level change. This area would be revegetated with species suitable to the local environment in order to assist in minimizing impact.

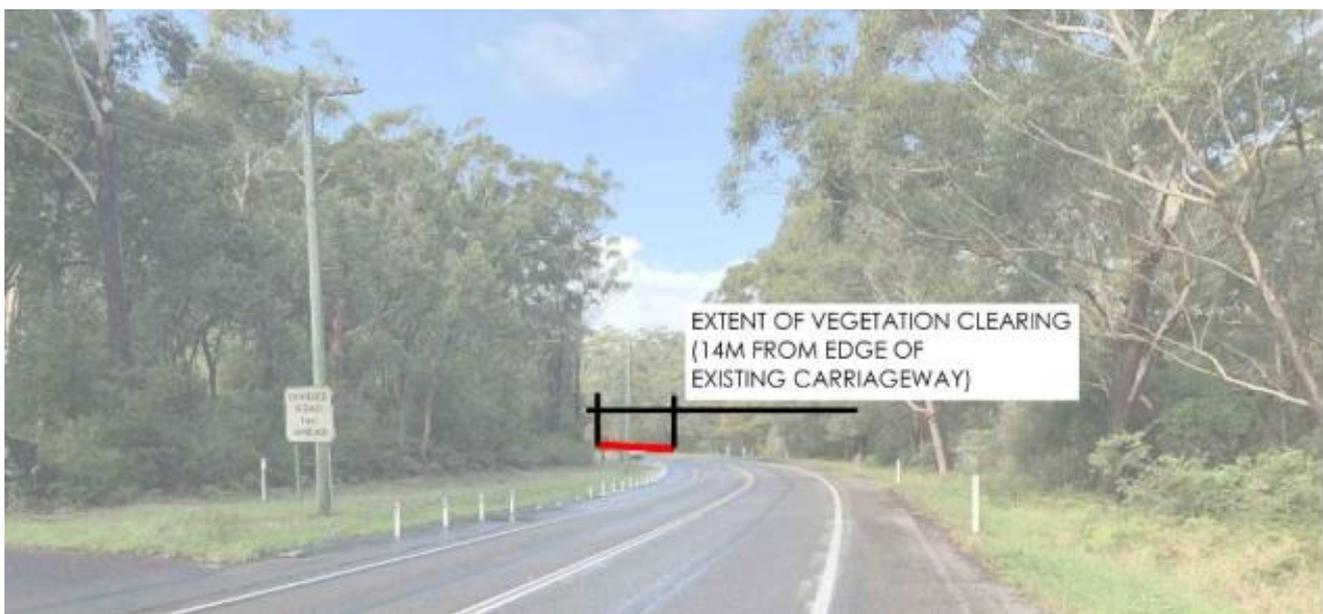


Figure 6-15 Viewpoint 3

Viewpoint 4

Viewpoint four has been taken from the eastern end of the site (refer Figure 6-16). This viewpoint looks south west towards the site, however due to the crest in the road, the retaining walls would not be visible. There are areas on either side of the road that would require clearing. Works in this location include a landscape mound located where the road splits, vegetation clearing for the road widening / clear zones and the fauna fence and access track which would be visible until the new planting works establish.

The sensitivity is low to moderate given the minimal construction outside the road widening and existing vegetation located outside the proposal boundaries. The landscape mound would be located in existing cleared area. The magnitude is low there are no built structures proposed in this zone, other than median barriers, batters would be revegetated and existing established vegetation beyond the extent of works would remain. The impact is low due to the extent of existing vegetation and the fact that no built structures are required, batters formed to accommodate the level change and landscape mounds would be revegetated with species suitable to the local environment. This in conjunction with the presence of established vegetation, would ensure the impact is minimal.

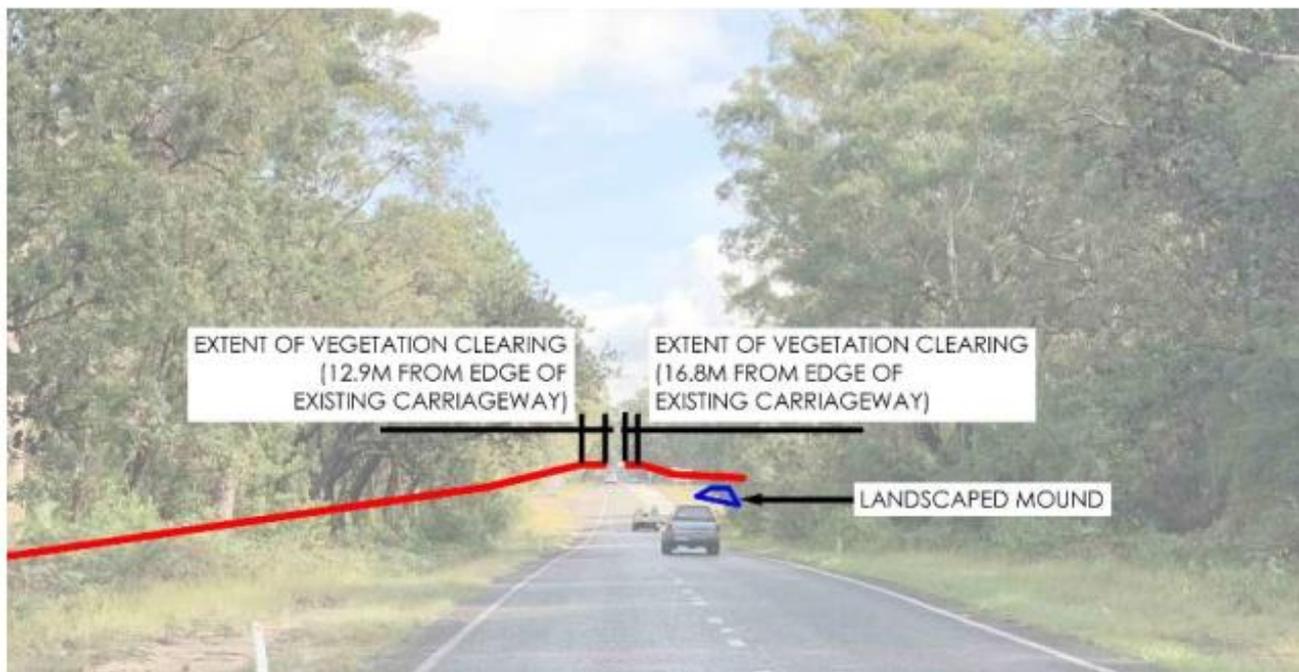


Figure 6-16 Viewpoint 4

Landscape character assessment

Section 1 – Cut retaining wall

The sensitivity is low to moderate given the existing vegetation located outside the proposal boundaries. The magnitude is moderate to high due to the size of the retaining wall. The impact is moderate due to the requirement to cut into the existing batter and hence a retaining wall is required as high as five metres. This has an impact due to its visibility on road users however visual access to the wall would be minimal due to the limited extent of the proposed wall.

Section 2 – Fill retaining wall

The sensitivity is low to moderate given the existing vegetation located outside the proposal boundaries. The magnitude is low to moderate as the main impact would be the inclusion of a low vehicle barrier. The impact is low due to the road widening and requirement to build a fill retaining wall. A concrete vehicle barrier would also be required on top of the wall for road user safety. In addition, this wall will rarely be seen on the lower side due to the existing land use.

Section 3 – No retaining wall

The sensitivity is low to moderate given the existing vegetation located outside the proposal boundaries. The magnitude is low as there are no built structures proposed in this zone. The impact is low due to minimal changes in road levels, no built structures are required and any batters formed to accommodate the level change would be revegetated with local species.

Landscape impact would be affected by the type of retaining wall required due to the changes in topography of the proposal. The only impact would be on the road users travelling along Nelson Bay Road. The impact would be the visual presence of the cut retaining wall, the vehicle barriers and the batters until the revegetation establishes. Due to the nature of the existing dense vegetation along either side of the road and sweeping bends located at either end of the proposed alignment exposure would be for a relatively short period.

No residents would be visually impacted due to their proximity to the proposal and the presence of existing vegetation.

Conclusion

All zones and viewpoints have a similar landscape character comprised of vegetated forest aligning the existing road corridor. With the exception of a short stretch impacted by the construction of the cut retaining wall, impact is limited to removal of trees, inclusion of a median barrier and widening of the road as well as a fauna fence and access track. Although there is an electrical easement within close proximity to the north of the proposed works, a sufficient vegetation buffer would be retained to ensure this is not seen. The greatest impact would be where the cut retaining wall is proposed within Section 1.

Overall, the proposal would have a low impact on the site's landscape character and visual amenity. The proposal is to occur within an established road corridor. The proposal would result in landscape character and visual impact however the impact would be reduced with the implementation of the mitigation measures including the establishment of new planting works.

6.4.4 Safeguards and management measures

The recommended safeguards and mitigation measures to minimise the impacts of the proposal on landscape and visual are listed in Table 6-31 .

Table 6-31 Landscape and visual safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Revegetation	Revegetation of roadside batters, landscape mounds, in front of the fauna fence and other areas disturbed by proposed works using species suitable to the local environment.	Contractor	Construction	Appendix G
Retaining walls	Implementation of an appropriate treatment to retaining walls to create interest and to be complementary to the landscape character through which the road works is proposed	Transport for NSW	Detailed design	Appendix G
Temporary lighting	During night works temporary lighting will be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting and the TMP	Contractor	Construction	AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting, Traffic Control at Work Sites Manual (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i>
Visual impact of ancillary sites	Ancillary sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including avoiding temporary light spill into residences during night works	Contractor	Construction	Core standard safeguard
Visual amenity	Work to be carried out in accordance with Transport for NSW EIA-N04 Guideline for Landscape Character and visual impact assessment	Contractor	Construction	Standard safeguard EIA-P05-G01- T02

6.5 Soil and water

6.5.1 Methodology

The following reports have been used to inform the assessment of the impact on soil and geology from construction and operation of the proposal, Geotechnical Factual Report (Roads and Maritime, 2019) and Nelson Bay Road: Williamtown to Bobs Farm Preliminary Environmental Investigation (PEI) (Roads and Maritime, 2019). In addition, geotechnical investigations conducted by SMEC informed the detailed design. Database searches were conducted between the 4 and 10 of December 2019 using the NSW Natural Resource ATLAS online resource, held by the NSW Department of Primary Industries - Water.

The Australian Rainfall and Runoff (AR and R) (Institution of Engineers Australia, 2016) has been adopted for the design of the proposal. This AR and R provides designers with the most current information on design flood estimation and is widely accepted as a design guideline for all flood and stormwater related design in Australia.

6.5.2 Existing environment

The proposal area is located on top of a low sand dune and is bounded by a power easement running parallel to the existing alignment on its northern side and by rural residential properties on the southern side at the western extent of the proposal. Another larger power easement crosses Nelson Bay Road at the eastern extent. The existing road is surrounded by remnant native bushland on both sides.

The existing road is flat to slightly undulating and comprises a single travel lane and shoulder in each direction. The existing road is generally constructed close to natural surface levels (within about one metre) except on the southern side at about Chainage 350 where it is constructed on fill and east of this on the northern side where it is constructed in cut.

The Coastal Quaternary Geology Map (1:100,000 scale) for the Nelson Bay Area indicates that the proposal area is underlain by Holocene dune marine sands. The PEI (Roads and Maritime 2019) notes that Shoal Bay Assemblage is evident on higher grade areas (localised dune formations) and is characterised by steep slopes, foundation hazards, and is non-cohesive with low fertility.

Groundwater

Tomaree Groundwater Source.

This is a sand plain extending between Tilligerry Creek and the coastline from the drainage complex of Bobs Farm Creek; Fenninghams Island Creek and Murrumburrimbah Swamp near Anna Bay in the south; and the mouth of Tilligerry Creek at Taylors Beach around the margin of Port Stephens to Tomaree Head at Shoal Bay to the north. This area now total 62 kilometres squared. The sand deposits are variable in thickness consisting of an upper layer of uniform dune sand between two to 20 metre thick overlying a lower layer commonly more than 40 metre thick which is characterised by the localised presence of clay lenses, charcoal fragments and peat. The sand deposits are consistently underlain by a dark grey to black organic clay, presumed to be the Medowie Clay Member.

About a third of the groundwater source is covered by Tomaree National Park. There are a number of groundwater-dependent ecosystems in the area, including terrestrial vegetation and wetlands. The groundwater source also provides important base flows to rivers and tidal creeks. This groundwater source is critical to the town water supply for the Tomaree Peninsula. Groundwater extraction for domestic purposes also occurs.

Stockton Groundwater Source:

This is located on the Lower North Coast between the villages of Stockton and Anna Bay. It consists of a series of parallel small dune ridges with intervening lowland swales tending to swamps. The Stockton Groundwater Source is located between the coastline and Tilligerry Creek. It extends from the Hunter River at Stockton in the south, to the drainage complex of Bobs Farm Creek, Fenninghams Island Creek, and Murrumburrumbah Swamp near Anna Bay in the north. The area of the Stockton Groundwater Source area totals about 113 square kilometres.

Groundwater is used predominantly for domestic purposes accessed through basic spear point extraction systems. Some entitlement is also used for irrigation and commercial purposes. Located within the groundwater source are the Worimi Conservation Lands which cover the Worimi National Park, Worimi State Conservation Area, and Worimi Regional Park. Groundwater in these aquifers is used for urban water supply by Hunter Water Corporation for potable water supply in the Newcastle area. The proposal area is at a reduced level (RL) of 6.3 metres above AHD. A search of the Water NSW database was carried out on 4 March 2020 (WaterNSW, 2020). There are four within a 500 metre radius of the proposal area and two within the 500 metre radius of the ancillary site A as shown in Table 6-32 and Figure 6-17.

Table 6-32 Summary of registered groundwater bores

Borehole ID	Standing water level (m BGL)	Distance and direction from site	Purpose
GW078488	9.0	112.40 metres from proposal	Domestic
GW079678	NA	267.97 metres from proposal	NA
GW079397	NA	267.97 metres from proposal	NA
GW079391	NA	285.58 metres from proposal	NA
GW080231	2	280.44 metres from ancillary site E	NA
GW080216 (Spear)	0	419.90 metres from ancillary site E	NA

Surface water

A small portion of the eastern section of the proposal is within the Stockton Sandbed drinking water catchment. There are numerous drainage easement and natural water course within the proposal area. The study area is situated between Stockton Beach, located 2.2 kilometres to the south, and Tilligerry Creek, located 1.6 kilometres to the north. Tilligerry Creek is classified as a fourth order (Strahler) stream and has associated swamp and estuarine environments which connects with the extensive Hunter Wetlands system. Tilligerry Creek flows north into Port Stephens and the Karuah River.

Drainage and flooding

There are no existing drainage structures within the proposal area. All surface flows infiltrate the subgrade through the permeable ground materials and then is conveyed through the site through the sandy grade.

The proposal is above the one in 100 year flood planning level. All surface flows infiltrate the subgrade through permeable ground layers and conveyed through the site through the sandy subgrade.

Acid sulfate soil

Acid sulfate soils are acidic soil horizons (layers) resulting from the aeration of soil materials rich in iron sulfides. Acid sulfate soils generally occur within the following locations:

- Marine or estuarine sediments deposited during the Holocene period

- Soils typically less than five metres above sea level
- Marine or estuarine settings/environments.

A review of the NSW OEH (2019) eSPADE website and the Digital Atlas of Australian Soils (ASRIS, CSIRO 2019) was undertaken to assess the potential for ASS to exist on site. Both mapping resources indicate acid sulfate soil risk identifies the proposal area and the ancillary site are in a low risk area (refer Figure 6-18).



- Proposal area boundary
- Site compound
- ▲ Bore
- ◆ Spear

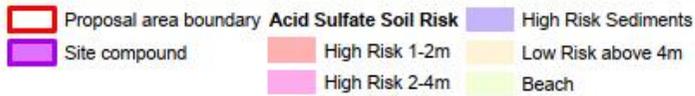
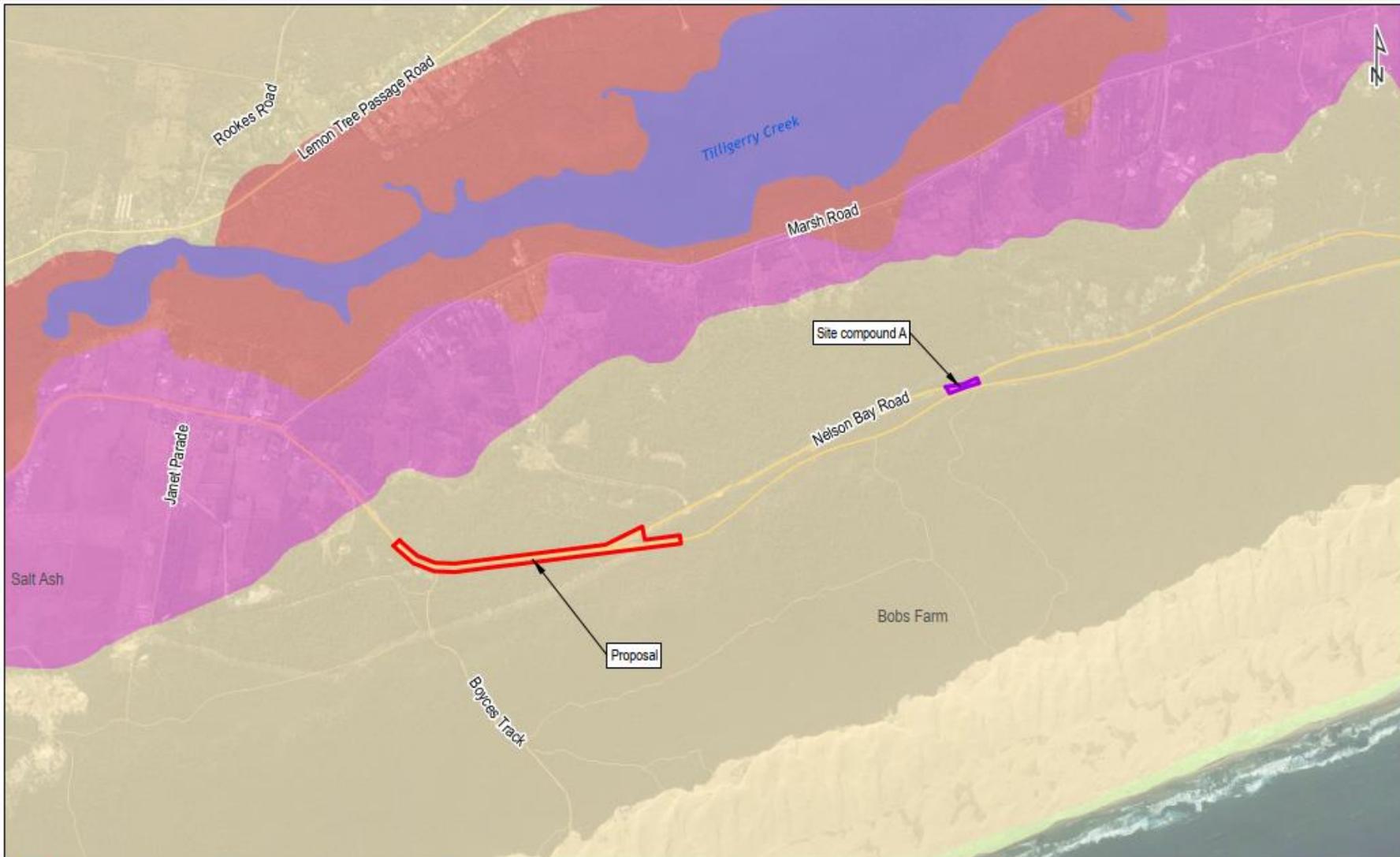
Nelson Bay Road Upgrade Section 1 30012877

Groundwater Fig. 6-17

Roadnet MDS 2019, Imagery: © Department of Customer Service 2020



Figure 6-17 Groundwater bores and spear locations near the proposal and ancillary site



Nelson Bay Road Upgrade Section 1 30012877

Acid Sulfate Soils Fig. 6-18

Roadnet MDS 2019, Imagery: © Department of Customer Service 2020



Figure 6-18 Acid sulfate soil locations - proposal area and ancillary site

6.5.3 Potential impacts

Construction

General construction activities that have the potential to impact on soils include:

- Ancillary site preparation and operation
- Clearing and grubbing of new road alignment
- Stockpiling of topsoil, spoil and imported materials
- Removal of unsuitable material on new road alignment
- Construction of new road alignment
- Handling and stockpiling of material (imported and spoil)
- Movement of heavy vehicles across exposed earth
- Generation of construction waste
- General waste generation from ancillary site operation
- Accidental spills of materials such as hydrocarbons and chemicals.

During construction, there would be potential for sediment and nutrient laden runoff from areas disturbed by construction to impact Worimi National Park to the south. Areas which would present a high risk of soil erosion include locations where both surface gradients and slope lengths combined would increase the erosive potential of storm water runoff. During construction, these locations would typically include:

- Areas stripped of vegetation
- Clearing and grubbing of new road alignment
- Stockpiling of topsoil, spoil and imported materials
- Fill embankments
- Road formation construction
- Concentrated flow paths e.g. catch drains, batter drains, drainage outlets etc.

The proposal would be constructed within the existing road corridor. It is estimated that the total area of land disturbed by the proposal would be about 59,000 square metres which includes the existing road alignment. An ancillary site would be required for the construction of the proposal and would be used for stockpiling of materials, laydown areas, storage of plant and equipment and office accommodation and amenities. Refer S.3.3.1 of this REF for the ancillary site location and size.

Groundwater

As the proposal area is at an RL of 6.3 metres and elevated above the surrounding low lying areas it is not expected that groundwater would be intercepted during construction of the proposal.

Drainage and flooding

It is not proposed to provide any drainage structures for the proposal.

The proposal is not expected to cause flooding.

Operation

During the operation, the road area would be paved and any disturbed areas would be revegetated and stabilized so the proposal would not have an impact on geology and soils. Contaminates including heavy metals and hydrocarbons can build up on road surfaces and roadside corridors in dry weather which, during rainfall events, can be transported to surrounding watercourses or infiltrate into the groundwater system.

6.5.4 Safeguards and management measures

Table 6-33 provides the safeguards and mitigations measures proposed to address potential impacts on soils from the proposal.

Table 6-33 Soil and water safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil loss and water quality	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP would address the management of stockpiles including their location.	Contractor	Preconstruction Construction	Section 2.1 QA G38 Soil and Water Management <i>Transport for NSW Stockpile Management Guideline (2015)</i>
Soil loss and water quality	A site specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented as part of the SWMP and will show the location of all erosion and sediment controls (ERSED). The ESCP will be progressively updated to address changes in construction staging. The ESCP will include arrangements for the following: <ul style="list-style-type: none"> • Identification of high risk construction activities and appropriate ERSED controls including off-site/site water separation • Management of weather events, including monitoring of potential high risk events (such as storms), specific controls and follow-up maintenance • Location and management of stockpiles including ERSED controls 	Contractor	Preconstruction Construction	Section 2.2 QA G38 Soil and Water Management Landcom's Managing Urban Stormwater: Soils and Construction series <i>Transport for NSW Stockpile Management Guideline (2015)</i>
Stockpile management	Stockpiles will be designed, established, operated and decommissioned in accordance with the Transport for NSW Stockpile Site Management Guideline 2015.	Contractor	Construction	Standard safeguard
Groundwater	Hydrocarbon refuelling areas and chemical stores to be lined/or bunded and at least 50 metres from any groundwater source to minimise potential of pollution	Contractor	Construction	Section 4.3 QA G36 Environment Protection

6.6 Traffic and transport

6.6.1 Methodology

Assessment of the proposal's construction impact on traffic and transport was undertaken using data from construction staging plans and projected vehicle volumes to establish potential traffic delays caused by construction of the proposal. Operationally, the proposal has been assessed on the following criteria:

- Road safety
- Current access arrangements
- Repair of the existing pavement.

6.6.2 Existing environment

This section of the Nelson Bay Road is a 1.2 kilometre section of a two lane undivided carriageway with a signed speed limit of 100 kilometres per hour. There are no designated cycle paths or pedestrian paths and due to the narrow shoulder this route has been classified as a high-difficulty on-road cycling environment.

Current traffic volumes and network performance

Traffic surveys were undertaken by Transport for NSW in December 2018, January 2019 and March 2019 for Nelson Bay Road outside of school holidays, with the AM peak between 6-9 AM and the PM peak between 3-6 PM to determine the average daily traffic. The count location relevant to Section 1 was located east the intersection of Nelson Bay Road and Marsh Road (location M-9) (refer Figure 6-19).



Figure 6-19 Traffic count locations (Source: Arcadis Traffic Modelling Report)

Nelson Bay Road is also subject to peak period congestion with high levels of percentage time spent following (PTSF). This is exacerbated during holiday periods when traffic volumes increase to and from the tourist area of Nelson Bay. A summary of total vehicles counted has been provided in Table 6-34 below. Heavy vehicle traffic volumes were also surveyed and are summarised in Table 6-35 .

Table 6-34 Daily traffic volumes (all vehicles) on Nelson Bay Road, east of Marsh Road 2018/2019

Road Section	Daily Traffic Volumes (all vehicles)			
	Average weekly	Average weekday	Average weekend	Weekend vs weekday
Nelson Bay Road, east of Marsh Road	18,750	19,580	16,680	-15%

Table 6-35 Daily heavy vehicle average traffic volumes on Nelson Bay Road, east of Marsh Road 2019

Daily heavy vehicles		Percentage of heavy vehicle total volume
Average Weekday (5 days)	Average Weekend (2 days)	
1,530	1,030	8%

Crash history

Crash data was collected for the Nelson Bay Road area from April 2014 to March 2019 to determine the location, frequency and severity of the recorded crashes within this timeframe (refer Table 6-36). A total of 3 crashes occurred between April 2014 and March 2019 along Nelson Bay Road, east of Marsh Road. Refer to Table 6-36 for the location of the crashes.

Table 6-36 Crashes on Nelson Bay Road, east of Marsh Road 2013-2018

Impact type	Severity	Year	Type of road
Vehicle-object	Serious injury	2015	Two way undivided
Rear end	Serious injury	2015	Two way undivided
Rear end	Minor/other injury	2018	Divided road



Figure 6-20 Location of crashes for Nelson Bay Road (Section 1)

Public transport services

Bus services in the area are operated by Port Stephens Coaches, running from Nelson Bay (and Anna Bay), towards Newcastle and Raymond Terrace, with the first service departing Fingal Bay at 4:55 am, and the last service returning at 10:43 pm. The bus route map shows that services 131, 135 and 139 operate through the proposal area (refer Figure 6-21). There are two bus stops within the proposal area have no bays forcing buses to stop on carriageway shoulders. This presents a safety issue to road users as it significantly increases the risk of collision between stationary, decelerating, or accelerating buses and other vehicles which also impacts the operational efficiency of the road network. After consultation with bus operators, Transport for NSW has confirmed that two existing bus stops that are currently located within the proposal area would be removed and decommissioned.

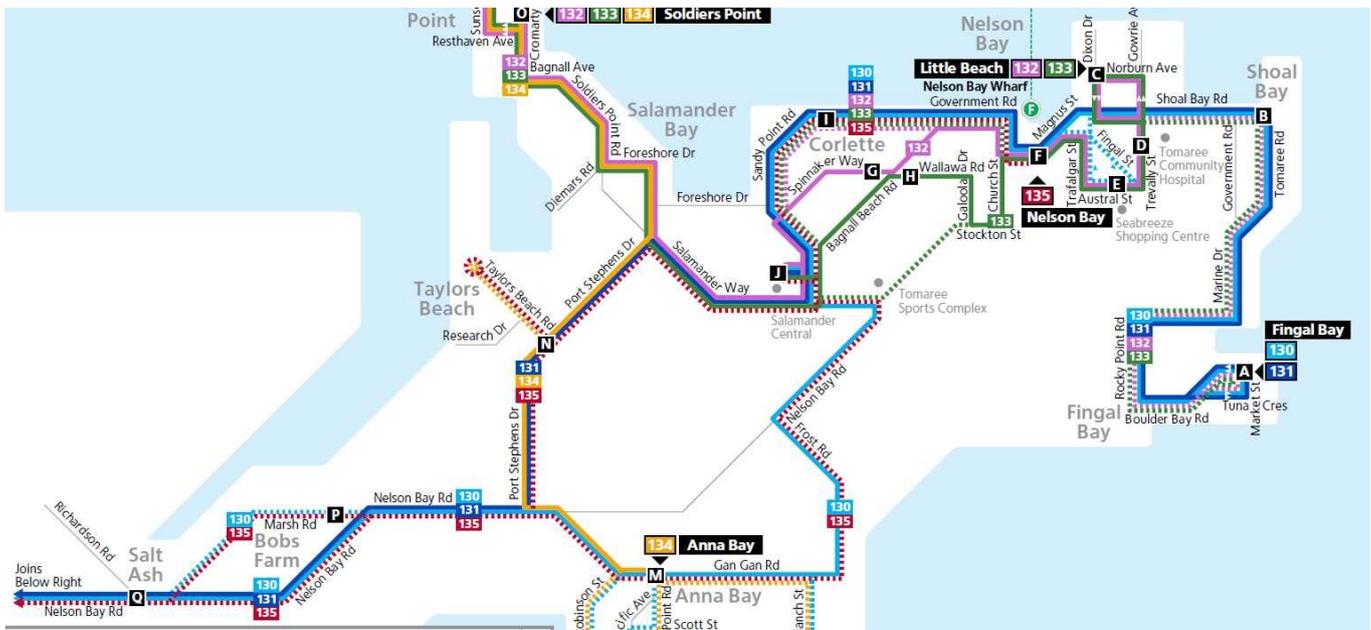


Figure 6-21 Port Stephens bus networks routes

Future traffic growth

The Transport for NSW linear regression modelling spreadsheet and EMME based Strategic Traffic Forecast Model (STFM) were used to determine peak period traffic volume forecasts by direction of travel on Nelson Bay Road Section 1 in the 2019 (base year), 2025, 2035, and 2045 modelled years. The forecast demand provided by the STFM are summarised in Table 6-37 .

Table 6-37 Forecast weekday traffic volumes (all vehicles)

Road Section	Forecast daily traffic volumes (all vehicles)			
	Existing 2019	Forecast 2025	Forecast 2035	Forecast 2045
Nelson Bay Road, east of Marsh Road	19,580	21,900	25,800	29,800

6.6.3 Potential impacts

Construction

It is expected there would be a moderate impact on traffic and network performance during construction. Road user delay is based on the detailed construction staging strategy and requirements for traffic control.

The proposed construction staging of the proposal would reduce impact on through traffic and road user delay (refer Table 3-1). As most works are offline, the impact to traffic is due to the reduction in speed limits past the work. The interruption to traffic during construction Stage one and Stage two would be the reduction in speed limit from the existing post speed limit of 80km/h to 60 kmh. For Stage three (western tie in) it is proposed to construct the western tie as night works under alternate flow conditions via stop/slow traffic control or via temporary traffic signals. As these works are proposed at night, traffic volumes are substantially lower. Queue lengths would be managed on site by traffic controllers to avoid excessive queues. In Stage three the worst case road user delay will occur when a vehicle just misses getting through the site. Queue analysis undertaken indicates that it would take about 40 seconds for the queue to clear during the worst period overnight.

Table 6-38 Road user delay summary

Construction Stage	Road user delay (seconds)	Queue
Stage 1: offline construction of pavement widening along the eastbound carriageway	18	No queue: one lane open in each direction
Stage 2: offline construction of westbound shoulder widening and existing pavement rehabilitation	18	No queue: one lane open in each direction
Stage 3: online western tie works with contra flow / alternate flow in operation (worst case)	134	60 metre queue length
Stage 3: western tie in (average case)	18	No queue: one lane open in each direction
Stage 3: eastern tie in	60	No queue: one lane open in each direction

For the duration of the construction phase when the construction site is active and workers are undertaking activities behind construction barriers next to live traffic, the posted speed limit would generally be reduced to 60 kilometres per hour. There may be times when workers are operating immediately adjacent live traffic without temporary traffic barriers when the posted speed limit is reduced to 40 kilometres per hour. Generally, one lane in each direction would be provided on Nelson Bay Road during construction of the proposal. During earthworks and pavement widening phases only one lane would be provided with one direction of travel permitted and traffic control in place. The locations where this arrangement is applied would be staged to limit the length under construction at any one time in order to reduce the impact on traffic.

During construction a temporary U-turn facility at the eastern limit of works would be built to allow work vehicles to make U-turns within the worksite to minimise interaction with non-construction traffic and for efficiency. Exact access locations would be determined by the construction contractor dependent on the construction phase. During some construction stage there would be a traffic temporary crossover at ancillary site 1.8km east of the proposal (refer to Figure 3-7).

Construction staff parking would be provided at the ancillary site and within the proposal area. It is expected that up to 80 heavy vehicle movements would occur during the peak construction period on a typical working day. Light vehicles and small plant are estimated at 60 movements per day.

Operation

Traffic and safety benefits

Two scenarios were modelled: “Base Case” and “Project Case”. The Base Case scenario maintains the existing single carriageway section of Nelson Bay Road from east of Marsh Road to the existing dual carriageway near Bobs Farm. The Project Case involved a four-lane divided carriageway with a posted speed of 100 km/h. The performance analysis determined that:

- The Project Case would not change the total vehicle kilometres travelled compared to future Do Minimum.
- The Project Case would reduce the total vehicle hours travelled by between 10% per cent and 11% both AM and PM peak, over the period 2025 – 2045.
- The Project Case would increase average travel speed for the modelled study area by up to 10 kilometres per hour between the intersection of Marsh Road and Bobs Farm in both the AM and PM peaks, by 2045.

Design of the proposal has resulted in the following safety benefits for Section 1:

- Increased road capacity
- Improved pavement
- Shoulder widening
- Improved road design geometry
- Median separation with median barrier.

A median separated dual carriageway provides a significantly safer road environment than a two-way two-lane road without median separation.

Bus services

Local and regional bus services operating in the area would also benefit from improved travel times and efficiency as a result of the proposal. The two existing bus stops would be removed and decommissioned as part of the proposal.

6.6.4 Safeguards and management measures

The recommended safeguards and management measures to minimise impacts to traffic and transport during construction of the proposal are outlined in Table 6-39.

Table 6-39 Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Transport for NSW <i>Traffic Control at Work Sites Manual</i> (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i> (Roads and Maritime, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • Confirmation of haulage routes • Measures to maintain access to local roads and properties 	Contractor	Preconstruction Construction	Section 4.8 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> • 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. 			
Changed transport and access	Road users, local residents and local business are to be informed a minimum of five days of changes conditions, including the likely disruptions to access (if applicable)	Transport for NSW Contractor	Preconstruction Construction	Section 3.7 of QA G36 Communication
Disruption to traffic and transport	Real-time information is to be made available to road users through temporary Variable Message Signs (VMS), the Live Traffic and 131 500 websites, and the media	Contractor	Construction	Section 3.7 of QA G36, Communication Traffic Control at Work Sites Manual (RTA, 2010), QA G10 Control of Traffic
Disruption to traffic and transport	Construction staging and materials are to be managed to minimise the number of haulage and delivery vehicles required on site	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010), QA G10 Control of Traffic
Disruption to traffic and transport	The designated site access points and haulage routes are to be used	Contractor	Construction	Traffic Control at Work Sites Manual

Impact	Environmental safeguards	Responsibility	Timing	Reference
				(RTA, 2010), QA G10 Control of Traffic
Disruption to traffic and transport	Construction finish times to be planned for minimal impact to the afternoon peak traffic flows	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010), QA G10 Control of Traffic
Disruption to traffic and transport	Installation of advisory and directional signage, line marking and pavement markings to direct motorists via the safest and most convenient route	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010), QA G10 Control of Traffic
Disruption to traffic and transport	Delivering plant and equipment to the site outside of peak traffic flow	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010), QA G10 Control of Traffic

6.7 Air quality

6.7.1 Methodology

The proposal's impact on air quality has been considered in a qualitative assessment, referencing existing local air quality information and the likely extent of emissions during construction and operation.

The following databases were searched to inform the baseline characterisation of the local environment.

- National Pollution Inventory (NPI) (NPI, 2020)
- Air Quality Index (AQI) (DECCNSW, 2020)
- Bureau of Meteorology Climate change data. (BoM, 2020).

6.7.2 Existing environment

The review of the NPI database (2017/2018) undertaken on 25 February 2020 identified two facilities with a 15 kilometre radius of the proposal, being

- Air BP Newcastle (Williamtown-NSW)
- Tanilba Bay Wastewater Treatment Works (Mallabula-NSW).

The 2017/2018 data for these facilities reports that collectively they emitted six different pollutants including

- Ammonia (total)
- Ethylbenzene
- Total Nitrogen
- Total Phosphorus
- Total Volatile Organic Compounds
- Xylenes (individual or mixed isomers).

Air Quality Index rating	AQI value	Pollutant concentration			
		1 hour PM ₁₀	1 hour PM _{2.5}	1 hour NO ₂	1 hour SO ₂
		µg/m ³	µg/m ³	pphm	pphm
Very Good	0 - 33	< 27.2	< 21.1	< 4.1	< 6.8
Good	34 - 66	27.2 - 53.6	21.1 - 41.5	4.1 - 8.0	6.8 - 13.4
Fair	67 - 99	53.7 - 80.0	41.6 - 62.0	8.1 - 12.0	13.5 - 20.0
Poor	100 - 149	80.1 - 120.0	62.1 - 93.0	12.1 - 18.0	20.1 - 30.0
Very Poor	150 - 199	120.1 - 160.0	93.1 - 124.0	18.1 - 24.0	30.1 - 40.0
Hazardous	> 200	> 160.0	> 124.0	> 24.0	> 40.0

Figure 6-22 Air Quality Index rating and pollution concentration

A health alert is issued when the regional air quality index (RAQI) value reaches 100 or above, this is considered to be poor (100-149), very poor air quality (150-199) and hazardous (>200) (refer Figure 6-22).

A plot of the daily RAQI in the Lower Hunter area for the last 12 months, between 24/02/2019 and 24/02/2020 is shown in Figure 6-23.

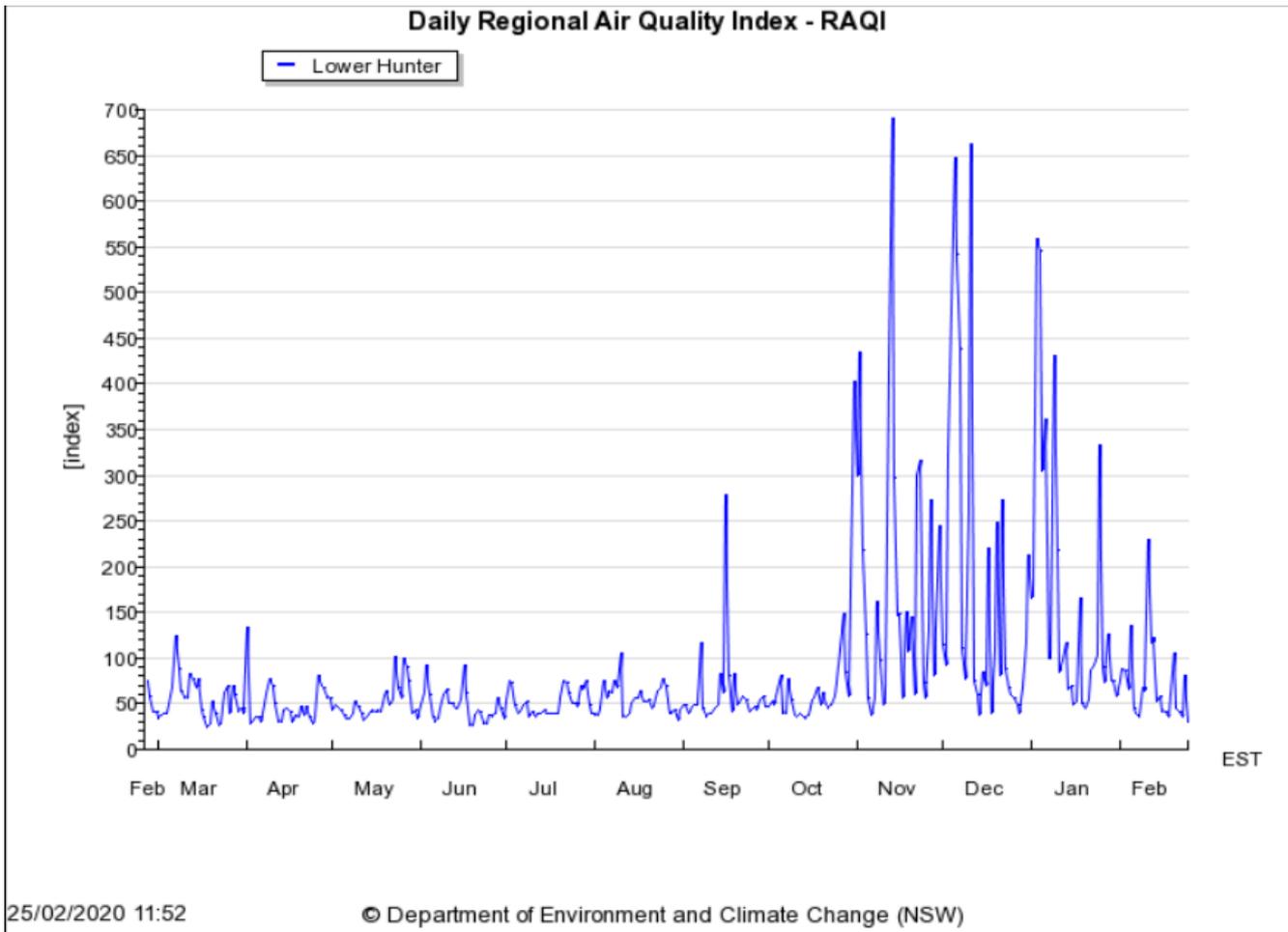


Figure 6-23 Daily RAQI values recorded at Lower Hunter monitoring station (DECCNSW, 2020a)

As shown in Figure 6-23, there were 26 days of poor air quality (100-149), six days of very poor air quality (150-199) and 32 days of hazardous air quality (>200). Poor air quality was fairly consistent until September 2019 with the commencement of bushfires in the region which resulted in increasing background concentrations through to February 2020 when bushfires were extinguished

The Stockton monitoring site is located about 20 kilometres from the proposal site and measures PM2.5 and PM10 at hourly intervals. Figure 6-24 shows a plot of daily averages of PM2.5 for the last 12 months between 24/02/2019 and 24/02/2020. Figure 6-25 shows a plot of the daily averages of PM10 for the same 12 month period. Due to the severity and longevity of the bushfire season both PM2.5 and PM10 significantly exceeded the threshold for poor quality. PM2.5 had four days of poor air quality (62.1-93) and two days of very poor air quality (93.1-124). PM10 had 24 days of poor air quality (80.1-120), three days of very poor (120.1-160) and three days of hazardous (>160). Poor air quality was consistent with the bushfires that were present in the area from September 2019 to February 2020.

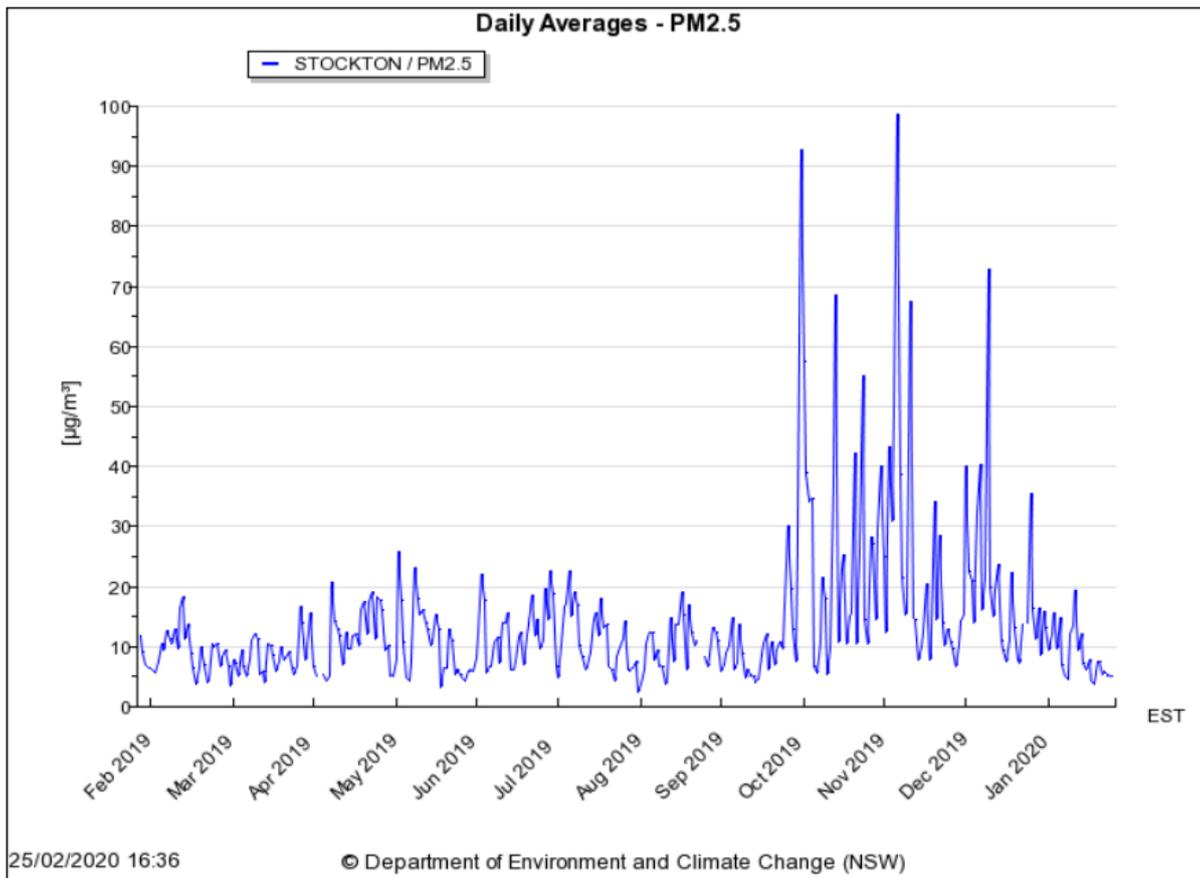


Figure 6-24 PM2.5 levels recorded at the Stockton monitoring station (DECCNSW, 2020b)

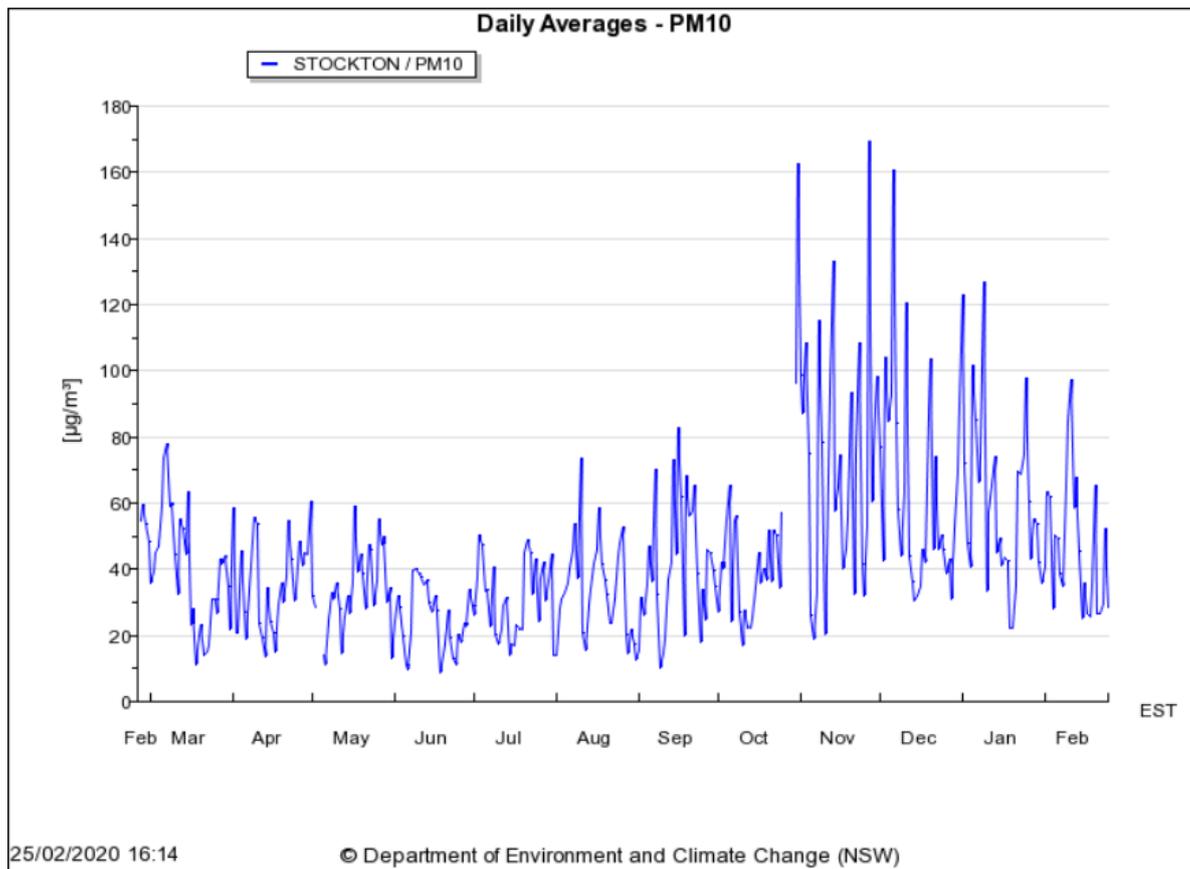


Figure 6-25 PM10 levels recorded at the Stockton monitoring station (DECCNSW, 2020b)

Climate data for the local area was obtained from the BoM (2020) station located at the Nelson Bay (Nelson Head) (station number 061054) about 15 kilometres north east of the proposal area. Climate data for the locality is summarised as follows

- Annual average rainfall is 1,338.9 millimetres, with June receiving the highest average monthly rainfall of about 159.0 millimetres
- Annual mean maximum temperature is 27.4 degrees. The warmest months are December to February, with mean maximum temperatures during these months ranging from 26.1 degrees to 21.7 degrees. The coolest month is July, with a mean maximum temperature of 17.6 degrees and a mean minimum temperature of 9.1 degrees.

Air pollutants can be dispersed and transported by local wind patterns. The nearest weather station with this information is also Nelson Bay (Nelson Head). This weather station indicates mean 9am wind speed ranges from 11.6 kilometres per hour in March to 15.9 kilometres per hour in June.

6.7.3 Potential impacts

Construction

During construction, dust levels would vary in relation to the type and extent of activities being carried out, weather conditions and the area of soil being exposed. A total of about 59,000 square metres in area would be progressively disturbed by the proposal, with about 5,003 cubic metres of cut material which would be reused as fill within the proposal area. These activities would potentially generate dust as it would leave areas temporary exposed and would require the stockpiling of excavated and imported soils and materials. Dust generation can be intensified during dry and windy conditions, particularly on hot days. Sources of dust and dust generation activities are expected to include:

- Vehicle and plant movements around the site
- Vegetation clearing and topsoil stripping
- Earthworks, including excavation and fill activities
- Handling, transfer and stockpiling of soil and materials
- Erosion of stockpiles and exposed areas.

Machines and other construction vehicles emit exhaust fumes and odours during the application of asphalt and line marking. These sources would generate PM2.5 and PM10 from exhaust, road abrasion, tyre wear, break wear and the resuspension of particles. Based on the proposal's construction scope of work and duration, and the scheduling of machinery operations (not all machinery operation simultaneously), potential emissions affecting local air quality would be expected to be minor and short term.

Operation

During operation, air quality impacts are not expected to differ greatly from the existing situation. Improved traffic flow would have potential to reduce air emissions in the immediate vicinity as a result.

6.7.4 Safeguards and management measures

Safeguards and management measures would be implemented to avoid, minimise or manage potential air quality impacts. These safeguards and management measures are shown in Table 6-40.

Table 6-40 Air quality safeguard and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
General air quality impacts	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include:</p> <ul style="list-style-type: none"> • Identification of potential risks/impacts due to the work/activities as dust generation activities • Management measures to minimise risk of dust generation including use of water carts for dust suppression • A process for monitoring dust on-site • A process for altering management measures as required and reprogramming construction activities if the safeguards and management measures do not adequately restrict dust generation 	Contractor	Preconstruction Construction	Section 4.4 QA G36 Environment Protection
Dust emissions	Stockpiles would be managed in accordance with the Transport for NSW requirements	Contractor	Construction	<i>Transport for NSW Stockpile Site Management Guideline</i>
Dust emissions	Work will cease when levels of visible airborne dust become excessive	Contractor	Construction	Section 4.4 QA G36 Environment Protection
Dust emissions	Works that disturb vegetation, soil or stockpiles will not be carried out during strong winds (over 40 km/h) as this may affect receivers (visibility on roads)	Contractor	Construction	Section 4.4 QA G36 Environment Protection
Dust emissions	<p>Stockpiled materials will be covered, stabilised or stored in areas not subject to high wind.</p> <p>Water will also be used to control dust on uncovered stockpiles.</p> <p>Stockpiles will be rolled or compacted</p>	Contractor	Construction	Section 4.4 QA G36 Environment Protection
Dust emission	All trucks will be covered when transporting material to and from the site	Contractor	Construction	Section 4.4 QA G36 Environment Protection

6.8 Waste and contamination

6.8.1 Methodology

The methodology was conducted:

- A desktop review of information relevant to the history of sites within the proposal area to determine past and present land uses.
- A databased search of NSW EPA contaminated land record and public record for licences, applications, notices, audit or pollution studies and reduction program.
- Review of MI Engineers Quantity Take Offs (MI Engineers 2020).

6.8.2 Policy setting

The safe storage, handling, transport, recovery and disposal of water is governed by the POEO Act and the WARR Act. Generators of waste as responsible for the correction classification of the waste they produce in accordance with the EPA Waste Classification Guidelines Part 1: Classifying waste (the Waste Classification Guidelines). A waste register is required to ensure that legislative requirements are met. The WARR Act provides a framework for considering resource management and is given effect by the NSW Waste Reduction and Purchasing Policy (WRAPP). Under the WRAPP Reporting Guidelines, agencies are required to give priority to buying material with recycled content, when it is cost and performance competitive to do so. Their plans must set out how the agency would reduce waste and increase purchases of recycled products, with baseline and performance data on:

- Total quantities of wastes being generated and recycled
- Total quantities of recycled content materials being purchases.

Transport for New South Wales contractors are required to propose recycled-content materials where they are cost and performance competitive and are the environmental equivalent (or better) than non-recycled alternatives. Specific materials that are targeted for reuse or recycling in the Transport for New South Wales Environmental Sustainability Strategy that are relevant to this proposal are included in Table 6-41.

Table 6-41 Target wastes for reuse

Target wastes	Recover target
Asphalt removal and replacement	Recover 95% of all asphalt for reuse
Concrete pavement and infill areas	Recover 76% of concrete for reuse
Waste steel from traffic control devices, including signage and electrical infrastructure	Recover 76% of steel for reuse
Waste aggregate	Recover 76% of aggregate for reuse
Virgin excavated natural materials (VENM)	Recover 95% of all VENM for reuse

The Transport for NSW *Re-use of waste off-site: Waste Fact Sheet 9* (Roads and Maritime, 2016) outlines the potential off-site re-uses for typical wastes from Transport for New South Wales construction projects.

These re-use opportunities do not require environmental licensing from the EPA, provided that all conditions for off-site re-use are met.

The Transport for NSW *Management of Wastes on Roads and Maritime Services Land Procedure* (Roads and Maritime, 2014) was developed in 2014 to minimise the risks of construction waste on Transport for NSW land. The procedure includes best practice and contingency planning for construction wastes on sites, benchmark preconstruction site assessment to establish the condition of a Transport for NSW owned site prior to hand over to a construction contractor, and a post-construction site condition assessment guide to verify that no unauthorised wastes remain on site post-construction.

6.8.3 Existing environment

Contamination

A search of the EPA Contaminated Lands Register on 6 March 2020 (EPA, 2020), indicates the proposal and ancillary site are not within a contaminated site. Sites have been identified in the suburbs of the proposal and ancillary site are shown in Table 6-42 .

Table 6-42 Contaminated sites within the vicinity of the proposal and ancillary areas

Site Name	Address	Contamination activity type	Management Class	Distance from site
Bob's Farm	15 Fenningham Island Road, Bobs Farm	Other Industry	Regulation under CLM Act not required	9 kilometres from the proposal
Hunter Land Effluent Pond	38 Cabbage Tree Road, Williamtown	Other Industry	Regulation under CLM Act not required	1.5 kilometres from ancillary site A

Waste

Transport for NSW is committed to ensuring responsible management of unavoidable waste and to promoting the reuse of such waste through appropriate measures in accordance with the resource management hierarchy principles embodied in the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). The resource management hierarchy principles in order of priority in the WARR Act are:

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

By adopting the above principles, Transport for NSW encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development.

6.8.4 Potential impacts

Construction

The largest quantities of waste likely to be generated by construction activity would be spoil from excavations, clearing grubbing and removal of pavement and subgrade (refer Table 6-43). Where possible, excavated spoil would be re-used again onsite in construction and landscaping activities. Excess excavated spoil would be stockpiled within the proposal area or at ancillary site as described in Section 3.4 and shown in Figure 3-7.

Waste streams likely to be generated during the construction phase are:

- Excess spoil from excavations
- Asphalt and subgrade material
- Green waste from clearing and grubbing
- Roadside steel posts, signs and poles
- Packaging and general waste from construction staff
- Waste water from wash-downs
- Redundant sediment and erosion controls such as silt fences.
- Disused conduits and cables from redundant utilities.

Table 6-43 Waste materials

Activity type	Estimate of quantity
Vegetation clearing	1,200m ³
Clearing and grubbing	35,500m ²
Demolition and removal of existing pavement, tie-in and milling	15,330m ²
Non-contaminated spoil (other than topsoil)	5,041m ³

* Note: quantities are based on 100% detailed design Quantity Take Off (MI Engineers).

Mulch from clearing grubbing would be reused on site for erosion and sediment controls and site restoration. Surplus quantities of mulch disposed offsite would be managed in accordance with the NSW EPA Resource Recovery Order (*The mulch order (2016)*) which requires preparation and implementation of risk management protocol for land application of mulch.

Excess material suspected of being contaminated would be disposed of at a licensed facility by a licensed contractor in accordance with NSW EPA Waste Classification Guidelines (EPA, 2014).

Operation

Waste

Operational aspects of the proposal would be generally similar to those that currently exist with the operation and maintenance of Nelson Bay Road. There would be limited volumes of waste generated and minimal resources used and the primary source of waste (litter, fly tipping) would be from road users. The proposal would therefore have a negligible impact on waste management during operation.

Contamination

There are minor contamination risks associated with the operation of the proposal including spills from heavy vehicles and motor vehicles. Spills and other potential contamination sources during operation would be managed by implementation of standard emergency spill procedures and associated safeguards.

6.8.5 Safeguards and management measures

The recommended safeguards and management measures to minimise impacts to waste and contamination during construction of the proposal are outlined in Table 6-44 .

Table 6-44 Waste and contamination safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction waste	<p>A Waste Management Plan (WMP) is to be prepared and implemented as part of the CEMP and include:</p> <ul style="list-style-type: none"> Measures to avoid and minimise waste associated with the project Classification of wastes generated by the project and management options (re-use, recycle, stockpile, disposal) Classification of wastes received from off-site for use in the project and management options Identifying any statutory approvals required for managing both on and offsite waste, or application of any relevant resource recovery exemptions Procedures for storage, transport and disposal Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions <p>The WMP would be prepared taking into account Transport for NSW <i>Environmental Procedure – Management of Wastes on Roads and Maritime Services Land</i> and any Transport for NSW Waste Fact Sheets.</p>	Contractor	Preconstruction Construction	Section 4.11 QA G36 Environment Protection
Construction waste	Waste would be classified in accordance with the methods and specifications of the NSW EPA Waste Classification Guidelines 2014	Contractor	Construction	NSW EPA Waste Classification Guidelines 2014

Impact	Environmental safeguards	Responsibility	Timing	Reference
Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Transport for NSW <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Contractor	Construction	Section 4.3 QA G36 <i>Environment Protection</i>
Contaminated land	If contamination is encountered a Contaminated Land Management Subplan (CLMS) would be prepared and implemented. Contaminated material would be managed in accordance with CLMS	Contractor	Construction	Section 4.2 QA G36 Environment Protection
Offsite disposal of mulch	Preparation and implementation risk management protocol for land application of mulch	Transport for NSW Contractor	Construction	NSW EPA Resource Recovery Order (<i>The mulch order</i> (2016))

6.9 Non-Aboriginal heritage

6.9.1 Methodology

A desktop investigation was completed to identify any non-Aboriginal heritage within the proposal. Searches were conducted to identify any previously recorded heritage within the proposal area. Database searches were undertaken on February 26, 2020 and included the following:

- State Heritage Register (SHR) and State Heritage Inventory (SHI)
- Australian Heritage Database
- Australia's National Heritage List
- Port Stephens LEP
- Transport for NSW's s170 register

6.9.2 Existing environment

Historical context

Coal and timber resources were identified in the Newcastle area in 1797, with the first official expedition into the Hunter led by Lieutenant-Colonel Paterson in the winter of 1801 the purpose of which was to explore the lower part of the Coal River, as it was then known, and to determine the nature of the reserves of coal. By 1821 settlers had occupied land as far north as Singleton by grazing and cultivation, extending northward to Ravensworth by 1824 and to the Karuah by 1825 (EMM, 2019).

Because Stockton Beach faces in a generally southerly direction, it forms a dangerous lee shore for sailing ships, small steamships and even for the bulk carrier 'Sygna' wrecked there in 1974. At least seventy and probably as many as 100 vessels were lost on Stockton Beach due to their inability to tack out of the bight.

Listed non-Aboriginal heritage items

The search of heritage registers identified two heritage items within 500 metres of the proposal (refer to Table 6-45 and Figure 6-26). The historic heritage sites are listed on the Port Stephens LEP.

Table 6-45 Listed heritage items in the vicinity of the proposal area

Name	Source	Number	Location	Comments
St Saviour's Anglican Church, including WWI memorial plaque	Port Stephens LEP	I108	12 Cabbage Tree Road, Williamtown	At least 9 kilometres from proposal area
"Devon House", including former Moxey's slab cottage, dairy, hay shed and slab barn	Port Stephens LEP	I209	150 Cabbage Tree Road, Williamtown	At least 9 kilometres from proposal area
Sabre jet fighter aircraft	Port Stephens LEP	I110	49 Medowie Road, Williamtown	At least 9 kilometres from proposal area

Name	Source	Number	Location	Comments
Farm silo	Port Stephens LEP	I111	20 Steel Street, Williamtown	At least 9 kilometres from proposal area
Stockton Beach Dune System, including Aboriginal site and shell middens, ship wrecks, WWII ramparts, tank traps, proofing range, rifle range and tin huts	Port Stephens LEP	I34	14 and 20A Popplewell Road, Fern Bay, 33, 35 and 37 Coxs Lane, Fullerton Cove, 27, 30, 32, 34, 40 and 42 Stockton Bight Track, Fullerton Cove, 3006 Nelson Bay Road, Salt Ash and 4080A Nelson Bay Road, Bobs Farm	Adjacent to proposal area, Ancillary Site A

Stockton Beach Dune System History

Stockton Beach is a twenty mile arc of sand without a rock to break its surface until Morna Point. In the mid nineteenth century a series of severe weather cycles destroyed the frontal dunes which had been weakened by cattle grazing. In the early 19th century the ocean was 100 metres further out than it is now. There were no drifting sands but a woodland which bound the dunes together. Ever since then the dunes have increased in area and pushed inland by the southerly and westerly winds. It is estimated they have moved inland about one metre per year (OEH, 2020).



- Proposal area boundary
- Site compound
- Heritage Conservation (HER)**
- Item - General

Nelson Bay Road Upgrade Section 1 30012877

Non-Aboriginal Heritage Fig. 6-26

Roadnet MDS 2019, Imagery: © Department of Customer Service 2020



Last updated by: FA13847 on 28/09/2020 at 15:08

Location: \\AUNCF\SV002\group\Projects\30012877 - Nelson Bay Road Stage 1\1000 Engineering\112_GIS\Map\REF\30012877_F006_31_Heritage.mxd

Figure 6-26 Non-Aboriginal heritage sites adjacent to the proposal area and ancillary site

6.9.3 Potential impacts

Construction

There is potential to impact unknown non-Aboriginal heritage items during construction of the proposal however this potential is considered low given that vegetation beyond the road formation has not been subject to previous disturbance.

Operation

The proposal is not expected to impact any non-Aboriginal heritage items in operation.

6.9.4 Safeguards and management measures

Safeguards and management measures would be implemented to avoid, minimise or manage potential non-Aboriginal heritage impacts. These safeguards and management measures have been identified in Table 6-46 .

Table 6-46 Non-Aboriginal safeguard and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	<ul style="list-style-type: none"> The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied. 	Contactors	Construction	Section 4.10 QA G36 <i>Environment Protection</i>

6.10 Socio-economic, property and land use

6.10.1 Methodology

A socio-economic impact assessment was prepared for the proposal in accordance with the Transport for NSW Environmental Impact Assessment Practice Note – Socio-economic Assessment (EIA-N05) and the Transport for NSW draft methodology for assessing significance of socio-economic impacts. Observations regarding social and economic issues within the proposal area are based on 2016 Australian Bureau of Statistics (ABS, 2020) census data and relevant government and industry regional summary reports.

6.10.2 Existing environment

Land use

The proposal area includes road reserve associated with the existing Nelson Bay Road and areas of crown waterways at Tilligerry Creek. Adjacent to the Nelson Bay Road reserve are privately owned land, Worimi National Park and land owned by Worimi Local Aboriginal Land Council. European agricultural practices have occurred throughout much of the area and present land uses include agriculture, horse and cattle grazing, hobby farms and low-density housing, as well as recreational and industrial businesses. The study area has been subjected to a moderate to high level of disturbance associated with vegetation clearing and construction of Nelson Bay Road itself. Utilities in the proposal area are discussed in Section 3.5.

Demographics

The proposal is primarily in the suburb of Salt Ash with a small portion located, including the ancillary site in the suburb of Bobs Farm. Both these suburbs are located in the Port Stephens LGA. The combination of these two suburbs represent the proposal area. Key information is presented in Table 6-47 below.

Table 6-47 Population statistics of the proposal area (ABS, 2016)

Indicator	Salt Ash	Bobs Farm	Total	Per cent	Port Stephens LGA	Per cent
Total population	1,128	451	1,579		69,556	
Proportion of people ages 14 years of younger	119	63	182	11.5%	12,514	18.0%
Proportion of people aged 65 years or older	214	75	289	18.3%	15,958	22.9%
Total travel to work total	489	207	696	-	27,602	
Travel to work by car (as driver)	330	134	464	66.7%	19,479	70.6%
Travel to work by car (as passenger)	21	14	35	5.0%	1,254	4.5%

Economic profile

The key economic indicators for the proposal area from the 2016 Census include:

- The median weekly household income for Salt Ash (\$1,289) and Bobs Farm (\$1,286) compared to Port Stephens LGA (\$1,180)

- There were 734 people who reported being in the labour force in the week before Census night in the proposal area. Of these 34.2% per cent were employed full time, 23.6 per cent were employed part-time and 4.3 per cent were unemployed (compared to the Port Stephens LGA with 7.2 per cent unemployment)
- The most common occupations in the proposal area included:
 - Technicians and Trades Workers: 18.3 per cent
 - Community and Personal Service Workers: 14 per cent
 - Managers: 14 per cent
 - Professionals: 12.5 per cent

There are significant variances in industry of employment in the proposal area due to the number of employed persons over 15 years.

- Of the employed people in Salt Ash 4.3 per cent worked in Road Freight Transport. Other major industries of employment included Cafes and Restaurants 3.3 per cent, Offshore Longline and Rack Aquaculture three per cent, Defence three per cent and Supermarket and Grocery Stores 2.8 per cent
- Of the employed people in Bobs Farm, 5.5 per cent worked in Supermarket and Grocery Stores. Other major industries of employment included House Construction 4.9 per cent, Plumbing Services 4.3 per cent, Coal Mining 3.7 per cent and Carpentry Services 3.7 per cent.

Travel behaviors

On average in the proposal area, about 43.3 per cent of employed people drove to work each day.. Other options included working from home with 6.6 per cent in Salt Ash and 11.3 per cent in Bobs Farm. Public transport was very minimal with one per cent in Salt Ash and zero per cent in Bobs Farm.

Access and connectivity

There is currently no designated cycle paths or pedestrian paths that have been provided along Nelson Bay Road and the route has been clarified by Transport of NSW as a high difficulty on road cycling environment due to its narrow shoulder. As described in Section 6.6, buses on routes 131, 135 and 139 travel along the proposal, there are currently two bus stops within the proposal that would be removed as part of the upgrade.

Property access adjustments

Table 6-48 Table 6-48 below identifies existing property access within the vicinity of the project and impacts from the proposal.

Table 6-48 Property accesses

Location	Access Type	Comment
CH. 29760 – Southern side	Residential access	Within proposal boundary but beyond physical works.
CH. 29760 – Northern side	Residential access	Within proposal boundary but beyond physical works.
CH. 29910 – Southern side	Residential access	Within proposal boundary but beyond physical works.
CH. 29960 – Northern side	Maintenance access track	Within proposal works. Worimi LALC electrical easement access. No impact anticipated

Location	Access Type	Comment
CH. 30020 – Southern side	Boyce’s Trail access	Within proposal works. National Parks and Wildlife Services access is included in design.
CH. 30380 – Northern Side	Foot track	Within proposal works. Impact anticipated. Located at decommissioned bus stop, foot track to electrical easement in Worimi LALC.
CH. 30940 – Northern side	Maintenance access track	Within proposal works. Access track to be removed due to sight distance constraints on inside of horizontal curve. Additional access track located beyond project extents.
CH. 30930 – Southern side	Easement Trail - Maintenance access track	Within proposal works. Existing National Parks and Wildlife Services access is wide gravel track up to shoulder, with gate and signage. Access is included in design.

Property acquisition or property adjustment

No property acquisition or property adjustment is required.

6.10.3 Potential impacts

Construction

Demographics

The proposal is not expected to have a direct impact on the demographic profile of the study area.

Travel behaviour

Due to the lack of alternative routes in the area, the proposal is not expected to have an impact on the current travel behaviours. However, it is expected that at times there would need to be changes to local traffic conditions. These include:

- Speed limit reductions in the construction area
- Increased truck movements associated with construction activities
- Partial or complete stoppages of traffic for some construction activities.

Where possible, the most disruptive work would be undertaken outside of peak periods.

Economic profile

Construction of the proposal is not expected to significantly influence the economic indicators for the study area.

Business and industry

Impacts during construction to business, industry and tourism would be limited to impacts from changes to traffic conditions. Temporary delays and disruptions during construction would also impact on freight travel times, increasing transportation costs and vehicle operating costs.

Access and connectivity

During construction, temporary impacts on access and connectivity may be experienced for road users and freight networks, due to:

- Temporary changes to road conditions, including partial or full closure of lanes to allow for road widening works and intersection upgrades, and temporary speed reductions, leading to temporary traffic delays and disruptions along Nelson Bay Road
- Temporary delays for emergency services
- Increase in construction traffic along Nelson Bay Road, including heavy vehicles.

During construction, changes to road conditions near to construction works and access changes may impact on perceptions of road safety for some motorists travelling along Nelson Bay Road.

Amenity

Construction of the proposal would impact the local amenity of the area temporarily. These impacts relate to increased noise and dust from construction activities, additional traffic on Nelson Bay Road

Operation

Demographics

The proposal is not expected to have a direct impact on the demographic profile of the study area.

Travel behaviour

The proposal is not expected to have an impact on travel behaviours. However, the proposal would improve travel times and provide a safer journey for road users.

Economic profile

Operation of the proposal is not expected to influence the economic indicators for the study area.

Access and connectivity

The proposal would improve the safety of the highway and reduce the likelihood and severity of vehicle crashes along the corridor. This would facilitate safer and quicker access for local and regional communities and to other areas of NSW for freight, residents and visitors. Local and regional bus services and emergency vehicles would benefit from the proposal through improved travel times.

Amenity

The proposal would result in some improvement to the local amenity through better traffic flow. No operational noise impacts on sensitive receivers are anticipated as a result of the proposal.

6.10.4 Safeguards and management measures

A summary of the safeguards and mitigation measures relevant to potential socio-economic, property and land use associated with the proposed works are provided in Table 6-49 below.

Table 6-49 Socio-economic, property and land use safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic and communication	<p>A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum):</p> <ul style="list-style-type: none"> • Mechanisms to provide details and timing of proposed activities to 	Transport for NSW Contractor	Preconstruction Construction	Standard safeguards EIA-P05-G01-T02

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>affected residents, including changed traffic and access conditions</p> <ul style="list-style-type: none"> Contact name and number for complaints. <p>The CP will be prepared in accordance with the <i>Community Involvement and Communications Resource Manual</i> (RTA, 2008).</p>			
Socio-economic	The Construction Contractor will inform residents before any interruptions to utility services that may be expected during utility adjustments in accordance with the Community Engagement Plan	Contractor	Construction	Additional safeguard
Consultation	Ongoing stakeholder and community consultation would be undertaken in accordance with the Transport for NSW Communication Toolkit	Transport for NSW Contractor	Construction	Additional safeguard
Complaints	A complaints handling procedure and register would be included in the CEMP and would include that all complaints would be responded to in	Contractor	Preconstruction Construction	Additional safeguard

6.11 Cumulative impacts

6.11.1 Study area

The cumulative impact assessment has considered developments within the Port Stephens LGA and greater Newcastle area. Cumulative impacts could be experienced if construction or operation of the proposal coincided with construction or operation of other local developments such as other road upgrades, commercial/industrial and private development.

6.11.2 Broader program of work

The broader Williamstown to Bobs Farm duplication project would address increasing peak hour traffic congestion, road safety risks and reliability of travel on Nelson Bay Road. Planning for broader Williamstown to Bobs Farm duplication project is in strategic phase, and a preferred alignment has not been identified.

To accelerate the delivery program for the duplication of Nelson Bay Road, the broader project has been separated into separate stages of work. The strategic assessment has identified that the Section 1 stage of works (the proposal) can be accelerated on the basis that the preferred alignment (on-line) has already been chosen for this section. The proposal is a relatively simple design with construction works being undertaken within the road corridor.

The proposal will not be affected by the alignment options currently being considered for the broader Williamstown to Bobs Farm duplication project. All alignment options being considered for the broader Williamstown to Bobs Farm duplication project will tie-in to the western end of the proposal and so rely on the completion of construction the proposal.

M1 Pacific Motorway forecast the Pacific Highway at Raymond Terrace

The NSW Government has provided \$4.3 million in 2018-2019 to continue planning for a future extension of the M1 Pacific Motorway to the Pacific Highway at Raymond Terrace. M1 Pacific Motorway extension to Raymond Terrace Changes to the revised concept design were displayed for community comment in August and September 2016. Timing for construction is not confirmed and would be dependent on planning approval, future traffic needs and funding availability.

6.11.3 Potential impacts

Construction

There is potential that the construction periods of some of these developments would overlap resulting in cumulative impacts. The key cumulative impacts during construction include:

- Increased construction vehicle traffic on local roads causing congestion and delays
- Cumulative air quality impacts from dust and vehicle emissions associated with multiple construction work
- Temporary changes to the visual amenity of the area through the removal of vegetation and temporary infrastructure associated with construction of the proposal and the ancillary site (offices, amenities, material storage and stockpiles).

Operation

The proposal, in combination with all the road upgrade would result in cumulative benefits for Nelson Bay Road corridor and to the locality by increased capacity of the road network, improved traffic flow and journey times and improved road safety. Operational noise and airy quality impacts would be addressed during design on a project-by-project basis to minimise impacts on sensitive receivers. A summary of the potential cumulative and operational impacts is provided in Table 6-50 .

Table 6-50 Summary of potential cumulative impacts

Environmental factor	Construction	Operation
Biodiversity	Vegetation would be removed to allow construction of projects. The exact extent of clearing and associated impact would depend on finalisation of detailed design and construction methods of each development. Cumulative assessment of impacts on biodiversity values of developments within five kilometres of the proposal concluded the cumulative impact resulting from the upgrade would not be significant.	There would be a positive impact with the hydromulching of disturbed areas and surrounding native species recolonising these areas over time and enhancing biodiversity.
Visual	The presence of construction vehicles, plant and equipment would impact the visual amenity of the area	There would be a positive impact with maturing of vegetation in landscaped areas growing over time and nullifying visual impacts.
Traffic	All of the other projects and developments in the immediate vicinity of the proposal area are likely to require additional light, and heavy vehicles movements during the construction period for transportation of building materials and wastes.	It is unlikely that the proposal would result in any cumulative operational traffic impacts.

6.11.4 Safeguards and management measures

Refer to Table 6-51 below and the safeguards listed in Chapter 6 (Sections 6-1 to 6-10) of the REF.

Table 6-51 Cumulative impacts safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative construction impacts	The CEMP would consider potential cumulative impacts from surrounding development activities as they become known.	Contractor	Construction	Additional safeguard

7. Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements required prior to construction are also listed.

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result 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 Project Environmental Management Plan (PEMP) and a Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The PEMP and CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The PEMP and CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Officer, Hunter Region prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP and PEMP would be developed in accordance with the specifications set out in the [adjust as necessary: QA Specification G36 – *Environmental Protection (Management System)*, QA Specification G38 – *Soil and Water Management (Soil and Water Plan)*, QA Specification G40 – *Clearing and Grubbing*, QA Specification G10 – *Traffic Management*].

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 Transport for NSW Environment Manager prior to commencement of the activity. 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>	Transport for NSW Contractor	Preconstruction Construction	Transport for NSW standard safeguard
GEN2	General - notification	All businesses, residential properties and other key stakeholders (e.g. schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Transport for NSW Contractor	Preconstruction	Transport for NSW standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN3	General – environmental awareness	<p>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.</p> <p>Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:</p> <ul style="list-style-type: none"> • Areas of Aboriginal heritage sensitivity • Threatened species habitat • Adjoining residential areas requiring particular noise management measures. 	Transport for NSW Contractor	Detailed design Preconstruction	Transport for NSW standard safeguard

Biodiversity

B1	Biodiversity impacts	<p>A Flora and Fauna Management Plan will be prepared in accordance with Transport for NSW's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (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 <i>Landscape Guideline</i> (RTA, 2008) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Procedures addressing relevant matters specified in the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens. 	Contractor	Detailed design Preconstruction	Section 4.8 QA G36 <i>Environment Protection</i>
B2	Removal of native vegetation	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Contractor	Preconstruction	Appendix C

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	Contractor	Preconstruction	Appendix C
		Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
		Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
		The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal footprint	Contractor	Construction	Appendix C
		Any removal of trees adjacent to the proposal boundary that are likely to create a safety risk to road users requires written approval from Transport for NSW and consultation with relevant land owners.	Contractor	Preconstruction	Clause 88 of the Roads Act 1993
B3	Removal of threatened plants	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal footprint.	Contractor	Construction	Appendix C
		Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
		The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads	Contractor	Construction	Appendix C

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		and Traffic Authority, 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal footprint.			
B4	Removal of threatened species habitat and habitat features	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
		Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	Contractor	Construction	Appendix C
		Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
B5	Injury and mortality of fauna and fragmentation of identified habitat corridors	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
		Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
		The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal footprint.	Contractor	Construction	Appendix C
		Road-kill and connectivity impacts will be minimised for Koalas and other less-mobile fauna species via: <ul style="list-style-type: none"> Installation of fauna exclusion fencing along the southern side of Nelson Bay Road in areas of likely occurrence (about just west of Boyces Trail east to the Easement Trail). 	Contractor	Construction	Appendix C

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Fauna exclusion fencing site location selection and design specifics to be assessed by a suitably qualified person. Installation of 'Koala Warning Signs' or 'Injured Native Wildlife Signs' in areas of potential wildlife conflict areas or crossing points. Implement regular slashing of roadside vegetation in clear zones to minimise the height of ground cover in potential conflict areas or crossing point. 			
B6	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
B7	Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011). Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
B8	Invasion and spread of pests	Pest species will be managed within the proposal site.	Contractor	Construction	Appendix C
B9	Invasion and spread of pathogens and disease	Implement hygiene procedures for the use of vehicles and the importation of materials to the proposal footprint in accordance with <i>Guide 7: Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011). Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	Contractor	Construction	Appendix C
B10	Changes to hydrology and impacts to groundwater	Construction to be completed in accordance with 'Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction, Sydney' (Blue Book) (Department of Environment and Climate Change, 2008).	Contractor	Construction	Appendix C

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
	dependant ecosystems				
Aboriginal heritage					
AH1	Aboriginal heritage	<p>The <i>Standard Management Procedure – Unexpected Heritage Items</i> (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. Work will only re-start once the requirements of that Procedure have been satisfied.</p> <p>If there is a confirmed discovery of archaeological Aboriginal human remains it is recommended that consultation occur with the identified knowledge holders in relation to: the development of a Management Plan for proposed works in the relevant area; cultural ceremonies in relation to the human remains and the site of their occurrence; and, repatriation of the human remains.</p>	Transport for NSW	Construction	<p>Section 4.9 QA G36 Environment Protection</p> <p>CVA (refer Appendix E)</p>
AH2	Aboriginal heritage	<p>An AHIP is required for proposed impacts to Aboriginal site OFOC1 (AHIMS 38-4-1600):</p> <ul style="list-style-type: none"> • An AHIP is proposed for 10 years to allow for the proposed development to be completed. • The AHIP should limited to the existing road corridor, inclusive of partial impacts to OFOC1 (AHIMS 38-4-1600). • The AHIP conditions should allow for unmitigated impacts to any unidentified Aboriginal objects (excluding human skeletal remains) within the proposed AHIP boundary. It is anticipated that any such objects are likely to be highly disturbed and of similarly low significance as the known OFOC1 (AHIMS 38-4-1600). • An Aboriginal Site Impact Recording Form (ASIRF) must be submitted to Heritage NSW and AHIMS to document impacts to the site in accordance with AHIP conditions. 	Transport for NSW Contractor	Preconstruction Construction	ACHAR (refer Appendix D)
AH3	Aboriginal heritage	All land-disturbing activities must be confined to within the existing road corridor. Prior to commencement of construction activities, the perimeter of the proposal area should be fenced with high visibility curtilage to prevent	Contractor	Construction	ACHAR (refer Appendix D)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		inadvertent impacts outside of the area assessed including to the possible women's tree.			
AH4	Aboriginal heritage	<p>Completion of cultural heritage awareness training will be a requirement of the Construction Environmental Management Plan for all employees and contractors during project construction.</p> <p>An Aboriginal cultural heritage awareness training package should be delivered as part of the site induction for all contractor(s) and maintenance personnel involved in the construction works. The training package to be developed by a cultural heritage specialist in consultation with the RAPs and Knowledge Holders. The training package should at a minimum ensure awareness of the cultural significance of the project area, the requirements of the AHMP and relevant statutory responsibilities, and the identification of unexpected heritage items and appropriate management procedures.</p>	Contractor	Construction	<p>ACHAR (refer Appendix D)</p> <p>CVA (refer Appendix E)</p>
AH5	Aboriginal heritage	<p>In the event that known or suspected human skeletal remains are encountered within the study area, the immediate vicinity will be secured and the find reported to the environmental manager, the police and the state coroner on the same day of the find (as required for all human remains discoveries). Additionally:</p> <ul style="list-style-type: none"> • The environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material • If it is determined that the skeletal material is ancestral Aboriginal remains, Heritage NSW will be contacted for advice, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains and the site will be recorded in accordance with the • National Parks and Wildlife Act 1974 and Heritage NSW guidelines. 	Transport for NSW Contractor	Construction	ACHAR (refer Appendix D)
AH6	Aboriginal cultural values	An Aboriginal Heritage Management Plan (AHMP) should be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). The AHMP should provide specific guidance on measures and controls to be undertaken to avoid and mitigate impacts on Aboriginal cultural heritage during construction. This should include protection measures to be applied during construction, including but not limited to the	Contractor	Preconstruction Construction	CVA (refer Appendix E)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		recommendations set out in this table, as well as contractor training in general Aboriginal cultural heritage awareness and management of Aboriginal heritage values.			
AH7	Aboriginal cultural values	The AHMP should provide for an addition to the <i>Unexpected Heritage Items Procedure 2015</i> to require the notification of the identified knowledge holders within 48 hours of any discovery of potential archaeological Aboriginal skeletal remains during the proposed works.	Transport for NSW Contractor	As required	CVA (refer Appendix E)
AH8	Aboriginal heritage	The development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist on the cultural values and historical records relating to the cultural landscape of the Section 1 study area with a focus on the three values identified in Table 2. The report to be produced as a full colour booklet for distribution to local libraries and educational institutions. The content of the booklet to be developed in consultation with the RAPs and Knowledge Holders.	Transport for NSW Contractor	Preconstruction Construction	Cultural Values Assessment

Noise and vibration

N1	Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the 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, taking into account Beyond the Pavement: urban design policy, process and principles (Roads and Maritime, 2014). • 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. 	Contacto	Preconstruction Construction	Section 4.6 of QA G36 Environment Protection
----	---------------------	--	----------	------------------------------	--

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
N2	Noise and vibration	<p>All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least 5 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Transport for NSW Contractor	Preconstruction Construction	Section 3.7 QA G36 Environment Protection
N3	Noise and vibration	<ul style="list-style-type: none"> • Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone numbers. • Notification should be a minimum of five working days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required 	Transport for NSW Contractor	Preconstruction Construction	Appendix F
N4	Site induction	<p>All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:</p> <ul style="list-style-type: none"> • All project specific and relevant standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) 	Contractor	Construction	Appendix F

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Environmental incident procedures 			
N5	Construction hours and scheduling	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and or vibration levels should be scheduled during less sensitive time periods	Contractor	Construction	Appendix F
N6	Asphalt paving Day Out of Hours Residential Receiver R1	<ul style="list-style-type: none"> V = Validation of predicted noise levels N = Notification <ul style="list-style-type: none"> Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them R2 = Respite Period <ul style="list-style-type: none"> Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month. DR = Duration Respite <ul style="list-style-type: none"> Respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. In this instance and where it can be strongly justified it may be beneficial to increase the number of evenings or nights worked through Negotiated Respite so that the proposal can be completed more quickly. Pre-purchased movie tickets or a similar offer may also provide respite for the community while providing provision for additional out of hours work. This measure is determined on a proposal-by- 	Contractor	Construction	Appendix F

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<p>proposal basis and may not be applicable to all Transport for NSW proposals.</p> <ul style="list-style-type: none"> – The receivers that should be liaised with to gain community support for Negotiated Respite include those where out of hours work exceed the NML. – Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Negotiated Respite. 			
N7	Day Out of Hours Residential Receivers R2 and R8	<p>Notifications (letterbox drop or equivalent) (N)</p> <p>Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them</p>	Transport for NSW Contractor	Construction	Appendix F

Landscape and Visual

LV1	Revegetation	Revegetation of roadside batters, landscape mounds, in front of the fauna fence and other areas disturbed by proposed works using species suitable to the local environment.	Contractor	Construction	Appendix G
LV2	Retaining walls	Implementation of an appropriate treatment to retaining walls to create interest and to be complementary to the landscape character.	Transport for NSW	Detailed design	Appendix G
LV3	Temporary lighting	Temporary site lighting must be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting and the TMP	Contractor	Construction	AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting,

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
					<i>Traffic Control at Work Sites Manual (RTA, 2010) and QA Specification G10 Control of Traffic</i>
LV4	Visual impact of ancillary sites	Ancillary sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including avoiding temporary light spill into residences during night works	Contractor	Construction	Core standard safeguard
LV5	Visual amenity	Work to be carried out in accordance with Transport for NSW EIA-N04 Guideline for Landscape Character and visual impact assessment	Contractor	Construction	Standard safeguard EIA-P05-G01-T02

Soil and water

SW1	Soil loss and water quality	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP would address the management of stockpiles including their location.	Contractor	Preconstruction Construction	Section 2.1 QA G38 Soil and Water Management Transport for NSW Stockpile Management Guideline (2015)
SW2	Soil loss and water quality	A site specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented as part of the SWMP and will show the location of all erosion and sediment controls (ERSED). The ESCP will be progressively updated to address changes in construction staging. The ESCP will include arrangements for the following:	Contractor	Preconstruction Construction	Section 2.2 QA G38 Soil and Water Management Landcom's Managing

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> • Identification of high risk construction activities and appropriate ERSED controls including off-site/site water separation • Management of weather events, including monitoring of potential high risk events (such as storms), specific controls and follow-up maintenance • Location and management of stockpiles including ERSED controls 			Urban Stormwater: Soils and Construction series Transport for NSW Stockpile Management Guideline (2015)
SW3	Stockpile management	Stockpiles will be designed, established, operated and decommissioned in accordance with the Transport for NSW Stockpile Site Management Guideline 2015.	Contractor	Construction	Transport for NSW Stockpile Management Guideline (2015)
SW4	Groundwater	Hydrocarbon refuelling areas and chemical stores to be lined/or bunded and at least 50 metres from any groundwater source to minimise potential of pollution	Contractor	Construction	Section 4.3 QA G36 Environment Protection
Traffic and transport					
TT1	Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Transport for NSW Traffic Control at Work Sites Manual (RTA, 2010) and QA Specification G10 Control of Traffic (Roads and Maritime, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • Confirmation of haulage routes • 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 	Contractor	Preconstruction Construction	Section 4.8 QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> 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. 			
TT2	Changed transport and access	Road users, local residents and local business are to be informed a minimum of five days of changes conditions, including the likely disruptions to access (if applicable)	Transport for NSW Contractor	Preconstruction Construction	Section 3.7 QA G36 Communication
TT3	Disruption to traffic and transport	Real-time information is to be made available to road users through temporary Variable Message Signs (VMS), the Live Traffic and 131 500 websites, and the media	Transport for NSW Contractor	Construction	Section 3.7 QA G36 Communication Traffic Control at Work Sites Manual (RTA, 2010) and QA G10 Control of Traffic
TT4	Disruption to traffic and transport	Construction staging and materials are to be managed to minimise the number of haulage and delivery vehicles required on site	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010) and QA G10 Control of Traffic

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
TT5	Disruption to traffic and transport	The designated site access points and haulage routes are to be used	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010) and QA G10 Control of Traffic
TT6	Disruption to traffic and transport	Construction finish times to be planned for minimal impact to the afternoon peak traffic flows	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010) and QA G10 Control of Traffic
TT7	Disruption to traffic and transport	Installation of advisory and directional signage, line marking and pavement markings to direct motorists via the safest and most convenient route	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010) and QA G10 Control of Traffic
TT8	Disruption to traffic and transport	Delivering plant and equipment to the site outside of peak traffic flow	Contractor	Construction	Traffic Control at Work Sites Manual (RTA, 2010) and QA G10 Control of Traffic

Air quality

AQ1	General air quality impacts	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include:</p> <ul style="list-style-type: none"> • Identification of potential risks/impacts due to the work/activities as dust generation activities 	Contractor	Preconstruction Construction	Section 4.4 if QA G36 Environment Protection
-----	-----------------------------	--	------------	------------------------------	--

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> • Management measures to minimise risk of dust generation including use of water carts for dust suppression • A process for monitoring dust on-site • A process for altering management measures as required and reprogramming construction activities if the safeguards and management measures do not adequately restrict dust generation 			
AQ2	Dust emissions	Stockpiles would be managed in accordance with the Transport for NSW requirements	Contractor	Construction	<i>Transport for NSW Stockpile Site Management Guideline</i>
AQ3	Dust emissions	Work will cease when levels of visible airborne dust become excessive	Contractor	Construction	Section 4.4 QA G36 Environment Protection
AQ4	Dust emissions	Works that disturb vegetation, soil or stockpiles will not be carried out during strong winds (over 40 km/h) as this may affect receivers (visibility on roads)	Contractor	Construction	Section 4.4 QA G36 Environment Protection
AQ5	Dust emissions	Stockpiled materials will be covered, stabilised or stored in areas not subject to high wind. Water will also be used to control dust on uncovered stockpiles. Stockpiles will be rolled or compacted	Contractor	Construction	Section 4.4 QA G36 Environment Protection
AQ6	Dust emissions	All trucks will be covered when transporting material to and from the site	Contractor	Construction	Section 4.4 QA G36 Environment Protection

Waste

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
W1	Construction waste	<p>A Waste Management Plan (WMP) is to be prepared and implemented as part of the CEMP. The WMP will include:</p> <ul style="list-style-type: none"> • Measures to avoid and minimise waste associated with the project • Classification of wastes generated by the project and management options (re-use, recycle, stockpile, disposal) • Classification of wastes received from off-site for use in the project and management options • Identifying any statutory approvals required for managing both on and offsite waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions <p>The WMP would be prepared taking into account the Transport for NSW Environmental Procedure – Management of Wastes on Transport for NSW Services Land and relevant Transport for NSW Waste Fact Sheets.</p>	Contractor	Preconstruction Construction	Section 4.11 QA G36 Environment Protection
W2	Construction waste	Waste would be classified in accordance with the methods and specifications of the NSW EPA Waste Classification Guidelines 2014	Contractor	Construction	NSW EPA Waste Classification Guidelines 2014
W3	Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Transport for NSW <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Contractor	Construction	Section 4.3 of QA G36 <i>Environment Protection</i>
W4	Contaminated land	If contamination is encountered a Contaminated Land Management Sub-Plan (CLMS-P) would be prepared and implemented. Any contaminated material would be managed in accordance with CLMS-P	Contractor	Construction	Section 4.2 QA G36

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
					Environment Protection
W5	Offsite disposal of mulch	Preparation and implementation risk management protocol for land application of mulch	Transport for NSW Contractor	Construction	NSW EPA Resource Recovery Order (<i>The mulch order</i> (2016))
Non-Aboriginal heritage					
NAH1	Non-Aboriginal heritage	<ul style="list-style-type: none"> The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied. 	Transport for NSW Contractor	Construction	Section 4.10 QA G36 Environment Protection
Socio-economic, property and land use					
SE1	Socio-economic and communication	<p>A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum):</p> <ul style="list-style-type: none"> Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints. <p>The CP will be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008).</p>	Transport for NSW Contractor	Preconstruction Construction	Standard safeguards EIA-P05-G01-T02
SE2	Socio-economic	The Construction Contractor will inform residents before any interruptions to utility services that may be expected during utility adjustments in accordance with the Community Engagement Plan.	Transport for NSW Contractor	Preconstruction / Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SE3	Consultation	Ongoing stakeholder and community consultation would be undertaken in accordance with the Transport for NSW Communication Toolkit.	Transport for NSW	Construction	Additional safeguard
SE4	Complaints	A complaints handling procedure and register would be included in the CEMP and would include that all complaints would be responded to in a timely manner.	Contractor	Preconstruction Construction	Additional safeguard
Cumulative impacts					
CU1	Cumulative construction impacts	The CEMP would consider potential cumulative impacts from surrounding development activities as they become known.	Contractor	Construction	Additional safeguard

7.3 Licensing and approvals

Table 7-2 Summary of licensing and approvals required

Instrument	Requirement	Timing
<i>NSW Roads Act 1993 Section 138</i>	Road Occupancy Licence	Prior to commencement of the activity.
<i>National Parks and Wildlife Act 1974 Section 90</i>	Aboriginal Heritage Impact Permit	Prior to commencement 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 ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

8.1 Justification

8.1.1 Social factors

As documented in Section 6, there would be some short-term negative social impacts as a result of the disturbance and change during construction of the proposal. The combined effect of construction noise, traffic delays, dust, property access changes, and general disturbance caused by construction activity, and associated construction traffic and machinery movements, would result in a general loss of amenity for residents, road users and others who live near the proposal area and those who visit the proposal area on a regular basis.

As documented in Section 6.6.3, speed restrictions and traffic delays have the potential to increase travel time for road users on Nelson Bay Road. Impacts during construction to business, industry and tourism would be limited to impacts from changes to traffic conditions.

Compared with the 'do nothing' option where the existing road is not upgraded, the long-term effect would be an overall social benefit through upgrading the Nelson Bay Road at this location.

8.1.2 Biophysical factors

The design of the proposed upgrade of the road alignment at Salt Ash and Bobs Farm on Nelson Bay Road has reduced the amount of native vegetation removed to a total of 2.27 hectares of vegetation.

Assessments of significance have been carried out and determined that the proposal is unlikely to have a significant impact on any of the biodiversity values present within the study area.

8.1.3 Economic factors

Aside from the disruption from temporary traffic delays during construction which have potential to increase transportation and vehicle operating costs, construction of the proposal is not expected to significantly influence the economic indicators for the study area.

Compared with the 'do nothing' option, the proposal would potentially deliver long-term economic benefits associated with upgrading the road at Salt Ash and Bobs Farm and reduce travel times for road users.

8.1.4 Public interest

The public interest is best served through the equitable distribution of resources, and investment in public infrastructure that fulfils the needs of the majority. The proposal represents a cost-efficient investment in public infrastructure that would maximise the long-term social and economic benefits, while minimising the long-term negative impacts on communities and the environment. During the construction phase, the proposal would result in impacts on Aboriginal heritage, biodiversity, air quality, water quality, landscape

and visual amenity, traffic and noise. Compared with the 'do nothing' option, these impacts would be outweighed by the long-term benefits of upgrading the road at Salt Ash and Bobs Farm once the proposal is operational.

As a result, construction of the proposal is considered to be in the public interest.

8.2 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 proposal would improve the transport network while minimising impacts on the natural and built environment. It is therefore consistent with the objective of promoting the social and economic welfare of the community and a better environment.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in Sections 8.2.1 to 8.2.4 below.
1.3(c) To promote the orderly and economic use and development of land.	The proposal represents the improvement of land used for arterial road purposes. The continued use of the land for that purpose and the proposed upgrade of Nelson Bay Road at Salt Ash and Bobs Farm represents the orderly economic use and development of land.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the project.
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.	The proposal would have some impact on the natural environment. Measures have been proposed to reduce that impact, refer Section 6.2 Biodiversity.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal has potential to impact Aboriginal cultural heritage. Measures have been proposed to reduce that impact, refer Section 6.2. The proposal would not have impact on built heritage, Section 6.9.
1.3(g) To promote good design and amenity of the built environment.	The proposal incorporates measures to minimise impacts on the built environment including landscape plantings and retaining wall design (refer Section 6.4).
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 the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment	Not relevant to the proposal.

Object	Comment
between the different levels of government in the State.	
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Community participation has occurred during the proposal's development. Refer to Section 5 of the REF.

8.2.1 The precautionary principle

This principle states that 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.

Evaluation and assessment of alternative options have aimed to reduce the risk of serious and irreversible impacts on the environment. Stakeholder consultation raised issues for consideration and a range of specialist studies were undertaken for key issues to provide accurate and impartial information to assist in the evaluation of options.

The detailed assessment of potential environmental impacts in the preparation of the detailed design has sought to minimise impacts on the urban and natural amenity of the proposal area while maintaining engineering feasibility and safety for all road users. Several safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed because of lack of scientific certainty.

A construction environment management plan would be prepared prior to commencing construction. This requirement would ensure that the proposed activities achieve a high-level of environmental performance. No mitigation measures or management mechanisms would be postponed because of a lack of information.

8.2.2 Intergenerational equity

The principle states that 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'. The proposal would improve reliability of access into and out of the Port Stephens region, improve road safety and travel time. The proposal would also benefit future generations by ensuring that it does not give rise to long-term adverse impacts on the environment.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a lower level of service on this important road. The proposal would benefit future generations by ensuring Nelson Bay Road at Salt Ash and Bobs Farm is upgraded to ensure a reliable road connection for road users providing positive benefits to road users and the wider community.

8.2.3 Conservation of biological diversity and ecological integrity

This principle states that the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.

A thorough assessment of the existing local environment has been undertaken to identify and manage any potential impacts of the proposal on local biodiversity. Specific design efforts have been taken to avoid and minimise impacts on biodiversity. Where impacts could not be avoided, management measures for future offsetting have been provided.

8.2.4 Improved valuation, pricing and incentive mechanisms

This principle requires that 'costs to the environment should be factored into the economic costs of a project'.

The REF has examined the environmental consequences of the proposal and identified management measures and safeguards for areas which have the potential to experience adverse impacts.

Requirements imposed in terms of implementation of these mitigation measures would result in an economic cost to Transport for NSW. The implementation of management measures and safeguards would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

The design for the proposal has been developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the concept design for the proposal has been developed with an environmental objective in mind.

8.3 Conclusion

The proposed upgrade of B63 Nelson Bay Road at Salt Ash and Bobs Farm is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken 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 NPW Act, 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.

A number of 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 some impacts on biodiversity, air quality, landscape and visual amenity, traffic and noise. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve safety, improve driving conditions, reduce travel times]. On balance 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 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 *Environment Protection and Biodiversity Conservation Act 1999*. 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.



David Wells

Senior Environmental Scientist

SMEC Australia Pty Ltd

Date: 12 May 2021

I have examined this review of environmental factors and accept it on behalf of Transport for NSW.

Kate Hagan

Project Development Manager

Transport for NSW

Date:

10. References

- Australian Bureau of Statistics (ABS) 2016, Census Data
<http://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20search%20by%20geography> accessed on 7 February 2020.
- Bureau of Metrology 2020b, Climate statistics for Australian locations: Nelson Bay (Nelson Head)
http://www.bom.gov.au/climate/averages/tables/cw_061054.shtml, accessed 23 February 2020
- Department of Environment and Climate Change (NSW), 2020a, Daily Regional Air Quality Index – RAQI Lower Hunt **<https://www.dpie.nsw.gov.au/air-quality/search-for-and-download-air-quality-data>** accessed 24 February 2020
- Department of Environment and Climate Change (NSW), 2020b, Daily Averages PM2.5 and PM10 **<https://www.dpie.nsw.gov.au/air-quality/search-for-and-download-air-quality-data>** accessed 24 February 2020.
- Department of Planning, Industry and Environment, 2020, Threatened Species Profile Database
- EMM Consulting (EMM) 2020, *Nelson Bay Road Upgrade – Section 1 Aboriginal Cultural Heritage Assessment Report*
- Environment Protection Authority, 2017, Williamstown Management Area, <https://www.epa.nsw.gov.au/-/media/epa/corporatesite/resources/community/williamstownmanagementareamap.pdf>, viewed 6 March 2020.
- Environment Protection Authority, 2018, Background and ongoing management, **<https://www.epa.nsw.gov.au/working-together/community-engagement/community-news/raaf-williamtowncontamination/background-and-ongoing-management>**, viewed 6 March 2020.
- Institution of Australian Engineers, 2016, Australian Rainfall and Runoff
- MI Engineers 2020, Quantity Take Offs SOR 100% DD W2BF Stage 1 Draft for TfNSW
- Muller Acoustic Consulting 2020 (MAC), Noise and Vibration Assessment Nelson Bay Road Upgrade Section 1
- NSW Government 2017a, NSW State Priorities: Making it Happen (State Priorities), **<https://www.nsw.gov.au/improving-nsw/premiers-priorities/>**
- National Pollution Inventory (NPI) 2020 **<http://www.npi.gov.au/>** accessed 24 February 2020
- Office of Environment and Heritage, 2020, Stockton Beach Dune System, <https://www.environment.nsw.gov.au/heritageapp/ViewHeritageltemDetails.aspx?ID=2280081>, accessed 25 February 2020.
- Roads and Maritime Services 2016, *Construction Noise and Vibration Guideline. NSW Government*
- Roads and Maritime 2016, *Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report*
- Roads and Maritime Services 2019, *Nelson Bay Road duplication: Williamstown to Bobs Farm – Project development and concept design Community and stakeholder engagement plan*
- SMEC 2020, *Nelson Bay Road Section 1 Detailed Design Report*
- Transport for NSW 2020, *Nelson Bay Road Upgrade - Williamstown to Bobs Farm Community Consultation Report*

Terras Landscape Architects and Consulting Arborists (Terras) 2020, *Nelson Bay Road Duplication Urban Design Report and Landscape Character and Visual Impact Assessment*.

Water New South Wales 2020 Real time water database,
<https://realtimedata.watersw.com.au/water.stm> accessed on 4 March 2020.

Waters Consultancy 2020, *Nelson Bay Road Upgrade (Section 1) Project Aboriginal Cultural Values Assessment Report*

WSP 2020, *Nelson Bay Road Duplication: Williamstown to Bobs Farm Section 1 Biodiversity Assessment Report*

Terms and acronyms used in this REF

Term / Acronym	Description
AADT	Annual Average Daily Traffic
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ADT	Average Daily Traffic
AoS	Assessment of Significance
BOM	Bureau of Meteorology
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i> . Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i> . Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process
EPL	Environment Protection Licence
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

Term / Acronym	Description
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GDE	Groundwater Dependent Ecosystems
GSP	Gross State Product
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act
LGA	Local Government Area
MNES	Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
NCA	Noise Catchment Areas
NML	Noise Management Level
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
NT Act	<i>Native Title Act 1993</i>
OEH	Office of Environment and Heritage
PACHCI	<i>Procedure for Aboriginal Cultural Heritage Consultation and Investigation</i>
PEI	Preliminary Environmental Investigation
PCT	Plant Community Type
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
Port Stephens LEP	Port Stephens Local Environmental Plan 2013

Term / Acronym	Description
QA Specifications	Specifications developed by Transport for NSW for use with road work and bridge work contracts let by Transport for NSW
RBL	Rating Background Level
REF	Review of environmental factors
Roads and Maritime	Roads and Maritime Services
RNP	Road Noise Policy
SAT	Spot Assessment Technique
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act
SHR	State Heritage Register
TEC	Threatened ecological community
Transport for NSW	Transport for New South Wales
TSC Act	<i>Threatened Species Conservation Act 1995</i>
VDV	Vibration Dose Value
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001</i>
WM Act	<i>Water Management Act 2000</i>

Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance and Commonwealth land

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
<p>a) Any environmental impact on a community?</p> <p>During construction, it is anticipated that there will be short-term impacts relating to noise, vibration, dust and traffic. These impacts would affect adjacent residents. There would also be some temporary, short-term property access changes during construction.</p> <p>The long-term benefit of the proposal would result in an upgraded road and improved safety for the community.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), shorter term</p> <p>Positive (moderate), long term</p>
<p>b) Any transformation of a locality?</p> <p>Construction of the proposal would temporarily transform the existing locality, predominantly through a negative visual amenity impact, associated with the removal of vegetation and road construction activities.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), long term</p>
<p>c) Any environmental impact on the ecosystems of the locality?</p> <p>The proposal would remove a total of 2.27 hectares of vegetation of which 0.11 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest), listed as Endangered under BC Act.</p> <p>Assessments of impact significance were conducted for all threatened species and ecological communities considered likely to be affected by the proposal. These impact assessments determined that the proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), long term</p>
<p>d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</p> <p>During construction, there would be a reduction of aesthetic amenity associated with the removal of vegetation and road construction activities.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p>

Factor	Impact
<p>e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</p> <p>There would be an effect on a locality having archaeological and cultural significance for present or future generations. OFOC1 (AHIMS 38-4-1600) is assessed as being of overall low archaeological/scientific significance.</p> <p>The proposal area is of cultural significance to the Aboriginal community. 18 individual plants have been located of an endangered orchid genus <i>Diurus arenaria</i> that is identified as culturally significant. No other locationally specific sites of intangible cultural significance within the proposal area were identified during the cultural values assessment process. The proposal area lies within the zone of traditional patterns of movement between Tilligerry Creek and the beach front and between Tomaree and Fullerton Cove. These patterns of movement were associated with resource collection, community gatherings and ceremonial activities and hold significance as an important element of the cultural landscape.</p> <p>The landscape surrounding the proposal area is one that is rich in cultural value with a range of locations identified within it as holding cultural significance including significant resource areas, Story or Dreaming Paths, ceremonial grounds, corroboree grounds, burial places, pathways, and traditional and historical living places.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), long term</p> <p>Negative (moderate), long term</p>
<p>f) Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)?</p> <p>There would be an impact on the habitat of protected fauna with 2.27 hectares of foraging woodland habitat permanently removed. Protected flora recorded within the proposal area. The assessment of significance determined that the removal of this habitat would not constitute a significant impact for threatened species.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), long term</p>
<p>g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</p> <p>The proposal would not be any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Nil</p>
<p>h) Any long-term effects on the environment?</p> <p>It is unlikely that the proposal would have any long-term effects on the environment.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Nil</p>

Factor	Impact
<p>i) Any degradation of the quality of the environment?</p> <p>There is potential for temporary degradation of the quality of the environment during construction of the proposal through soil and water, biodiversity, air quality, and traffic and access impacts.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p>
<p>j) Any risk to the safety of the environment?</p> <p>The construction phase has the potential to temporarily decrease safety due to road work and the movement of construction plant. Operation of the proposal would improve the safety of the environment by providing a road with improved safety performance for road users.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p> <p>Positive (minor), long term</p>
<p>k) Any reduction in the range of beneficial uses of the environment?</p> <p>During construction, there would be reduction of beneficial uses with additional vehicles associated with construction using the Nelson Bay Road to access the proposal area. For road users travelling on the Nelson Bay Road there would be short term delays and detours during certain phases of construction. For operation there would be benefits to road users including reduced travel time and a safer road network.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p>
<p>l) Any pollution of the environment?</p> <p>The proposal could potentially result in minor temporary water pollution from sediments, soil nutrients, waste, and spilt fuels and chemicals. Management of water quality impacts would be carried out in accordance with the management measures detailed in Section 7.</p> <p>The proposal would result in minor temporary noise pollution from plant and machinery and dust pollution from construction activities.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p> <p>Negative (minor), short term</p>
<p>m) Any environmental problems associated with the disposal of waste?</p> <p>Any waste generated during the proposed works would be contained and removed for disposal to approved facilities or to licensed landfill.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Nil</p>

Factor	Impact
<p>n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</p> <p>The proposal would require resources such as gravel, concrete and asphalt, which are common construction materials and readily available. The proposal would not create any an increased demand on these resources.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p>
<p>o) Any cumulative environmental effect with other existing or likely future activities?</p> <p>There is the potential for the proposal to have a cumulative environmental effect with other existing or likely future activities. The key cumulative impacts associated with construction include traffic congestion and delays, dust and noise, visual amenity and removal of native vegetation.</p> <p>The proposal would have a long-term positive cumulative impact on travel times, road safety and efficiency.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Negative (minor), short term</p> <p>Positive (moderate), long term</p>
<p>p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?</p> <p>The proposal is not located within a coastal area and would not result in any impact on coastal processes and coastal hazards.</p>	<p>Nil</p>

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act 1999, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Agriculture, Water and the Environment.

A referral is not required for proposed actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
a) Any impact on a World Heritage property	There is no World Heritage property adjacent or nearby the proposal. Nil impact
b) Any impact on a National Heritage place?	There is no National Heritage place adjacent or nearby the proposal. Nil impact
c) Any impact on a wetland of international importance?	There is no National Heritage place adjacent or nearby the proposal. Nil impact
d) Any impact on a listed threatened species or communities? The proposal will impact listed threatened species or communities. However these impacts are not likely to be significant impacts on threatened species, ecological communities or migratory species, within the meaning of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> . MNES include threatened flora, fauna and communities, however a referral of the proposal for consideration as a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is not required. An additional mitigation measure (fauna fencing on the southern boundary) would be implemented to address potential impacts on wildlife movement for less-mobile fauna including Koala (<i>Phascolarctos cinereus</i>) and Spotted-tailed Quoll (<i>Dasyurus maculatus maculatus</i>). The implementation of the recommended mitigation measure means it is unlikely that residual impact of the proposal would result in a significant impact to biodiversity within the locality.	Yes. Minor impact

Factor	Impact
<p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	
<p>e) Any impacts on listed migratory species?</p> <p>Four migratory species were recorded or assessed as having a moderate or higher likelihood of occurrence within the study area recorded within or above the study area. These species have the potential to utilise a wide variety of habitats, including disturbed / modified areas. The habitats within the study area are unlikely to constitute important habitat for any of the listed species, due to the habitat present is unlikely to support significant proportions of the population of any migratory species nor are the habitats critical to any life stage of these species. Due to their mobile nature, the mentioned species are likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur.</p> <p>Impacts would be managed and mitigated through safeguards listed in Chapter 7 of this REF.</p>	<p>Yes. Minor impact</p>
<p>f) Any impact on a Commonwealth marine area?</p>	<p>There is no Commonwealth marine area adjacent or nearby the proposal.</p> <p>Nil impact</p>
<p>g) Does the proposal involve a nuclear action (including uranium mining)?</p>	<p>The proposal does not involve a nuclear action (including uranium mining)</p> <p>Nil impact.</p>
<p>h) Additionally, any impact (direct or indirect) on Commonwealth land?</p>	<p>Nil</p>

Appendix B

Statutory consultation checklists

Infrastructure SEPP

Certain development types

Development type	Description	Yes / No	If 'yes' consult with	ISEPP clause
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No		ISEPP cl. 95A
Bus Depots	Does the project propose a bus depot?	No		ISEPP cl. 95A
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No		ISEPP cl. 95A

Development within the Coastal Zone

Issue	Description	Yes / No / NA	If 'yes' consult with	ISEPP clause
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No		ISEPP cl. 15A

Note: See interactive map here: <https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management>. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Stormwater	Are the works likely to have a <i>substantial</i> impact on the stormwater management services which are provided by council?	No		ISEPP cl.13(1)(a)
Traffic	Are the works likely to generate traffic to an extent that will <i>strain</i> the capacity of the existing road system in a local government area?	No		ISEPP cl.13(1)(b)
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will this connection have a <i>substantial</i> impact on the capacity of any part of the system?	No		ISEPP cl.13(1)(c)

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a <i>substantial</i> volume of water?	No		ISEPP cl.13(1)(d)
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a <i>minor</i> or <i>inconsequential</i> disruption to pedestrian or vehicular flow?	Yes	Port Stephens Council	ISEPP cl.13(1)(e)
Road & footpath excavation	Will the works involve more than <i>minor</i> or <i>inconsequential</i> excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	No		ISEPP cl.13(1)(f)

Local heritage items

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than <i>minor</i> or <i>inconsequential</i> ?	No		ISEPP cl.14

Flood liable land

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a <i>minor</i> extent?	No		ISEPP cl.15
Flood liable land	Are the works located on flood liable land? (to any extent). If so, do the works comprise more than minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance	No		ISEPP cl.15AA

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable land* published by the New South Wales Government.

Public authorities other than councils

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the <i>National Parks and Wildlife Act 1974</i> , or on land acquired under that Act?	Yes	Office of Environment and Heritage (NPWS)	ISEPP cl.16(2)(a)
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No		ISEPP cl. 16(2)(b)
Aquatic reserves	Are the works adjacent to an aquatic reserve or a marine park declared under the <i>Marine Estate Management Act 2014</i> ?	No		ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the <i>Sydney Harbour Foreshore Authority Act 1998</i> ?	No		ISEPP cl.16(2)(d)
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No		ISEPP cl.16(2)(f)
Artificial light	Would the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	N/A		ISEPP cl.16(2)(g)
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No		ISEPP cl. 16(2)(h)
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> ?	No		ISEPP cl. 16(2)(i)

Appendix C

Biodiversity Assessment



Transport
for NSW

Nelson Bay Road Duplication: Williamtown to Bobs Farm – Section 1

Biodiversity Assessment Report

Transport for NSW | July 2020

BLANK PAGE

Transport for NSW

Nelson Bay Road Duplication: Williamtown to Bobs Farm – Section 1

Biodiversity Assessment Report

July 2020

Prepared by WSP and Transport for NSW



Copyright: The concepts and information contained in this document are the property of Transport for NSW. Use or copying of this document in whole or in part without the written permission of Transport for NSW constitutes an infringement of copyright.

Project no: PS113589

Date: 14/07/2020

Rev	Date	Details
A	7/02/2020	Working draft
B	29/05/2020	Draft report
C	14/07/2020	Incorporation of clearing boundary

Author, Reviewer and Approver details				
Prepared by:	Tanya Bangel Troy Jennings	Date: 14/07/2020	Signature:	
Reviewed by:	Toby Lambert	Date: 14/07/2020	Signature:	
Approved by:	Alex Cockerill	Date: 14/07/2020	Signature:	

This report has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or disturbance constraints.

In preparing the report, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

No sampling technique can eliminate the possibility that results are not totally representative of conditions encountered. The conclusions are based upon the data and the ecological surveys and are therefore merely indicative of the condition of the study area at the time of preparing the report. Also, it should be recognised that conditions, including the presence of threatened biodiversity, can change with time. No sampling technique can eliminate the possibility that a species is present within the proposal area. Within the limitations imposed by the scope of services, the surveys and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

The report has been prepared for the benefit of the client (and no other party). WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Except as provided below parties other than the client should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Executive summary

Transport for NSW is proposing to upgrade Section 1 of the Williamtown to Bobs Farm section of Nelson Bay Road (the proposal – subject to assessment in this report). The study area of the proposal extends for approximately 1 km at Salt Ash in NSW. It is comprised of linear patches of roadside vegetation which border Worimi National Park and Worimi Local Land Council land.

The key impact on biodiversity associated with the proposal would involve the direct removal of 2.27 ha of native vegetation and associated habitat, including:

- 0.11 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest) – listed as Endangered under BC Act.

The summary of native vegetation removal is presented in the table below:

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in NSW	Proposal area (Ha)
PCT 1646 Smooth-barked Apple – Blackbutt – Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Good	-	-	68%	1.76
	Moderate	-	-		0.09
	Regrowth	-	-		0.31
PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Moderate	Endangered	-	45%	0.11
Total native vegetation impacted					2.27

One threatened ecological community was recorded within the study area being, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions which is listed as Endangered under the BC Act. No threatened ecological communities listed under the EPBC Act were recorded within the study area.

One threatened flora species, *Diuris arenaria* (Sand Doubletail), listed as Endangered under the BC Act was recorded within the study area. Individuals recorded form part of a larger substantial local population which extends from the study area through Worimi National Park, Worimi Conservation Area to a biodiversity offset area located approximately 2 km south west of the study area. A large area of this population is conserved under the Saving Our Species program whilst other areas of the population are protected within Worimi National park and a biodiversity offset area which has been established for another project in the locality. Approximately 18 *Diuris arenaria* (Sand Doubletail) individuals, which occur on the periphery of this large local population will be affected by the proposal, this impact may be reduced following the detailed design phase of the proposal.

Field surveys recorded six threatened fauna species including:

- Varied Sittella (*Daphoenositta chrysoptera*) listed as Vulnerable under the BC Act
- Little Lorikeet (*Glossopsitta pusilla*) listed as Vulnerable under the BC Act
- White-bellied Sea-eagle (*Haliaeetus leucogaster*) listed as Vulnerable under the BC Act
- White-throated Needletail (*Hirundapus caudacutus*) listed as Vulnerable under the EPBC Act
- Little Bent-wing Bat (*Miniopterus australis*) listed as Vulnerable under the BC Act
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) listed as Vulnerable under the BC Act.

Likelihood of occurrence assessments identified an additional 19 threatened fauna species of having a moderate or high likelihood of occurrence within the study area. These species include:

- Three woodland birds
- Two forest owls
- Three predatory birds; and
- Eleven mammal species.

Assessments of impact significance were conducted for all threatened species and ecological communities considered likely to be affected by the proposal. These impact assessments determined that the proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats.

Given the proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement (SIS) is not required under the BC Act to support this proposal. In respect to Matters of National Environmental Significance (MNES) matters including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

Additional mitigation measures should be implemented to address potential impacts on wildlife movement for less-mobile fauna such as the Koala and Spotted-tailed Quoll. Additional mitigation measures include implementation of Koala fencing on the southern boundary to minimise impacts. With the implementation of recommended mitigation measures proposed it is unlikely that residual impact of the proposal will result in a significant impact to biodiversity within the locality.

It is however Transport's policy that biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) would be provided for impacts that exceed predetermined thresholds. The 'Transport for NSW Guidelines for Biodiversity Offsets' (November 2016) indicates that the following offsets would be required by the proposal given residual impacts associated with the development footprint exceed the predetermined thresholds as specified in the guideline:

- 5.88 ha of habitat for EPBC Act listed species including Spotted-tailed Quoll, Grey-headed Flying-fox, New Holland Mouse and Large-eared Pied Bat
- 5.88 ha of habitat for BC Act listed species credit species including Squirrel Glider and Brush-tailed Phascogale
- 54 *Diuris arenaria* (Sand Doubletail) individuals.

A Biodiversity Offset Strategy will be developed to identify biodiversity credits and/or supplementary measures for these entities.

Contents

Executive summary	i
Glossary of terms for this template	v
Definitions	v
Abbreviations	x
1 Introduction	1
1.1 Proposal background.....	1
1.2 The proposal.....	1
1.3 Study area	1
1.4 Report objectives	2
1.5 Legislative context	5
2 Methods	6
2.1 Personnel	6
2.2 Background research.....	7
2.3 Habitat assessment and likelihood of occurrence	8
2.4 Field survey	9
2.5 Limitations	23
3 Existing environment	24
3.1 Summary of landscape features	24
3.2 Plant community types.....	24
3.3 Flora recorded	33
3.4 Fauna recorded	33
3.5 Threatened ecological communities.....	33
3.6 Groundwater dependent ecosystems.....	36
3.7 Threatened species and populations	37
3.8 Aquatic habitat.....	43
3.9 Critical habitat.....	43
3.10 Wildlife connectivity corridors.....	43
3.11 NSW State Environmental Planning Policy's.....	44
3.12 Matters of National Environmental Significance	46
4 Impact assessment	56
4.1 Construction impacts	56
4.2 Indirect/operational impacts	62
4.3 Cumulative impacts	66
4.4 Assessments of significance	67
4.5 Impact summary	70
5 Avoid, minimise and mitigate impacts	75
5.1 Avoidance and minimisation	75
5.2 Mitigation measures.....	75

6	Offset strategy	81
6.1	Quantification of impacts.....	81
7	Conclusion	84
8	References	86
	Appendix A – Flora species recorded	90
	Appendix B – Habitat assessment table	103
	Appendix C – Test of significance	121
	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	122
	<i>Diuris arenaria</i> (Sand Doubletail).....	125
	Threatened forest owls.....	128
	Threatened woodland birds	130
	Threatened birds of prey	132
	Threatened blossom nomads	134
	Threatened ground-dwelling mammals.....	138
	Threatened arboreal mammals	142
	Hollow-dwelling Microchiropteran bats	149
	Cave-dwelling Microchiropteran bats.....	151

Glossary of terms for this template

Definitions

Definitions

*	Denotes exotic species
BAM	Biodiversity Assessment Method 2017 that supports the Biodiversity Conservation Act 2016.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: <ul style="list-style-type: none">• Genetic diversity – the variety of genes (or units of heredity) in any population.• Species diversity – the variety of species.• Ecosystem diversity – the variety of communities or ecosystems.
Biodiversity credits	Ecosystem credits or species credits
Biodiversity credit report	The report produced by the Biodiversity Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (Office of Environment & Heritage, 2017b).
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of proposal (Office of Environment & Heritage, 2017b).
Biodiversity Credit Calculator (BCC)	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site (Office of Environment & Heritage, 2017b).
Biodiversity values map	Is established according to clause 7.3 of the BC Regulation 2017. Development within an area identified on the map requires assessment using the BAM.
Candidate species	Species considered likely to occur within the study area based on the presence of suitable habitat and outcome of likelihood of occurrence assessment.
Critical habitat	The whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community (Department of Environment and Conservation, 2004b). Critical habitat is listed under both the Biodiversity Conservation Act 2016 and the <i>Environment Protection and Biodiversity Conservation Act 1999</i> and both the State (DPIE) and Federal (DAWE) environment agencies maintain a register of this habitat. Capitalisation of the term 'Critical Habitat' in this report refers to the habitat listed specifically under the relevant State and Commonwealth legislation.
Cryptic species	An inconspicuous species which can be difficult to identify.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the <i>Environmental Planning and Assessment Regulation 2000</i> for cumulative impact assessment requirements.

Definitions

Department of Planning, Industry and Environment (DPIE)	The NSW Department develops and implements state policy, programs and legislation to protect and conserve Australia's natural environment and cultural heritage and administers the <i>Biodiversity Conservation Act 2016</i> .
Department of Agriculture, Water and the Environment (DAWE)	This Commonwealth Department that develops and implements national policy, programs and legislation to protect and conserve Australia's natural environment and cultural heritage and administers the <i>Environment Protection and Biodiversity Conservation Act 1999</i> .
Development footprint	The area to be directly impacted by the proposal during construction activities. Analogous with proposal area (see definition for proposal area).
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (Commonwealth of Australia, 2012). Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat, and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (Office of Environment and Heritage, 2017).
Ecosystem credit	A measurement of the value of threatened ecological communities and threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT (Office of Environment and Heritage, 2017).
Exotic	Introduced from outside the area (Stralberg et al., 2009). Used in the context of this report to refer to species introduced from overseas.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
High Threat Weed	Vascular plants not native to Australia that if not controlled will invade and outcompete native species. A list of high threat weeds is available as part of the BAM Calculator (https://www.lmbc.nsw.gov.au/bamcalc)
IBRA bioregion and subregions	A bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions and subregions based on their dominant landscape-scale attributes.
Indirect impact	An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: <ul style="list-style-type: none">• Occur over a wider area than just the site of the development• Have a lower intensity of impact in the extent to which they occur compared to direct impacts• Occur off site• Have a lower predictability of when the impact occurs• Have unclear boundaries of responsibility (Office of Environment and Heritage, 2017).
Key Threatening Processes	A process that threatens, or could threaten, the survival, abundance or evolutionary development of native species, populations or ecological communities (Department of Environment and Conservation, 2004b). Key Threatening Processes are listed under the <i>Biodiversity Conservation Act 2016</i> , the <i>Fisheries Management Act 1994</i> and the <i>Environment Protection and Biodiversity Conservation Act 1999</i> . Capitalisation of the term 'Key Threatening Processes' in this report refers to those processes listed specifically under the relevant state and Commonwealth legislation.

Definitions

Locality	Taken to be a real chance or possibility (Department of Environment and Conservation, 2004b).
Likely	The area within 10 km of the study area.
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (Office of Environment and Heritage, 2017).
MNES	Matters of national environmental significance are matters which are protected under Part 3 of the Environment Protection and Biodiversity Conservation Act 1999 and include: world heritage properties; national heritage properties; wetlands of international importance; listed threatened species and communities; migratory species; Commonwealth marine areas.
Migratory species	Species protected as Migratory under the Environment Protection and Biodiversity Conservation Act 1999. Listed migratory species are those listed in the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) and Republic of Korea – Australia Migratory Bird Agreement (RoKAMBA). Listed migratory species also include any native species identified in an international agreement approved by the Minister (Matthei, 1995). Capitalisation of the term 'Migratory' in this report refers to those species listed as Migratory under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> .
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (Department of Environment and Climate Change, 2002).
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Native vegetation	(a) trees (including any sapling or shrub or any scrub), (b) understorey plants, (c) groundcover (being any type of herbaceous vegetation), (d) plants occurring in a wetland. A plant is native to New South Wales if it was established in New South Wales before European settlement (Biodiversity Conservation Act 2016).
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Plant Community Type (PCT)	Plant Community Types (PCTs) and their relationship to a vegetation formation and vegetation class is managed and maintained in the BioNet Vegetation Classification Database. PCTs were developed as an unambiguous master community-level classification and consolidated two existing vegetation classifications – the NSW Vegetation Classification and Assessment database & the Biometric Vegetation Types database (Environment Energy and Science Group, 2020b).
Population	A group of organisms, all of the same species, occupying a particular area (Office of Environment and Heritage, 2017).
Priority Weeds	An introduced species listed under the <i>Biosecurity Act 2015</i> . Under the Act, priority weeds have specific control measures for each region.
Proposal	The upgrade of approximately 1 kilometres of Nelson Bay Road in Salt Ash, New South Wales.

Definitions

Proposal area	The area of land that is directly impacted on by the proposal that is being assessed under the <i>Environmental Planning and Assessment Act 1979</i> , including access roads, and areas used to store construction materials. It includes the construction and operational areas for the proposal.
Region	A bioregion defined in a national system of bioregionalisation. For this study, this is the Sydney Basin Bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell, 1995).
Significant	Important, weighty, or more than ordinary (as defined by the Department of Environment and Climate Change, 2007).
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that are assessed according to Section 6.4. of the BAM
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species richness	Species richness is simply the number of species present in a sample, community, or taxonomic group. Species richness is one component of the concept of species diversity, which also incorporates evenness, that is, the relative abundance of species (Matteson and Langellotto, 2010).
Species Profile and Threats Database (SPRAT)	A government managed database to provide information about species and ecological communities listed under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> .
Study area	The area surveyed during field work, this area will be directly affected by the proposed development (proposal area) and includes additional areas likely to be affected by the development, either directly or indirectly (Department of Environment and Climate Change, 2007).
Target species	A species has been identified within the study area or is considered to have a moderate to high likelihood of occurrence and may be impacted by the proposal. A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
Threatened biodiversity	Threatened species, populations or ecological communities, or their habitats as listed under the <i>Biodiversity Conservation Act 2016</i> , <i>Fisheries Management Act 1994</i> or the <i>Environment Protection and Biodiversity Conservation Act 1999</i> .
Threatened Biodiversity Data Collection	Part of the BioNet database, published by EES Group and accessible from the BioNet website at www.bionet.nsw.gov.au .
Threatened species, populations and ecological communities	Species, populations and ecological communities listed as Vulnerable, endangered or critically endangered (collectively referred to as Threatened) under the <i>Biodiversity Conservation Act 2016</i> , <i>Fisheries Management Act 1994</i> or the <i>Environment Protection and Biodiversity Conservation Act 1999</i> . Capitalisation of the terms 'threatened', 'vulnerable', 'endangered' or 'critically endangered' in this report refers to listing under the relevant state and/or Commonwealth legislation.

Definitions

Viable local population	A population that has the capacity to live, develop, and reproduce under normal conditions, unless the contrary can be conclusively demonstrated through analysis of records and references (Department of Environment and Climate Change, 2007).
Weed	A plant growing out of place or where it is not wanted: often characterised by high seed production and the ability to colonise disturbed ground quickly (Stralberg et al., 2009). Weeds include both exotic and Australian native species of plant naturalised outside of their natural range.

Abbreviations

Abbreviations

BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BDAR	Biodiversity Development Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BAR	Biodiversity Assessment Report
CEMP	Construction Environmental Management Plan
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DPIE	Department of Planning, Infrastructure and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EES Group	Environment, Energy and Science Group within DPIE
EIS	Environmental Impact Statement
EP&A Act	<i>Environment Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Federal)</i>
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographical Regionalisation of Australia
KMA	Koala Management Area
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NSW	New South Wales
PCT	Plant Community Type
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
Transport	Transport for NSW

1 Introduction

1.1 Proposal background

Nelson Bay Road is an important arterial road which extends from Stockton Bridge in the south to Nelson Bay in the north, in New South Wales (NSW) **Error! Reference source not found.** The road connects motorists travelling between the Newcastle and the Nelson Bay regions. It also provides an important link to the Newcastle Airport and the Royal Australian Airforce base. Transport for NSW (Transport) is undertaking investigations and subsequent upgrade works to improve the safety and travel times on Nelson Bay Road.

The proposed Section 1 upgrade to Nelson Bay Road at Salt Ash (subject of this report) is required to reduce congestion, improve safety of and increase the capacity of the road to cater for predicted future traffic volumes. To increase the capacity, widening of Nelson Bay Road is required to create additional lanes.

Transport are currently preparing a Review of Environmental Factors (REF) to assess potential impacts on the environment associated with the duplication of Nelson Bay Road at Salt Ash (Section 1) in NSW (henceforth referred to as the 'proposal'). This Biodiversity Assessment has been prepared in general accordance with the 'Biodiversity Assessment Practice Note (EIA-N06, Resource 4)' to support the proposal's REF.

1.2 The proposal

Transport proposes to upgrade Nelson Bay Road at Salt Ash (the proposal) to a dual carriageway. The proposal would be wholly within the existing road corridor and would involve building about one kilometre length of dual carriageway from one kilometre east of Marsh Road to two kilometres east of Marsh Road at Salt Ash. The proposal is located within the Port Stephens Council local government area (LGA). Worimi National Park is immediately adjacent to the south and private owned land occurs to the north.

The proposal is required to:

- Reduce peak period traffic congestion
- Improve road safety of all road users.

The proposal would be built wholly within the existing road corridor. The eastern extent of the proposal would tie in with the Anna Bay to Bobs Farm duplication that was completed in 2015.

One ancillary site has been identified about 1.5 kilometres east of the proposal area for use during construction.

Key features of the proposal include:

- One kilometre dual carriageway with:
 - 3.5 metre travel lanes
 - 2.5 metre shoulders
 - 100 kilometre per hour posted speed limit
 - 110 kilometre per hour design speed
 - Median separation barrier
 - Two retaining walls
 - Utility relocations.

1.3 Study area

The proposal is located along the existing Nelson Bay Road which extends for approximately 1 km in Salt Ash NSW (Figure 1.1). It is comprised of linear patches of roadside vegetation which borders residential areas, Worimi National Park and Worimi Local Aboriginal Land Council land.

The following areas are discussed throughout the Biodiversity Assessment Report (BAR) and are defined as:

- Proposal area: is the environmental assessment construction footprint as defined by Transport for NSW (Transport) for the project (refer to Figure 1.2).
- Study area: includes the proposal area and areas surveyed as part of the biodiversity assessment
- Locality: This is taken to be a 10 kilometre radius surrounding the proposal area
- The study area is located in the North Coast bioregion (Karuah Manning subregion) (Thackway and Cresswell, 1995).

1.4 Report objectives

The objectives of this report are to:

- Inform the design and evaluation of the proposal
- Form part of future assessments of the Nelson Bay Road Project to fulfil the requirements of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act)
- Provide biodiversity assessment information for the preparation of the proposal's review of environmental factors (REF) document/s
- Take into account all matters affecting or likely to affect terrestrial and aquatic biodiversity as a result of the proposal
- Identify any likely biodiversity offset obligations in accordance with the Biodiversity Offset Guidelines (Roads and Maritime Services, 2016).

This report identifies and assesses the likely impacts to species, populations and communities listed as threatened under the *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).



Legend

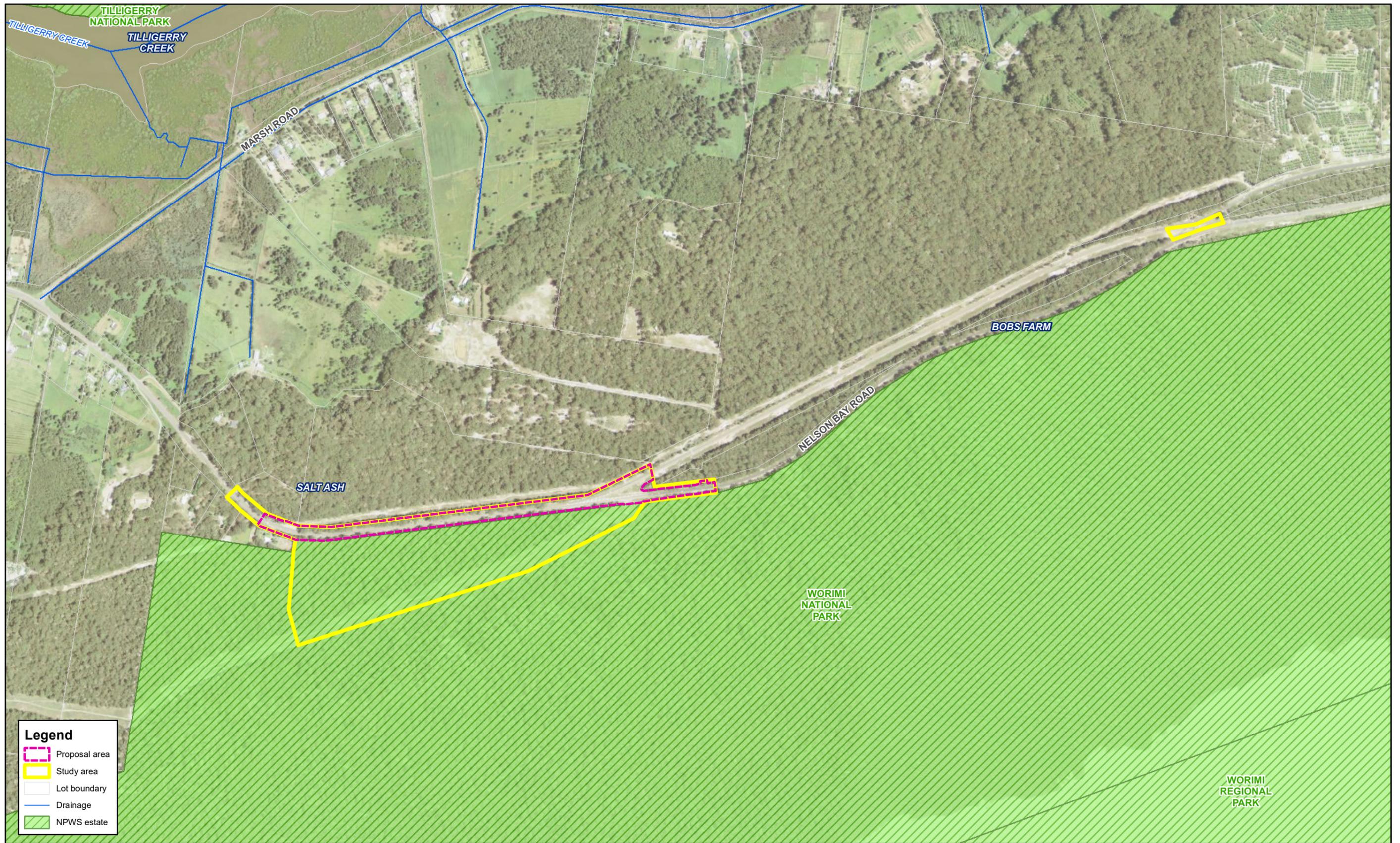
Study area

Map: PS113589_BAR_002_A1	Author: SuansriR		 1:15,000 Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3
Date: 9/07/2020	Approved by: - T.Bangel		
<small>Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community; Metromap; NSWSS</small>			
<small>© WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.</small>			



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 1.1
Location of proposal



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Map: PS113589_BAR_001_A1
 Author: SuansriR
 Date: 8/07/2020
 Approved by: - T.Bangel



 1:10,000
 Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3

© Department of Customer Service 2020
 Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap
 © WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.



Figure 1.2
The proposal

1.5 Legislative context

A Review of Environmental Factors (REF) has been prepared to satisfy Transport duties under s5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to “examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity” and s.5.5 in making decisions on the likely significance of any environmental impacts. This BAR forms part of the REF being prepared for the proposal and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Sections 7.3 of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and endangered ecological communities is assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General’s requirements or a Biodiversity Proposal Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

In September 2015, a “strategic assessment” approval was granted by the Federal Minister in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The approval applies to Transport road activities being assessed under Division 5.1 (formerly Part 5) of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Transport road proposals are assessed via an REF which:

- Must address and consider potential impacts on nationally listed threatened species, populations, ecological communities and migratory species, including application of the “avoid, minimise, mitigate and offset” hierarchy
- Do not require referral to the Federal Department of the Environment for these matters, even if the activity is likely to have a significant impact.

To assist with this, assessments are required in accordance with the Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment, 2013c).

2 Methods

2.1 Personnel

The contributors to the preparation of this report, their qualification and roles are provided in Table 2.1.

Table 2.1 Contributors and their roles

Name	Role	Qualifications
Alex Cockerill	Ecology National Team Executive – Project director and technical review	Bachelor of Science (Hons); Accredited BAM Assessor (BAAS17020)
Toby Lambert	Principal Ecologist – Technical review	Bachelor of Environmental Science; Accredited BAM Assessor (BAAS17046)
Debbie Landenberger	Principal Ecologist – Field survey and report preparation	Bachelor of Science (Hons); Accredited BAM Assessor (BAAS18187)
Josie Stokes	Principal Ecologist – Microchiropteran bat call analysis	Bachelor of Science
Tanya Bangel	Senior Ecologist – Project manager, field survey and report preparation	Bachelor of Environmental Science and Management (Hons); Diploma of Conservation and Land Management; Accredited BAM Assessor (BAAS18076)
Allan Richardson	Senior Ecologist – Field survey and report preparation	Bachelor of Environmental Science (Hons); Accredited BAM Assessor (BAAS19072)
Julia Emerson	Ecologist – Field survey and report preparation	Bachelor of Environment; Certificate 3 Conservation and Land Management; Accredited BAM Assessor (BAAS18034)
Troy Jennings	Ecologist – Field survey and report preparation	Bachelor of Biodiversity and Conservation; Certificate 3 Conservation and Land Management; Masters of Wildlife Management; Accredited BAM Assessor (BAAS18172)
Gavin Shelly	Graduate Ecologist – Field survey	Bachelor of Environmental Science and Management
Rob Suansri	GIS Consultant – Mapping and data management	Bachelor of Science (Hons); Master of Science in Geoscience

All work was carried out under the appropriate licences, including scientific licences as required under Clause 22 of the National Parks and Wildlife Regulations 2002, Section 132C of the NPW Act (License Number: SL100630) as well as an animal research authority issued by the Department of Trade and Investment, Regional Infrastructure and Services.

2.2 Background research

A background review of existing information was completed to identify the existing environment within the locality. Specifically, this review focused on identifying the following:

- The likely distribution of vegetation communities, based on previous mapping and aerial photograph interpretation, to allow for targeted field verification
- A list of candidate threatened species and populations of plants to consider during vegetation surveys and habitat assessment
- A list of candidate threatened species and populations of animals and migratory animals to consider during field-based habitat assessment
- Local landscape-scale features of potential significance to biodiversity; e.g. riparian zones and potential wildlife movement corridors
- Evaluate baseline information and determine whether additional surveys, mapping and reporting is required
- If any Areas of Outstanding Biodiversity Value were present.

The desk-based assessment included analysis of the following resources:

- Existing biodiversity reports prepared for the proposal including:
 - *Nelson Bay Road: Williamtown to Bob's Farm – Preliminary environmental investigation* (WSP, 2019)
 - *Nelson Bay Road Duplication: Williamtown to Bob's Farm – Preliminary biodiversity investigation* (WSP, 2019).
- Local broad-scale vegetation mapping of the study area:
 - *Greater Hunter Native Vegetation Mapping V4.0* (Sivertsen et al., 2011)
 - *Hunter, Central and Lower North Coast Vegetation Classification and Mapping* (Somerville, 2009)
 - *Vegetation Survey, Classification and Mapping – Lower Hunter and Central Coast Region* (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2003, Parsons Brinckerhoff, 2013).
- Previous studies, reports and guidelines relevant to the proposal and locality including:
 - *Port Stephens Council Comprehensive Koala Management Plan of Management* (Port Stephens Council, 2002)
 - *Saving our Species Report: Managing koala populations for the future: constituent populations of the Central ARKS Port Stephens sub-area* (Biolink Ecological Consultants, 2018)
 - *Koala Habitat Planning Map* (Land Use Planning Sustainable Planning Group, 2007)
 - *Summary of Koala Data for Port Stephens LGA* (Port Stephens Council, 2019)
 - *Specialist advice for Referral to DoE for Nelson Bay Road Upgrade Bobs Farm to Anna Bay Stage 3* (Transport for NSW, 2013)
 - *Review of Environmental Factors Addendum – MR108 Nelson Bay Road Upgrade Cromarty Lane to Port Stephens Drive Additional fauna impact mitigation* (Hills Environmental, 2013)
 - *Supplementary ecological survey - Nelson Bay Road Upgrade, Stage 3* (Niche, 2013).
- Priority weed lists for the Hunter region (Department of Primary Industries, 2020c)
- Topographic maps and aerial photographs.

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the study area were obtained from a range of databases as detailed in Table 2.2.

Table 2.2 Database searches completed

Database	Search date	Area searched	Reference
Bionet Atlas of NSW Wildlife	29/08/2019 28/01/2020	10 km buffer around the study area	Office of Environment Energy and Science (2020)
Protected Matters Search Tool	29/08/2019 28/01/2020	10 km buffer around the study area	Department of Agriculture, Water and the Environment (2020a)
PlantNet	29/08/2019, 28/01/2020	LGA spatial search	Royal Botanic Gardens (2020)
NSW Department of Primary Industries (Fishing and Aquaculture) spatial data	29/08/2019, 28/01/2020	10 km buffer around the study area	Department of Primary Industries (2020a)
Coastal SEPP search NSW Department of Planning and Environment	29/08/2019, 28/01/2020	10 km buffer around the study area	NSW Department of Planning and Environment (2018)
Critical habitat registers			
NSW Areas of Outstanding Biodiversity Value Register	29/08/2019 28/01/2020	10 km buffer around the study area	Environment Energy and Science Group (2020a)
Commonwealth Critical Habitat register	29/08/2019 28/01/2020	10 km buffer around the study area	Department of Agriculture, Water and the Environment (2020b)
DPI Critical Habitat Register	29/08/2019 28/01/2020	10 km buffer around the study area	NSW Department of Primary Industries (2020)
Bureau of Meteorology Atlas of Groundwater Dependant Ecosystems	29/08/2019 28/01/2020	10 km buffer around the study area	Bureau of Meteorology (2020)

2.3 Habitat assessment and likelihood of occurrence

A habitat assessment was completed to assess the likelihood of occurrence of each threatened species, population and community (threatened biodiversity) identified with the potential to occur in the study area. All threatened biodiversity identified during background research were considered. The habitat assessment was utilised to inform the identification of appropriate targeted surveys and was revisited after the surveys were completed based on the habitat components identified in the study area. The assessment was based on the habitat profile for the species and other habitat information in the Threatened Species Profile Database (Environment Energy and Science Group, 2020c). The assessment also included consideration of the dates and locations of nearby records and information about species populations in the locality.

The assessment results are summarised in Section 3 and are provided in full in the likelihood of occurrence assessments in Appendix B.

For this study, the likelihood of occurrence of threatened and migratory species and populations was determined based on the criteria shown in Table 2.3 below.

Table 2.3 Likelihood of occurrence classification and criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

2.4 Field survey

The field survey aimed to ground-truth the results of the background research and habitat assessment. As such, all threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence. A description of all field surveys completed to inform this report is provided below.

2.4.1 Weather conditions

Weather conditions can affect activity (and therefore detectability) of some species. If adverse weather conditions occur during field surveys the validity of survey techniques are affected and can impact the probability of detecting a species if it was present within the study area. During the field survey program weather conditions were generally mild with low to moderate winds and temperatures recorded. Low amounts of rainfall were received during the survey program. These conditions were somewhat favourable and are outlined in Table 2.4.

Table 2.4 Field survey dates and weather conditions

Date	Temp. Min. (°C)	Temp. Max. (°C)	Wind direction (Km/hr)	Rain (mm)
15 April 2019	13.4	23.3	S 39	1.4
16 April 2019	14.2	24.2	ESE 33	3.6
20 August 2019	8.9	19.9	WSW 22	0
22 August 2019	10.5	16.6	SSE 20	0
23 August 2019	9.8	17.6	SSE 20	0
30 August 2019	10.8	14.5	SE 15	0
11 September 2019	7.3	19.7	SW 19	0.4
24 September 2019	11.4	20.5	WSW 9	0

Date	Temp. Min. (°C)	Temp. Max. (°C)	Wind direction (Km/hr)	Rain (mm)
18 November 2019	17.0	25.5	ENE 20	0
19 November 2019	17.5	31.0	SW 13	0
20 November 2019	17.0	23.2	S 15	0
21 November 2019	17.2	26.8	NNE 6	0
22 November 2019	-	29.0	NNE 6	0
17 January 2020	20.8	27.0	SW 9	4.4
24 June 2020	9.6	17.3	WNW 57	0

Note: Source from Nelson Bay AWS (Station 61054). June 2020 weather data sourced from Williamtown RAAF (Station 61078).

2.4.2 Vegetation surveys

The field surveys aimed to ground-truth the results of the background research including desktop analysis of vegetation and habitat assessment. The floristic diversity and possible presence of threatened species was assessed using a combination of survey techniques including; plot-based (quadrat/transect), rapid point assessments and parallel line transverses in accordance with the relevant guidelines.

Verification of existing vegetation mapping

Vegetation within the study area and locality has been previously mapped at the regional scale by the following:

- Vegetation Survey, Classification and mapping – Lower Hunter and Central Coast Regional Environment Management Strategy (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2000) (LHCCREMs)
- Lower Hunter Vegetation Mapping (Parsons Brinckerhoff, 2013)
- Hunter, Central and Lower North Coast Vegetation Classification and Mapping (Somerville, 2009) (HCCREMs).

Field validation (ground-truthing) of this existing mapping within the proposal area was completed to confirm the vegetation structure, dominant canopy species, native diversity, underlying geology, condition and presence of threatened ecological communities. This was based on the completion of random meanders, rapid data points and drive by assessments.

Five vegetation integrity plots, as described in the Biodiversity Assessment Methodology (BAM) (Office of Environment & Heritage, 2017a), were completed across all vegetation types recorded.

The information collected during the survey was used to determine the Plant Community Type (PCT) for each vegetation type recorded as detailed in the BioNet Vegetation Classification System (Environment Energy and Science Group, 2020b) and whether vegetation within the study area aligned to any state or commonwealth listed ecological communities.

Condition of vegetation

The vegetation within the study area was firstly assessed to a PCT and then aligned to a vegetation zone which is defined in the BAM as '*an area of native vegetation on the subject land that is the same PCT and has a similar broad condition state*' (Office of Environment & Heritage, 2017a). A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition.

The broad condition states which were applied to vegetation within the study area are summarised in Table 2.5. These factors were defined by using factors such as levels of disturbance, weed invasion and resilience.

Table 2.5 Vegetation broad condition states

Broad condition state	Description
Good	Native vegetation where all tree, shrub, grass and/or forb structural growth form groups expected for a PCT are present. This condition type displays resilience to weed invasion. Weeds may exist in this vegetation type but generally exhibit <20% foliage cover.
Moderate	Vegetation where one or more structural understorey components is either entirely removed or severely reduced. Exotic weed cover is generally >20%.
Regrowth	Native vegetation where a proportion of over-storey and mid-storey species characteristic of the PCT are naturally regenerating. Most over-storey species present have a diameter at breast height <5cm, and there are no trees at the large tree benchmark present. This native vegetation may also include native plantings. Groundcover component is generally >50% native however may be co-dominated by exotic species in highly modified landscapes.
Derived	PCTs that have changed to an alternative stable state because of land management practices since European settlement. Over-storey structural components of derived communities have either entirely been removed or are severely reduced (i.e. derived native grasslands with or without scattered paddock trees). Exotic weed cover is <50%.
Native Plantings	Areas where native plant species (both indigenous and non-indigenous to the region) have been planted. Groundcover component may be either be dominated or co-dominated by native and exotic species depending on current or historic land management practices.

Plot and transect survey

Vegetation surveys were carried out in accordance with the BAM (Office of Environment & Heritage, 2017a). A plot based full floristic survey was carried out based on a 20 x 20 m quadrat, with function data collected using and 20m x 50m plot (henceforth referred to as a vegetation integrity plot (VI plot)).

Native vegetation recorded within the study area was aligned to Plant Community Types (PCTs) as contained in the BioNet Vegetation Classification Database (Environment Energy and Science Group, 2020b). This was achieved by identifying native vegetation to formation, class and type and its corresponding Threatened Ecological Community (where applicable). Furthermore, other characteristics such as florist composition, underlying geology, soil type, landform and other description attributes were collected were available and assessed against BioNet Vegetation Classification Database PCT profiles.

Areas of non-native vegetation were also identified and mapped. Data was collected in these areas through rapid point assessments to show the composition and abundance of non-native vegetation within the study area.

The number of plots completed for each identified vegetation zone is provided in Table 2.6 with the location of each transect/plot identified in Table 2.7 below and Figure 3.1 in Section 3.

Table 2.6 Vegetation survey effort

Plant community type	Vegetation zone	Area in proposal area (ha)	Minimum Number of VI Plots required (BAM 2017)	Survey effort
PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Good	0.11	1	Q3
PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Good	1.76	2	Q7 & Q8
	Moderate	0.09	1	Q2
	Regrowth	0.31	1	Q1
Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation	n/a	2.98	None required as vegetation is not native and does not align to a recognised NSW PCT	Rapid point assessments and random meanders
Miscellaneous ecosystem: Urban/Exotic Plantings	n/a	0.03		

Table 2.7 BAM VI plots completed within the study area

Plot ID	Vegetation type and zone	Condition	Easting	Northing	Orientation
Q1	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Regrowth	401878	6371248	70
Q2	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Moderate	400804	6371201	140
Q3	PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Good	401710	6371215	260
Q7	PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Good	401522	6371177	70
Q8		Good	401158	6371131	70

Zone 56, GDA94

2.4.3 Targeted flora surveys

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence (Appendix B). Targeted flora surveys were completed by conducting reference checks, parallel line traverses, random meanders and during BAM VI plot surveys. A summary of the targeted flora surveys completed is provided in Section 2.4.6 and Table 2.8.

Vegetation integrity plots

Plot and transect surveys were carried out in accordance with the BAM (Office of Environment & Heritage, 2017a). At each plot and transect survey location, dedicated 20 minute searches were conducted for threatened species assessed as having a moderate or high likelihood of

occurrence within each vegetation type sampled. The number of plots completed for each identified vegetation zone is provided in Table 2.6 with the location of each transect/plot identified in Table 2.7 and Figure 3.1 in Section 3.

Parallel line traverses

Targeted flora surveys in the form of parallel line transverses were used to search for threatened species assessed as having a moderate or high likelihood of occurrence within the high condition vegetation within the study area. This involved two ecologists searching along a parallel transverses across potential habitat for each threatened species. This methodology is consistent with the current guidelines for NSW threatened plant surveys (Office of Environment & Heritage, 2016).

Random Meander

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by (Cropper, 1993), whereby the recorder walks in a random meander throughout the study area recording all species observed (including threatened species), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community, its species richness and records of threatened plants.

Random meander surveys were conducted to locate candidate threatened species and populations within area of suitable habitat. Where a threatened flora species was located, parallel field traverses were then conducted to determine the size and extent of the population.

Local population survey of *Diuris arenaria* (Sand Doubletail)

Following the identification of *Diuris arenaria* (Sand Doubletail) within the study area, a targeted survey for the species was completed within areas of Worimi National Park immediately south of the proposal area. The intention of this survey was to identify the extent of the local population to aid in determining the nature and scale of potential impacts the proposal may have on the species and local population.

This survey included a one day inspection by an ecologist where all individuals observed were recorded with a hand-held GPS unit.

2.4.4 Targeted fauna surveys

Fauna surveys were conducted within the study area during late August 2019 and November 2019. Surveys were undertaken for threatened species identified during desktop assessments, which were considered likely to use habitats within the study area. Survey session seasonality were selected to target candidate species with seasonal survey requirements and activity. While fauna surveys were undertaken, habitat assessments were also conducted to assess the value of the habitats present for threatened fauna. Throughout all survey periods, opportunistic observations of all fauna species were recorded. Fauna survey locations are provided in Figure 2.1.

Generally, surveys followed the methods described in the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft (Department of Environment and Conservation, 2004b). Targeted surveys and methodology are outlined below, and a summary of survey effort is provided in Section 2.4.6 and Table 2.9.



Legend

- Anabat
- Call playback
- Remote camera
- Spotlight transect
- Trap line (Elliot A and B)
- Proposal area
- Study area

Map: PS113589_BAR_003_A1
 Author: SuansriR
 Date: 8/07/2020
 Approved by: - T.Bangel



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 2.1
 Fauna survey effort

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community; NearMap
 © WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.

Nocturnal surveys

Nocturnal surveys were conducted in late August 2019 and November 2019, consisting of spotlighting and call playback. The methodologies of each survey technique are described below.

Spotlighting

The objective of this survey technique was to target arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. Spotlighting was done after dusk within suitable habitat within the study area. Two person hours of survey effort was carried out each night on foot using two spotlights. The survey concentrated on areas that contained suitable habitat for nocturnal species, with sighted animals identified to the species level.

Call playback

Call playback was used to survey for threatened owls (i.e. Powerful Owl) and arboreal mammals (i.e. Koala & Squirrel Glider) using the methods of Kavanagh and Peake (1993) and Debus (1995). Call playback was conducted after dusk each night, within suitable habitat in the study area. For this survey an initial listening period of 10 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animals in the immediate vicinity. The calls of the target species were then played intermittently for five minutes followed by a 10-minute listening period. After the calls were played, another 10 minutes of spotlighting was carried out in the vicinity to check for animals attracted by the calls, but not vocalising. Calls were broadcast using a portable call playing device and amplified through a megaphone.

Diurnal bird surveys

Bird surveys were completed by actively walking through the nominated site (transect) over a period of 20 minutes. All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred in the morning and evening. Birds were also recorded opportunistically during all other surveys.

Blossom nomads such as the Swift Parrot, Regent Honeyeater and Little Lorikeet are dependent on the variable mosaic of blossom resources at local, regional and state scales. Whilst the Little Lorikeet is generally locally nomadic in response to blossom resources, the Swift Parrot and Regent Honeyeater are usually only winter visitors to coastal NSW regions for blossom; the Swift Parrot more so, as the entire population retires to Tasmania during the summer breeding period. Opportunistic blossom surveys were undertaken within remnant vegetation in the study area for Little Lorikeet and other blossom nomad activity during August 2019. In addition, habitat and the presence of blossom and/or lerp resources were noted and identified within the study area for the potential utilisation by threatened blossom nomads

Koala spot assessments

In addition to habitat assessment, the Spot Assessment Technique (SAT) was undertaken within the study area to identify the presence and / or level of Koala usage within native vegetation. The SAT identifies whether local Koala tree species preferences by measuring the rate at which each surveyed tree is utilised by Koalas.

The SAT involves measuring activity within the immediate area surrounding a tree of any species known to have been utilised by Koalas, or otherwise considered to be of some importance for Koala conservation and/or assessment purposes. A minimum of 29 surrounding trees are sampled systematically for Koala faecal pellets for 1 metre around the base of each tree. The activity of Koala usage for each SAT is then expressed as the percentage equivalent of the proportion of the surveyed trees within each SAT. The percentage is then compared to prescribed ranges for activity levels for Koalas within NSW (Phillips and Callaghan, 2011).

Rather than just representative SAT points, all trees over 10cm DBH throughout the study area were surveyed for potential Koala scats and bark scratches to assess the presence/absence of Koala activity within the study area. All tree species were surveyed due to intermittent occurrences of *Eucalyptus robusta* (Swamp Mahogany) and the supplementary koala habitat status of land within which the study area occurs (Land Use Planning Sustainable Planning Group, 2007).

Remote cameras

Remote motion sensing infra-red cameras were positioned in the study area to target terrestrial mammals (i.e. Spotted-tailed Quoll). Six remote cameras were used to target threatened mammals in appropriate microhabitats in the study area for fourteen consecutive nights in November. Cameras were placed approximately 1m above the ground level and bait. Cameras were also used to target other animals occurring within survey locations including introduced species.

Elliot and Cage Trapping

Elliot A and Elliot B traps were set in the field for four consecutive nights in November 2019 to target small to medium sized terrestrial & arboreal mammals. Each trap was baited with a suitable food source for each of the targeted species. Traps were checked at dawn each morning and captured animals were identified to species level before being released. All live trapping followed guidelines and policies for wildlife research in accordance with animal ethics protocols.

Anabats

Two ultrasonic Anabat detectors (Anabat Express, Titley Scientific QLD) were deployed within the study area for four nights to record echolocation calls of microchiropteran bats. The Anabat detectors recorded bat vocalisations across each night with the recordings starting at dusk. Bat activity is used as a substitute for abundance, and is based on the number of microchiropteran bat calls recorded during the survey period, including those calls assigned to a species complex (i.e. not positively attributable to an individual species).

Microbat call analysis was completed by Josie Stokes (Principal Ecologist, WSP), with the presentation of data considering the guidelines of the Australasian Bat Society. Calls were analysed using Anabat Insight software (Version 1.9.1) with reference to '*Bat calls of NSW: Region based guide to the echolocation calls of Microchiropteran bats*' (Pennay et al., 2004).

Opportunistic sightings

Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provided indirect information on animal presence and activity.

During these surveys, a hand-held GPS was used to record the locations of:

- hollow-bearing trees;
- aquatic habitats;
- rock outcrops.

Fauna habitat assessment

Fauna habitat assessments were undertaken to assess the likelihood of threatened fauna species (those species known or predicted to occur within the locality from the literature and database review) occurring within the study area. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species are likely to occur within the study area, if they are not observed during field surveys.

Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground cover, including the presence of flowering and fruiting trees representing potential foraging resources;
- presence of hollow-bearing trees offering potential roosting and breeding habitat for arboreal mammals, birds and herpetiles;
- presence of ground cover vegetation, leaf litter, rock outcrops and fallen timber increasing niche opportunity for ground-dwelling mammals, birds and herpetiles;
- presence of waterways (ephemeral or permanent) and water bodies.

Condition of Fauna habitat

The following criteria were used to evaluate the condition of habitat values:

- **Good:** A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **Moderate:** Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **Poor:** Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

2.4.5 Aquatic Surveys

The habitat value of waterways (i.e. habitat sensitivity and classification of waterways for fish passage) is characterised in accordance with '*NSW DPI (Fisheries) document Policy and Guidelines for fish habitat conservation and management*' (Department of Primary Industries, 2013).

Detailed aquatic fauna survey is warranted if a project crosses any Class 1 watercourse (Major fish habitat) or a Class 2 watercourse (Moderate fish habitat) that has been identified as having a moderate or high potential to be occupied by a threatened aquatic species of animal.

The proposal does not cross any Class 1 or Class 2 watercourses and no detailed aquatic surveys were conducted.

Key Fish Habitat

No Key Fish Habitat occurs within the study area or likely to be affected by the proposal (Department of Primary Industries, 2020b).

2.4.6 Summary of survey effort

Targeted surveys were completed for threatened flora and fauna species identified as having a moderate to high chance of occurring. Surveys generally adhered to the methods described in the NSW Guide to Surveying Threatened Plants (Office of Environment & Heritage, 2016) and the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft (Department of Environment and Conservation, 2004b).

The survey effort undertaken for threatened flora species for the proposal is summarised in Table 2.8 with threatened fauna survey effort shown in Table 2.9. The location of survey effort is illustrated on Figure 2.1.

Table 2.8 Survey effort for candidate threatened flora species

Scientific name	Survey technique	Survey effort	Optimum survey period	Period surveyed	Comments
<i>Angophora inopina</i>	Targeted surveys - BAM VI Plots, Parallel Line Traverses and Random Meanders Opportunistic sightings whilst conducting other surveys	Targeted - 46 person hours in habitat Opportunistic – 60 person hours in habitat	All year	15 & 16 April 2019 20, 22, 23 & 30 August 2019 11 & 24 September 2019 18 November 2019 17 January 2020	-
<i>Eucalyptus camfieldii</i>			All year		
<i>Eucalyptus parramattensis subsp. decadens</i>			All year		
<i>Melaleuca biconvexa</i>			All year		
<i>Melaleuca groveana</i>			All year		
<i>Prostanthera densa</i>			All year		
<i>Diuris arenaria</i>		Targeted - 16 person hours in habitat	Sept	11 & 24 September 2019	Reference populations visited prior to surveys to confirm flowering period.
<i>Tetratheca juncea</i>			Sept - Oct		
<i>Diuris praecox</i>		Targeted – 14 person hours in habitat Opportunistic – 16 person hours in habitat	Aug	20, 22, 23 & 30 August 2019	
<i>Corybas dowlingii</i>		Targeted - 7 person hours in habitat	Aug-Nov	24 June 2020	
<i>Grevillea parviflora subsp. parviflora</i>		Targeted - 38 person hours in habitat Opportunistic – 56 person hours in habitat	Oct – Dec	20 to 23 & 30 August 2019 11 & 24 September 2019 18 November 2019	
<i>Asperula asthenes</i>	Targeted – 8 person hours in habitat Opportunistic – 44 person hours in habitat	Oct – Mar	18 November 2019 17 January 2020	-	
<i>Callistemon linearifolius</i>		Oct – Mar			
<i>Cryptostylis hunteriana</i>		Nov – Jan			
<i>Lindernia alsinoides</i>		Nov – Feb			
<i>Persicaria elatior</i>	Targeted – 1 hour in habitat Opportunistic – 1 hour in habitat	Dec - May	15 & 16 April 2019 17 January 2020	-	
<i>Pterostylis chaetophora</i>	Targeted – 24 person hours in habitat	Sept – Nov	11 & 24 September 2019 18 November 2019	-	

Scientific name	Survey technique	Survey effort	Optimum survey period	Period surveyed	Comments
<i>Rhizanthella slateri</i>		Opportunistic - 40 person hours in habitat	Sept – Nov		

Table 2.9 Survey effort for candidate threatened fauna species

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
Birds					
Diurnal Forest birds					
Diamond Firetail	Standard 20-minute search of a 2 ha area Opportunistic sightings	Daily (minimum one 20 mins survey per day)	All year Blossom nomads (Swift Parrot & Regent Honeyeater) – Winter Gang-gang (Breeding – Oct-Jan) Glossy Black Cockatoo (Breeding - Apr-Aug) Square-tailed Kite (Breeding – Sept-Jan) Little Eagle (Breeding - Aug – Oct)	August and November 2019	Surveys undertaken across multiple vegetation communities within the study area
Dusky Woodswallow					
Gang-gang Cockatoo		8 days of opportunistic daylight surveys			
Glossy Black Cockatoo		2 days of opportunistic daylight surveys for blossom nomads			
Little Eagle					
Little Lorikeet					
Regent Honeyeater					
Scarlet Robin					
Square-tailed Kite					
Spotted Harrier					
Swift Parrot					
Varied Sittella					
Nocturnal birds of prey					
Powerful Owl	Spotlighting surveys and	6 nights	May to Aug Breeding	Winter / Spring 2019	-

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
Barking Owl	Owl call playback		May to Dec Breeding		
Masked Owl			May to Aug Breeding		
Arboreal nocturnal mammals					
Koala	Scat searches (SPOT Assessment)	4 x Spot Assessment Technique sites (SATs) plus searches of all trees over 10cm DBH within entire study area	All year	August & November 2019	-
	Spotlight transects	6 nights			
	Call playback	4 nights			
	Opportunistic sightings	7 days of opportunistic daylight surveys			
Squirrel Glider	Spotlight transects Arboreal Elliott B trapping Habitat assessments made Call playback (Yellow-bellied Glider and Squirrel Glider)	Spotlighting – 6 nights Call playback – 4 nights 18 Elliot B traps x 4 consecutive nights – 72 trap nights	All year	August & November 2019 (Spotlighting and call playback) November 2019 (Spotlighting, call playback and trapping)	-
Brush-tailed Phascogale					
Yellow-bellied Glider					
Greater Glider					
Grey-headed Flying-fox	Spotlight transects	6 nights	All year Oct – Nov Breeding	August & November 2019	No roosting camps identified within or near study area
	Opportunistic sightings	7 days of opportunistic daylight surveys			
Spotted-tailed Quoll	Opportunistic sightings	2 days – 1 night	All year	August & November 2019	-

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
	Remote cameras	6 cameras x 14 consecutive nights – 84 trap nights		November 2019	
	Spotlight transects	6 nights		August & November 2019	
Terrestrial mammals					
Common Planigale	Elliot A trapping	60 Elliot A traps x 4 consecutive nights – 240 trap nights	Spring	November 2019	-
New Holland Mouse					
Long-nosed Potoroo	Remote cameras	6 cameras x 14 consecutive nights – 84 trap nights	Spring	November 2019	
	Spotlight transects	6 nights	Spring	August & November 2019	
	Opportunistic sightings	8 days	All year	August & November 2019	
Microchiropteran bats					
Little Bent-winged Bat	Anabat surveys Hollow-bearing tree surveys Searches for caves, artificial structures etc.	4 nights consecutive nights of acoustic recordings	Dec – Feb Breeding	November 2019	Habitat Assessments undertaken to identify any key habitat within study area (i.e. caves, water bodies etc.) – absence of important breeding habitat (e.g. caves) within study area. Harp trapping with considered not necessary due to lack of important breeding or foraging components for some targeted species (i.e. Bentwing bats and Southern Myotis).
Eastern Bent-winged Bat			8 days		
Southern Myotis			Oct - Mar		
Large-eared Pied Bat			Nov – Jan Breeding		
Large Bent-wing Bat			Dec – Feb Breeding		
Eastern Cave Bat			Dec – Feb Breeding		
Eastern False Pipistrelle			All year		
Eastern Coastal Free-tailed Bat			All year		

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
Yellow-bellied Sheath-tail-bat			All year		
Greater Broad-nosed Bat			All year		
Amphibians					
Wallum Froglet	Spotlighting surveys Opportunistic sightings Habitat Assessments	8 days	All year	August & November 2019	Due to the lack of important habitat components within study area (i.e. water bodies – wetlands, dams etc.) these species were not followed up with additional targeted surveys.
Mahony's Toadlet			Oct – Mar		
Green and Golden Bell Frog			Nov – Mar		

2.5 Limitations

No sampling technique can eliminate the possibility that a species is present within a study area. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present within the study area during surveys. The conclusions in this report are based upon data acquired for the proposal and the environmental field surveys, therefore, they are merely indicative of the environmental condition of the study area at the time of preparing the report, including the presence or otherwise of species. It should be recognised that study area conditions, including the presence of threatened species, can change with time.

Targeted surveys have been conducted to detect target sedentary animal species and threatened flora species that are considered likely to occur within the study area based on habitat characteristics and previous records. As the actual distribution and the range of habitat utilised by some species is not fully understood, there is always a small possibility that other species could occur on the site despite being considered to have a low likelihood of occurrence based on their known range and known habitats.

2.5.1 Other limitations

Other limitations relating to the conclusions contained in this report are detailed in the following sections.

Reliance on externally supplied information

In preparing this study, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations. Except as otherwise stated in the study, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this study (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

Study for benefit of client

This document has been prepared for the exclusive benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study).

Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

2.5.2 Changing circumstances

To the best of WSP's knowledge, the proposal presented and the facts and matters described in this study reasonably represent the client's intentions at the time of preparation of the study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the proposal and of its possible environmental impact.

WSP will not be liable to update or revise this assessment to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the document.

3 Existing environment

This section describes the environmental context of the study area including abiotic and biotic features of the landscape area. The context of the study area assists in assessing likelihood of occurrence for threatened species and determining PCTs.

3.1 Summary of landscape features

The landscape context of the study area, including IBRA bioregions and subregions, Mitchell landscapes, catchment areas and land uses are described in Table 3.1.

Table 3.1 Landscape features

Landscape feature	Subject land
IBRA bioregions and subregions	North Coast Bioregion / Karuah Manning Subregion
NSW landscape regions (Mitchell landscapes)	Sydney - Newcastle Barriers and Beaches
Local Government Area (LGA)	Port Stephens Council
Native vegetation extent in the buffer area	Native vegetation cover has been identified as approximately 71% (therefore falls within the >70% native vegetation cover class as defined using BAM). This assumes that the proposal is not classified as linear infrastructure under BAM (i.e. not >3.6 km in length).
Rivers and streams	None identified within study area
Important and local wetlands	No important wetlands occur within the study area.
Connectivity features	Vegetation within the study area forms part of a large remnant patch which provides connectivity to the north-east and south-west. Wildlife connectivity to the north and south is hindered by barriers associated with Nelson Bay Road, transmission easements and rural/urban developments. The southern portion of the study area forms part of the Worimi National Park.
Areas of Geological Significance and Soil Hazard Features	The site does not contain any areas of geological significance
Areas of outstanding biodiversity value	No declared areas of outstanding biodiversity value occur in or near the site
Key Fish Habitat	No Key Fish Habitat occurs within the study area or likely to be affected by the proposal .(Department of Primary Industries, 2020b).

3.2 Plant community types

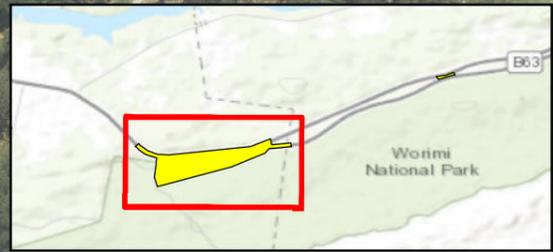
Two native PCTs and two non-native miscellaneous ecosystems were recorded within the study area. The two native vegetation communities were assigned to four discrete vegetation zones based on broad vegetation class criteria outlined in Table 3.2.

A summary of the vegetation types recorded within the study area and proposal area are outlined in Table 3.2, illustrated in Figure 3.1.

Table 3.2 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) study area	Area (ha) impacted
PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Moderate	Yes – Swamp Sclerophyll Forest (Endangered – BC Act)	0.20	0.11
PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Good	No	15.64	1.76
	Moderate		0.24	0.09
	Regrowth		4.84	0.31
Total extent of native vegetation			20.92	2.27
Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation	n/a	No	3.93	2.98
Miscellaneous ecosystem – urban/exotic plantings	n/a	No	0.03	0.03
Total extent of non-native vegetation			3.96	3.01
Total native and non-native vegetation			24.88	5.28

Detailed description and selection justification for each PCT and vegetation zone is provided below.



Legend

- BAM VI Plot
- Proposal area
- Study area

Native Plant Community Types (PCT)

- PCT 1646
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, Good Condition
- PCT 1646
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, Moderate Condition
- PCT 1646
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, Regrowth
- PCT 1717
Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast, Moderate Condition, (BC Act)

Miscellaneous ecosystems

- Urban/exotic plantings
- Highly disturbed areas with no or limited native vegetation

Map: PS113589_BAR_004_A1
 Author: SuansriR
 Date: 8/07/2020
 Approved by: - T.Bangel



1:4,000
 Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3

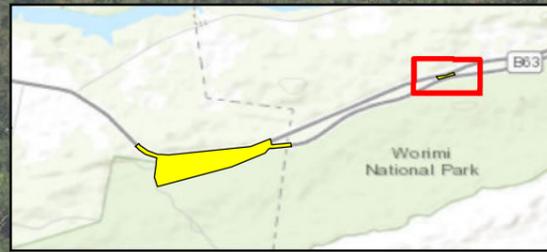
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community; NearMap

© WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 3.1a
 Plant Community Types



Legend

- Study area
- Miscellaneous ecosystems**
- Highly disturbed areas with no or limited native vegetation

Map: PS113589_BAR_004_A1	Author: SuansriR
Date: 8/07/2020	Approved by: - T.Bangel



1:1,500

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community; NearMap

© WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 3.1b
Plant Community Types

PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak – Saw Sedge swamp forest of the Central Coast and Lower North Coast

The occurrence of this vegetation type within the proposal area is illustrated in Figure 3.1 with photographic representation provided in Photo 3.1. An overview of floristic and structural composition is presented in Table 3.3 and a general description provided below.

Vegetation formation: KF_CH9 Forested Wetlands

Vegetation class: Coastal Swamp Forests

Other mapping sources:

- MU 37 Swamp Mahogany – Paperbark Forest (Parsons Brinckerhoff, 2013, Lower Hunter and Central Coast Regional Environmental Management Strategy, 2003)
- MU 181 Broad-leaved Paperbark / Swamp Mahogany / Swamp Oak / Saw Sedge swamp forest (Somerville, 2009).

Estimate of percent cleared: 68%

Conservation status: This vegetation type is consistent with the Swamp Sclerophyll Forest on Coastal Floodplains threatened ecological community listed as Endangered under the BC Act. This vegetation type is not consistent with any threatened ecological community listing under the EPBC Act.

Landscape position: PCT 1717 occurred in small ephemeral depressions which would likely become inundated and water logged intermittently in response to high rainfall events.

PCT justification: Floristic composition and dominance is consistent with PCT 1717 i.e. canopy dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany); sub-canopy and shrub layer was dominated by juvenile *Melaleuca quinquenervia* (Broad-leaved Paperbark) and ground stratum consisted of *Lomandra longifolia* (Spiny-headed Mat-rush), *Imperata cylindrica* (Blady Grass) and *Dianella caerulea* var. *producta* (Blue-flax Lily).

The study area is located on the coastal floodplain associated with Tilligery Creek. The structure is that of an open forest and is low lying. This PCT occurs on sandy loams in the eastern portion of the study area.

Based on floristic, geographic and geological characteristics, this vegetation type is considered consistent with the scientific description and distribution information outlined for PCT 1717 within BioNet Vegetation Classification (Environment Energy and Science Group, 2020b).

Vegetation zones: One distinct vegetation zone was assigned within this vegetation type based on broad condition state which included:

Modified: Although the canopy was structurally intact, understorey components contained low species diversity and appeared modified. A high density of *Melaleuca quinquenervia* juveniles occurred in the shrub layer.

Vegetation integrity survey plots: Q3 - see Appendix A for full floristic and structural data.



Photo 3.1 PCT 1717 Moderate

Table 3.3 PCT 1717 overview of floristic and structural composition

Structure	Average height and height range (m)	Average cover	Typical species
Trees	15-20	20-30	Dominated by <i>Melaleuca quinquenervia</i> (Broad-leaved Paperbark) with scattered <i>Eucalyptus robusta</i> (Swamp Mahogany)
Small trees	2-6	10-50	<i>Melaleuca quinquenervia</i> (Broad-leaved Paperbark)
Shrubs	2-1.5	10-30	<i>Melaleuca quinquenervia</i> (Broad-leaved Paperbark), <i>Dodonaea triquetra</i> (Large-leaf Hop-bush) and <i>Leucopogon lanceolatus</i>
Ground covers	0.5-1.5	0-10	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), juvenile <i>Melaleuca quinquenervia</i> (Broad-leaved Paperbark), <i>Dianella caerulea</i> var. <i>producta</i> (Blue-flax Lily), <i>Imperata cylindrica</i> (Blady Grass) and <i>Pteridium esculentum</i> (Common Bracken). Weed species recorded included <i>Cenchrus clandestinus</i> * (Kikuyu) and <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> * (Bitou Bush).

PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.2 to Photo 3.4. An overview of floristic and structural composition is presented in Table 3.4 and a general description provided below.

Vegetation formation: KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Coastal Dune Dry Sclerophyll Forests

Other mapping sources:

- MU 33 Coastal Sand Apple – Blackbutt Forest (Parsons Brinckerhoff, 2013, Lower Hunter and Central Coast Regional Environmental Management Strategy, 2003)
- MU 113 Smooth-barked Apple/ Blackbutt/ Old Man Banksia coastal sands woodland (Somerville, 2009)
- MU128 Smooth-barked Apple/Blackbutt/Old Man Banksia woodland on coastal sands of the central and Lower North Coast (Sivertsen et al., 2011).

Estimate of percent cleared: 45%

Conservation status: This vegetation type does not align with any threatened ecological community listed under the BC Act or the EPBC Act. PCT 1646 does however provide habitat for a threatened orchid species; *Diuris arenaria* (Sand Doubletail). This species was recorded within the higher quality patches of PCT 1646 within the study area.

Landscape position: Occurs on coastal dune sands at elevations below 100 m above sea level.

PCT Justification: Floristic composition and dominance is consistent with PCT 1646 i.e. canopy was dominated by *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Smooth-barked Apple) and *Banksia serrata* (Old Man Banksia). Sub-canopy was formed from *Monotoca elliptica* (Tree Broom-heath) and *Banksia serrata* (Old Man Banksia). Shrub layer consisted of *Leptospermum polygalifolium* subsp. *pologalifolium* (Tantoon), *Acacia ulicifolia* (Prickly Moses) and *Monotoca elliptica* (Tree Broom-heath). Ground stratum species consisted a combination of grasses, ferns and herbs which are diagnostic of PCT 1646.

The study area is located on coastal sand dunes and has an open forest structure.

Based on floristic, geographic and geological characteristics, this vegetation type is considered consistent with the scientific description and distribution information outlined for PCT 1646 within BioNet Vegetation Classification (Environment Energy and Science Group, 2020b).

Vegetation zones: Three distinct vegetation zones were assigned within this vegetation type based on broad condition state which included:

Good: Vegetation was structurally intact, weed cover was generally low and characteristic species of the community were recorded.

Modified: One moderate condition patch of this community occurred in the west of the study area which consisted of a canopy layer with no mid or shrub stratum layers, the ground layer was dominated by weeds. The mid, shrub layers were absent within this condition type.

Regrowth: This condition class had a dense to sparse mid-stratum of naturally regenerating midstorey and canopy species representative of PCT 1646. Other parts of this PCT had no mid stratum or canopy layer with a sparse shrub layer. This shrub layer was diverse with greater than 50% native understory cover. The weed cover was generally but with exotic grasses and herbs occurring on the edges of the community.

Vegetation integrity survey plots: Q1, Q2, Q7, Q8 – see Appendix A for full floristic and structural data.

	
Photo 3.2 PCT 1646 Good	Photo 3.3 PCT 1646 Moderate
	
Photo 3.4 PCT 1646 Regrowth	

Table 3.4 PCT 1646 overview of floristic and structural composition

Structure	Average height and height range (m)	Average cover	Typical species
Trees	25	35-50	<i>Angophora costata</i> (Smooth-barked Apple), <i>Eucalyptus pilularis</i> (Blackbutt) and <i>Banksia serrata</i> (Old Man Banksia)
Small trees	4-8	15-25	<i>Banksia serrata</i> (Old Man Banksia) and <i>Monotoca elliptica</i> (Tree Broom-brush)
Shrubs	1.5-3	0-5	<i>Monotoca elliptica</i> (Tree Broom-heath), <i>Dodonaea triquetra</i> (Large-leaf Hop-bush), <i>Leucopogon lanceolatus</i> , <i>Acacia ulicifolia</i> (Prickly Moses) and <i>Leptospermum polygalifolium</i> subsp. <i>pologalifolium</i> (Tantoon). The exotic weed species <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> (Bitou Bush) and <i>Lantana camara</i> (Lantana) occur within this stratum in disturbed areas.
Ground covers	0.1-1.5	40-60	<i>Pteridium esculentum</i> (Bracken Fern), <i>Imperata cylindrica</i> (Blady Grass), <i>Themeda tridentata</i> (Kangaroo Grass), <i>Tetratheca ericifolia</i> and <i>Dianella caerulea</i> var. <i>producta</i> (Blue Flax-lily).

Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation

This vegetation type does not align to any recognised plant community type in NSW due to its limited native vegetation and degraded condition. As such, it has been aligned to Highly disturbed areas with no or limited native vegetation. Within the study area this vegetation type was mostly dominated by exotic perennial grass species such as *Ehrharta erecta** (Panic Veldtgrass), *Cenchrus clandestinum** (Kikuyu), *Megathyrsus maximus** (Guinea Grass), *Eragrostis curvula** (African Love Grass), Paspalum species (Paspalum), *Chloris gayana** (Rhodes Grass), *Melinis repens** (Red Natal Grass) and *Bidens pilosa** (Cobblers Pegs).

This vegetation type was recorded in areas where >50% of the understorey was comprised of exotic species and no canopy was present. Overall, this vegetation formed 3.93 ha within the study area (Figure 3.1) and is depicted below in Photo 3.5.



Photo 3.5 Miscellaneous ecosystem - highly disturbed areas with no or limited native vegetation

Miscellaneous ecosystem – urban/exotic plantings

This vegetation type does not align to any recognised plant community type in NSW and is the result of ornamental landscape plantings. Only a single small patch of this miscellaneous ecosystem occurred occupying 0.03 ha of the study area.

3.3 Flora recorded

Within the study area, a total of 135 flora species were recorded. Of these, 59 species (44%) were exotic species or native planted ornamental species and 76 species (56%) were native. One threatened flora species was recorded within the study area; *Diuris arenaria* (Sand Doubletail) which is listed as Endangered under the BC Act. A full inventory of flora species recorded and vegetation integrity plot data is presented in Appendix A.

3.3.1 Priority Weeds

Of the 59 exotic species recorded, three are listed as Priority Weeds under the NSW *Biosecurity Act 2015* (Biosecurity Act) for the Greater Hunter Local Land Service region (Table 3.5) and are also listed Weeds of National Significance (WONS). Under the Biosecurity Act, land managers are required to follow the regional and non-regional duties which have been allocated to each Priority Weed.

Table 3.5 Weeds of concern recorded within the study area

Scientific name	Common name	Priority weed duty	WONS
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> *	Bitou Bush	Prohibition on dealings Must not be imported into the State or sold	Yes
<i>Lantana camara</i> *	Lantana		Yes
<i>Senecio madagascariensis</i> *	Fireweed		Yes

3.4 Fauna recorded

Sixty-two fauna were recorded during field surveys, which included 46 birds, 13 mammals, three reptiles (Appendix A). Of the recorded fauna, seven are listed as threatened or migratory under either the BC Act or EPBC Act (Table 3.6).

Table 3.6 Threatened or migratory fauna recorded in the study area

Scientific name	Common name	BC Act	EPBC Act
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M
<i>Hirundapus caudacutus</i>	White-throated Needle-tail	-	V, M
<i>Micronomus norfolkensis</i>	Eastern Freetail Bat	V	-
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M

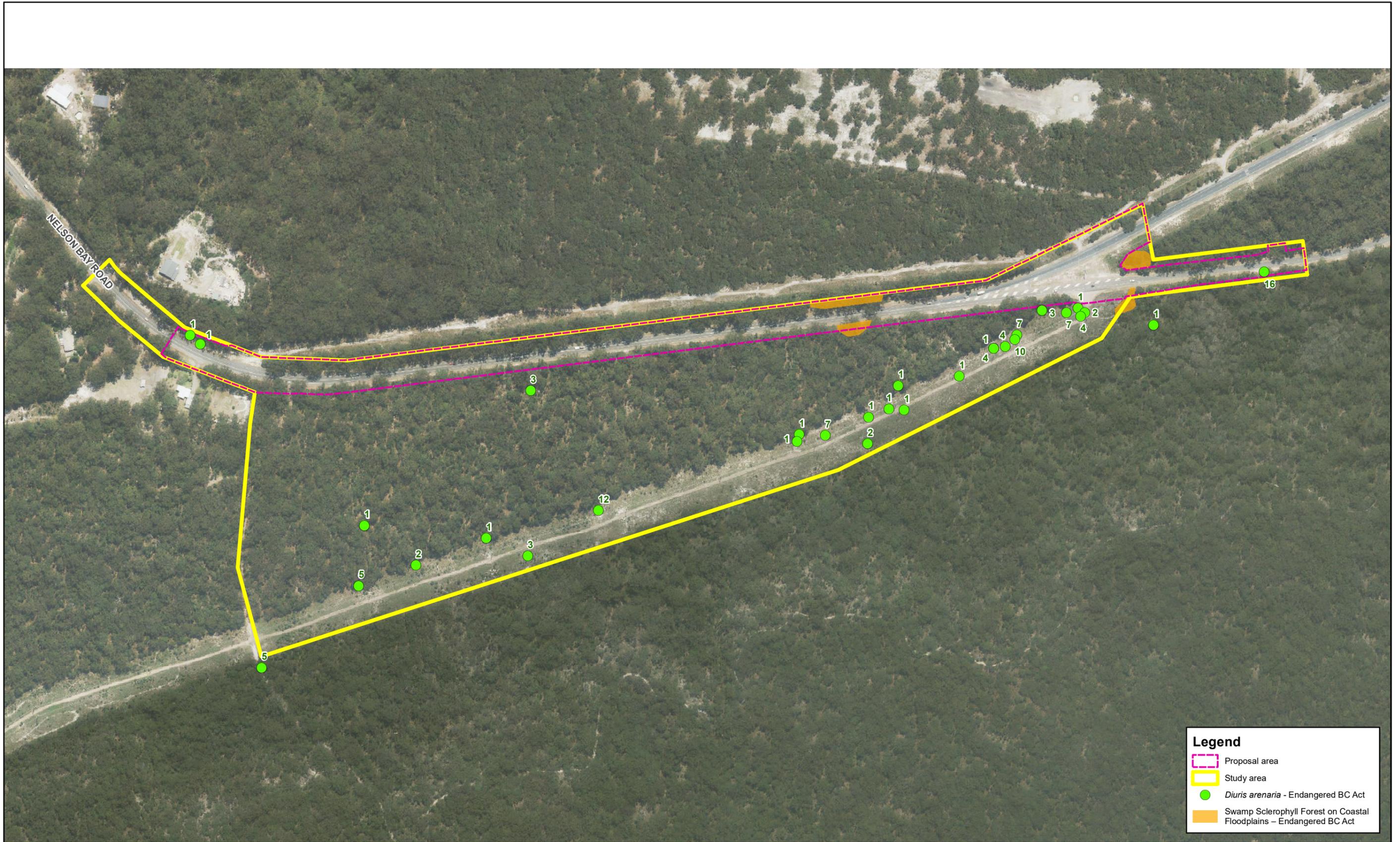
3.5 Threatened ecological communities

One threatened ecological community was recorded within the study area; being Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest). This threatened ecological community is listed as Endangered under the BC Act however is not listed under the EPBC Act. The occurrence of this threatened ecological community within the study area is shown in Figure 3.2.

All areas of PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast (PCT 1717) recorded in the study area were consistent with the Swamp Sclerophyll Forest final determination (NSW Scientific Committee, 2011). A comparison of the Swamp Sclerophyll Forest final determination and PCT 1717 attributes within the study area is provided in Table 4.1.

Table 3.7 A comparison of Swamp Sclerophyll Forest on Coastal Floodplains final determination criteria and PCT 1717 attributes within the study area

Final determination listing criteria	Swamp Sclerophyll Forest on Coastal Floodplain	PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast
Area occupied by the EEC	Occurs in the NSW North Coast, Sydney Basin and South East Corner Bioregions	PCT 1717 occurs in the North Coast IBRA Bioregion
Soils	The community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains	The eastern portion of the PCT has been mapped as occurring on Boyces Track Soil Landscape (eSpade, 2020), which the soil consists of sandy loams. The study area occurs on the coastal floodplain associated with Tilligerry Creek.
Elevation	Does the PCT occur below 20 m	The PCT occurs at elevations between 10 m and 20 m
Floristic Structure	The community is typically open forest but can be reduced the canopy to scattered trees. In some areas, the tree stratum is low and dense, so the community takes on the structure of a scrub.	The PCT within the study area is that of an open forest, however the density of the mid storey is dense due to regrowth due to previous disturbance.
Assemblage of Species	59 characteristic species of Swamp Sclerophyll Forest on Coastal Floodplains are listed in the Scientific Determination	Five of these species were recorded during the flora surveys. Only one BAM plot was conducted due to the small area of Swamp Sclerophyll Forest that occurs within the study area. This PCT was moderately disturbed due to impacts associated with the construction/operation of Nelson Bay Road and other surrounding land uses. Whilst, the species diversity was low, the PCT contained a high density of <i>Melaleuca quinquenervia</i> and <i>Pteridium esculentum</i> .
Location within LGAs	Previously recorded from the local government areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	This PCT occurs within the Port Stephens LGA.
Outcome		Yes



Legend

- Proposal area
- Study area
- *Diuris arenaria* - Endangered BC Act
- Swamp Sclerophyll Forest on Coastal Floodplains – Endangered BC Act

Map: PS113589_BAR_005_A1	Author: SuansriR
Date: 8/07/2020	Approved by: - T.Bangel



Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community; NearMap

© WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 3.2
Threatened flora species and ecological communities

3.6 Groundwater dependent ecosystems

Groundwater dependant ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater (Department of Land and Water Conservation, 2002). When considering GDEs, groundwater is generally defined as the saturated zone of the regolith (the layer of loose rock resting on bedrock, constituting the surface of most land) and its associated capillary fringe, however it excludes soil water held under tension in soil pore spaces (the unsaturated zone or vadose zone) (Eamus et al., 2006).

GDEs include a diverse range of ecosystems from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water) (Hatton and Evans, 1998). Eamus et al. (2006) considers the following broad classes of these ecosystems:

- Aquifer and cave ecosystems, where stygofauna (groundwater-inhabiting organisms) may reside within the groundwater resource. The hyporheic zones (see ecosystem 5 in figure above) of rivers and floodplains are also included in this category because these ecotones often support stygobites (obligate groundwater inhabitants).
- All ecosystems dependent on the surface expression of groundwater. This category includes base-flow rivers and streams, wetlands (see ecosystems 2 and 3 in Figure 3.3), some floodplains and mound springs and estuarine seagrass beds. While it is acknowledged that plant roots are generally below ground, this class of groundwater dependant ecosystems requires a surface expression of groundwater, which may, in many cases, then soak below the soil surface and thereby become available to plant roots.
- All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the saturated zone of the water table) when roots penetrate this zone. This class includes terrestrial ecosystems such as River Red Gum (*Eucalyptus camaldulensis*) forests on the Murray–Darling basin (see ecosystems 1 and 4 in Figure 3.3). No surface expression of groundwater is required in this class of groundwater dependant ecosystems.

GDEs possess a range of values, including being important and sometimes rare ecosystems in themselves, as well as providing important ecosystem services such as water purification (Department of Land and Water Conservation, 2002).

The dependence (or interaction) of the vegetation communities identified within the proposal footprint, on groundwater was determined by aligning them with the groundwater dependant ecosystem types identified by Eamus et al. (2006) (Figure 3.3).

PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest and PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland vegetation communities are highly to moderately likely to be GDEs which are reliant on surface expressions of groundwater or on subsurface groundwater in the study area (Bureau of Meteorology, 2020).

PCTs identified within the study area are considered likely to be classified as terrestrial GDEs or “Vadophytic vegetation” (Figure 3.3). No groundwater aquifer or cave systems, or wetlands were identified within the study area from the field surveys and desktop assessment.

Geotechnical investigations completed to date have not identified any groundwater or perched water tables occurring within the proposal area. The proposed works will largely be located within existing fill associated with the existing carriageway and road formation. As such, the proposal is considered unlikely to significantly interfere with subsurface or groundwater flows associated with the coastal floodplain of Tilligerry Creek.

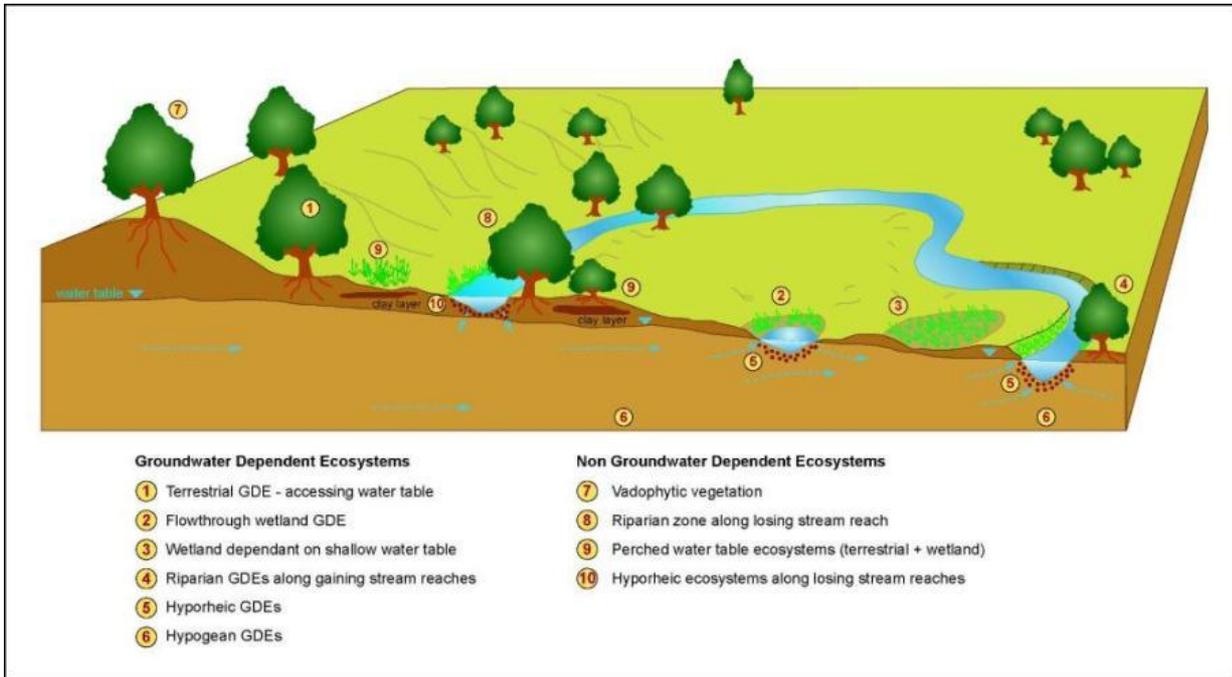


Figure 3.3 Conceptual biophysical model of groundwater dependent ecosystems

3.7 Threatened species and populations

3.7.1 Threatened flora species

The desktop assessment identified 30 BC Act listed threatened flora species as being known or predicted to occur in the locality of the study area. Of these 18 were considered to have a moderate or high likelihood of occurrence based on the habitat available within the study area (Appendix B and Table 3.8). These species became candidate for detailed targeted surveys. Targeted threatened flora surveys have been completed for all but candidate species.

Table 3.8 outlines candidate species, their conservation status, potential occurrence and whether they are likely to be affected by the proposal. Each species affected is considered further with respect to Section 5A and MNES significance assessments which are provided Appendix C.

Table 3.8 Threatened flora habitat assessment and surveys results

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act ¹	EPBC Act ²			
<i>Angophora inopina</i>	Charmhaven Apple	V	V	Moderate	No	No - surveyed
<i>Asperula asthenes</i>	Trailing Woodruff	V	V	Moderate	No	No - surveyed
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	Moderate	No	No - surveyed
<i>Corybas dowlingii</i>	-	E1	-	Moderate	No	No - surveyed
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Moderate	No	No - surveyed
<i>Diuris arenaria</i>	-	E1	-	Recorded	Yes	Yes - surveyed

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act ¹	EPBC Act ²			
<i>Diuris praecox</i>	Rough Double Tail	V	V	Moderate	No	No - surveyed
<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V	V	Moderate	No	No - surveyed
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	-	V	V	Recorded	No	No - surveyed
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Moderate	No	No - surveyed
<i>Lindernia alsinoides</i>	Noah's False Chickweed	E1	-	Moderate	Yes	No - surveyed
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Moderate	No	No - surveyed
<i>Melaleuca groveana</i>	Groves Paperbark	V	-	Moderate	No	No - surveyed
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Moderate	No	No - surveyed
<i>Prostanthera densa</i>	Villous Mint-bush	V	V	Moderate	No	No - surveyed
<i>Pterostylis chaetophora</i>	-	V	-	Moderate	No	No - surveyed
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	V	V	Moderate	No	No - surveyed
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	Moderate	No	No - surveyed

1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act

2. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

All recorded or potentially occurring threatened biodiversity are discussed further below.

***Diuris arenaria* (Sand Doubletail)**

Diuris arenaria (Sand Doubletail) is listed as an Endangered species and a SAIL entity under the BC Act. A population of 18 *Diuris arenaria* individuals were recorded within the proposal area during targeted seasonal surveys (Photo 3.6). The species occurred along the Nelson Bay Road verge in good and regrowth condition patches of PCT 1646 Smooth-barked Apple – Blackbutt – Old Man Banksia Woodland.

Following the identification of *Diuris arenaria* within the proposal area, an additional targeted survey for the species was completed within areas of Worimi National Park immediately south of the proposal area. The intention of this survey was to identify the extent of the local population to aid in determining the nature and scale of potential impacts the proposal may have on the species. This survey identified a further 90 individuals as occurring immediately south of the proposal area.

Individuals recorded form part of a larger substantial local population of *Diuris arenaria* which extends from the study area through Worimi National Park, Worimi Conservation Area to a biodiversity offset area located approximately 2 km south west of the study area. A large area

of this population is conserved under the Saving Our Species program, within Worimi National Park and within a biodiversity offset area which has been established for another project in the locality. Approximately 18 *Diuris arenaria* (Sand Doubletail) individuals, which occurs on the periphery of this large local population will be affected by the proposal, this impact may be reduced following the detailed design phase of the proposal.

The location of *Diuris arenaria* individuals identified within the study area are illustrated in Figure 3.2.



Photo 3.6 *Diuris arenaria* (Sand Doubletail) recorded within the study area

3.7.2 Threatened fauna species

The desktop assessment identified 64 BC Act threatened fauna species as being known or predicted to occur in the locality of the study area. Of these 24 were considered to have a moderate to high likelihood to occur within the study area (Appendix B and Table 3.9) based on the habitat available within the study area. These species became candidate species for detailed targeted fauna surveys.

Table 3.9 outlines candidate species, their conservation status, potential occurrence and whether they are likely to be affected by the proposal. Each species affected is considered further with respect to Section 5A and MNES significance assessments which are provided Appendix C.

The location of fauna species recorded within the study area are illustrated in Figure 3.4.

Table 3.9 Threatened fauna habitat assessment and surveys results

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
Birds						
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	Moderate	No	Yes
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Recorded	No	Yes
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo	V	-	Moderate	No	Yes
<i>Circus assimilis</i>	Spotted Harrier	V	-	Moderate	No	Yes
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Recorded	No	Yes
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M	Recorded	No	No
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Moderate	No	Yes
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Moderate	No	Yes
<i>Petroica boodang</i>	Scarlet Robin	V	-	Moderate	No	Yes
<i>Ninox strenua</i>	Powerful Owl	V	-	Moderate	No	Yes
<i>Tyto novaehollandiae novaehollandiae</i>	Masked Owl (southern mainland)	V	-	Moderate	No	Yes
Mammals						
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll	V	E	Moderate	No	Yes
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Moderate	Yes – breeding habitat only	Yes – no SAI entity will be impacted
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Moderate	No	Yes
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-	Recorded	Yes – breeding habitat only	Yes – no SAI entity will be impacted
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	Moderate	Yes – breeding habitat only	Yes – no SAI entity will be impacted
<i>Mormopterus (Micronomus) norfolkensis</i>	Eastern Freetail Bat	V	-	Recorded	No	Yes
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	High	No	Yes

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	High	No	Yes
<i>Phascolarctos cinereus</i>	Koala	V	V	Moderate	No	Yes – no important habitat is likely to be impacted
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	High	No	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Moderate	No	Yes
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Moderate	No	Yes
<i>Vespadelus trougtoni</i>	Eastern Cave Bat	V	-	Moderate	Yes – breeding habitat only	Yes – no SAI entity will be impacted

3. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act

4. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

NOTE: EPBC Migratory species that are not listed as Threatened have not been included in the table, these species have been included in Section 3.12 below.



Legend

- Eastern Freetail Bat
- Little Bentwing Bat
- Little Lorikeet
- Varied Sittella
- White-bellied Sea-eagle
- Hollow-bearing tree
- Proposal area
- Study area

Map: PS113589_BAR_006_A1	Author: SuansriR
Date: 8/07/2020	Approved by: - T.Bangel



1:4,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community; NearMap

© WSP Australia Pty Limited (WSP) Copyright in the drawings, information and data recorded is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF © WSP Australia Pty Limited.



WILLIAMTOWN TO BOB'S FARM UPGRADE - SECTION 1

Figure 3.4
Threatened fauna and hollow-bearing trees

3.8 Aquatic habitat

No aquatic habitat was identified within the study area. Furthermore, no Key Fish Habitat has been mapped within the study area or likely to be affected by the proposal (Department of Primary Industries, 2020b).

3.9 Critical habitat

The registers of critical habitat listed under the EPBC Act, BC Act and FM Act searched during the desktop analysis and no critical habitat was found to occur within or in the locality of the study area.

3.10 Wildlife connectivity corridors

Wildlife corridors are generally links of native vegetation that join two or more areas of similar habitat and are critical for sustaining ecological processes, such as provision for animal movement and the maintenance of viable populations (Department of Environment, 2016).

Wildlife corridors in association with the study area are already subject to fragmentation due to the existing Nelson Bay Road, the associated power easements both north and south of Nelson Bay Road as well as clearing for residential development at the western end of the study area. Whilst these barriers are not impassable, they may already limit regular fauna movement. However, due to large patches of continuous vegetation occurring on either side of the study area and the existing road being single lane in both directions, fauna species (especially larger and more mobile species) may still cross the study area. The extent of contiguous vegetation associated with Worimi National Park to the south of the study area, suggests that the study area is not likely to act as a key wildlife corridor in isolation.

3.10.1 Koala corridors

Koala movement corridors have been identified previously within the Port Stephens LGA (Biolink Ecological Consultants, 2018, Land Use Planning Sustainable Planning Group, 2007). Research by Biolink Ecological Consultants (2018) has identified that Koala movement generally occurs between patches of 'preferred' Koala habitat.

The majority of Koala movements have been identified to occur to the north and west of the study area from Tilligerry - Salt Ash to the high-density population hub at Anna Bay (Photo 3.7).

Koala's were found to use these 'preferred' habitat patches to the north and west of the study area as 'stepping stones' to move generally in an east to west direction.

As the study area contained 'supplementary' habitat, as demonstrated by the few individual records in proximity to the study area, it is unlikely that it would act as an important Koala corridor for the local population. However, it cannot be discounted that irregular occurrences may occur within the study area, such as during local dispersal movement.

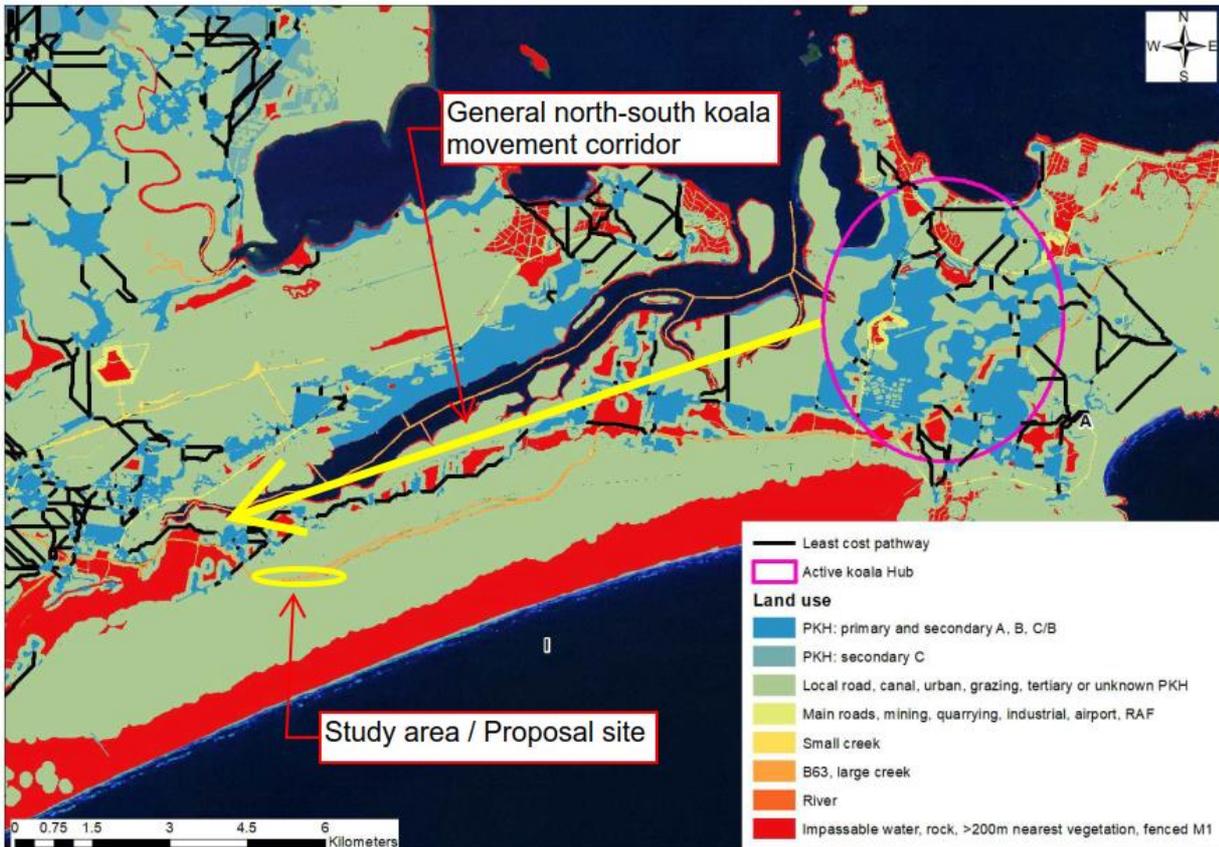


Photo 3.7 Identified Koala movement corridor – to the north and west of the study area

3.11 NSW State Environmental Planning Policy's

There are two NSW State Environmental Planning Policy's (SEPPs) that relate to biodiversity that are considered for the study area. These are:

- SEPP (Coastal Management) 2018
- SEPP (Koala Habitat Protection) 2019.

An overview of each SEPP and the relevance to the study area is provided below.

3.11.1 SEPP (Coastal Management) 2018

The State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) was introduced to provide an integrated policy for coastal assets. Under the Coastal Management SEPP, areas of 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' have been mapped across NSW.

None of the study area occurs within areas mapped as either Coastal Wetlands or their buffers as determined by the Coastal Management SEPP (NSW Department of Planning and Environment, 2018). As such, the proposal is considered unlikely to directly impact on mapped Coastal Wetlands.

3.11.2 SEPP (Koala habitat protection) 2019

The Koala Habitat Protection SEPP came into effect on the 4 March 2020. Although the study area occurs in the Port Stephens LGA which is listed under Schedule 1, the proposal does not require assessment in accordance with the SEPP as it is an activity being considered under Division 5.1 of the EP&A Act.

Although the proposal is not required to be assessed in accordance with the SEPP in the interests of completeness it should be noted that the proposal does occur within a known important koala population. It is therefore recommended that the proposal considers the

mitigation measures and recommendations within the Port Stephens Comprehensive Koala Plan of Management (CKPoM) (Port Stephens Council, 2002).

Targeted surveys conducted for the presence of Koala's, including Spot Assessment Technique across the entire study area, did not record any evidence (e.g. scratches, observations or vocalisations) of this species within the study area. The study area is located in an area where Blackbutt/Smooth-barked Apple associations dominate over a large area, which, due to their non-preferred feed-tree status, are unlikely to encourage regular Koala use. There are no Koala sightings recorded within or in proximity to the study area, which is likely due to the lack of 'preferred' habitat. Additionally, no 'preferred' habitat has been mapped as occurring to the south and east of the study area.

Due to a lack of 'preferred' koala habitat and minimal number of preferred feed trees within the study area it is considered unlikely that the study area is important to Koalas for breeding and feeding purposes. The site may however be used on an intermittent basis during broader landscape dispersal movements to access preferred habitat.

Koala Plan of Management

The purpose of the Port Stephens CKPoM (Port Stephens Council, 2002) is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline.

The study area occurs within the Fullerton Cove/Stockton Bight Koala Management Unit (KMU) and the proposal aims to be consistent with the actions outlined in the Port Stephens CKPoM associated with this KMU. This area of KMU has predominately 'supplementary' Koala habitat, with majority of 'preferred' Koala habitat located to the north outside of the study area near 'Bobs Farm'.

The Port Stephens CKPoM has established 'habitat conservation' measures for this KMU and relevant actions to the proposal are shown in Table 3.10.

Table 3.10 Fullerton Cove/Stockton Bight Koala Management Unit actions and mitigation measures

Fullerton Cove/Stockton Bight KMU actions	Proposal mitigation measures
Habitat restoration should be undertaken in areas of mainly cleared land located adjacent to large patches of Supplementary Koala habitat along Stockton Bight	Removal of any supplementary Koala habitat has been kept minimal, as far as possible

Road mortality

Two stretches of Nelson Bay Road that abut this KMU have been identified as koala 'black spots' for vehicle strike and road mortality. One area is along Nelson Bay Road in the vicinity of Oakvale/Salt Ash and the other black spot is Nelson Bay Road in the vicinity of Williamtown. Both these 'black spots' do not occur within the study area. Although Koala road strike or road mortality in the study area is not currently quantifiable, Koala have been injured by collisions with motor vehicles further east along Nelson Bay Road between Bobs Farm and Anna Bay (Transport for NSW, 2013).

Whilst the study area does not contain preferred habitat for the Koala it may be used on an intermittent basis during broader landscape dispersal movements to access preferred habitat. Therefore, the main potential impact to the important population would likely be through mortality from vehicle strike.

An assessment of potential road strike and road mortality impacts on the species is discussed in Section 4.1.5. Mitigation measures to reduce the potential for these impacts on the Koala with the study area are provided in Section 5.2.

3.12 Matters of National Environmental Significance

The focus of this section is threatened species, populations and communities and migratory species listed under the EPBC Act. It also included a discussion of the following MNES as they relate to biodiversity:

- World and national heritage
- Wetlands of international and national importance.

3.12.1 Threatened communities listed under the EPBC Act

No vegetation types recorded within the study area corresponded to any threatened ecological community listed under the EPBC Act.

3.12.2 Threatened flora listed under the EPBC Act

The desktop assessment identified 20 EPBC Act listed threatened flora species as being known or predicted to occur in the locality of the study area. Of these, 12 were considered to have a moderate likelihood of occurrence (Appendix B and Table 3.11) based on habitat available in the study area. These species became candidate species for detailed targeted fauna surveys.

No EPBC Act listed threatened flora species were recorded within the study area during targeted surveys and therefore no EPBC Act listed flora species are considered likely to be impacted by the proposal.

Table 3.11 Threatened flora species listed on the EPBC Act with moderate or higher likelihood of occurrence.

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Affected species?
<i>Angophora inopina</i>	Charmhaven Apple	V	V	Moderate. Associated habitat present in the form of PCT 1646 and PCT 1717. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Asperula asthenes</i>	Trailing Woodruff	V	V	Moderate. Associated habitat present in the form of PCT 1717. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Moderate. Associated habitat present in the form of PCT 1646. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Diuris praecox</i>	Rough Double Tail	V	V	Moderate. Associated habitat present in the form of PCT 1646. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Affected species?
<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V	V	Moderate. Associated habitat present in the form of PCT 1646. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	-	V	V	Moderate. Associated habitat present in the form of PCT 1646 and PCT 1717. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Moderate. Associated habitat present in the form of PCT 1717. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Moderate. Associated habitat present in the form of PCT 1717. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Moderate. Associated habitat present in the form of PCT 1717. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Prostanthera densa</i>	Villous Mint-bush	V	V	Moderate. Associated habitat present in the form of PCT 1646. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	V	V	Moderate. Associated habitat present in the form of PCT 1646. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Affected species?
<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	Moderate. Associated habitat present in the form of PCT 1646. No individuals of this species were recorded during targeted surveys conducted under suitable seasonal survey conditions or have been recorded previously.	No – surveyed

1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act
2. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act

3.12.3 Threatened fauna listed under the EPBC Act

The desktop assessment identified 26 EPBC Act listed threatened fauna species as being known or predicted to occur in the locality of the study area (Appendix B). Of these, six were either recorded or are considered likely to utilise habitat identified within the study area (Table 3.12).

One EPBC Act listed threatened fauna species was recorded within the study area during targeted surveys being White-throated Needletail (Figure 3.4).

Table 3.12 Threatened fauna species listed on the EPBC Act with moderate or higher likelihood of occurrence.

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Affected species?
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll	E	-	Moderate. Marginal habitat within study area due to the proximity to a busy roadway, but the study area may occur within the home range of local individuals and intermittent occurrences cannot be discounted. No breeding components identified in study area.	Yes
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Moderate. Suitable foraging, likely that local individuals may use the study area on at least an intermittent basis. No breed habitat within study area	Yes
<i>Phascolarctos cinereus</i>	Koala	V	V	Moderate. Marginal habitat within study area. Lack of preferred Koala feed trees species occurring in the study area. Study area doesn't provide 'core koala habitat'. Irregular occurrences in study may occur when accessing core habitat in the greater locality.	Yes – however no preferred habitat on site
<i>Hirundapus caudacutus</i>	White-throated Needletail	V	-	Recorded. Recorded foraging in air space above the study area. Unlikely to use terrestrial habitat associated with the study area.	No – no habitat not likely to be impacted

Scientific name	Common Name	BC Act ¹	EPBC Act ²	Potential occurrence	Affected species?
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	High. Habitat within study area is likely to form part of this species' foraging range and it is likely to occur during seasonal blossoming events. No roost camps in study area.	Yes
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	V	-	Moderate. Study area contains suitable sandy substrates and suitable habitat.	Yes

1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act

2. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

Koala habitat summary

The Koala is listed as Vulnerable under the EPBC Act. There is a known population within the Port Stephens LGA that is regarded as a population that is important within the Hunter region. Under the EPBC Act an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Although the study area falls within the Port Stephens LGA, mapping of Koala habitat locations and Koala road strike areas derived from a study by Biolink Ecological Consultants (2018), show that there are no road strikes associated with the roadway occurring within the study area and that there is no 'preferred' Koala habitat associated with the study area. Although no road strikes or road mortality of Koalas have been recorded in the study area there have been Koalas injured by collisions with motor vehicles further east along Nelson Bay Road between Bobs Farm and Anna Bay (Transport for NSW, 2013).

All trees of all species over 10cm DBH occurring in the study area were surveyed for potential Koala scats and bark scratches. All tree species were surveyed due to intermittent occurrences of *Eucalyptus robusta* (Swamp Mahogany) and the supplementary koala habitat status of land within which the study area occurs (Land Use Planning Sustainable Planning Group, 2007).

Dominant canopy trees within the study area included *E. pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple), whilst the midstorey was dominated by young canopy species and *Banksia serrata* (Old-man Banksia). The study area contained a small number of locations where low-lying depressions have encouraged colonisation by *Melaleuca quinquinervia* (Broad-leaved Paperbark) and the occasional Swamp Mahogany. However, these areas were mixed with the prevailing Blackbutt/Apple community and Swamp Mahogany occurred in low numbers in association with the small patch of PCT 1717 mapped (approx. 0.20 ha within the study area and 0.11 ha within the proposal area).

No Koala activity was recorded within the study area via SAT results or other signs such as scratches, observations or vocalisations. Furthermore, habitats surrounding the study area continue to be dominated by Blackbutt/Apple dominated communities, which are unlikely to attract Koalas due to a lack of preferred foraging opportunities. Due to the lack of 'preferred' koala habitat and minimal number of preferred feed trees within the study area, it is considered unlikely that the study area is important to Koalas for breeding and feeding purposes. As such, habitat within the study area may be used intermittently during broader landscape dispersal movements to access preferred habitat.

Federal Koala Habitat Assessment Tool

The Koala Habitat Assessment Tool within the 'EPBC Act referral guidelines for the vulnerable Koala' (Department of the Environment, 2014) was used to determine whether Koala habitat within the study area classifies as 'habitat critical to the survival of the Koala' (Figure 3.5). To be classified as habitat critical to the survival of the Koala vegetation must score 5 or above using the habitat assessment tool. A summary of the assessment completed is provided in Table 5.1.

Koala habitat within the study area scored 7 out of 10 (Table 5.1) using the Koala Habitat Assessment Tool. Therefore, habitat within the study area technically constitutes habitat critical to the survival of the species.

A comparison of the projects potential impacts was assessed against Figure 2 of the EPBC Act referral guidelines for the vulnerable Koala (Department of the Environment, 2014) to determine where impacts were likely to be adverse and subsequently whether an EPBC Act referral would be required. Results of this assessment concluded that there was a level of uncertainty regarding whether the proposal would have an adverse effect on habitat critical to the species (Figure 3.6).

On further consideration, it was determined that the proposal is unlikely to have an adverse impact on the habitat critical for the species due to the following:

- Vegetation within the study area is mapped as supplementary habitat for the Koala (Land Use Planning Sustainable Planning Group, 2007). Due to the lack of 'preferred' koala habitat and minimal number of preferred feed trees (i.e. *Eucalyptus robusta*) within the study area it is considered unlikely that the study area is important to Koalas for breeding and feeding purposes. The site may however be used on an intermittent basis during broader landscape dispersal movements to access preferred habitat. Only 0.11 ha of habitat which contained preferred Koala feed trees would be impacted by the proposal.
- No Koalas or evidence of Koalas (such as scats or scratches) were recorded in the study area during targeted surveys completed. BioNet (2020) indicate that records of the species within 2 km of the study area are sparse and most are greater than 5-10 years old (approx. 4 records within the past 5 years).
- Although road strikes or road mortality of Koalas have been recorded in the broader locality further east between Bobs Farm and Anna Bay (Transport for NSW, 2013), no road strikes have been recorded in association with the roadway occurring within the study area (Biolink Ecological Consultants, 2018). Furthermore, no koala 'black spots' for vehicle strike and road mortality occur within the study area.
- Specific mitigation measures to minimise potential impacts on Koala will be implemented (Section 4 and Section 5.2). These mitigation measures would include the preparation of an appropriate tree clearing procedure and erection of Koala exclusion fencing along the southern side of Nelson Bay Road to prevent/deter Koala's crossing the road where a concrete median barrier will be constructed. If implemented, these and the other mitigation measures detailed in Section 5.2 will ameliorate potential impacts on the species.
- The EPBC Act significant impact assessment concluded that the proposal is unlikely to have a significant impact on these species (Appendix C).

In summary, the proposal is considered unlikely to have an adverse impact on habitat critical to the survival of the Koala. As such, an EPBC Act referral and SIS are not considered necessary.

Attribute	Score	Inland	Coastal
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	Evidence of one or more koalas within the last 2 years.
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years.	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 5 years.
	0 (low)	None of the above.	None of the above.
Vegetation composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	Has forest or woodland with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.	Has forest or woodland with only 1 species of known koala food tree present.
	0 (low)	None of the above.	None of the above.
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 1000 ha.	Area is part of a contiguous landscape ≥ 500 ha.
	+1 (medium)	Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha.	Area is part of a contiguous landscape < 500 ha, but ≥ 300 ha.
	0 (low)	None of the above.	None of the above.
Key existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. Areas which score 0 for koala occurrence and have no dog or vehicle threat present	
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.	
	0 (low)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, OR Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	

Figure 3.5 EPBC Act Koala habitat assessment tool (Department of the Environment, 2014)

Table 3.13 Completed EPBC Act Koala habitat assessment tool for habitat within the study area

Attribute	Score	Habitat appraisal	
Koala occurrence	1	Desktop	Database searches identified approx. four Koala records within 2 km the proposal area in the last 5 years. No records for Koala have been recorded in the past two years.
		On-site	No Koalas individuals or traces of Koalas (scats, scratching etc.) were recorded within the study area.
Vegetation structure and composition	2	Desktop	Vegetation within the study area is mapped as supplementary habitat for the Koala in Port Stephens Council Koala Habitat Planning Map (Land Use Planning Sustainable Planning Group, 2007).
		On-site	Habitat ground-truthing was carried out during field surveys which identified two Koala feed tree species listed under Schedule 2 of the Koala Habitat Protection SEPP (<i>Eucalyptus pilularis</i> and <i>Eucalyptus robusta</i>). Only one of these species is identified as a preferred Koala feed tree species in the North Coast Koala management areas as listed on the DPIE Koala habitat and feed trees webpage (i.e. <i>Eucalyptus robusta</i>).
Habitat connectivity	2	The study area is a part of a contiguous landscape that is >500h.	
Key existing threats	1	Desktop	No records of Koala mortality or dog attack were identified within 2 km of the study area on BioNet. There have however been Koala injuries and fatalities along other sections of Nelson Bay Road between Bobs Farm and Anna Bay (Transport for NSW, 2013). In addition, the fact that the site is located near roads increases roadkill risk.
		On-site	The status of dog populations and level of predation is not known. Dogs may occur in residences to the west however for the remaining portion of the study area predation by dogs are unlikely given they are surrounded by Worimi National Park and Worimi Aboriginal Local Land Council land where dogs are probably unlikely to occur. No evidence of Koala mortality from vehicle strike was observed in the study area during surveys completed.
Recovery value	1	Uncertain – linear roadside vegetation subject to existing edge effects and fragmentation associated with Nelson Bay Road. It is however connected to large areas of supplementary Koala habitat in the locality and the local Port Stephens population is likely to be genetically robust and operate as a viable population.	
Total	7	Decision: a score of 7 obtained therefore site technically contains potential critical habitat.	

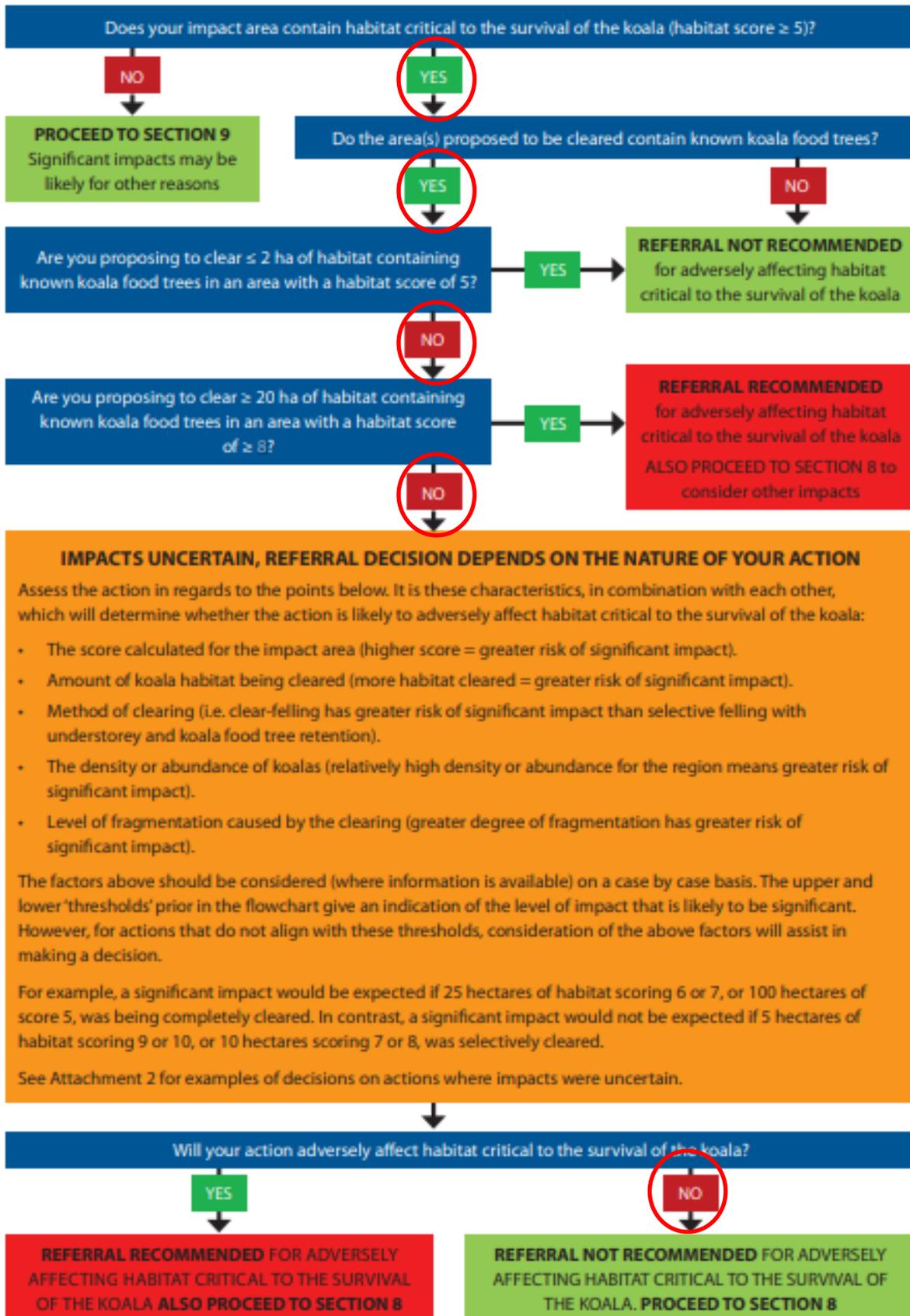


Figure 3.6 Assessment of adverse effects on habitat critical to the survival of the Koala (Department of the Environment, 2014)

3.12.4 Migratory Species

Migratory species are protected under international agreements, to which Australia is a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered Matters of NES and are protected under the EPBC Act.

Database searches identified 39 migratory species to potentially occur within the study area. Majority of these were marine species, due to no marine habitat within the study area these were excluded. During field surveys two migratory species listed under the EPBC Act, were recorded (Table 3.14). An additional two migratory species are considered to have a moderate likelihood of occurring within the study area.

Table 3.14 Migratory fauna species recorded or with a moderate or higher likelihood of occurrence.

Scientific name	Common Name	Status		Potential occurrence
		BC Act ¹	EPBC Act ²	
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	Moderate
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Moderate
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Recorded
<i>Hirundapus caudacutus</i>	White-throated Needle-tail	V	M	Recorded

1. Migratory (M) as listed on the EPBC Act

The White-throated Needle-tail was recorded foraging in airspaces above the study area and it is considered likely that individuals would intermittently hunt in the aerial habitats associated with the locality during seasonal occurrences. The species is not however considered likely to use terrestrial habitats within the study area. As such, this species is not considered likely to be affected by the proposal and has not been considered further.

As with the Fork-tailed Swift it is unlikely to use the study area's terrestrial habitats but may seasonally occur in the airspaces above it.

Although both the Black-faced Monarch and Rufous Fantail breed locally, the study area does not contain the denser forests they prefer for breeding site selection. However, occasional individuals cannot be discounted within the study area during migratory movements or post-breeding dispersals.

These species have the potential to utilise a wide variety of habitats, including disturbed / modified areas. The habitats within the study area are unlikely to constitute important habitat for any of the listed species, due to the habitat present is unlikely to support significant proportions of the population of any migratory species nor are the habitats critical to any life stage of these species. Due to their mobile nature, the mentioned species are likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur.

3.12.5 Oceanic Species

In addition to the return of many migratory estuarine fauna, listed as migratory or threatened, within Commonwealth, and State legislations, another group of fauna, oceanic species, were strongly influenced by the study area's relative proximity to the Tasman Sea. Such species as Sea Turtles, Whales, Albatross, Shearwaters and Petrels were returned from database searches. Due to their lack of suitable habitat within the study area or estuarine habitats within the vicinity of the study area, these species were not considered for impact assessment.

3.12.6 Wetlands of international importance

Databases searches revealed two wetlands of international importance within 10 kilometres of the study area:

- The Hunter estuary wetlands

- Myall Lakes.

The study area does not contain waterways that are connected to the above wetlands of international importance and therefore is considered unlikely to impact upon these wetlands.

3.12.7 World or national heritage

Databases searches revealed no occurrence of any listed world or national heritage places within 10 kilometres of the study area.

4 Impact assessment

A description of the proposal's potential impacts on biodiversity during the construction and operational phases are summarised in this chapter. The impacts have been separated into direct, indirect and cumulative impact categories and include the following:

- Construction impacts
 - Removal of native vegetation and threatened ecological communities
 - Removal of threatened flora species
 - Removal of threatened fauna habitat and habitat features
 - Injury and mortality of fauna.
- Indirect/operational impacts
 - Alteration to wildlife connectivity and habitat fragmentation
 - Edge effects on adjacent native vegetation and habitat
 - Invasion and spread of weeds
 - Invasion and spread of pests
 - Invasion and spread of pathogens and disease
 - Changes to hydrology
 - Impacts to Groundwater Dependent Ecosystems
 - Noise, light and vibration.
- Cumulative impacts.

Where applicable, impacts are also correlated with relevant key threatening processes. Impact evaluation, significance assessments and residual impacts are discussed further in Section 8, Section 9 and Appendix C.

4.1 Construction impacts

4.1.1 Removal of native vegetation

It is estimated that 2.27 ha of native vegetation would require removal by the proposal. A breakdown of approximate native vegetation removal of each PCT and vegetation zone is provided below in Table 4.1. Discussion of relevant key threatening processes related to direct impact on vegetation are shown in Table 4.2.

The proposal would also result in the removal of areas of the following miscellaneous ecosystems:

- Highly disturbed areas with no or limited native vegetation
- Urban/exotic plantings.

Table 4.1 Impacts on native vegetation

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in NSW	Proposal area (Ha)
PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	Moderate	E	-	68%	0.11
PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast – Good condition	Good	-	-	45%	1.76
	Moderate			71%	0.09
	Regrowth				0.31
Total native vegetation impacted					2.27

1. Based on the VIS classification database.

2. Area to be cleared based on ground-truthed vegetation mapping within the study area.

Table 4.2 Key threatening processes associated with the removal of native vegetation

Key threatened process	BC Act	EPBC Act	Impact of the proposal
Clearing of native vegetation	X	Not listed	The proposal will contribute to this process through the clearing of 2.27 ha of native vegetation.
Land clearance	Not listed	X	

4.1.2 Removal of threatened flora

There will be direct impacts on one threatened flora species listed as Endangered under the BC Act; being *Diuris arenaria* (Sand Doubletail). Eighteen individuals were recorded in the proposal area within good and regrowth condition PCT 1646. It is assumed that all 18 individuals will require removal by the project assuming impacts to the entirety of the proposal area.

A breakdown of the direct impacts to threatened flora species and their habitats is provided in Table 4.3.

Table 4.3 Impacts on threatened flora

Species	Potential occurrence	Impacted by proposal?	Impact (ha/ individuals)
<i>Diuris arenaria</i> (Sand Doubletail)	Recorded	Yes – individuals recorded within good and regrowth condition PCT 1646	18 individuals (2.07 ha of suitable habitat)

4.1.3 Removal of threatened fauna habitat

The extent of vegetation removal estimated to result from the proposal is outlined above in Section 4.1.1. This vegetation provides suitable habitat and habitat features for a range of threatened fauna species listed under the BC Act and/or EPBC Act. As such, direct impacts to habitat for threatened fauna species would occur during construction.

The direct impacts of the proposal on threatened fauna habitat has been estimated based on a worst-case scenario (i.e. removal of all vegetation within the proposal area). A breakdown of the direct impacts on threatened fauna species is provided in Table 4.4.

Table 4.4 Impacts on threatened fauna and fauna habitat

Species	Potential occurrence	Impacted by proposal?	Impact (ha)
Dusky Woodswallow (<i>Artamus cyanopterus</i>)	Moderate	Yes	2.27
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	Recorded	Yes	2.27
Scarlet Robin (<i>Petroica boodang</i>)	Moderate	Yes	2.27
Gang-Gang Cockatoo (<i>Callocephalon fimbriatum</i>)	Moderate	Yes	2.27
Powerful Owl (<i>Ninox strenua</i>)	Moderate	Yes	2.27
Masked Owl (<i>Tyto novaehollandiae novaehollandiae</i>)	Moderate	Yes	2.27
Little Eagle (<i>Hieraaetus morphnoides</i>)	Moderate	Yes	2.27
Square-tailed Kite (<i>Lophoictinia isura</i>)	Moderate	Yes	2.27
Spotted Harrier (<i>Circus assimilis</i>)	Moderate	Yes	2.27
Little Lorikeet (<i>Glossopsitta pusilla</i>)	Recorded	Yes	2.27

Species	Potential occurrence	Impacted by proposal?	Impact (ha)
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	High	Yes	2.27
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	Moderate	Yes	2.27
Little Bent-wing Bat (<i>Miniopterus australis</i>)	Recorded	Yes	2.27
Large Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	Moderate	Yes	2.27
Eastern Cave Bat (<i>Vespadelus troughtoni</i>)	Moderate	Yes	2.27
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	Moderate	Yes	2.27
Eastern Coastal Freetail Bat (<i>Micronomus norfolkensis</i>)	Recorded	Yes	2.27
Yellow-bellied Sheathtail-bat (<i>Saccolaimus flaviventris</i>)	Moderate	Yes	2.27
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	Moderate	Yes	2.27
Squirrel Glider (<i>Petaurus norfolcensis</i>)	Moderate	Yes	2.27
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	Moderate	Yes	2.27
Koala (<i>Phascolarctos cinereus</i>)	Moderate	Yes	2.27
Spotted-tailed Quoll (<i>Dasyurus maculatus maculatus</i>)	Moderate	Yes	2.27
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	Moderate	Yes	2.27

Key threatening processes associated with removal of key fauna habitat features are identified in Table 4.5 below.

Table 4.5 Key threatening processes associated with the removal of fauna habitat features

Key threatened process	BC Act	EPBC Act	Impact of the proposal
Loss of hollow-bearing trees	X	Not listed	Approximately 16 hollow-bearing trees will require removal.
Removal of dead wood and dead trees	X	Not listed	Dead wood on the ground which is scattered through the study area would likely require removal.

4.1.4 Aquatic impacts

No waterways occur within the proposal area or are will be impacted upon by the proposal.

4.1.5 Injury and mortality

Injury and mortality of fauna could occur during both construction activities and during operation of the road. Specifically, injury and mortality may occur:

- During construction when vegetation and habitat is being cleared and when trenches are dug
- When machinery and plant is moved to, from and on site
- During public use of the road during the operational phase of the proposal.

These impacts in relation to the construction and operational phases of the proposal are discussed in this section. A summary of wildlife injury and mortality impacts, species to be impacted and the nature of these impacts is provided in Table 4.6.

During construction of the proposal

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed.

Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

During operation of the proposal

There is a chance of fauna mortality during the operational phase of the proposal through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike.

As there is no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations of fauna is relatively unknown. An exception to this is the availability of some vehicle collision data for the Koala along Nelson Bay Road. Two stretches of Nelson Bay Road have been identified as koala 'black spots' for vehicle strike and road mortality. One area is along Nelson Bay Road in the vicinity of Oakvale/Salt Ash and the other black spot is Nelson Bay Road in the vicinity of Williamtown. Both these 'black spots' do not occur within the study area. Furthermore, although no road strikes or road mortality of Koalas have been recorded in the study area, there have been Koala injuries by collisions with motor vehicles further east along Nelson Bay Road between Bobs Farm and Anna Bay (i.e. 18 Koalas injured along or in adjacent areas to Nelson Bay Road prior to 2013) (Transport for NSW, 2013).

With the proposal expanding an existing road the risk of vehicle strike has potential to incrementally increase, particularly for less mobile mammal species such as the Koala and Spotted-tailed Quoll. The main impacts associated with this would include:

- Potential long-term decrease in the size of a local population via mortality from vehicle strike
- Increase in existing road barrier (both in width of carriageway and installation of concrete median) which may trap or increase the length of time an animal will need to spend on the road to cross thereby leading to an increase in chance of a collision with a vehicle.

The significance of such an impact cannot be predicted as there is no definitive data available, however potential impacts will endeavour to be reduced through the implementation of mitigation measures detailed in Section 5.2.

Table 4.6 Potential for injury and mortality of fauna as a result of the proposal

Activity with potential to cause mortality	Native animals with potential to be affected	Nature and magnitude of the impact of the proposal
Vegetation/habitat removal during construction		
Removal of mature trees with hollows as well as dead standing trees	<ul style="list-style-type: none"> • Hollow-dependent bats (including threatened species as listed in Table 4.4) • Hollow-nesting and canopy-nesting birds (including threatened species as listed in Table 4.4) • Arboreal mammals • Arboreal reptiles • Arboreal frogs. 	<p>Vegetation removal will be undertaken in accordance with the mitigation measures detailed in Section 5.2. <i>Best practice management guidelines</i> (Roads and Traffic Authority, 2011, NSW Roads and Maritime Services, 2012) where considered to identify these appropriate mitigation measures to minimise fauna injury and mortality during construction. These measures however are unlikely to eliminate injury and mortality completely.</p> <p>Mortality of smaller species of native reptiles and frogs may occur. These smaller, non-threatened species are generally abundant and the mortality caused by the proposal is unlikely to have a substantial long-term impact on populations of these species.</p>
Removal of understorey, groundcover and topsoil	<ul style="list-style-type: none"> • Small woodland birds species which nest in understorey vegetation and breed locally as listed (including threatened species listed in Table 4.4) • Ground-dwelling reptiles • Ground-dwelling mammals (including threatened species listed in Table 4.4) • Frogs. 	<p>Threatened birds, bats and mammals</p> <p>The level of mortality and injury of both non-threatened and threatened species of birds, bats and mammals is likely to be low with the implementation of the mitigation measures mentioned above. The implementation of measures such as pre-clearance surveys and 'spotter-catchers' supervising vegetation clearance will reduce impacts associated with injury and mortality of fauna during the construction phase of the proposal.</p>
Machinery/plant and vehicle movements during construction		
Movement of machinery between locations within the study area	<ul style="list-style-type: none"> • Terrestrial reptiles, frogs and mammals • Birds. 	<p>Occasional mortality of native animals may occur during vehicle movements within the proposal area. With the implementation of speed limits and briefing of staff, the level of construction-phase mortality of native wildlife is likely to be negligible.</p>

Activity with potential to cause mortality	Native animals with potential to be affected	Nature and magnitude of the impact of the proposal
Roadkill post-construction	<ul style="list-style-type: none"> • Terrestrial, semi-aquatic and arboreal reptiles and frogs • Mammals (e.g. Koala, Spot Tailed Quoll and bat species) • Birds including owls, woodland birds, blossom nomads and raptors (including threatened species listed In Table 4.4). 	<p>All roads have potential to result in the mortality (roadkill) of native animals. The risk of roadkill is higher where roads and/or associated landscaped areas:</p> <ul style="list-style-type: none"> • Traverse areas of substantial animal habitat • Are located near natural or artificial water bodies • Contain food sources (e.g. mown grass verges, nectar-producing shrubs) which attract animals to the road edge • Have high speed limits • Provide poor visibility of wildlife (e.g. due to bends, crests and poor lighting) • Contain multiple lanes in each direction. <p>Threatened birds and bats likely to occur within the impact area are at low risk of roadkill, since majority of threatened species are mobile (fly) and generally feed high in the canopy of vegetation. However, some species such as forest owls and predatory birds (raptors) would readily feed on roadkill and would be placed at some risk of road-strike mortality.</p> <p>Threatened mammals, particularly the Koala and Spotted-tailed Quoll are likely to occur within the study area and cross Nelson Bay Road to access potential habitat in the broader landscape which makes them susceptible to vehicle collision.</p> <p>While it is not possible to eliminate the risk of roadkill occurring, it is possible to minimise roadkill through consideration of the above factors in the design of roads and associated landscaping and infrastructure. It is also possible to reduce roadkill risk by encouraging animals to cross roads more safely through provision of features such as:</p> <ul style="list-style-type: none"> • Fauna fencing • Fauna rope bridges • Landscaping which encourages birds and bats to fly higher over roads. <p>As part of the proposal the implementation of mitigation measures such as the installation of fauna exclusion fencing (specifically Koala fencing) will reduce potential impacts on fauna. Overall, with adequate consideration of factors associated with roadkill in preparation of the detailed design and erection of fauna exclusion fencing, the proposal is unlikely to result in significant levels of roadkill mortality of threatened species but could instead improve the current situation along Nelson Bay Road.</p> <p>It should be noted that multiple options were assessed to reduce potential roadkill impacts however options were limited due to surrounding land use (such as Worimi National Park, transmission easements, private residences and Worimi lands) and safety/design restrictions.</p>

4.2 Indirect/operational impacts

4.2.1 Alteration to wildlife connectivity and habitat fragmentation

Habitat fragmentation is physical dividing up of one or more continuous habitats into separate smaller 'fragments'. This new dividing habitat type is often artificial and inhospitable to most species remaining within the fragments. These newly created habitats (cleared areas or planted roadside vegetation) are more likely to be used by species (mostly generalists) that are considered aggressive (Grey, Clarke et al. 1998) and can further impact on the population levels of the species remaining in the adjoining natural habitat fragments. In addition to the loss of habitat area, the process of fragmentation can impact on species within the newly created fragments in several ways, including barrier effects, genetic isolation, and edge effects.

The proposal would not break apart continuous habitats into separate smaller fragments. The proposal would however result in an increase in isolation of habitats as the current habitat patches would be made smaller which would increase the physical distance between habitat fragments. The isolation that may be caused by the proposal is not likely to have an appreciable impact on nomadic or migratory species such as birds. The proposal is likely to be detrimental to the dispersal of arboreal mammals and other species including frogs and reptiles, but the effects would only be marginally greater than that which is already experienced.

The predicted level of isolation from the proposal is not likely to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. Functional connectivity for many species would remain in the study area. However, local division of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability for some species may result.

The current alignment of Nelson Bay Road divides the remaining habitats in the study area creating a barrier which serves some restriction to fauna movements between habitat patches. However, functional habitat connectivity for more mobile species (e.g. birds, flying-foxes, insectivorous bats, insects, plants) is still present. The current roadways do not totally prevent fauna movement between habitat fragments (fauna can and likely do cross the road) as no impassable barriers occur but the road does create a considerable hazard.

Whilst no impassable barriers presently occur (i.e. fencing, water bodies or large areas of development) the proposal would involve the construction of a solid concrete barrier median strip which would extend for most of the proposals length. This will create an impassable barrier for some ground-dwelling and less-mobile fauna reducing terrestrial fauna movement within the study area and increasing the risk of roadkill from vehicle collision.

Given the potential for the proposal to have a negative impact on wildlife movement via the construction of a concrete barrier an evaluation of connectivity and mitigation options to minimise these impacts was undertaken. Four options were evaluated based on risks and benefits (Table 4.7). Based on evaluation of these four options, option 4 was determined as the most suitable outcome for the proposal. This option provides road mitigation preventing terrestrial wildlife movement across section of Nelson Bay Road whilst ensuring that road safety guidelines are adhered to.

Table 4.7 Connectivity option assessment

Option number	Proposed options	Negatives	Positives
1	'Do nothing' – maintain existing status – no mitigation	<ul style="list-style-type: none"> Likely to increase fauna road kill impacts Safety concerns to road users due to fauna collision. 	<ul style="list-style-type: none"> Low cost Provides limited terrestrial connectivity.
2	Provide road mitigation with both under and over passes at key crossing locations, including fauna fencing	<ul style="list-style-type: none"> Feasibility of underpass design significantly limited by surrounding land tenures including Worimi National Park to the south, private residences to the west and Worimi Local Aboriginal Council Land to the north. Would result in additional clearing of intact remnant vegetation which provides habitat for threatened flora and fauna species. 	<ul style="list-style-type: none"> Reduce roadkill and provide for terrestrial/arboreal fauna crossing north - south Retain access to habitat to the north of Nelson Bay Road for terrestrial species along the eastern end of the study area.
3	Median strip constructed out of Ezy Guard rather than a solid concrete barrier	<ul style="list-style-type: none"> Design non-conformances due to lack of crash cushions especially for road with high speed zone and volume of traffic Increase in safety hazards and concerns of road users. 	<ul style="list-style-type: none"> Increase wildlife movement Reduced roadkill.
4	Provide road mitigation through fauna exclusion fencing to prevent terrestrial movement across Nelson Bay Road where concrete barrier median strip occurs	<ul style="list-style-type: none"> Reduce terrestrial connectivity to adjoining vegetation north of Nelson Bay Road, particularly to the west of the study area Increased clearing footprint to allow for the installation of the fauna exclusion fence (3m width required). 	<ul style="list-style-type: none"> Reduce road kill, particularly for local population of Koala and other less mobile mammals Enable fauna crossing to occur to the east of the study area where Nelson Bay Road splits. Although fauna would be required to cross two roads the vegetated median will provide temporary refuge and reduce width of barriers/time to cross.

4.2.2 Edge effects on adjacent native vegetation and habitat

Linear infrastructure developments are known to cause disturbances in terms of reducing habitat quality in adjacent areas. This is largely linked to an increase in edge effects associated with fragmentation and the creation/increase in barriers. Edge effects lead to the following interferences which may be temporary or permanent:

- Altered soil moisture conditions
- Altered light conditions (shading, reduced-shading, artificial lighting)
- Noise and vibration (construction and operation)
- Weed invasion (associated with soil disturbance and roadside littering).

The proposal occurs within an area which is already subject to edge effects associated with the existing Nelson Bay Road carriage way, transmission easements and residential properties. The proposal has, where possible, been designed to avoid impacts habitats that are of higher quality and/or protected under conservation (including areas of Worimi National Park and Worimi Local Land Council land).

The proposal will incrementally increase existing edge effects within the study area. Given the current edge effects however this incremental increase is likely to be of low magnitude.

Mitigation measures to minimise impacts associated with edge effects are provided in Section 5.2.

4.2.3 Invasion and spread of weeds

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of proposal activities). Proliferation of weeds is likely to occur during construction and operation, although impacts would be greatest during vegetation clearing associated with the construction phase of the proposal. The most likely causes of weed dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases.

Weed invasion varies in intensity within the study area however is largely concentrated in areas immediately adjacent the road carriageway which is regularly maintained (i.e. slashed to increase visibility). There are also areas within remnant vegetation in the study area which contain problematic weeds. As such, weeds must be managed during construction.

Mitigation measures designed to limit the spread and germination of weeds are provided in Section 5.2.

4.2.4 Invasion and spread of pests

From a biodiversity conservation perspective, pest animals include all species that have a negative impact on the functioning of natural ecosystems and/or the conservation of threatened biodiversity. Pests therefore include both exotic and native species. Exotic pests present or likely to occur on within the proposal footprint include the Fox, Rabbit, Brown Hare, Cat, Common Myna, House Mouse, Black Rat and Common Starling.

These species have the potential to affect uncommon or threatened indigenous biodiversity through predation (e.g. Black Rat, Cat, Fox), grazing (e.g. Rabbit, Brown Hare) and competition for breeding habitat (e.g. Common Myna and Common Starling).

Many highly invasive and destructive pest species which are found overseas or interstate have not yet become established or presently have restricted distributions in NSW. Several such species are the subject of Key Threatening Process listings (e.g. Red Imported Fire Ant, Yellow Crazy Ant, Large Earth Bumblebee, Cane Toad). The primary risk associated with these species is the importation of goods or materials from interstate or overseas locations where populations of these species are well established. If the importation of goods from overseas or interstate is required appropriate pest control mitigation measures would be applied.

The study area provides habitat for a range of commonly occurring pest species including European Fox and Rabbits. Proposal activities have the potential to disperse pest species out of the proposal footprint across the surrounding landscape, but the magnitude of this impact would be low and mitigation measures are not deemed necessary.

4.2.5 Invasion and spread of pathogens and disease

Plant and animal pathogens can affect threatened biodiversity through direct mortality and modification to vegetation structure and composition. The following pathogens are considered to have potential to affect the biodiversity within the proposal footprint and are the subject of Key Threatening Process listings:

- Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)
- Exotic Rust Fungi (order Pucciniales, e.g. Myrtle rust fungus *Uredo rangelii*)
- Phytophthora Root Rot Fungus (*Phytophthora cinnamomi*).

These three pathogens have all been recorded in the North Coast bioregion and have potential to occur on within the proposal area at present or in the future. The main way in which Exotic Rust Fungi and Phytophthora Root Rot Fungus may be spread is through the movement of infected plant material and/or soil. The construction and operation of the

proposal may increase the risk of disturbing and spreading these pathogens. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the proposal area, the risk of introducing these pathogens would, however, be low. Preferential use of plant materials sourced on-site (e.g. mulch, seeds) used for vegetation restoration would also help to minimise this risk.

Amphibian Chytrid Fungus can be spread through the movement of infected animals or water (including mud or moist soil) from infected areas. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the proposal footprint, the risk of introducing this pathogen to uninfected areas is low.

Pathogens would be managed within the proposal site according to the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011) (see Section 5.2).

4.2.6 Changes to hydrology

The existing hydrological conditions of the proposal are already affected by altered landform and altered stormwater runoff and velocity as a result of surrounding land uses and existing roads. The proposal may result in further alteration to the hydrology of the study area due to an increase in surface runoff.

Transport have used the study areas natural sandy infiltration features and properties (including shallow swales) as a drainage design philosophy to minimise impacts associated with hydrology. It is recommended that the stormwater design for the proposal be done in accordance with 'Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction, Sydney' (Blue Book) (Department of Environment and Climate Change, 2008) to avoid potential impacts to surrounding native vegetation communities.

4.2.7 Groundwater dependent ecosystems

The PCTs within the study area are likely to be opportunistic facultative GDEs that depend on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) when an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function.

Geotechnical investigations completed to date have not identified any groundwater or perched water tables occurring within the proposal area. It is noted however that these surveys did not cover the full extent of the study area. The proposed works will largely be located within existing fill which is sandy in nature associated with the existing carriageway and road formation. As such, the proposal is considered unlikely to significantly interfere with subsurface or groundwater flows associated with the coastal floodplain of Tilligerry Creek.

4.2.8 Noise, light and vibration

Considering the existing levels of noise and vibration from the surrounding urban development and the high levels of use of the existing Nelson Bay Road by vehicles, it is unlikely there would be a significant increase in noise and vibration during operation of the proposal. This is likely due to most animal species within the proposal area and surrounds already being habituated to periodic noise disturbance from human activity and road activity. Therefore, biodiversity are unlikely to be significantly affected by the proposal's operational noise.

There is however potential for impacts to locally common fauna from noise and vibration during construction of the proposal. These impacts may result in fauna temporarily avoiding habitats adjacent to the construction however traffic noise is likely to be significant deterrent to most fauna groups already. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

Lighting maybe used at night to enable work to be completed that may result in impacts to nocturnal fauna. Nocturnal species such as possums and microchiropteran bats may avoid the habitat in the study area during construction as temporary 'daylight' conditions would be created by the mobile lighting system. This impact is considered temporary and would not have long lasting effects on the biodiversity of the study area. The magnitude of this impact

would be low and mitigation measures are not deemed necessary. Alternatively, there are species which forage on insects attracted to lights thereby these impacts may temporarily benefit some species.

4.3 Cumulative impacts

The potential cumulative biodiversity impact as a consequence of the construction and operation of the proposal are discussed here within the context of the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context.

In assessing the cumulative impact of a proposal, it is important to consider whether the additive effects of multiple proposals may cause such a critical threshold to be reached for any threatened biodiversity affected.

Several developments are underway or planned in the locality, that also impact on biodiversity values that are likely to be impacted by the current proposal. Some of the projects in the locality that will contribute to cumulative impacts include:

- Sand quarries including:
 - Tanilba Northern Dune sand extraction project: project will require the removal of 8.2 ha of native vegetation including 4.2 ha of Coastal Sand Apple – Blackbutt Forest (aligns to PCT 1646). Preferred Koala habitat, associated with Swamp Mahogany - Paperbark Swamp Forest, was recorded however impacts on it were avoided by the project. Species considered likely to be affected by the proposal include Koala, Squirrel Glider, microchiropteran bats, Varied Sittella, New Holland Mouse, Grey-headed Flying-fox, Little Lorikeet, Wallum Froglet and White-bellied Sea-eagle. The biodiversity assessment concluded that the project would not have a significant impact on any threatened ecological community, species or endangered population (Kleinfelder., 2014).
 - Macka's Sand Operations: project will require the removal of 48 ha of Coastal Apple – Blackbutt Forest (aligns to PCT 1646) over a 10 to 20 year period which would be progressively revegetated and rehabilitated. No preferred Koala habitat was recorded and habitat within the study area was not considered to support a resident population of Koala. Sixteen threatened fauna species were identified as having potential to use habitats to be impacted including the Squirrel Glider, Grey-headed Flying-fox, Masked Owl, Powerful Owl, Spotted-tailed Quoll, Brush-tailed Phascogale, Koala, Eastern Pygmy Possum, Glossy Black Cockatoo, Swift Parrot and numerous microchiropteran bats. The biodiversity assessment concluded that the project would not have a significant impact on any threatened ecological community, species or endangered population (Umwelt, 2009a, Umwelt, 2009b). Biodiversity offsets for this project include populations of *Diuris arenaria* (Sand Doubletail) (Umwelt, 2016) which are likely to form part of the local population being impacted by the proposal.
- Previous upgrades to Nelson Bay Road between Cromarty Lane and Port Stephens Drive. Impacts on biodiversity values associated with the project included:
 - Removal of 4.85 ha of native vegetation including the removal of 0.70 ha of Swamp Mahogany – Flooded Gum – Paperbark Open Forest (forms part of Swamp Sclerophyll threatened ecological community and 4.10 ha of Blackbutt – Smooth-barked Apple Open Forest (aligns to PCT 1646) (Hills Environmental, 2012, Hills Environmental, 2013).
 - Koala: project removed approx. 5 ha of supplementary Koala habitat as defined under SEPP 44 and approximately 0.7 ha of habitat considered to be '*critical to the survival of the Koala*' as outlined in the '*EPBC Act referral guidelines for the vulnerable Koala*' (Department of the Environment, 2014). Habitat removed was identified as not contained preferred Koala foraging habitat and was likely to rather operate as a movement corridor within the landscape. Main potential impacts were long-term reduction in the size of an important population through mortality associated with vehicle collision (same impact for Spotted-tailed Quoll). Mitigation measures were

implemented to reduce potential impacts and the project was considered unlikely to have a significant impact on the species (Transport for NSW, 2013).

- Threatened species considered likely to be affected included *Diuris praecox* (Newcastle Doubletail), Grey-headed Flying-fox, several microchiropteran bats species, Varied Sittella, Little Lorikeet and Swift Parrot.
- The biodiversity assessment concluded that the project would not have a significant impact on any threatened ecological community, species or endangered population.
- Small-scale local residential developments: publicly available information for these developments do not provide sufficient information regarding impacts on biodiversity.

Impacts associated with the proposal will incrementally increase these impacts on biodiversity within the locality. The proposal's impacts however are unlikely to exacerbate current project impacts to a point where they would lead to a significant impact on biodiversity. In comparison to these other local developments the impacts of the proposal are relatively low.

4.4 Assessments of significance

Assessments of significance have been conducted for threatened species, populations or ecological communities which have been positively identified within the study area or that are considered to have a moderate or high likelihood of using habitat which will be affected by the proposal.

The proposed works are being assessed under Part 5, Division 5.1 of the EP&A Act. As such, assessments of significance have been undertaken in accordance with the following published guidelines and legislation:

BC Act listed threatened ecological communities and species:

- Part 7 Division 1 Section 7.3 of the BC Act - outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species or ecological communities listed under the BC Act
- *Threatened Species Test of Significance Guidelines: The Assessment of Significance* (Office of Environment & Heritage, 2018) - outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the former 'seven-part test'.

MNES:

- *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance for EPBC Act listed biodiversity* (Department of the Environment, 2013c) – guideline to assist in deciding whether an action will have a significant impact on EPBC Act matters and subsequently whether an EPBC Act referral may be required
- *EPBC Act referral guidelines for the vulnerable Koala* (Department of the Environment, 2014).

Combined assessments of significance have been conducted for groups of species that have similar life history and habitat requirements; e.g. small woodland birds, terrestrial mammals.

The overall outcome of the tests of significance (see Appendix C) indicate that there is a high level of certainty that the impacts to threatened biodiversity are unlikely to be significant. Given the proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement (SIS) is not required under the BC Act to support this proposal. In respect to Matters of National Environmental Significance (MNES) matters including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

The results of the significance assessments completed are summarised below in Table 4.8 for BC Act biodiversity values and Table 4.9 for MNES.

Table 4.8 Summary findings of the BC Act test of significance

Biodiversity Conservation Act 2016 test of significance						
Threatened species or communities	Significance assessment question ¹					Likely significant effect?
	a	b	c	d	e	
Swamp Sclerophyll Forest on Coastal Floodplain	X	N	N	N	Y	Unlikely
<i>Diuris arenaria</i> (Sand Doubletail)	N	X	N	N	Y	Unlikely
Dusky Woodswallow (<i>Artamus cyanopterus</i>)	N	X	N	N	Y	Unlikely
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	N	X	N	N	Y	Unlikely
Scarlet Robin (<i>Petroica boodang</i>)	N	X	N	N	Y	Unlikely
Gang-Gang Cockatoo (<i>Callocephalon fimbriatum</i>)	N	X	N	N	Y	Unlikely
Powerful Owl (<i>Ninox strenua</i>)	N	X	N	N	Y	Unlikely
Masked Owl (<i>Tyto novaehollandiae novaehollandiae</i>)	N	X	N	N	Y	Unlikely
Little Eagle (<i>Hieraaetus morphnoides</i>)	N	X	N	N	Y	Unlikely
Square-tailed Kite (<i>Lophoictinia isura</i>)	N	X	N	N	Y	Unlikely
Spotted Harrier (<i>Circus assimilis</i>)	N	X	N	N	Y	Unlikely
Little Lorikeet (<i>Glossopsitta pusilla</i>)	N	X	N	N	Y	Unlikely
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	N	X	N	N	Y	Unlikely
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	N	X	N	N	Y	Unlikely
Little Bent-wing Bat (<i>Miniopterus australis</i>)	N	X	N	N	Y	Unlikely
Large Bent-winged Bat (<i>Miniopterus oriana oceanensis</i>)	N	X	N	N	Y	Unlikely
Eastern Cave Bat (<i>Vespadelus troughtoni</i>)	N	X	N	N	Y	Unlikely
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	N	X	N	N	Y	Unlikely
Eastern Coastal Freetail Bat (<i>Micronomus norfolkensis</i>)	N	X	N	N	Y	Unlikely
Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>)	N	X	N	N	Y	Unlikely
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	N	X	N	N	Y	Unlikely
Squirrel Glider (<i>Petaurus norfolcensis</i>)	N	X	N	N	Y	Unlikely
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	N	X	N	N	Y	Unlikely
Koala (<i>Phascolarctos cinereus</i>)	N	X	N	N	Y	Unlikely
Spotted-tailed Quoll (<i>Dasyurus maculatus maculatus</i>)	N	X	N	N	Y	Unlikely

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

1. Significance Assessment Questions as set out in the BC Act:
 - a in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
 - b in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
 - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
 - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
 - c in relation to the habitat of a threatened species or ecological community:
 - (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.
 - d whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
 - e whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

Table 4.9 Summary findings of the EPBC Act significance assessments

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population +	Likely Significant Impact
	1	2	3	4	5	6	7	8	9		
Vulnerable species*											
Koala (<i>Phascolarctos cinereus</i>)	N	N	N	N	N	N	N	N	N	Y	Unlikely
Spotted-tailed Quoll (<i>Dasyurus maculatus maculatus</i>)	N	N	N	N	N	N	N	N	N	N	Unlikely
Large-eared Pied Bat (<i>Chalinobius dwyeri</i>)	N	N	N	N	N	N	N	N	N	N	Unlikely
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	N	N	N	N	N	N	N	N	N	N	Unlikely
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	N	N	N	N	N	N	N	N	N	N	Unlikely

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- 1) lead to a long-term decrease in the size of an important population of a species
- 2) reduce the area of occupancy of an important population
- 3) fragment an existing important population into two or more populations
- 4) adversely affect habitat critical to the survival of a species
- 5) disrupt the breeding cycle of an important population
- 6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- 7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- 8) introduce disease that may cause the species to decline, or
- 9) interfere substantially with the recovery of the species.

An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range. The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered an important population for the purposes of this assessment.

4.5 Impact summary

A summary of potential impacts that have been addressed in this report are presented in Table 4.6.

Table 4.10 Summary of impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Removal of native vegetation (including threatened ecological communities)	Native vegetation	Direct	2.27 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation (BC Act) • Land clearance (EPBC Act) 	Known
	Swamp Sclerophyll Forest threatened ecological community		0.11 ha			
Removal of threatened flora species and habitat	<i>Diuris arenaria</i> (Sand Doubletail)	Direct	18 individuals / 2.07 ha of suitable habitat	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation (BC Act) • Land clearance (EPBC Act) 	Known
Removal of threatened fauna habitat removal and habitat features	Numerous threatened bird and mammal species (refer to Table 6.4 for full listed of threatened species to be affected)	Direct	2.27 ha 16 hollow bearing trees	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation (BC Act) • Land clearance (EPBC Act) • Removal of dead wood and dead trees (BC Act) • Loss of Hollow-bearing Trees (BC Act) • Bushrock removal (BC Act). 	Known
Injury and mortality of fauna	Applicable to less mobile or sedentary fauna	Direct	Site based	Short term – construction phase Long term – operational phase	<ul style="list-style-type: none"> • n/a 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Wildlife connectivity and habitat fragmentation	Applicable to less mobile or sedentary fauna	Direct / Indirect	Local	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation (BC Act) • Land clearance (EPBC Act) 	Known
Edge effects on adjacent native vegetation and habitat	All areas of native vegetation adjacent the proposal area	Indirect	Local	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation (BC Act) • Land clearance (EPBC Act) • Invasion and establishment of exotic vines and scramblers (BC Act) • Invasion and establishment of Scotch Broom (<i>Cytisus scoparius</i>) (BC Act) • Invasion of native plant communities by African Olive (<i>Olea europaea</i> L. subsp. <i>cuspidata</i>) (BC Act) • Invasion, establishment and spread of Lantana camara (BC Act) • Invasion of native plant communities by Bitou Bush and Boneseed (BC Act) • Invasion of native plant communities by exotic perennial grasses (BC Act) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (BC Act and EPBC Act). 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Invasion and spread of weeds	All areas of native vegetation	Indirect	Local / Regional	Long term	<ul style="list-style-type: none"> • Invasion and establishment of exotic vines and scramblers (BC Act) • Invasion and establishment of Scotch Broom (<i>Cytisus scoparius</i>) (BC Act) • Invasion of native plant communities by African Olive (<i>Olea europaea</i> L. subsp. <i>cuspidata</i>) (BC Act) • Invasion, establishment and spread of Lantana camara (BC Act) • Invasion of native plant communities by Bitou bush and Boneseed (BC Act) • Invasion of native plant communities by exotic perennial grasses (BC Act) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (BC Act and EPBC Act) 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Invasion and spread of pests	Applicable to all flora and fauna species and habitat	Indirect	Local / Regional	Long term	<ul style="list-style-type: none"> • Competition and grazing by the feral European Rabbit (<i>Oryctolagus cuniculus</i>) (BC Act and EPBC Act) • Competition and habitat degradation by feral goats (<i>Capra hircus</i>) (BC Act and EPBC Act) • Herbivory and environmental degradation caused by feral deer (BC Act) • Invasion and establishment of the Cane Toad (<i>Bufo marinus</i>) (BC Act) • The biological effects, including lethal toxic ingestion, caused by Cane Toads (<i>Bufo marinus</i>) (EPBC Act) • Predation and hybridisation of feral dogs (<i>Canis lupus familiaris</i>) (BC act) • Predation by the European Red Fox (<i>Vulpes vulpes</i>) (BC Act and EPBC Act) • Predation by the feral cat (<i>Felis catus</i>) (BC Act and EPBC Act) • Predation by Plague Minnow or Mosquito Fish (<i>Gambusia holbrooki</i>) (BC Act) • Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (<i>Anoplolepis gracilipes</i>) on Christmas Island, Indian Ocean (EPBC Act) • The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, <i>Solenopsis invicta</i> (fire ant) (EPBC Act) • Predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>) (BC Act and EPBC Act) 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Invasion and spread of pathogens and disease	Applicable to all flora and fauna species and habitat	Indirect	Local / Regional	Long term	<ul style="list-style-type: none"> • Infection of native plants by <i>Phytophthora cinnamomi</i> (BC Act) • Dieback caused by the root-rot fungus (<i>Phytophthora cinnamomi</i>) (EPBC Act) • Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (BC Act) • Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations (BC Act and EPBC Act) • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (BC Act) • Infection of amphibians with chytrid fungus resulting in chytridiomycosis (EPBC Act) 	Known
Groundwater dependent ecosystems	All native vegetation	Indirect - operational	Local	Long term	<ul style="list-style-type: none"> • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands 	Known
Changes to hydrology	All native vegetation	Direct/ Indirect	Local	Long term	<ul style="list-style-type: none"> • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands 	Known
Noise, light and vibration	Applicable to all fauna species.	Direct/ Indirect	Local	Short term – operational Long-term – construction	<ul style="list-style-type: none"> • n/a 	Known

5 Avoid, minimise and mitigate impacts

In managing biodiversity, Transport aims to achieve a balanced outcome, taking account of environmental considerations together with economic and community objectives. This includes a balanced approach to examining the environmental consequences of an activity, recognising that achieving an optimal outcome often requires compromise and decisions regarding environmental values. A key part of Transport for NSW's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

1. Avoid and minimise impacts as the highest priority
2. Mitigate impacts where avoidance is not feasible or practicable in the circumstance
3. Offset where residual, significant unavoidable impacts would occur.

5.1 Avoidance and minimisation

Avoiding environmental impacts as the first step is consistent with the application of the precautionary principle. Transport's priority is to avoid impacts to the environment. This can be achieved by:

- Early consideration of environmental issues via the identification of constraints during the early phases of the proposal
- Avoidance and minimisation through design and selection of preferred alignment options
- Implementation of on-ground safeguards during construction, operation and maintenance of the activity.

A Preliminary Biodiversity Investigation (PEI) was prepared during the early stages of concept design development of the Williamstown to Bobs Farm Nelson Bay Road Upgrade proposal which identified areas of high biodiversity value that should be avoided where possible such as Coastal Wetlands identified by the Coastal Management SEPP. By avoiding these biodiversity values, a project REF was deemed to be the best approach for assessment for Section 1 of the proposal (i.e. between Salt Ash and Bobs Farm which is subject of this report).

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. In identifying suitable work sites, the first preference is to locate existing cleared and disturbed areas that have good access, are not within immediate proximity to waterways, and that support good site management practices (for example, management of material stockpiles). The proposal compound site has been proposed in highly disturbed areas to avoid impacts to biodiversity. Areas of focus to avoid have included:

- Known population of 18 *Diuris arenaria* (Sand Doubletail) individuals recorded in the proposal area
- Endangered ecological communities i.e. small patches of Swamp Sclerophyll Forest
- Areas that contain known threatened fauna species populations and suitable fauna species habitat.

The implementation of on-ground controls have also been included for the proposal to further reduce impacts on biodiversity values. The controls are discussed in Section 5.2.

5.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases. The Transport biodiversity guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of a project, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate. Mitigation measures as outlined in the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011) and *Wildlife Connectivity Guidelines for Road Projects* (NSW Roads

and Maritime Services, 2012) are recommended for implementation (see Table 7.1). Additional species-specific and site-specific mitigation measures are also provided in Table 5.1.

Table 5.1 Proposed mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	Prior to construction	Effective	The predicted residual impact to native vegetation species habitat is estimated at up to 2.27 ha.
	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	During construction	Effective	
	Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	
	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal footprint.	During construction	Proven	
Removal of threatened plants	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal footprint.	During construction	Proven	The predicted residual impact to threatened species habitat is estimated at up to 18 <i>Diuris arenaria</i> (Sand Doubletail) individuals and 2.07 ha of threatened flora habitat.
	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal footprint.	During construction	Proven	
Removal of threatened species habitat and habitat features	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	The predicted residual impact to native vegetation species habitat is estimated at up to 2.27 ha.
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	
	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Proven	
Injury and mortality of fauna and fragmentation of identified habitat corridors	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	The mitigation measures should be effective, but injury or death may still occur. Minor loss of adjacent vegetation due to road widening or integration and implementation of fauna fencing.
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal footprint.	During construction	Proven	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	<p>Road-kill and connectivity impacts will be minimised for Koalas and other less-mobile fauna species via:</p> <ul style="list-style-type: none"> • Installation of Koala proof fencing along the southern side of Nelson Bay Road in areas of likely occurrence (approximately just west of Boyces Trail east to the Easement Trail). • Koala proof fencing site location selection and design specifics to be assessed by a suitably qualified person. • Installation of 'Koala Warning Signs' or 'Injured Native Wildlife Signs' in areas of potential wildlife conflict areas or crossing points. • Implement regular slashing of roadside vegetation in clear zones to minimise the height of ground cover in potential conflict areas or crossing points. 	Construction and post construction	Effective	
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	No residual impact is anticipated.
Invasion and spread of weeds	<p>Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).</p> <p>Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).</p>	During construction	Effective	Minor proliferation of weeds may occur at edges of proposal area during the operational phase.
Invasion and spread of pests	Pest species will be managed within the proposal site.	During construction	Effective	None expected
Invasion and spread of pathogens and disease	<p>Implement hygiene procedures for the use of vehicles and the importation of materials to the proposal footprint in accordance with <i>Guide 7: Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).</p> <p>Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).</p>	During construction	Effective	Minimal. With the implementation of these procedures, the risk of introducing pathogens would be greatly reduced.

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Changes to hydrology and impacts to groundwater dependant ecosystems	Construction to be completed in accordance with 'Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction, Sydney' (Blue Book) (Department of Environment and Climate Change, 2008).	Construction	Effective	Minor alteration to surface water flows and as per impacts to PCTs.

6 Offset strategy

6.1 Quantification of impacts

The need for biodiversity offsets is founded in the theory of 'avoid, minimise and mitigate' the impacts of projects. The accepted approach to environmental assessment requires that, in the first instance, environmental impacts are avoided or minimised as far as possible and subsequently reduced to acceptable levels through appropriate mitigation techniques. Where measures to avoid and mitigate impacts are not feasible or cost effective, then offset strategies can be used to compensate the residual impacts of the development on biodiversity.

Although efforts have been made to avoid, minimise and mitigate ecological impacts associated with the proposal, some residual impacts would occur. This biodiversity assessment identified that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (Section 4.4 and Appendix C). In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply to the proposal.

Transport would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in the Transport '*Guideline for Biodiversity Offsets*' (Roads and Maritime Services, 2016). A comparison of the proposal's residual impacts against the predetermined thresholds is provided in Table 6.1. The assessment indicates that offsets would be required for this proposal as the impacts exceed biodiversity offset thresholds.

An estimate of the quantum of offsets required in accordance with the simplified offset ratios within Table 2 of the Transport '*Guideline for Biodiversity Offsets*' (Roads and Maritime Services, 2016) has been provided in Table 6.2.

Table 6.1 Transport offset thresholds

Description of activity or impact	Consider offsets or supplementary measures	Does the proposal trigger an offset
Activities in accordance with Transport for NSW Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	No
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	No
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	No
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition	No
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Yes, 1.96 ha of habitat (in moderate to good condition) for the Spotted-tailed Quoll, Grey-headed Flying-fox, New Holland Mouse and Large-eared Pied Bat would be directly impacted.
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	No, <5 ha of NSW TEC would be impacted upon. Furthermore, no TEC present is subject to a SIS.
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing > 1ha or where the species is the subject of an SIS	Yes – 1.96 ha of habitat (in moderate to good condition which contains hollow bearing trees) for Squirrel Glider and Brush-tailed Phascogale which are both species credit species. Yes – Removal of 18 <i>Diuris arenaria</i> (Sand Doubletail) individuals.
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database (TSPD)	Where clearing > 5ha or where the species is the subject of an SIS	No, <5 ha of NSW listed threatened species habitat for ecosystems species will be impacted. Furthermore, no species are subject to a SIS.
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	No, Type 1 or Type 2 sensitive key fish habitat will not be impacted by the proposal.

Table 6.2 Offset quantum based on REF proposal offset ratios

Type of impact	Offset ratio	Proposal impact	Potential offset obligation
Loss of threatened fauna species	Offset area of habitat lost at a ratio of 3:1	1.96 ha of nationally listed threatened fauna species habitat in moderate to good condition	5.88 ha of habitat for Spotted-tailed Quoll, Grey-headed Flying-fox, New Holland Mouse and Large-eared Pied Bat
		1.96 ha of NSW listed threatened species credit species habitat	5.88 ha of habitat for Squirrel Glider and Brush-tailed Phascogale.
Loss of threatened flora species	Offset individuals lost at a ratio of 3:1	18 <i>Diuris arenaria</i> (Sand Doubletail) individuals	54 <i>Diuris arenaria</i> (Sand Doubletail) individuals.

7 Conclusion

This Biodiversity Assessment Report has been prepared to support a Review of Environmental Factors for the proposed duplication of Nelson Bay Road at Salt Ash in NSW (the proposal). Results of the field surveys and desk based investigations completed identified two PCTs within the study area based on floristic composition, geological substrate and landscape position. These included:

- PCT 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast; and
- PCT 1717 Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast.

In addition, two non-native vegetation type were assigned to miscellaneous ecosystem classes, being highly disturbed areas with no or limited native vegetation and urban/exotic plantings.

One threatened ecological community was recorded within the study area being, Swamp Sclerophyll Forest which is listed as Endangered under the BC Act. No threatened ecological communities listed under the EPBC Act were recorded within the study area.

One threatened flora species, *Diuris arenaria* (Sand Doubletail), listed as Endangered under the BC Act was recorded within the study area. A population of 18 individuals was recorded within the study area which formed part of a larger local population within the locality. During the 2019 targeted surveys a further 90 individuals of this local population were recorded immediately to the south of Nelson Bay Road within Worimi National Park. *Diuris arenaria* will be affected by the proposal via the direct removal of approximately 18 individuals, this impact may be reduced following the detailed design phase of the proposal.

Field surveys recorded six threatened fauna species utilising habitat within the study area including:

- Varied Sittella (*Daphoenositta chrysoptera*) listed as Vulnerable under the BC Act
- Little Lorikeet (*Glossopsitta pusilla*) listed as Vulnerable under the BC Act
- White-bellied Sea-eagle (*Haliaeetus leucogaster*) listed as Vulnerable under the BC Act
- White-throated Needletail (*Hirundapus caudacutus*) listed as Vulnerable under the EPBC Act
- Little Bent-wing Bat (*Miniopterus australis*) listed as Vulnerable under the BC Act
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) listed as Vulnerable under the BC Act.

Likelihood of occurrence assessments identified an additional 19 threatened species of having a moderate or high likelihood of occurrence within the study area. These species include:

- Three woodland birds
- Two forest owls
- Three predatory birds; and
- Eleven mammal species.

The key impacts of the proposal include the removal of 2.27 ha of native vegetation and associated habitat including:

- 0.11 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest) - listed as Endangered under BC Act; and
- 18 *Diuris arenaria* (Sand Doubletail) individuals.

Fauna injury or death is another key impact associated with the proposal due to the construct a concrete barrier within the median strip. This will create a solid barrier which will reduce fauna movement within the immediate locality of the proposal, especially for less-mobile mammal species such as the Koala and Spotted-tailed Quoll. Indirect / operational impacts including a minor increase in habitat isolation. Invasion and spread of weeds, invasion and

spread of pests, and invasion and spread of pathogens and disease are a risk with a proposal of this type. Noise, light and vibration would be increased during construction and operation.

The overall outcome of the tests of significance and EPBC Act assessments of significance (see Appendix C) indicate that there is a high level of certainty that the impacts to threatened biodiversity are unlikely to be significant. Given the proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement (SIS) is not required under the BC Act to support this proposal. In respect to Matters of National Environmental Significance (MNES) matters including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

Minimisation of biodiversity impacts would occur at the detailed design phase. However, mitigation measures would need to be implemented during the construction and operational phases to further lessen the potential ecological impacts of the proposal. The '*Roads and Maritime Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects*' (Roads and Traffic Authority, 2011) identifies a range of mitigation techniques to be applied and these techniques must be implemented during construction. Due to the presence of an endangered ecological community, population of a threatened flora species (*Diuris arenaria*) and proximity of the development footprint to Worimi National Park, exclusion zones would be established to delineate the works limit boundary to ensure no accidental impacts occur.

Additional mitigation measures should be implemented to address potential impacts on wildlife movement for less-mobile fauna such as the Koala and Spotted-tailed Quoll. Additional mitigation measures include implementation of Koala fencing on the southern boundary to minimise impacts. With the implementation of recommended mitigation measures proposed it is unlikely that residual impact of the proposal will result in significant impact to biodiversity within the locality.

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur. This biodiversity assessment identified that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act. In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

It is however Transport's policy that biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) would be provided for impacts that exceed predetermined thresholds. The 'Transport for NSW Guidelines for Biodiversity Offsets' (November 2016) indicates that the following offsets would be required by the proposal given residual impacts associated with the current development footprint exceed the predetermined thresholds as specified in the guideline:

- 5.88 ha of habitat for EPBC Act listed species including Spotted-tailed Quoll, Grey-headed Flying-fox, New Holland Mouse and Large-eared Pied Bat
- 5.88 ha of habitat for BC Act listed species credit species including Squirrel Glider and Brush-tailed Phascogale
- 54 *Diuris arenaria* (Sand Doubletail) individuals.

A Biodiversity Offset Strategy will be developed to identify biodiversity credits and/or supplementary measures for those entities impacted.

8 References

- BIOLINK ECOLOGICAL CONSULTANTS 2018. Managing koala populations for the future: constituent populations of the Central ARKS Port Stephens sub-area. Uki, NSW.
- BUREAU OF METEOROLOGY. 2020. *Bureau of Meteorology - Groundwater Dependent Ecosystems Atlas* [Online]. Available: <http://www.bom.gov.au/water/groundwater/gde/> [Accessed 2020].
- CLEMENTS, A. 2019. Assessment of the status of *Corybas dowlingii* D.L. Jones. CSIRO.
- COMMONWEALTH OF AUSTRALIA 2012. Environment Assessment Manual - Implementing Chapter 4, EPBC Act.: Commonwealth of Australia,.
- CROPPER, S. C. 1993. *Management of Endangered Plants*, Melbourne, CSIRO Australia.
- DEBUS, S. J. S. 1995. Surveys of large forest owls in Northern New South Wales: methodology, calling behaviour and owls responses. *Corella*, 19, 38-50.
- DEPARTMENT OF ENVIRONMENT 2013. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. In: ENVIRONMENT, D. O. (ed.). Canberra, ACT: Commonwealth of Australia.
- DEPARTMENT OF ENVIRONMENT. 2016. *National Wildlife Corridors Plan* [Online]. Department of Environment, . Available: <http://www.environment.gov.au/topics/biodiversity/biodiversity-conservation/wildlife-corridors/what-are-wildlife-corridors> [Accessed].
- DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2002. Descriptions for NSW (Mitchell) Landscapes Version 2.
- DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2007. Threatened species assessment guidelines. The assessment of significance. Hurstville: Department of Environment and Climate Change.
- DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. Managing Urban Stormwater: soils and construction, Vol 2D: main road construction. South Sydney: Department of Environment and Climate Change NSW.
- DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2004a. Natural Resources Management Advisory Series Note 7- bat roosts Coffs Harbour: North East Branch, Department of Environment and Conservation.
- DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2004b. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft). Hurstville: Department of Environment and Conservation.
- DEPARTMENT OF AGRICULTURE, WATER AND THE ENVIRONMENT. 2020a. *Protected Matters Search Tool* [Online]. Available: <https://www.environment.gov.au/epbc/protected-matters-search-tool> [Accessed 2020].
- DEPARTMENT OF AGRICULTURE, WATER AND THE ENVIRONMENT. 2020b. *Register of Critical Habitat* [Online]. Available: <https://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl> [Accessed 2020].
- DEPARTMENT OF LAND AND WATER CONSERVATION 2002. The NSW State Groundwater Dependent Ecosystem Policy. Sydney: Department of Land and Water Conservation.
- DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update). Wollongbar: NSW Department of Primary Industries,.
- DEPARTMENT OF PRIMARY INDUSTRIES. 2020a. *Fisheries NSW Spatial Data Portal* [Online]. Available: https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal [Accessed 2020].

- DEPARTMENT OF PRIMARY INDUSTRIES. 2020b. *Key Fish Habitat - Port Stephens LGA*. Prepared by GIS Section, Fisheries Ecosystem Branch, Division of Fisheries, Compliance and Regional Relations, NSW DPI.
- DEPARTMENT OF PRIMARY INDUSTRIES. 2020c. *NSW WeedWise* [Online]. Available: <https://weeds.dpi.nsw.gov.au/> [Accessed 2020].
- DEPARTMENT OF THE ENVIRONMENT 2013a. Matters of National Environmental Significance - Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999.
- DEPARTMENT OF THE ENVIRONMENT 2013b. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. *In*: ENVIRONMENT, D. O. (ed.). Canberra, ACT: Commonwealth of Australia.
- DEPARTMENT OF THE ENVIRONMENT 2013c. Significant Impact Guidelines 1.1 - Matters of National Environmental Significance Canberra: Department of the Environment.
- DEPARTMENT OF THE ENVIRONMENT 2014. EPBC Act Referral Guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and Australian Capital Territory). Commonwealth of Australia, 2014.
- DEPARTMENT OF THE ENVIRONMENT, W., HERITAGE AND THE ARTS, 2009. National Koala Conservation and Management Strategy 2009–2014. Canberra: Natural Resource Management Ministerial Council.
- DEPARTMENT OF THE ENVIRONMENT WATER HERITAGE AND THE ARTS 2009. EPBC Act Policy Statement 1.1 Matters of National Environmental Significance, Significant Impact Guidelines. Canberra: Department of the Environment Water Heritage and the Arts.
- EAMUS, D., FROEND, R., LOOMES, R., HOSE, G. & MURRAY, B. 2006. A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. *Australian Journal of Botany*, 24, 97–114.
- ENVIRONMENT ENERGY AND SCIENCE GROUP. 2020a. *Areas of Outstanding Biodiversity Value register* [Online]. Available: <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register> [Accessed 2020].
- ENVIRONMENT ENERGY AND SCIENCE GROUP. 2020b. *BioNet Vegetation Classification Database Version 2.1* [Online]. [Accessed 2020].
- ENVIRONMENT ENERGY AND SCIENCE GROUP. 2020c. *Threatened Species Profile Database* [Online]. Available: <http://www.bionet.nsw.gov.au/> [Accessed 2020].
- ESPALLARGAS, N. 2005. The Distribution and Threatening Processes of *Diuris praecox* and *Diuris arenaria* on the Tomaree Peninsula. Unpublished report to Port Stephens Council The University of Newcastle - Work Placement Project.
- HATTON, T. & EVANS, R. 1998. Dependence of ecosystems on groundwater and its significance to Australia. Canberra: Land and Water Resources Research and Development Corporation.
- HIGGINS, P. J. & PETER, J. M. (eds.) 2002. *Handbook of Australian, New Zealand and Antarctic Birds*, Melbourne: Oxford University Press.
- HILLS ENVIRONMENTAL 2012. MR108 Nelson Bay Road Upgrade - Bobs Farm to Anna Bay Stage 3 Cromarty Land to Port Stephens Drive. Hammonville: Prepared for Roads and Maritime Services.
- HILLS ENVIRONMENTAL 2013. Review of Environmental Factors Addendum – MR108 Nelson Bay Road Upgrade Cromarty Lane to Port Stephens Drive Additional fauna impact mitigation Sydney: Prepared for Roads and Maritime Services.
- KAVANAGH, R. & PEAKE, P. 1993. Survey procedures for nocturnal forest birds: an evaluation of the variability in census results due to temporal factors, weather and technique. *In* Olsen, P. (ed.), . *Australian Raptor Studies*. Melbourne: Australian Raptor Association, RAOU.

- KLEINFELDER. 2014. Biodiversity Management Plan – Tanilba Northern Dune Extension. Warners Bay: Prepared for Sibelco Australia Limited.
- LAND USE PLANNING SUSTAINABLE PLANNING GROUP. 2007. *Port Stephens Local Government Area - Koala Habitat Planning Map*.
- LOWER HUNTER AND CENTRAL COAST REGIONAL ENVIRONMENTAL MANAGEMENT STRATEGY 2000. Vegetation Survey, Classification and Mapping - Lower Hunter and Central Coast Regional Environment Management Strategy Sydney: Lower Hunter and Central Coast Regional Environment Management Strategy (LHCCREMS).
- LOWER HUNTER AND CENTRAL COAST REGIONAL ENVIRONMENTAL MANAGEMENT STRATEGY 2003. Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy Technical Report 2003, Digital Aerial Photo Interpretation and Updated Extant Vegetation Community Map. Callaghan, NSW: Lower Hunter and Central Coast Regional Environment Management Strategy.
- MATTESON, K. C. & LANGELLOTTO, G. A. 2010. Determinates of inner city butterfly and bee species richness. *Urban Ecosyst*, 1-15.
- MATTHEI, L. E. 1995. *Soil Landscapes of the Newcastle 1:100,000 sheet*, Sydney, Department of Land and Water Conservation.
- NICHE 2013. Nelson Bay Road Upgrade, Stage 3 - Supplementary ecological survey Prepared for Roads and Maritime Services.
- NSW DEPARTMENT OF PLANNING AND ENVIRONMENT. 2018. *State Environmental Planning Policy (Coastal Management) 2018 - maps spatial viewer* [Online]. Available: http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=SEPP_CoastalManagement [Accessed 2018].
- NSW DEPARTMENT OF PRIMARY INDUSTRIES. 2020. *Register of critical habitat* [Online]. Available: <https://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what/register> [Accessed 2020].
- NSW ROADS AND MARITIME SERVICES 2012. Wildlife Connectivity Guidelines – Managing wildlife connectivity on road projects. Sydney.
- NSW SCIENTIFIC COMMITTEE. 2011. *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing* [Online]. Available: <http://www.environment.nsw.gov.au/determinations/SwampSchlerophyllEndSpListing.htm> [Accessed 3 March 2016].
- OFFICE OF ENVIRONMENT & HERITAGE 2016. NSW Guide to Surveying Threatened Plants. Sydney: Office of Environment and Heritage.
- OFFICE OF ENVIRONMENT & HERITAGE 2017a. Biodiversity Assessment Method.
- OFFICE OF ENVIRONMENT & HERITAGE 2017b. Biodiversity Assessment Method.
- OFFICE OF ENVIRONMENT & HERITAGE 2018. Threatened Species Test of Significance Guidelines. Sydney.
- OFFICE OF ENVIRONMENT AND HERITAGE. 2017. *Vegetation Types Database* [Online]. Office of Environment and Heritage,. Available: <http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm> [Accessed].
- OFFICE OF ENVIRONMENT ENERGY AND SCIENCE. 2020. *BioNet Atlas of NSW Wildlife* [Online]. Available: <http://www.bionet.nsw.gov.au/> [Accessed].
- PARSONS BRINCKERHOFF 2013. Lower Hunter Vegetation Mapping. Report funded by the Department of Sustainability, Environment, Water, Population and Communities through the Sustainable Regional Development Program: Parsons Brinckerhoff, Canberra.
- PENNAY, M., LAW, B. & REINHOLD, L. 2004. Bat calls of NSW. Region based guide to the echolocation calls of microchiropteran bats. Sydney: New South Wales Department of Environment and Conservation and State Forests of New South Wales.
- PHILLIPS, S. & CALLAGHAN, J. 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. *Australian Zoologist*, 35, 774-780.

- PORT STEPHENS COUNCIL 2002. Port Stephens Council Comprehensive Koala Plan of Management (CKPoM). Port Stephens: Prepared by Port Stephens Council with the Australian Koala Foundation.
- PORT STEPHENS COUNCIL 2019. Summary of Koala Data for Port Stephens LGA.
- ROADS AND MARITIME SERVICES 2016. Guideline for Biodiversity Offsets. Roads and Maritime Services.
- ROADS AND TRAFFIC AUTHORITY 2011. Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects. Sydney: RTA.
- ROYAL BOTANIC GARDENS. 2020. *Plantnet - The Plant Information Network System of Botanic Gardens Trust Version 2.0* [Online]. National Herbarium of NSW, Royal Botanic Garden, Sydney, Australia. Available: <http://plantnet.rbgsyd.nsw.gov.au/> [Accessed 2020].
- SIVERTSEN, D., ROFF, A., SOMERVILLE, M., THONELL, J. & DENHOLM, B. 2011. Greater Hunter Native Vegetation Mapping Geobase Guide (Version 4.0). Internal Report for the Office of Environment and Heritage: Department of Premier and Cabinet, Sydney Australia.
- SOMERVILLE, D. 2009. Hunter, Central and Lower North Coast Vegetation Classification and Mapping. Tocal, NSW: Hunter Councils Environment Division for Hunter-Central Rivers Catchment Management Authority.
- STRALBERG, D., JONGSOMJIT, D., HOWELL, C., SNYDER, M., ALEXANDER, J., WIENS, J. & ROOT, T. 2009. Re-Shuffling of Species with Climate Disruption: A No-Analog Future for California Birds? *PLoS ONE*, 4, e6825.
- THACKWAY, R. & CRESSWELL, I. D. 1995. *An Interim Biogeographic Regionalisation of Australia*, Canberra, Australian Nature Conservation Agency.
- TRANSPORT FOR NSW 2013. Specialist advice for Referral to DoE for Nelson bay Road Upgrade Bobs Farm to Anna Bay Stage 3.
- UMWELT 2009a. Ecological Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash. Toronto: Prepared for Macka's Sand.
- UMWELT 2009b. Environmental Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash Toronto: Prepared for Macka's Sand.
- UMWELT 2016. Landscape Management Plan - Including Rehabilitation Management Plan and Long Term Management Plan. Teralba: Prepared for Macka's Sand.
- WSP 2019. Nelson Bay Road Duplication: Williamtown to Bob's Farm - Preliminary biodiversity investigation. Newcastle.

Appendix A – Flora species recorded

A1 – Recorded flora

Family	Scientific name	Common Name	BC Act status	EPBC Act status
Exotic species recorded				
Apiaceae	<i>Cyclospermum leptophyllum</i> *	Slender Celery		
Apiaceae	<i>Foeniculum vulgare</i> *	Fennel		
Apiaceae	<i>Hydrocotyle bonariensis</i> *	American Pennywort		
Apocynaceae	<i>Nerium oleander</i> *	Oleander		
Asteraceae	<i>Aster subulatus</i> *	Wild Aster		
Asteraceae	<i>Bidens pilosa</i> *	Cobblers Pegs		
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> *	Bitou Bush		
Asteraceae	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane		
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle		
Asteraceae	<i>Hypochaeris radicata</i> *	Catsear		
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed		
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle		
Asteraceae	<i>Taraxacum officinale</i> *	Common Dandelion		
Cyperaceae	<i>Cyperus brevifolius</i> *	Mullumbimby Couch		
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge		
Davalliaceae	<i>Nephrolepis cordifolia</i> *	Fishbone Fern		
Fabaceae (Faboideae)	<i>Trifolium arvense</i> *	Haresfoot Clover		
Fabaceae (Faboideae)	<i>Trifolium dubium</i> *	Lesser Trefoil		
Fabaceae (Faboideae)	<i>Trifolium hirtum</i> *	Rose Clover		
Fabaceae (Faboideae)	<i>Trifolium repens</i> *	White Clover		
Gentianaceae	<i>Centaurium erythraea</i> *	Common Centaury		
Juncaceae	<i>Juncus cognatus</i> *			
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel		
Malvaceae	<i>Sida rhombifolia</i> *	Paddys Lucerne		
Ochnaceae	<i>Ochna serrulata</i> *	Mickey Mouse Plant		
Oxalidaceae	<i>Oxalis latifolia</i> *	Large-leaf Wood-sorrel		
Passifloraceae	<i>Passiflora caerulea</i> *	Blue Passionflower		
Pinaceae	<i>Pinus elliotii</i> *	Slash Pine		
Plantaginaceae	<i>Plantago lanceolata</i> *	Lambs Tongues		
Poaceae	<i>Aira spp.</i>	Hairgrass		
Poaceae	<i>Andropogon virginicus</i> *	Whisky Grass		

Family	Scientific name	Common Name	BC Act status	EPBC Act status
Poaceae	<i>Axonopus fissifolius</i> *	Narrow-leafed Carpet Grass		
Poaceae	<i>Briza maxima</i> *	Quaking Grass		
Poaceae	<i>Briza minor</i> *	Shivery Grass		
Poaceae	<i>Chloris gayana</i> *	Rhodes Grass		
Poaceae	<i>Ehrharta erecta</i> *	Panic Veldtgrass		
Poaceae	<i>Eragrostis curvula</i> *	African Lovegrass		
Poaceae	<i>Hyparrhenia hirta</i> *	Coolatai Grass		
Poaceae	<i>Lolium perenne</i> *	Perennial Ryegrass		
Poaceae	<i>Megathyrsus maximus</i> *	Guinea Grass		
Poaceae	<i>Melinis repens</i> *	Red Natal Grass		
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum		
Poaceae	<i>Paspalum urvillei</i> *	Vasey Grass		
Poaceae	<i>Poa annua</i> *	Winter Grass		
Poaceae	<i>Cenchrus clandestinus</i> *	Kikuyu Grass		
Poaceae	<i>Setaria parviflora</i> *	Slender Pigeon Grass		
Poaceae	<i>Setaria pumila</i> *	Pale Pigeon Grass		
Poaceae	<i>Stenotaphrum secundatum</i> *	Buffalo Grass		
Poaceae	<i>Vulpia bromoides</i> *	Squirrel Tail Fescue		
Polygonaceae	<i>Polygonum aviculare</i> *	Wireweed		
Polygonaceae	<i>Rumex crispus</i> *	Curled Dock		
Primulaceae	<i>Lysimachia arvensis</i> *	Scarlet Pimpernel		
Rubiaceae	<i>Richardia stellaris</i> *			
Selaginaceae	<i>Hebenstretia dentata</i> *			
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco Bush		
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade		
Verbenaceae	<i>Lantana camara</i> *	Lantana		
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop		
Verbenaceae	<i>Verbena officinalis</i> *	Common Verbena		
Native species recorded				
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed		
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily		
Apiaceae	<i>Actinotus helianthi</i>	Flannel Flower		
Apiaceae	<i>Centella asiatica</i>	Pennywort		
Apiaceae	<i>Platysace lanceolata</i>	Shrubby Platysace		
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod		
Arecaceae	<i>Livistona australis</i>	Cabbage Palm		
Asclepiadaceae	<i>Marsdenia rostrata</i>	Common Milk Vine		

Family	Scientific name	Common Name	BC Act status	EPBC Act status
Bignoniaceae	<i>Pandorea pandorana</i> subsp. <i>pandorana</i>			
Celastraceae	<i>Denhamia silvestris</i>	Narrow-leaved Orangebark		
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew		
Dennstaedtiaceae	<i>Hypolepis muelleri</i>	Harsh Ground Fern		
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken		
Dilleniaceae	<i>Hibbertia linearis</i>			
Elaeocarpaceae	<i>Tetratheca ericifolia</i>			
Epacridaceae	<i>Leucopogon lanceolatus</i>	Lance Beard Heath		
Epacridaceae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath		
Epacridaceae	<i>Monotoca elliptica</i>	Tree Broom-heath		
Epacridaceae	<i>Monotoca scoparia</i>			
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush		
Euphorbiaceae	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	Cheese Tree		
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart, Native Poplar		
Euphorbiaceae	<i>Ricinocarpos pinifolius</i>	Wedding Bush		
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>	Variable Bossiaea		
Fabaceae (Faboideae)	<i>Bossiaea rhombifolia</i>			
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>			
Fabaceae (Faboideae)	<i>Glycine tabacina</i>			
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla		
Fabaceae (Faboideae)	<i>Kennedia rubicunda</i>	Red Kennedy Pea		
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Black Wattle		
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>			
Fabaceae (Mimosoideae)	<i>Acacia fimbriata</i>	Fringed Wattle		
Fabaceae (Mimosoideae)	<i>Acacia irrorata</i> subsp. <i>irrorata</i>	Green Wattle		
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle		
Fabaceae (Mimosoideae)	<i>Acacia suaveolens</i>	Sweet Wattle		
Fabaceae (Mimosoideae)	<i>Acacia ulicifolia</i>	Prickly Moses		
Haloragaceae	<i>Gonocarpus teucrioides</i>	Raspwort		
Lauraceae	<i>Cassytha glabella</i>			
Lauraceae	<i>Cassytha pubescens</i>			
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush		
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine		
Myrtaceae	<i>Angophora costata</i>	Sydney Red/Rusty Gum		

Family	Scientific name	Common Name	BC Act status	EPBC Act status
Myrtaceae	<i>Eucalyptus pilularis</i>	Blackbutt		
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany		
Myrtaceae	<i>Leptospermum juniperinum</i>			
Myrtaceae	<i>Leptospermum laevigatum</i>	Coast Teatree		
Myrtaceae	<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>			
Myrtaceae	<i>Melaleuca linariifolia</i>			
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark		
Orchidaceae	<i>Acianthus fornicatus</i>	Pixie Caps		
Orchidaceae	<i>Caladenia carnea</i>	White Caladenia		
Orchidaceae	<i>Caladenia picta</i>			
Orchidaceae	<i>Diuris arenaria</i>		E	
Oxalidaceae	<i>Oxalis perennans</i>			
Orchidaceae	<i>Pterostylis concinnia</i>	Trim Greenhood		
Orchidaceae	<i>Pterostylis longifolia</i>	Tall Greenhood		
Orchidaceae	<i>Pterostylis nutans</i>	Nodding Greenhood		
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>			
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush		
Pittosporaceae	<i>Billardiera scandens</i>	Appleberry		
Poaceae	<i>Cynodon dactylon</i>	Common Couch		
Poaceae	<i>Imperata cylindrica</i>	Bladey Grass		
Poaceae	<i>Panicum simile</i>	Two-colour Panic		
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass		
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed		
Proteaceae	<i>Banksia integrifolia</i>			
Proteaceae	<i>Banksia serrata</i>	Saw Banksia		
Proteaceae	<i>Persoonia levis</i>	Broad-leaved Geebung		
Proteaceae	<i>Conospermum taxifolium</i>	Variable Smoke-bush		
Ranunculaceae	<i>Clematis aristata</i>	Mountain Clematis		
Ranunculaceae	<i>Clematis glycinoides</i>	Headache Vine		
Rubiaceae	<i>Pomax umbellata</i>	Pomax		
Rutaceae	<i>Boronia ledifolia</i>	Showy Boronia		
Sapindaceae	<i>Dodonaea triquetra</i>	Large-leaf Hop-bush		
Smilacaceae	<i>Smilax glycyphylla</i>	Sweet Sarsparilla		
Zamiaceae	<i>Macrozamia communis</i>			

A2 – Vegetation integrity plot data

Q1

Date: 18/9/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	401878
PCT 1646 – Regrowth			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	Northing	6371248
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Orientation	70
													BAM Attributes 20x50m plot	
													Stem classes	Number / presence
<i>Pteridium esculentum</i>	50	500	EG						50				80+	No
<i>Hibbertia linearis</i>	5	10	SG			5							50-79	1 - All B. integrifolia
<i>Actinotus helianthi</i>	1	5	FG					1					30-49	Yes
<i>Leptospermum laevigatum</i>	1	6	SG			1							20-29	No
<i>Dodonaea triquetra</i>	0.5	4	SG			0.5							10-19	Yes
<i>Themeda triandra</i>	3	50	GG				3						5-9	No
<i>Briza maxima</i>	0.1	15	EX								0.1		<5	No
<i>Chrysanthemoides monilifera subsp. rotundata</i>	0.1	2	HT										Hollows	0
<i>Pomax umbellata</i>	0.5	5	FG					0.5					Length logs (m)	0
<i>Lomandra longifolia</i>	0.5	6	GG				0.5						BAM Attributes 1x1 plot (%)	
<i>Monotoca elliptica</i>	2	50	SG			2							Litter cover	74
<i>Leptospermum polygalifolium subsp. poly</i>	1	15	SG			1							Bare ground	
<i>Ricinocarpos pinifolius</i>	0.5	6	SG			0.5							Vegetation	
<i>Dianella caerulea</i>	0.9	50	FG					0.9					Rock	
<i>Bossiaea heterophylla</i>	0.1	2	SG			0.1							Cryptograms	
<i>Dillwynia retorta</i>	0.6	3	SG			0.6							Total	74
<i>Imperata cylindrica</i>	0.5	10	GG				0.5							
<i>Banksia integrifolia</i>	30	20	TG		30									
<i>Plantago lanceolata</i>	0.1	4	EX								0.1			
<i>Aira spp.</i>	0.3	6	EX								0.3			
<i>Vulpia bromoides</i>	0.1	3	EX								0.1			
<i>Acacia suaveolens</i>	0.2	1	SG			0.2								
<i>Gonocarpus teucroides</i>	0.3	15	FG					0.3						
<i>Eragrostis curvula</i>	2	30	HT										2	
<i>Acacia longifolia subsp. longifolia</i>	0.1	1	SG			0.1								
<i>Pandorea pandorana subsp. pandorana</i>	0.2	2	OG							0.2				
<i>Acacia decurrens</i>	0.1	1	TG		0.1									
<i>Hyparrhenia hirta</i>	0.2	25	HT										0.2	
<i>Eucalyptus ptilularis</i>	0.1	1	TG		0.1									
<i>Oxalis perennans</i>	0.1	2	FG					0.1						
<i>Cassytha glabella</i>	0.1	3	OG							0.1				
<i>Ehrharta erecta</i>	0.9	15	HT										0.9	
<i>Leucopogon lanceolatus</i>	1	10	SG			1								
<i>Boronia ledifolia</i>	0.6	8	SG			0.6								

Q2

Date: 11/9/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	400804
PCT 1646 - Moderate			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	Northing	6371201
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Orientation	
			114.6	106.8	25	10.9	0.5	0.2	70	0.2	7.8	7.7	BAM Attributes 20x50m plot	
													Stem classes	Number / presence
<i>Eucalyptus costata</i>	10	3	TG		10								80+	2
<i>Eucalyptus pilularis</i>	15	7	TG		15								50-79	4
<i>Pinus elliotii</i>	5	3	HT										30-49	Yes
<i>Monotoca scoparia</i>	10	2	SG			10							20-29	Yes
<i>Pteridium esculentum</i>	70	100	EG						70				10-19	Yes
<i>Macrozamia communis</i>	0.1	3	OG							0.1			5-9	No
<i>Pennisetum clandestinum</i>	2	1	HT									2	<5	Yes
<i>Imperata cylindrica</i>	0.5	50	GG				0.5						Hollows	2
<i>Dodonaea triquetra</i>	0.6	3	SG			0.6							Length logs (m)	16.7
<i>Ehrharta erecta</i>	0.1	100	HT											
<i>Dianella caerulea</i>	0.1	3	FG					0.1					BAM Attributes 1x1 plot (%)	
<i>Breynia oblongifolia</i>	0.1	5	SG			0.1							Litter cover	10
<i>Passiflora caerulea*</i>	0.1	1	EX								0.1		Bare ground	
<i>Chrysanthemoides monilifera subsp. rotundata</i>	0.6	10	HT									0.6	Vegetation	
<i>Livistona australis</i>	0.1	1	OG							0.1			Rock	
<i>Tetradlea ericifolia</i>	0.1	3	SG			0.1							Cryptograms	
<i>Ricinocarpos pinifolius</i>	0.1	2	SG			0.1							Total	10
<i>Acianthus fornicatus</i>	0.1	50	FG					0.1						

Q3

Date: 11/9/2019			Covers										Easting	
PCT 1717 - Moderate			# spp	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	401710	
			Count	Count	Count	Count	Count	Count	Count	Count	Count	6321215		
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Orientation		
			62.6	62.4	36	3.3	12	1	10	0.1	0.2	0.2	90	
													BAM Attributes 20x50m plot	
													Stem classes	Number / presence
													80+	3
													50-79	5
													30-49	Yes
													20-29	Yes
													10-19	Yes
													5-9	Yes
													<5	Yes
													Hollows	2
													Length logs (m)	15.1
													BAM Attributes 1x1 plot (%)	
													Litter cover	76
													Bare ground	
													Vegetation	
													Rock	
													Cryptograms	
													Total	76
<i>Eucalyptus robusta</i>	5	3	TG		5									
<i>Melaleuca quinquenervia</i>	30	96	TG		30									
<i>Imperata cylindrica</i>	10	200	GG				10							
<i>Lomandra longifolia</i>	2	6	GG				2							
<i>Dodonaea triquetra</i>	2	100	SG			2								
<i>Leucopogon lanceolatus</i>	0.9	3	SG			0.9								
<i>Pteridium esculentum</i>	10	100	EG						10					
<i>Leucopogon juniperinus</i>	0.1	1	SG			0.1								
<i>Chrysanthemoides monilifera subsp. rotundata</i>	0.2	6	HT									0.2		
<i>Persoonia levis</i>	0.1	1	SG			0.1								
<i>Monotoca elliptica</i>	0.1	1	SG			0.1								
<i>Dianella caerulea</i>	1	50	FG					1						
<i>Glycine tabacina</i>	0.1	1	OG							0.1				
<i>Acacia ulicifolia</i>	0.1	1	SG			0.1								
<i>Angophora costata</i>	1	1	TG		1									
<i>Hydrocotyle bonariensis</i>		1	EX								0			

Q7

Date: 16/4/19			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	401522
PCT 1646 - Good			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	Northing	6371177
Species			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Orientation	70
Cover	Abundance		110.8	105.8	50	21	10	4.2	20	0.6	5	4.5	BAM Attributes 20x50m plot	
<i>Eucalyptus pilularis</i>	25	5	TG		25								Stem classes	Number / presence
<i>Angophora costata</i>	15	10	TG		15								80+	1
<i>Monotoca elliptica</i>	10	10	SG			10							50-79	3
<i>Banksia serrata</i>	10	15	TG		10								30-49	Yes
<i>Leptospermum polygalifolium subsp. polygalifolium</i>	5	3	SG			5							20-29	Yes
<i>Pteridium esculentum</i>	20	100	EG						20				10-19	Yes
<i>Imperata cylindrica</i>	5	100	GG				5						5-9	Yes
<i>Themeda triandra</i>	2	20	GG				2						<5	Yes
<i>Dodonaea triquetra</i>	2	6	SG			2							Hollows	2
<i>Chrysanthemoides monilifera subsp. rotur</i>	0.5	2	HT										Length logs (m)	13
<i>Dianella caerulea var. producta</i>	4	50	FG					4					BAM Attributes 1x1 plot (%)	
<i>Pandorea pandorana subsp. pandorana</i>	0.3	5	OG							0.3			Litter cover	88
<i>Acacia longifolia subsp. longifolia</i>	3	4	SG			3							Bare ground	0
<i>Setaria pumila</i>	0.5	10	EX								0.5		Vegetation	12
<i>Megathyrus maximus</i>	4	20	HT									4	Rock	0
<i>Glycine tabacina</i>	0.1	1	OG							0.1			Cryptograms	0
<i>Leucopogon lanceolatus</i>	0.3	6	SG			0.3							Total	100
<i>Tetradlea ericifolia</i>	0.2	20	SG			0.2								
<i>Hardenbergia violacea</i>	0.1	1	OG							0.1				
<i>Homalanthus populifolius</i>	0.1	1	SG			0.1								
<i>Ricinocarpus pinifolius</i>	0.1	1	SG			0.1								
<i>Gonocarpus teucrioides</i>	0.1	1	FG					0.1						
<i>Lomandra longifolia</i>	3	30	GG				3							
<i>Acacia suaveolens</i>	0.2	1	SG			0.2								
<i>Parsonsia straminea</i>	0.1	1	OG							0.1				
<i>Acacia ulicifolia</i>	0.1	2	SG			0.1								
<i>Pomax umbellata</i>	0.1	1	FG					0.1						

Q8

Date: 16/4/2019			Covers										Easting	
			# spp	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	401158	
PCT 1646 – Good			25	Count	Count	Count	Count	Count	Count	Count	Count	Count	6371131	
			25	25	3	8	3	3	1	7	0	0	Orientation 70	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot	
			119.9	119.9	56	13.8	5.7	3.3	40	1.1	0	0	Stem classes	
			TG		6								Number / presence	
<i>Angophora costata</i>	6	2	TG		6								80+	3
<i>Eucalyptus pilularis</i>	35	3	TG		35								50-79	2
<i>Pteridium esculentum</i>	40	200	EG						40				30-49	Yes
<i>Banksia serrata</i>	15	15	TG		15								20-29	Yes
<i>Imperata cylindrica</i>	5	100	GG				5						10-19	Yes
<i>Pandorea pandorana subsp. pandorana</i>	0.3	20	OG							0.3			5-9	Yes
<i>Dianella caerulea var. producta</i>	3	50	FG					3					<5	Yes
<i>Marsdenia rostrata</i>	0.1	2	OG							0.1			Hollows	0
<i>Lomandra longifolia</i>	0.5	10	GG				0.5						Length logs (m)	36
<i>Tetratheca ericifolia</i>	0.2	5	SG			0.2							BAM Attributes 1x1 plot (%)	
<i>Dodonaea triquetra</i>	5	20	SG			5							Litter cover	72
<i>Monotoca elliptica</i>	7	15	SG			7							Bare ground	0
<i>Acianthus spp.</i>	0.2	40	FG					0.2					Vegetation	28
<i>Smilax glycyphylla</i>	0.3	2	OG							0.3			Rock	0
<i>Cassytha pubescens</i>	0.1	1	OG							0.1			Cryptograms	0
<i>Gonocarpus teucroides</i>	0.1	5	FG					0.1					Total	100
<i>Acacia longifolia subsp. longifolia</i>	0.3	2	SG			0.3								
<i>Bossiaea rhombifolia</i>	0.3	5	SG			0.3								
<i>Leucopogon lanceolatus</i>	0.8	5	SG			0.8								
<i>Acacia fimbriata</i>	0.1	1	SG			0.1								
<i>Acacia ulicifolia</i>	0.1	2	SG			0.1								
<i>Billardiera scandens</i>	0.1	1	OG							0.1				
<i>Parsonsia straminea</i>	0.1	1	OG							0.1				
<i>Themeda triandra</i>	0.2	5	GG				0.2							
<i>Glycine tabacina</i>	0.1	1	OG							0.1				

A3 – Recorded fauna

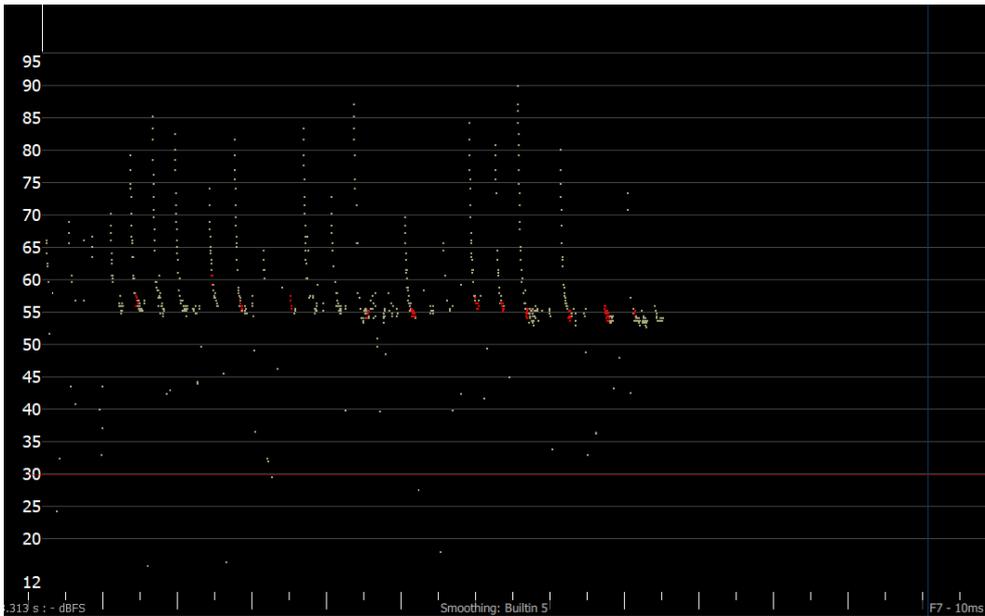
Scientific Name	Common Name	Native (N) or Introduced (I)	BC Act Status ¹	EPBC Act Status ²
Reptiles				
<i>Egernia major</i>	Land Mullet	N		
<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	N		
<i>Varanus varius</i>	Lace Monitor	N		
Birds				
<i>Acanthiza pusilla</i>	Brown Thornbill	N		
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	N		
<i>Accipiter novaehollandiae</i>	Grey Goshawk	N		
<i>Anthochaera carunculata</i>	Red Wattlebird	N		
<i>Anthochaera chrysoptera</i>	Little Wattlebird	N		
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	N		
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	N		
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	N		
<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo	N		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	N		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	N		
<i>Coracina tenuirostris</i>	Cicadabird	N		
<i>Cormobates leucophaea</i>	White-throated Treecreeper	N		
<i>Corvus coronoides</i>	Australian Raven	N		
<i>Cracticus nigrogularis</i>	Pied Butcherbird	N		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	N		
<i>Daphoenositta chrysoptera</i>	Varied Sittella	N		
<i>Dicaeum hirundinaceum</i>	Mistletoebird	N		
<i>Eopsaltria australis</i>	Eastern Yellow Robin	N		
<i>Glossopsitta pusilla</i>	Little Lorikeet	N	V	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	N	V	M
<i>Haliastur sphenurus</i>	Whistling Kite	N		
<i>Hirundapus caudacutus</i>	White-throated Needletail	N		V, M
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	N		
<i>Malurus cyaneus</i>	Superb Fairy-wren	N		
<i>Malurus lamberti</i>	Variegated Fairy-wren	N		
<i>Manorina melanocephala</i>	Noisy Miner	N		
<i>Meliphaga lewinii</i>	Lewin's Honeyeater	N		
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	N		
<i>Monarcha melanopsis</i>	Black-faced Monarch	N		M
<i>Myiagra rubecula</i>	Leaden Flycatcher	N		
<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	N		
<i>Neochmia temporalis</i>	Red-browed Finch	N		

Scientific Name	Common Name	Native (N) or Introduced (I)	BC Act Status ¹	EPBC Act Status ²
<i>Oriolus sagittatus</i>	Olive-backed Oriole	N		
<i>Pachycephala pectoralis</i>	Golden Whistler	N		
<i>Pachycephala rufiventris</i>	Rufous Whistler	N		M
<i>Philemon corniculatus</i>	Noisy Friarbird	N		
<i>Phylidonyris niger</i>	White-cheeked Honeyeater	N		
<i>Psophodes olivaceus</i>	Eastern Whipbird	N		
<i>Rhipidura albiscapa</i>	Grey Fantail	N		
<i>Rhipidura rufifrons</i>	Rufous Fantail	N		M
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	N		
<i>Sericornis frontalis</i>	White-browed Scrubwren	N		
<i>Todiramphus sanctus</i>	Sacred Kingfisher	N		
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	N		
<i>Zosterops lateralis</i>	Silvereye	N		
Mammals				
<i>Antechinus stuartii</i>	Brown Antechinus	N		
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	N		
<i>Pseudocheirus peregrinus</i>	Ring-tail Possum	N		
<i>Trichosurus vulpecula</i>	Brush-tail Possum	N		
<i>Wallabia bicolor</i>	Swamp Wallaby	N		
<i>Austronomus australis</i>	White-striped Free-tail Bat	N		
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	N		
<i>Micronomus norfolkensis</i>	Eastern Freetail Bat	N	V	
<i>Miniopterus australis</i>	Little Bent-winged Bat	N	V	
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	N		
<i>Vespadelus vulturnus</i>	Little Forest Bat	N		

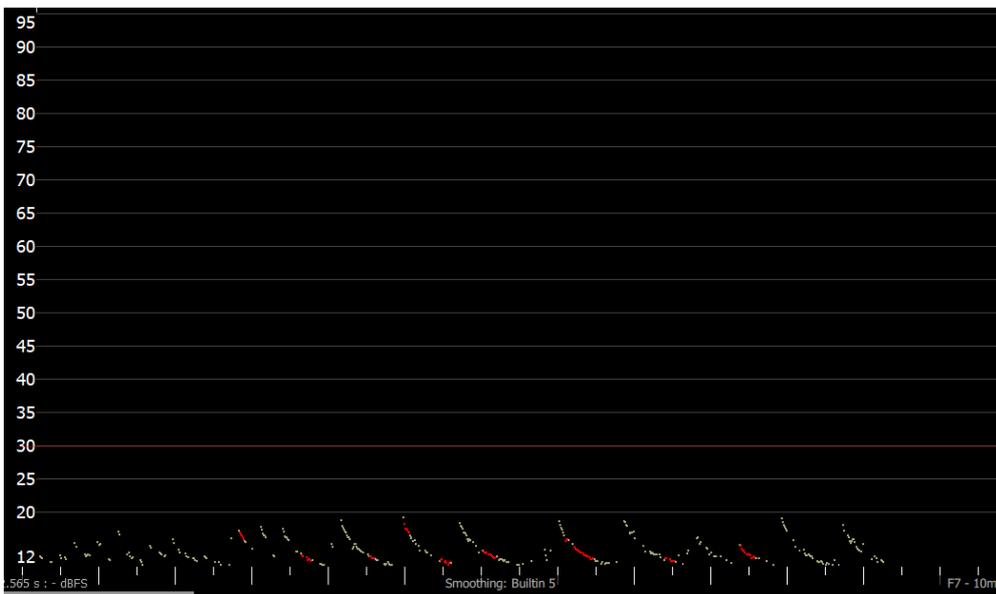
1. BC Act status: threatened species status under the *Biodiversity Conservation Act 2016*

2. EPBC Act status: threatened species status under the *Environment Protection and Biodiversity Conservation Act 1999*.

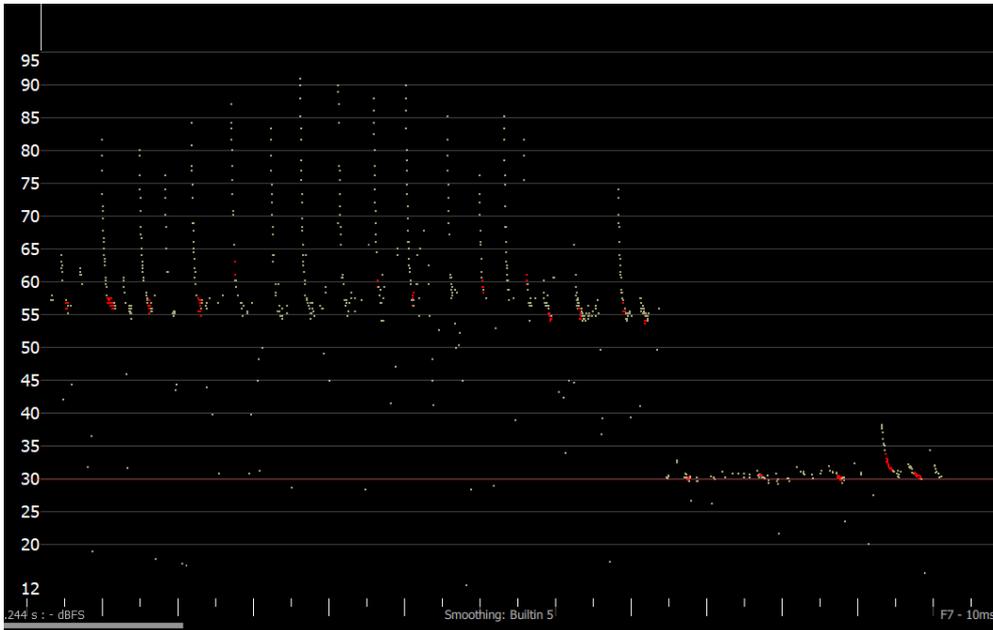
A4 – Bat call sonograms



An example of a Little bent-winged Bat (*Miniopterus australis*)



An example of a White-striped Free-tail Bat (*Austronomus australis*)



An example of a Little bent-winged Bat (*Miniopterus australis*) (mid-50 khz) and a short call sequence of a Gould's Wattled Bat (*Chalinolobus gouldii*) in the bottom right.

Appendix B – Habitat assessment table

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Habitat assessment table – threatened flora

Scientific Name	Common Name	BC Act ¹	EPBC Act ²	Habitat requirements	Source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Angophora inopina</i>	Charmhaven Apple	V	V	Restricted to the Charmhaven - Wyee area where it grows in open dry sclerophyll woodland of Eucalyptus haemastoma and Corymbia gummifera with a dense shrub understorey. Occurs on deep white sandy soils over sandstone, often with some gravelly laterite.	BioNet, PlantNet, PMST	Moderate – vegetation associations for the species were recorded and the species has been recorded frequently within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Asperula asthenes</i>	Trailing Woodruff	V	V	This small herb occurs only in NSW in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area. It grows in damp sites, often along river banks.	BioNet, PMST	Moderate – whilst the study area occurs at the species southern distribution limit, vegetation associations were recorded and the species has been previously recorded within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Caladenia porphyrea</i>	-	-	-	Caladenia porphyrea has a highly restricted geographic distribution. It has been recorded from 2 localities in the Wyong local government area c. 2 km apart.	PlantNet	Is a synonym with Caladenia quadrifaria and has been delisted from the BC Act. Therefore, this species has not been considered further.	No – species is considered unlikely to occur within the study area.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E1	V	Occurs south of Swansea where it grows on clay loam or sandy soils. Prefers low open forest with a heathy or sometimes grassy understorey. Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas.	PMST	Low – whilst marginal habitat may occur the study area is located north of the species known distribution (nearest record south of Catherine Hill Bay) and the species is not known to occur within the NSW North Coast IBRA Bioregion.	No – species is considered unlikely to occur within the study area.
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	Occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies. Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River.	BioNet, PlantNet	Moderate – vegetation associations recorded within the study area and the species has been recorded in the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.

Scientific Name	Common Name	BC Act ¹	EPBC Act ²	Habitat requirements	Source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Commersonia prostrata</i>	-	E1	E	Occurs south of Picton lakes where it mainly grows in gullies along the escarpment, south from Picton Lakes, on the Southern Tablelands (one plant at Penrose State Forest, one plant at Rowes Lagoon and one plant at Tallong) and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). It occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (<i>Eucalyptus pauciflora</i>) Woodland at Rose Lagoon; Blue leaved Stringybark (<i>E. agglomerata</i>) Open Forest at Tallong; and in Brittle Gum (<i>E. mannifera</i>) Low Open Woodland at Penrose; Scribbly Gum (<i>Eucalyptus haemostoma</i>) / Swamp Mahogany (<i>E. robusta</i>) Ecotonal Forest at Tomago. Associated native species may include <i>Imperata cylindrica</i> , <i>Empodisma minus</i> and <i>Leptospermum continentale</i> .	PlantNet, BioNet, PMST	Low – although recorded in the locality no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
<i>Corybas dowlingii</i>	-	E1	-	<i>Corybas dowlingii</i> is a tuberous orchid, forming clonal colonies. It commonly occurs in gullies of tall open forest, typically between 10 and 200m elevation and on well-drained gravelly soil.	BioNet, PlantNet	Moderate – vegetation associations recorded within the study area and the species has been recorded within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats.	PMST, PlantNet, BioNet	Moderate – vegetation associations recorded within the study area and the species has been recorded infrequently within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E1	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes. This species typically occurs at the ecotone between dry subtropical forest/woodland communities.	BioNet, PMST	Low – although recorded in the locality, no vegetation associations which constitute potential habitat were recorded within the study area.	No – species is considered unlikely to occur within the study area.
<i>Diuris arenaria</i>	-	E1	-	Restricted to the Tomaree Peninsula north of Newcastle where it grows in coastal heathy dry sclerophyll forest on sandy flats with patches of Themeda.	PlantNet, BioNet	Recorded – individuals were recorded within the study area.	Yes – individuals were recorded within the project area and the species is likely to be impacted upon by the Proposal.
<i>Diuris praecox</i>	Rough Double Tail	V	V	Occurs in coastal and near-coastal districts from Ourimbah to Nelson Bay where it grows in sclerophyll forest often on hilltops or slopes.	PMST, PlantNet, BioNet	Moderate – vegetation associations recorded within the study area and the species has been recorded frequently within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V	V	Occurs in scattered locations within a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Grows in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone, in coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include Brown Stringybark (<i>E. capitellata</i>), Scribbly Gum (<i>E. haemastoma</i>), Narrow-leaved Stringybark (<i>E. oblonga</i>), Silvertop Ash (<i>E. sieberi</i>), Smooth-barked Apple (<i>Angophora costata</i>), Dwarf Apple (<i>A. hispida</i>), Red Bloodwood (<i>Corymbia gummifera</i>), Scrub She-oak (<i>Allocasuarina distyla</i>), Slender Tea Tree (<i>Leptospermum trinervium</i>), and Fern-leaved Banksia (<i>Banksia oblongifolia</i>).	PMST, PlantNet, BioNet	Moderate – vegetation associations recorded within the study area and the species has been recorded frequently within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.

Scientific Name	Common Name	BC Act ¹	EPBC Act ²	Habitat requirements	Source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Eucalyptus glaucina</i>	Slaty Red Gum	V	V	Occurs from Taree to Broke where it is locally frequent but very sporadic and grows in grassy woodland on deep, moderately fertile and well-watered soil. Endemic on low coastal ranges and tablelands of central NSW, Taree to Broke, also near Casino.	PlantNet	Low – no vegetation associations recorded and the study area occurs outside the species known distribution.	No – species is considered unlikely to occur within the study area.
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	-	V	V	Locally frequent, grows in dry sclerophyll woodland on sandy soils in low, often wet sites.	PlantNet, PMST, BioNet	Moderate – vegetation associations recorded within the study area and the species has been recorded frequently within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Euphrasia arguta</i>	-	CE	CE	Rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008, it had not been collected for 100 years. Historically, it was recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. Ecological information from historical records is scarce including, 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', 'in meadows near rivers'. The populations that are currently known are located in the Nundle State Forest and on nearby private land, in eucalypt forest with a mixed grass and shrub understorey.	BioNet	Low – although there is a single record of this species within the locality it is not recent (1886). Furthermore, no vegetation associations were recorded and the study area is generally outside the species known current distribution.	No – species is considered unlikely to occur within the study area.
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct population near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales.	BioNet, PlantNet, PMST	Moderate – vegetation associations recorded within the study area and the species has been recorded infrequently within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Lindernia alsinoides</i>	Noah's False Chickweed	E	-	Grows in swampy sites in sclerophyll forest and coastal heath, north from Bulahdelah.	PlantNet, BioNet	Moderate – species has been recorded within the locality (single record near Tilligerry State Conservation Area) and vegetation associations for the species were recorded with the study area.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Maundia triglochoides</i>	-	V	-	Occurs north from Sydney. Grows in swamps, creeks or shallow freshwater 30 to 60 cm deep on heavy clay, low nutrients. Associated with wetland species such as <i>Triglochin procerum</i> .	BioNet, PlantNet	Low – although recorded in the locality and an associated PCTs was recorded, preferred habitat for the species was not identified in the study area (i.e. heavy clay soils).	No – species is considered unlikely to occur within the study area.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area. Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects.	PMST, PlantNet, BioNet	Moderate – vegetation associations recorded within the study area and the species has been recorded once within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Melaleuca groveana</i>	Groves Paperbark	V	-	Widespread, scattered populations in coastal districts north of Yengo National Park to southeast Queensland. Also found as a disjunct population near Torrington on the northern tablelands. It grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone on rocky outcrops and cliffs. It also occurs in dry shrubby open forest and woodlands	PlantNet	Moderate – vegetation associations recorded within the study area and the species has been recorded in the broader locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Occurs infrequently in coastal regions where it grows in damp places especially beside streams and lakes. Also occasionally occurs in swamp forest or associated with disturbance.	PlantNet, PMST, BioNet	Moderate – vegetation associations recorded within the study area and the species has been recorded within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.

Scientific Name	Common Name	BC Act ¹	EPBC Act ²	Habitat requirements	Source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Phaius australis</i>	Southern Swamp Orchid	E1	E	Previously occurred as far south as Port Macquarie but is now thought to only occur north of Coffs Harbour. Grows in coastal areas in swampy grassland or forest including rainforest, eucalypt or paperbark forest. Flowers sept-oct.	PMST	Low – although marginal quality habitat was recorded, the study area occurs outside the species known distribution (nearest record near Port Macquarie).	No – species is considered unlikely to occur within the study area.
<i>Prasophyllum sp. Wybong</i> (C. Phelps ORG 5269)	A leek orchid	-	CE	<i>Prasophyllum sp. Wybong</i> (C. Phelps ORG 5269) is known from seven populations in open eucalypt woodland and grassland in NSW. The species' area of occupancy is estimated to be 1.5 km ² with an estimated population size based on surveys in 2006 of 460 mature individuals. This species occurs within the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes IBRA Bioregions and the Border Rivers-Gwydir, Namoi, Hunter-Central Rivers and Central West Natural Resource Management Regions. The distribution of this species overlaps with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EPBC Act-listed threatened ecological community.	PMST	Low – study area occurs outside the species known distribution (>200km from nearest record) and no vegetation associations were recorded.	No – species is considered unlikely to occur within the study area.
<i>Prostanthera densa</i>	Villous Mint-bush	V	V	Occurs from Nelson Bay to Beecroft Peninsula where it grows in sclerophyll forest and shrubland, on coastal headlands and near-coastal ranges, on sandstone.	BioNet, PlantNet	Moderate – vegetation associations recorded within the study area and the species has been recorded within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Pterostylis chaetophora</i>	-	V	-	Preferred habitat of <i>Pterostylis chaetophora</i> is seasonally moist, dry sclerophyll forest with a grass and shrub understorey.	BioNet, PlantNet	Moderate – vegetation associations recorded within the study area and the species has been recorded once within the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	V	V	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.		Moderate – although not recorded in the locality little is known about the species and its habitat preferences a vegetation association identified on the species DPIE species profile was recorded within the study area.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	-	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of <i>R. rubescens</i> typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm.	PlantNet	Low – no preferred habitat was recorded within the study area and species has not been recorded within the locality.	No – species is considered unlikely to occur within the study area.
<i>Rhodomyrtus psidioides</i>	Native Guava	CE	-	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW.	BioNet	Low – although recorded within the locality no preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.

Scientific Name	Common Name	BC Act ¹	EPBC Act ²	Habitat requirements	Source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Senecio spathulatus</i>	Coast Groundsel	E1	-	Occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah) where it grows on primary dunes.	BioNet	Low – whilst a vegetation association of the species was recorded, it did not occur on primary dunes which is preferred habitat for the species. As such, the species is considered unlikely to occur.	No – species is considered unlikely to occur within the study area.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the Central Coast, Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	BioNet, PMST	Low – although recorded within the locality no associated PCTs or preferred habitat was recorded within the study area. If recorded the species would likely be a horticultural specimen.	No – species is considered unlikely to occur within the study area.
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	Occurs in coastal districts from Bulahdelah to Port Macquarie where it grows in dry sclerophyll forest and occasionally swampy heath in sandy, low nutrient soils with a dense understorey of grasses. Specifically, it is known to occur within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland.	BioNet, PlantNet, PMST	Moderate – vegetation associations recorded within the study area and the species has been recorded in the locality.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
<i>Zannichellia palustris</i>	-	E1	-	Grows in fresh or slightly saline stationary or slowly flowing water.	BioNet	Low – although recorded in the locality, no vegetation associations preferred by the species were recorded.	No – species is considered unlikely to occur within the study area.

1. Listed under the NSW *Biodiversity Conservation Act 2016* – E4 = Critically Endangered, E1 = Endangered Species, E2 = Endangered Population, V = Vulnerable.

2. Listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – X = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory.

3. Bionet = OEH Bionet Atlas of NSW Wildlife, EPBC Protected Matters Search Tool = Department of Agriculture, Water and the Environment's EPBC Protected Matters Search Tool and PlantNet = Royal Botanic Gardens PlantNet Spatial Search.

Habitat assessment table – threatened fauna

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
Invertebrates							
<i>Petalura gigantea</i>	Giant Dragonfly	-	E1	Found in permanent wetlands, both coastal and upland from moss Vale northwards to southern Queensland.	BioNet, PMST	Low. No suitable habitat within study area.	No
Fish							
<i>Epinephelus daemeli</i>	Black Rockcod	V	V ⁴	The Black Rockcod is found in warm temperate and subtropical parts of the south-western Pacific. Adult Black Rockcod can grow to 2 m in length and at least 80 kg in weight, but it is more common to see smaller fish (up to 1m/30kg).	PMST	Low. No suitable habitat within study area.	No
Amphibians							
<i>Crinia tinnula</i>	Wallum Froglet	V	-	Occurs along coast from south-eastern Queensland to Sydney. Mostly associated with swamps, dams and flooded roadside ditches, usually in heathland, where it is confined to acid, paperbark swamps and sedge swamps of the 'wallum' country. Males call any time of year. Breed in late winter.	BioNet	Low. No suitable habitat within study area.	No
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Exists as two distinct populations: a northern population on the sandstone geology of the Sydney Basin, from Wollemi National Park in the north, south to Jervis Bay; and a southern population in disjunct pockets from about Narooma south into eastern Victoria. In the northern population there is a marked preference for sandstone ridgetop habitat and broader upland valleys where the frog is associated with small headwater and slow flowing to intermittent creeklines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from collected water. Also observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised and are surrounded by undisturbed habitat. In the southern population, records appear to be associated with Devonian igneous and sedimentary formations and Ordovician metamorphics and are generally from more heavily timbered areas. It is absent from areas that have been cleared for agriculture or for urban development. Breed in summer and autumn in burrows in the banks of small creeks.	PMST	Low. No suitable habitat within study area.	No
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	This species occurs in fragment patches near coastal locations from Vic to south of the NSW-QLD border. For breeding it utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral wetlands. It is found in small pockets of habitat in otherwise developed areas and can occur in disturbed sites. There is a clear preference for sites with a complexity of vegetation structure and terrestrial habitat attributes which include extensive grassy areas and an abundance of shelter sites such as rocks, logs, tussock forming vegetation and other cover used for foraging and shelter. Over-wintering shelter sites may be adjacent to or some distance away from breeding sites but the full range of possible habitat used is not yet well understood.	PMST	Low. No suitable habitat within study area.	No
<i>Mixophyes balbus</i>	Stuttering Frog	E1	V	Terrestrial species, found in rainforest, Antarctic beech forest or wet sclerophyll forest. The species depends on freshwater streams and riparian vegetation for breeding and habitation. No records are known from riparian habitat that has been disturbed.	PMST	Low. No suitable habitat within study area.	No
<i>Uperoleia mahonyi</i>	Mahony's Toadlet	V	-	Inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species. Known records are associated with shallow ephemeral/semi-permanent water bodies with limited flow of water. Aquatic vegetation at breeding sites includes sedges (<i>Shoenoplectus</i> spp., <i>Baumea</i> spp. and <i>Lepironia articulata</i>) and Broadleaf Cumbungi (<i>Typha orientalis</i>).	BioNet	Low. No suitable habitat within study area. No permanent water bodies near or within study area. Low lying depressions during wet events may provide marginal habitat, however, without a permanent water in close proximity the study area it is unlikely to support individuals.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
Birds							
<i>Actitis hypoleucos</i>	Common Sandpiper	-	M	The Common Sandpiper frequents a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. It is mostly encountered along muddy margins or rocky shores and rarely on mudflats. It has been recorded in estuaries and deltas of streams, banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks.	PMST	Low. No suitable habitat within study area.	No
<i>Anthochaera phrygia</i> (syn. <i>Xanthomyza phrygia</i>)	Regent Honeyeater	CE	CE	Occurs mostly in box-ironbark forests and woodland and prefers wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with <i>Casuarina cunninghamiana</i> and <i>Amyema cabbagei</i> are important for feeding and breeding. Spotted Gum and Swamp Mahogany forests are also important feeding areas in coastal areas. Important food trees include <i>Eucalyptus sideroxylon</i> (Mugga Ironbark), <i>E. albens</i> (White Box), <i>E. melliodora</i> (Yellow Box) and <i>E. leucoxylon</i> (Yellow Gum).	BioNet, PMST	Low. The study area is not considered to be important for Regent Honeyeaters, due to low numbers in the wider Lower Hunter Region during seasonal movements and the abundance of similar and higher quality habitat surrounding the study area and its wider locality.	No
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	Breeds in the northern hemisphere, wintering south to Australia. It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. It mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. It also occurs over towns and cities. It mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. It sometimes occurs above forests. It probably roosts aerially, but has occasionally been observed to land.	PMST	Moderate. Although this species is likely to occasionally fly over the site on a seasonal basis, there is no suitable terrestrial habitat onsite.	No
<i>Arenaria interpres</i>	Ruddy Turnstone	-	M	Occurs at beaches and coasts with exposed rock, stony or shell beaches, mudflats, exposed reefs and wave platforms.	PMST	Low. No suitable habitat within study area.	No
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	The Dusky Woodswallow is widespread in eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region (Higgins and Peter, 2002) (Higgins and Peter, 2002). Often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with coarse woody debris. Birds are also often observed in farm land, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. In western New South Wales this species is primarily associated with River Red Gum/Black Box/Coolibah open forest/woodland associated with larger river/creek systems and is less common and far more patchily distributed in other communities such as mallee and cypress-pine woodland.	BioNet	Moderate. Potential habitat occurs within the study area.	Yes
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E1	E	Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spikerushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory..	BioNet, PMST	Low. No suitable habitat within study area.	No
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	Inland habitat consists of open forest and woodlands with few, if any, shrubs, and short, sparse grasses of less than 15cm in height, with scattered fallen timber, leaf litter and bare ground present. In coastal areas, structurally similar elements of tidal and estuarine communities (<i>Casuarina</i> woodlands, saltmarsh and mangroves) provide suitable habitat. Nesting sites are frequently located in relatively open areas, where ground cover is extremely low and/or sparse including native vegetation and mown lawns, ploughed paddocks and paddocks cut for hay, dirt and gravel roads, seaweed on sand beach, playing fields, vacant lots.	BioNet	Low. Preferred habitat not within study area. Records within greater locality.	No
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	M	Occurs in a variety of habitats: tidal mudflat, mangrove swamps, saltmarshes, shallow fresh, brackish, salt inland swamps and lakes; flooded and irrigated paddocks, sewage farms and commercial saltfields.	PMST	Low. No suitable habitat within study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Calidris canutus</i>	Red Knot	-	EM	In Australasia, the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	PMST	Low. No suitable habitat within study area.	No
<i>Calidris ferruginea</i>	Curlew Sandpiper	E1	CEM	Occurs in inter-tidal mudflats of estuaries, lagoons, mangrove channels and also around lakes, dams, floodwaters and flooded saltbush surrounding inland lakes.	PMST	Low. No suitable habitat within study area.	No
<i>Calidris melanotos</i>	Pectoral Sandpiper	-	M	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is usually found in coastal or near coastal habitat but occasionally further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands.	BioNet	Low. No suitable habitat within study area.	No
<i>Calidris ruficollis</i>	Red-necked Stint	-	M	Mostly found in coastal areas, including sheltered inlets, bays lagoons and estuaries. They also occur in shallow wetlands near the coast or inland, including lakes, waterholes and dams. They forage in mudflats, shallow water, sandy open beaches, flooded paddocks and in samphire feeding along the edges. The species roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle. Occasionally they roost on exposed reefs or shoals and amongst seaweed, mud and cow-pats. During high tides they may also use sand dunes and claypans.	BioNet, PMST	Low. No suitable habitat within study area.	No
<i>Calidris tenuirostris</i>	Great Knot	V	CEM	Generally a coastal species found on tidal mudflats and sandy ocean shores. A migratory species visiting Australian waters between September and March.	PMST	Low – marginal habitat, preferred habitat limited in study area.	No
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (<i>Eucalyptus pauciflora</i>) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	BioNet	Moderate - potential foraging habitat available in study area. Although hollow bearing trees were identified no breeding individuals or nests recorded during targeted surveys.	Yes
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	-	Occurs in eucalypt woodland and forest with <i>Casuarina/Allocasuarina</i> spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key <i>Allocasuarina</i> species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows.	BioNet, PMST	Low. The study area is considered unlikely to be important to local Glossy Black-Cockatoos considering due to lack of feed trees (<i>Allocasuarina</i>) and the abundance of similar and much higher quality habitat in the surrounding forests.	No
<i>Charadrius bicinctus</i>	Double-banded Plover	-	M	The Double-banded Plover is found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers. It is sometimes associated with coastal lagoons, inland saltlakes, exposed seagrass beds, exposed reefs and rock platforms and coastal sand dunes.	PMST	Low. No suitable habitat within study area.	No
<i>Charadrius mongolus</i>	Lesser Sand Plover	V	E	Migratory bird that migrates from the northern hemisphere to coastal areas of northern and east coast of Australia. The species is almost strictly coastal during the non-breeding season, preferring sandy beaches, mudflats of coastal bays and estuaries, sand-flats and dunes near the coast, occasionally frequenting mangrove mudflats (IUCN Redlist entry).	PMST	Low. No suitable habitat within study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Circus assimilis</i>	Spotted Harrier	V	-	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Preys on terrestrial mammals (e.g. bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.	BioNet	Moderate - potential marginal quality habitat available in study area. This species occurs sparsely in grassland habitats in the Lower Hunter Region and is unlikely to use habitats within the study area. Nevertheless, for the sake of due diligence, this species is included with other birds of prey that are assessed in Appendix C.	Yes
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper	V	-	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding.	BioNet	Low – prefers intact woodlands and forest of inland slopes and plains, the study area occurs outside of the regional range of this species.	No
<i>Cuculus optatus</i>	Oriental Cuckoo	-	M	A non-breeding migrant to Australia, it often inhabits rainforest, vine thickets, wet sclerophyll forest and open woodland and sometimes occurs in mangroves, wooded swamps and as vagrants in gardens. The population trend appears to be stable.	PMST	Low. No suitable habitat within study area. Irregular occurrence during seasonal movements cannot be discounted.	No
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	The Varied Sittella inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	BioNet, PMST	Recorded. Utilising habitat within study area.	Yes
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E1	E	The habitat of the Eastern Bristlebird is characterised by low dense vegetation. Fire is a feature of all areas where known populations occur. Given the poor flight ability of the species it is thought that few individuals survive the passage of fire, survival is dependant on the availability of fire refuges and recolonisation may be relatively slow. The bird is cryptic and camouflaged and rarely seen but may be detected by its distinctive, loud calls. Confined to NSW/Queensland border region, Illawarra region and NSW/Victorian border region.	PMST	Low. No suitable habitat in the study area.	No
<i>Dromaius novaehollandiae</i>	Emu	E2	-	Widespread throughout Aust. mainland in a variety of habitats from timbered areas to open country. Found from tropical monsoonal to temperate regions and at all altitudes from coasts to above winter snow-line in Great Dividing Range. Mostly found in flat undulating lands but also on timbered ridges, tablelands and moderately hilly terrain, also recorded on ocean beaches, wading in shallow estuarine inlets, mudflats, saltmarshes. Other coastal habitats include sandplains, sand-dunes, heathlands and low foothills. Tends to nest in areas of extensive cover where disturbance is infrequent and tend to avoid areas frequently disturbed by human activity.	BioNet	Low. Although individuals have been previously recorded in the locality, it is unlikely that such individuals are naturally occurring.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1	-	Widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish).	BioNet	Low. No suitable habitat within study area.	No
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which the Chats are unlikely to fly. The nearest extant populations outside Sydney Metropolitan CMA are at Ash Island north of Newcastle and Lake Illawarra, south of Wollongong. White-fronted Chats were previously recorded at Penrith Lakes (2001), Hawkesbury Swamps (2002), Tuggerah Lake (1997) and Lake Macquarie (1998).	BioNet	Low. No suitable habitat within study area.	No
<i>Erythrorhynchus radiatus</i>	Red Goshawk	CE	VM	Lives in coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers and along edges of rainforest. Nests are only built in trees taller than 20 meters which occur within 1 kilometre of a watercourse or wetland. Has a home range of 200 square kilometres and hunts for medium to large birds in open forests and gallery forest.	PMST	Low – marginal habitat within study area. May irregularly occur whilst foraging within greater locality. More known to occur in NE NSW.	No
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	BioNet, PMST	Low. No suitable habitat within study area.	No
<i>Gallinago megala</i>	Swinhoe's Snipe	-	M	During the non-breeding season Swinhoe's Snipe occurs at the edges of wetlands, such as wet paddy fields, swamps and freshwater streams. The species is also known to occur in grasslands, drier cultivated areas (including crops of rapeseed and wheat) and market gardens. Habitat specific to Australia includes the dense clumps of grass and rushes round the edges of fresh and brackish wetlands. This includes swamps, billabongs, river pools, small streams and sewage ponds. They are also found in drying claypans and inundated plains pitted with crab holes.	PMST	Low. No preferred habitat within study area.	No
<i>Gallinago stenura</i>	Pintail Snipe	-	M	During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands.	PMST	Low. No suitable habitat within study area.	No
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	The Little Lorikeet is a small green lorikeet with black bill and red patch on forehead and throat. The underside is yellow-green. Immatures are duller with less red on face and brown bill. Found in forests, woodland, treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria.	BioNet, PMST	Recorded. Study provides foraging and potential nesting habitat for local individuals.	Yes
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks.	PMST	Low. No suitable habitat in the study area. No records within the locality.	No
<i>Haematopus longirostris</i>	Pied Oystercatcher	E	-	Occurs in undisturbed beaches, sandspits, sandbars, tidal mudflats, estuaries and coastal islands. Occasionally found on rocky reefs, shores, rock stacks, brackish or saline wetlands and also in grassy paddocks, golf courses or parks near coast. Eggs are laid in shallow scrape in sand on open beach or among low growth behind beach.	BioNet	Low. No suitable habitat within study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs.	BioNet, PMST	Recorded. Flying over site. Unlikely to utilise the study area for foraging or breeding purposes. Was identified flying over the study area, during movements between habitat in the greater locality.	No
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-		BioNet	Moderate. Potential foraging habitat within study area. No breeding habitat recorded.	Yes
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	V, M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April.	BioNet, PMST	Recorded. Although this species was recorded fly over the study area, there is no suitable terrestrial habitat onsite.	No
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds.	BioNet	Low. No suitable habitat within study area.	No
<i>Lathamus discolor</i>	Swift Parrot	E1	CE	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering <i>Acacia pycnantha</i> , is indicated. Sites used vary from year to year.	BioNet, PMST	Low. Due to the very low numbers of Swamp Mahogany present and the separation of the study area from larger Swamp Mahogany patches, there is low likelihood of utilisation of the study area for foraging purposes. Intermittent occurrences under suitable seasonal conditions (blossom events) cannot be discounted.	No
<i>Limosa lapponica</i>	Bar-tailed Godwit	-	M	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas.	BioNet, PMST	Low. No suitable habitat within study area.	No
<i>Limosa limosa</i>	Black-tailed Godwit	V	M	A coastal species found on tidal mudflats, swamps, shallow river margins and sewage farms. Also found inland on larger shallow fresh or brackish waters. A migratory species visiting Australia between September and May.	PMST	Low. No suitable habitat within study area.	No
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes.	BioNet	Moderate. Potential foraging habitat within study area. No breeding habitat recorded.	Yes

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (South-Eastern)	V	-	Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia. The species appears unable to survive in remnants smaller than 100-200ha.	BioNet	Low. No preferred habitat within study area.	No
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	The Black-faced Monarch is widespread in eastern Australia. The Black-faced Monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. The Black-faced Monarch breeds in rainforest habitat, and generally nests near the top of trees with large leaves, in the tops of small saplings, or in lower shrubs.	PMST	Moderate. Although known to breed locally, the study area does not contain the denser forests they prefer for breeding site selection. However, occasional individuals cannot be discounted within the study area during migratory movements or post-breeding dispersals.	No
<i>Monarcha trivirgatus</i>	Spectacled Monarch	-	M	The Spectacled Monarch is widespread in eastern Australia. Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed.		Low. May rarely occur as a passage or dispersing migrant.	No
<i>Motacilla flava</i>	Yellow Wagtail	-	M	This species occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. This species also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. This species migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and in QLD and the north of NT and WA.	PMST	Low – although marginal quality habitat occur, individuals more likely to use higher quality habitats associated with Hexham Swamp and Ash Island.	No
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens.	PMST	Low. May infrequently occur as a passage or dispersing migrant.	No
<i>Ninox strenua</i>	Powerful Owl	V	-	A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, Casuarina or Callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally, feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands.	BioNet, PMST	Moderate. Marginal foraging and nesting habitat suggest the study area is likely to represent part of the home range of local individuals. No suitable nesting trees were actively used were recorded during targeted surveys.	Yes
<i>Numenius madagascariensis</i>	Eastern Curlew	-	CEM	Inhabits coastal estuaries, mangroves, mud flats and sand pits. It is a migratory shorebird which generally inhabits sea and lake shore mud flats, deltas and similar areas, where it forages for crabs and other crustaceans, clam worms and other annelids, molluscs, insects and other invertebrates. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in northern China, Korea and Russia.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Numenius minutus</i>	Little Curlew	-	M	On passage the species shows a preference for foraging and resting in swampy meadows near lakes and along river valleys. It overwinters on dry inland grassland, bare cultivation, dry mudflats and coastal plains of black soil with scattered shallow pools of freshwater, swamps, lakes or flooded ground. It shows a preference for short grass swards of less than 20 cm tall, and occasionally occurs in dry saltmarshes, coastal swamps, mudflats or sandflats in estuaries, or on the beaches of sheltered coasts.	PMST	Low. No preferred habitat within study area.	No
<i>Numenius phaeopus</i>	Whimbrel	-	M	Migrates to Taiwan, Philippines, PNG, and a race breeding in NE Siberia is found on the north and south-eastern coastlines of Australia. Juveniles arrive to Australia from spring to early summer. Usually only juveniles remain in Australia but very occasionally adults in breeding plumage may be seen in Australian winters.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Oxyura australis</i>	Blue-billed Duck	V	-	Relatively sparse throughout species range. Regularly found breeding in south-east Queensland, north-east South Australia and throughout New South Wales. Found on temperate, fresh to saline, terrestrial wetlands, and occupies artificial wetlands. Prefers deep permanent open water, within or near dense vegetation. Nest in rushes, sedge, Lignum Muehlenbeckia cunninghamii and paperbark Melaleuca.	BioNet	Low. No available habitat within study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Pandion haliaetus</i>	Eastern Osprey	V	M	Generally a coastal species, occurring in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers to far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish.	PMST	Low. No available habitat within study area. However, species may be seen flying over study area to access habitat within the greater locality.	No
<i>Petroica boodang</i>	Scarlet Robin	V	-	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude.	BioNet	Moderate – the species breeds in elevated woodland habitats of the Great Dividing Range and its foothills. They disperse from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds. Marginal habitat available. There are a small number of records locally, but these are likely cases of mistaken identity or very rare accidental occurrences. Nevertheless, for the sake of due diligence, this species is included in woodland species that are assessed in Appendix C.	Yes
<i>Plegadis falcinellus</i>	Glossy Ibis	-	M	It feeds in very shallow water and nests in freshwater or brackish wetlands with tall dense stands of emergent vegetation (e.g. reeds or rushes) and low trees or bushes. It shows a preference for marshes at the edges of lakes and rivers, as well as lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and irrigated cultivation. It less often occurs in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons. Roosting sites are often large trees that may be far from water. The nest is a platform of twigs and vegetation usually positioned less than 1 m above water in tall dense stands of emergent vegetation (e.g. reeds or rushes), low trees or bushes over water.	BioNet	Low. No suitable habitat within study area.	No
<i>Pluvialis fulva</i>	Pacific Golden Plover	-	M	Prefers sandy, muddy or rocky shores, estuaries and lagoons, reefs, saltmarsh, and or short grass in paddocks and crops. The species is usually coastal, including offshore islands; rarely far inland. Often observed on beaches and mudflats, sandflats and occasionally rock shelves, or where these substrates intermingle; harbours, estuaries and lagoons.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Pluvialis squatarola</i>	Grey Plover	-	M	In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes. They usually forage on large areas of exposed mudflats and beaches and occasionally in pasture and on muddy margins of inland wetlands. They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-	The eastern form of the species formerly ranged throughout eastern Australia from South Australia, through Victoria and broadly through NSW and central Queensland but is now extinct in South Australia, coastal Victoria and the ACT. In NSW, it occurs on the western slopes and plains but is less common at the higher altitudes of the tablelands. Isolated populations are known from coastal woodlands on the North Coast, in the Hunter Valley and from the South Coast near Nowra. Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. The species builds conspicuous dome-shaped nests and breeds co-operatively in sedentary family groups of 2-13 birds. Grey-crowned Babblers are insectivorous and forage in leaf litter and on bark of trees.	BioNet	Low. Preferred habitat does not occur within the study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	-	Occurs in rainforests, monsoon forests, adjacent eucalypt forests, fruiting trees on scrubby creeks or in open country.	BioNet	Low - There is no suitable habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	-	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic.	BioNet	Low - There is no suitable habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range.	PMST	Recorded. Study area represents seasonal foraging and breeding habitat.	No
<i>Rostratula australis</i> (syn. <i>R. benghalensis</i>)	Australian Painted Snipe (Painted Snipe)	E1	EM	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as Eucalyptus camaldulensis (River Red Gum), E. populnea (Poplar Box) or shrubs such as Muehlenbeckia florulenta (Lignum) or Sarcocornia quinqueflora (Samphire). Feeds at the water's edge and on mudflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest.	PMST	Low. No suitable habitat within study area.	No
<i>Sterna hirundo</i>	Common Tern	-	M	A non-breeding migrant to Australia, occurring mainly on the east coast and inhabiting marine, pelagic and coastal habitats. Mostly oceanic but often recorded in bays, harbours and estuaries and occasionally in coastal wetlands. Roosting occurs on unvegetated intertidal sandy ocean beaches, shores of estuaries, lagoons and sand bars.	BioNet	Low. No suitable habitat within study area.	No
<i>Sternula albifrons</i>	Little Tern	E1	-	Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets. They nest on sand-spits, sandbanks, ridges or islets in these habitats or gently sloping sandy ocean beaches and occasionally in sand-dunes.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Stictonetta naevosa</i>	Freckled Duck	V	-	In most years this species appear to be nomadic between ephemeral inland wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (<i>Muehlenbeckia cunninghamii</i>) within which they build their nests.	BioNet	Low. No suitable habitat within study area.	No
<i>Tringa brevipes</i> (syn. <i>Heteroscelus brevipes</i>)	Grey-tailed Tattler	-	M	It is often found on sheltered coasts with reefs, rock platforms or with intertidal mudflats. It is also found at intertidal rocky, coral or stony reefs, platforms and islets that are exposed at low tide. It has also been found in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It is rarely seen on open beaches and occasionally found around near-coastal wetlands, such as lagoons, lakes and ponds in sewage farms and salt works. Inland records for the species are rare. The species forages in shallow water, hard intertidal substrates, rock pools, intertidal mudflats, mangroves, banks of seaweed and among rocks and coral rubble, over which water may surge. The species roosts in mangroves, dense stands of shrubs, snags, rocks, beaches, reefs, artificial structures (sea walls, oyster racks), occasionally in near-coastal salt works and sewage ponds and rarely on sandy beaches or sand banks.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Tringa glareola</i>	Wood Sandpiper	-	M	Found in well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees and often with fallen timber. They also inhabit inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. This species uses artificial wetlands, including open sewage ponds, reservoirs, large farm dams, and bore drains and occasionally found in stony wetlands. The species forages on mud at the edges of wetlands, either along shores, among open scattered aquatic vegetation, or in clear shallow water.	BioNet	Low. No suitable habitat within study area.	No
<i>Tringa incana</i> (syn. <i>Heteroscelus incanus</i>)	Wandering Tattler	-	CEM	Generally found on rocky coasts with reefs and platforms, points, spits, piers, offshore islands and shingle beaches or beds. Occasionally seen on coral reefs or beaches, and tends to avoid mudflats Foraging habitat is among rocks or shingle, or in shallow pools at edges of reefs or beaches, mainly along the tideline. Wandering Tattlers have been recorded roosting or perching on top of boulders surrounded by or close to water.	BioNet	Low. No suitable habitat within study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Tringa nebularia</i>	Common Greenshank	-	M	Occurs in a range of inland and coastal environments. Inland, it occurs in both permanent and temporary wetlands, billabongs, swamps, lakes floodplains, sewage farms, salt works ponds, flooded irrigated crops. On the coast, it occurs in sheltered estuaries and bays with extensive mudflats, mangrove swamps, muddy shallows of harbours and lagoons, occasionally rocky tidal ledges. It generally prefers wet and flooded mud and clay rather than sand.	PMST, BioNet	Low. No suitable habitat within study area.	No
<i>Tringa stagnatilis</i>	Marsh Sandpiper	-	M	Occurs in coastal and inland wetlands (salt or fresh water), estuarine and mangrove mudflats, beaches, shallow or swamps, lakes, billabongs, temporary floodwaters, sewage farms and salt works ponds.	BioNet, PMST	Low. No suitable habitat within study area.	No
<i>Tryngites subruficollis</i>	Buff-breasted Sandpiper	-	M	Breeds in the high Arctic on well drained tundra with tussocks and scant vegetation. During migration it is found on many short grass habitats including agricultural grassland; uses wetlands for resting.	BioNet	Low. No suitable habitat within study area.	No
<i>Tyto longimembris longimembris</i>	Eastern Grass Owl	V	-	Typically found in tussock-grasslands but also occur in heathland, swamps, coastal dunes, tree-lined creeks, treeless plains, grassy gaps between trees and crops. Nest on the ground generally under tussocks. They generally feed on rodents but will also eat insects.	BioNet	Low. No suitable habitat within study area.	No
<i>Tyto novaehollandiae</i>	Masked Owl (southern mainland)	V	-	Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves.	BioNet	Moderate. Marginal foraging and nesting habitat suggest the study area is likely to represent part of the home range of local individuals. No suitable nesting trees were actively used were recorded during targeted surveys.	Yes
<i>Xenus cinereus</i>	Terek Sandpiper	V	M	In Australia widespread and common along north and east coasts than along south coastlines. It inhabits coastal areas, mostly saline intertidal mudflats in sheltered estuaries, embayments, harbours and lagoons; on islets, mudbanks or sandbanks and spits; often around mangroves.	PMST, BioNet	Low. No suitable habitat within study area.	No
Mammals							
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats, mainly in areas with extensive cliffs and caves and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Breeding habitat (maternity roosts) is located in roof domes in sandstone caves. Thought to forage below the forest canopy for small flying insects.	PMST	Moderate. Suitable foraging, likely that local individuals may use the study area on at least an intermittent basis. No breeding habitat within study area.	Yes
<i>Dasyurus maculatus</i>	Spotted-Tailed Quoll (Southern Subspecies)	V	E	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold. Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods.	BioNet, PMST	Moderate. Marginal habitat within study area due to the proximity to a busy roadway, but the study area may occur within the home range of local individuals and intermittent occurrences cannot be discounted. No breeding components identified in study area.	Yes
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high.	BioNet, PMST	Moderate. Potential foraging and roosting habitat within study area, so may visit site on an intermittent basis.	Yes

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-	Feeds on small insects beneath the canopy of well-timbered habitats including rainforest, Melaleuca swamps and dry sclerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred.	BioNet	Moderate. Potential foraging habitat within study area, so may visit site on an intermittent basis. No breeding habitat identified in study area.	Yes
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	This species is found along the east coast of Australia from Cape York in Queensland to Castlemaine in Victoria. Habitat includes rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands. Roosts in caves, old mines, stormwater channels and sometimes buildings with populations centred on maternity caves that are used annually for the birth and development of young.	BioNet	Moderate. Potential foraging habitat within study area, so may visit site on an intermittent basis. No breeding habitat identified in study area.	Yes
<i>Mormopterus norfolkensis</i>	Eastern Free-tail bat	V	-	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	BioNet	Moderate. Potential foraging and roosting habitat within study area, so may visit site on an intermittent basis.	Yes
<i>Myotis macropus</i>	Southern Myotis	V	-	Found in most habitat types in association with streams and permanent waterways usually at low elevations in flat or undulating landscapes from northern areas of Western Australia, and the Northern Territory, down the entire east coast and the southern coast of Australia to just west of the Victoria/South Australia border and inland along the Murray River. Roosts in caves, tree hollows, in clumps of dense vegetation (e.g. Pandanus), mines, tunnels, under bridges, road culverts and stormwater drains often in abandoned, intact Fairy Martin nests. Roost sites are strongly associated with bodies of water where this species commonly feeds on aquatic insects, shrimp and small fish at the water surface, however, aerial foraging for other insects is also known. Breeding habitat likely to coincide with roosting habitat.	BioNet	Low. No preferred foraging habitat (water bodies) habitat within study area, unlikely to roost within study area due to lack of suitable foraging habitat.	No
<i>Nyctophilus corbeni</i> (syn. <i>N. timoriensis</i>)	South-eastern Long-eared Bat (Corben's Long-eared Bat & Greater Long-eared Bat)	V	V	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bullocke (<i>Allocasuarina leuhmanni</i>) and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	BioNet	Low – preferred habitat not available within study area. Although recent record occurs within the locality it is a wildlife rehabilitation record and the study area occurs outside the species currently known distribution.	Yes
<i>Petauroides volans</i>	Greater Glider	-	V	The Greater Glider has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands, with a diet comprising of eucalypt leaves and occasional flowers. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. It also favours forests with a diversity of eucalypts to cater for seasonal variation in food abundance.	PMST	Low. No records within the locality. Preferred habitat and hollow-density not present within study area.	No
<i>Petaurus norfolkensis</i>	Squirrel Glider	V	-	The Squirrel Glider is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland. In NSW it is found in dry sclerophyll forest and woodland but not found in dense coastal ranges, inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. It is associated with mixed tree species stands with a shrub or Acacia midstorey. It requires abundant tree hollows for refuge and nest sites and feeds on gum of acacias, eucalypt sap and invertebrates.	BioNet	High. Suitable foraging and roosting habitat recorded, although not recorded during surveys the study area contains resident individuals.	Yes
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	-	V	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.	PMST	Low. No suitable habitat within study area.	No

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	Largely arboreal it occurs in a range of habitats which have reliable rainfall (500–2000 mm), but has preference for open dry sclerophyll forest on ridges (up to 600 m alt) with little/sparse ground cover. It nests in tree hollows and feeds at dusk on arthropods and small vertebrates.	BioNet	Moderate. Suitable foraging, likely that local individuals may use the study area on at least an intermittent basis.	Yes
<i>Phascolarctos cinereus</i>	Koala	V	V	Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum <i>Eucalyptus tereticornis</i> , Grey Gum <i>E. punctata</i> , Monkey Gum <i>E. cypellocarpa</i> and Ribbon Gum <i>E. viminalis</i> . In coastal areas, Tallowwood <i>E. microcorys</i> and Swamp Mahogany <i>E. robusta</i> are important food species, while in inland areas White Box <i>E. albens</i> , Bimble Box <i>E. populnea</i> and River Red Gum <i>E. camaldulensis</i> are favoured. Hawks Nest and Tea Gardens Population and population in the Pittwater LGA listed as Endangered under the NSW TSC Act.	BioNet, PMST	Moderate. Study area contains primarily supplementary habitat with small amount of preferred feed tree species found within southern portions of the site. The study area is considered unlikely to be important to Koalas for feeding purposes. However, local individuals may use the study area on at least an intermittent basis whilst moving throughout the greater locality.	Yes
<i>Planigale maculata</i>	Common Planigale	V	-	Occurs in a range of habitats from rainforest, sclerophyll forest, grasslands, marshlands and rocky areas, usually where there is ground cover and close to water. Builds small saucer-shaped nests of grass and bark.	BioNet	Low – although marginal habitat was recorded, there is only a single record in the locality which occurs at the species southern distribution limit (nearest next record is >50 km from study area). Furthermore, the species wasn't recorded during field investigations completed.	No
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	V	V	Disjunct distribution along coastal south-east Australia from near Gladstone in Queensland, to south-west Victoria and in Tasmania. Found from sea level up to 1500 metres in altitude generally in areas with rainfall greater than 760 millimetres. In NSW, it is found throughout coastal and subcoastal areas. Occurs in a range of habitats: coastal forest and woodland with a moderately dense heathy understorey, dense coastal scrubs or heath, wet and dry sclerophyll forest and sub-tropical, warm temperate and cool temperate rainforest of the eastern slopes and highlands. Often associated with gullies and forest ecotones. Open areas are used for foraging while areas of dense groundcover or understorey provide areas for shelter and protection from predators. Relatively thick ground cover is a major habitat requirement and it seems to prefer areas with light sandy soils. Feeds at dusk on roots, tubers, fungi, insects and their larvae and other soft bodied animals in the soil. Moves up and down slope as food resources become seasonally available.	BioNet, PMST	Low. Although potential habitat occurs, the species was not recorded during targeted surveys and there is only a single record of the species occurring within the locality (old record from 2006).	No
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	The New Holland Mouse is a small, burrowing native rodent. The species is similar in size and appearance to the introduced house mouse (<i>Mus musculus</i>), although it can be distinguished by its slightly larger ears and eyes, the absence of a notch on the upper incisors and the absence of a distinctive 'mousy' odour. Known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	BioNet, PMST	Moderate. Study area contains suitable sandy substrates and suitable habitat.	Yes
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lily pillies. It roosts in the branches of large trees in forests or mangroves.	BioNet, PMST	High. Likely that local individuals visit the study area regularly when site trees flower. No breeding habitat recorded in the study area.	Yes

Scientific name	Common Name	EPBC Act ¹	BC Act ²	Habitat	Data source ³	Likelihood of occurrence	Significant impact assessment required?
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	This species is widespread through tropical Australia and migrates to southern Australia in summer. Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts and breeds in tree hollows but has also been recorded roosting under exfoliating bark, in burrows of terrestrial mammals, in soil cracks and under slabs of rock and in the nests of bird and sugar gliders.	BioNet	Moderate. Potential foraging and roosting habitat within study area, records from 2007 near Tilligerry Nature Reserve	Yes
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically it forages at a height of 3–6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings.	BioNet, PMST	Moderate. Potential foraging and roosting habitat within study area, so may visit site on an intermittent basis.	Yes
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	BioNet	Moderate. Potential foraging habitat within study area, so may visit site on an intermittent basis. No breeding habitat identified in study area.	Yes

Appendix C – Test of significance

The Project will be assessed under Part 5 Division 5.1 of the EP&A Act. Under this assessment, Section 7.3 of the BC Act requires that a test of significance is undertaken to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the BC Act.

Assessment of habitat to be impacted upon by the Proposal found that there is potential within the study area for threatened biodiversity to occur. The following species have been assessed as part of this Proposal:

- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- *Diuris arenaria* (Sand Doubletail)
- Threatened forest owls
 - Powerful Owl
 - Masked Owl
- Threatened woodland birds
 - Gang-Gang Cockatoo
 - Varied Sittella
 - Scarlet Robin
 - Dusky Woodswallow
- Threatened birds of prey
 - Square-tailed Kite
 - Little Eagle
 - Spotted Harrier
- Threatened blossom nomads
 - Grey-headed Flying-fox
 - Little Lorikeet
- Threatened ground-dwelling mammals
 - Spotted-tailed Quoll
 - New Holland Mouse
- Threatened arboreal mammals
 - Squirrel Glider
 - Brush-tailed Phascogale
 - Koala
- Hollow-dwelling microchiropteran bats
 - Eastern False Pipistrelle
 - Eastern Coastal Freetail-bat
 - Yellow-bellied Sheath-tail Bat
 - Greater Broad-nosed Bat
- Cave-dwelling microchiropteran bats
 - Little Bent-winged Bat
 - Large Bent-winged Bat
 - Large-eared Pied Bat
 - Eastern Cave Bat.

For threatened biodiversity under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) significance assessments have been completed in accordance with the *Matters of National Environmental Significance, Significant Impact Guidelines 1.1* (Department of Environment, 2013). Species listed under both the BC Act and the EPBC Act has been assessed using both assessment guidelines separately. The following assessments were undertaken to consider impacts of works associated with the Proposal upon threatened species, populations or communities with a moderate or greater likelihood of occurring within the proposal area which were considered likely to be impacted by the proposal.

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Status

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest) is listed as an Endangered Ecological Community under the BC Act. This ecological community is not a listed threatened entity under the EPBC Act.

Specific impacts

Moderate condition patches of PCT 1717 within the study area are considered consistent with the Swamp Sclerophyll Forest threatened ecological community as they conform with the following locality, floristics, landscape and geological characteristics of Swamp Sclerophyll Forest as detailed in the NSW Scientific Committee Final Determination (NSW Scientific Committee, 2011):

- Occurred on sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains at elevations below 20 m
- Community occurred as an open forest and low scrub that contain characteristic species representative of Swamp Sclerophyll Forest as listed under Paragraph 1 of the NSW Scientific Determination.
- Occurred within the Central Coast LGA within the Sydney Basin IBRA bioregion.

The proposed action will require the clearing of 0.11 ha of moderate condition Swamp Sclerophyll Forest.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Within the locality of the proposal area (10 km), 1,195 ha of Swamp Sclerophyll Forest has been previously recorded by broad-scale mapping projects (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2000). The proposed action would require the removal of 0.11 ha of moderate condition Swamp Sclerophyll Forest which represents approximately <0.01% of that mapped within locality.

Swamp Sclerophyll Forest occurred as two linear patches parallel to Nelson Bay Road, west of the dual lane section of the proposal area. Each patch was small in extent and subject to existing edge effects associated with Nelson Bay Road. Although the Swamp Sclerophyll Forest recorded had a structurally intact canopy the midstorey and ground stratum contained low species diversity and cover.

Due to the context of the two patches to be impacted and the overall small proportion of Swamp Sclerophyll Forest to be impacted within the locality, it is considered unlikely that the proposed action will have an adverse effect on the extent of Swamp Sclerophyll Forest or substantially and adversely modify the composition of Swamp Sclerophyll Forest such that its local occurrence is likely to be placed at risk of extinction.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**

The proposed activity will impact 0.11 ha of moderate condition Swamp Sclerophyll Forest, which represents less than 0.1% of Swamp Sclerophyll Forest mapped within the locality.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The extent of habitat to be removed represents a very small proportion of potential habitat available within the surrounding landscape (<0.1%). Within the proposal area Swamp Sclerophyll Forest occurred as two linear patches along both sides of Nelson Bay Road, west of the dual lane section of the proposal area. These patches were small in extent and subject to existing fragmentation and isolation impacts associated with Nelson Bay Road. The action proposed will increase the width of the existing road corridor however will not create new areas of fragmentation.

Owing to the relatively small extent of potential habitat impacts and that impacts being restricted to vegetation with the existing road corridor; areas of habitat are considered unlikely to become significantly fragmented or isolated from other areas of habitat because of the proposed activity.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of habitat that may be impacted represents a small proportion of extent to Swamp Sclerophyll Forest within the surrounding landscape (<0.1 ha). Owing to the relatively small extent of potential habitat impacts and that impacts being restricted to vegetation with the existing road corridor, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of this ecological community in the locality.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to Swamp Sclerophyll Forest, the proposal has potential to directly contribute to the following key threatening process listed under the BC Act:

- Clearing of native vegetation
- Loss of hollow-bearing trees
- Removal of dead wood and trees.

The proposed action also has potential to indirectly contribute to the following key threatening process:

- Infection of native plants by *phytophthora cinnamomic*
- Introduction and establishment of exotic rust fungi of the order pucciniales pathogenic on plants of the family Myrtaceae
- Invasion of native plant communities by exotic perennial grasses
- Invasion, establishment and spread of lantana (*Lantana camara*).

The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (< 0.1 ha) in terms of the available habitat for this ecological community within the surrounding landscape.

Mitigation measures outlined in Section 5.2 of the main report have been recommended to decrease the impact of the key threatening process the proposed action may indirectly

contribute to. As such, the overall contribution of the proposed action to key threatening processes listed above is likely to be minimal.

Conclusion

The extent of habitat to be removed represents a very small proportion of potential habitat available within the surrounding landscape (<0.1%). The potential loss of 0.11 ha of habitat for Swamp Sclerophyll Forest is considered unlikely to be significant to the maintenance of this ecological community locally, and therefore the proposed works are considered unlikely to have a significant impact upon this Swamp Sclerophyll Forest, which might lead to its extinction locally.

***Diuris arenaria* (Sand Doubletail)**

Status

Diuris arenaria (Sand Doubletail) is listed as an Endangered species under the BC Act. This species is not a listed threatened entity under the EPBC Act.

Specific impacts

The proposed action will directly impact upon 18 *Diuris arenaria* individuals and 2.07 ha of suitable habitat for the species which includes good and regrowth patches of PCT 1646. These individuals form part of a substantial local population which also occurs in:

- Worimi Conservation Lands (including Wirimi National Park) located to the south and south west of the study area. This area forms part of the Worimi Saving Our Species management site for the species. During surveys completed for this proposal a total of 90 individuals were recorded from within the Worimi National Park and the transmission easement adjoining the south of the proposal area. The individuals recorded within the study area occur on the periphery of the local population which extends to the south west.
- Biodiversity offset site located immediately north of Stockton Sand Dunes, adjoining the eastern border of the Worimi Conservation Lands where there is a known population of 72 individuals (Umwelt, 2016).

Although the habitat within which individuals were recorded was of good and regrowth condition it occurred immediately adjacent Nelson Bay Road. As such, this habitat is exposed to existing factors such as edge effects, genetic barriers and fragmentation impacts associated with the Nelson Bay carriageway. Habitats within the adjoining areas where the local population is also known to occur, is located within lands protected in perpetuity under conservation agreements and is likely to be of higher quality than that being impacted by the proposal.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Diuris arenaria is a small terrestrial ground orchid which flowers between August and September. During its flowering period the species flowers are pollinated by insects. As the flower reaches the end of its life the seeds are released. The germination of seed is heavily dependent upon a symbiotic relationship with fungi and bacteria which erode the seed coat (Espallargas, 2005).

The impacts of the proposed action will be limited to directly impacting 18 *Diuris arenaria* individuals and 2.07 ha of suitable habitat for the species. Although the habitat within which individuals were recorded was of good and regrowth condition it occurred immediately adjacent Nelson Bay Road. As such, this habitat is exposed to existing factors such as edge effects, genetic barriers and fragmentation impacts associated with the Nelson Bay carriageway. Habitats within the adjoining areas where the local population is also known to occur, is located within lands protected in perpetuity under conservation agreements and is likely to be of higher quality than that being impacted by the proposal.

The predicted level of isolation from the proposal is not likely to be enough to prevent the dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. Given the extent of the viable population in higher quality vegetation immediately adjoining the proposal area and that this higher quality habitat is protected in perpetuity (i.e. within Worimi National Park and biodiversity offset lands) the proposed action is considered unlikely to significantly affect processes such as pollination, seed dispersal and recruitment of the species which could affect the breeding of any population of these species in the study area such that it would place the species at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**

The proposed action would require the removal of 2.07 ha of PCT 1646 which provides suitable habitat for the species. A total of 18 *Diuris arenaria* individuals will be impacted.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The extent of suitable habitat within the proposal area is already subjected to fragmentation impacts associated with the existing Nelson Bay Road carriageway, transmission easements, walking tracks and residential property which occurs in the surrounding landscape. As all works proposed will occur within the Nelson Bay road corridor, no areas of habitat are likely to become fragmented or isolated as a result of the proposed action. Minor increases to existing fragmentation are likely.

Owing to the context of the potential habitat for *Diuris arenaria* to be impacted, the proposed action is considered unlikely to result in areas of habitat becoming fragmented or isolated from other areas of habitat.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

Given the context of the habitat to be removed (i.e. habitat restricted to habitat within the road corridor) which is subject to existing edge effects, fragmentation and barriers which occur within the surrounding landscape and the extent of higher quality habitat in conservation reserves adjoining the proposal area, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of this ecological community in the locality.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the *Diuris arenaria*, the proposed action is considered likely to directly contribute to one key threatening processes listed under the BC Act; being clearing of native vegetation. The proposed action also has potential to indirectly contribute to key threatening processes associated with introduction, invasion and spread of weeds and pests. Mitigation measures outlined in Section 5.2 of the main report have been recommended to minimise these indirect impacts.

As such, the overall contribution of the proposed action to key threatening processes listed above is likely to be minimal.

Conclusion

The proposal will directly impact upon 18 *Diuris arenaria* individuals and 2.07 ha of suitable habitat for the species. These individuals form part of a substantial local population which also occurs in:

- Worimi Conservation Lands (including Wirimi National Park) located to the south and south west of the study area. This area forms part of the Worimi Saving Our Species management site for the species. During surveys completed for this proposal a 90 individuals were recorded from within the Worimi National Park and the transmission easement adjoining the south of the proposal area. The individuals recorded within the study area occur on the periphery of the local population which extends at least 2 km to the south west.
- Biodiversity offset site located immediately north of Stockton Sand Dunes, adjoining the eastern border of the Worimi Conservation Lands where there is a known population of 72 individuals (Umwelt, 2016).

The 18 individuals to be removed by the proposed action are therefore likely to only constitute a small proportion of the local population.

Furthermore, habitat within the proposal area occurs immediately adjacent the highway and subjected to existing edge effects and fragmentation impacts associated with the operation and maintenance of the Nelson Bay carriageway. Protected habitats which adjoin the proposal area are of higher quality and support many individuals which form part of the viable local population.

Due to the above, the proposed action is not considered likely to have a significant impact upon this species, which might lead to its extinction locally.

Threatened forest owls

Status

Powerful Owl (*Ninox strenua*) listed as Vulnerable under the BC Act.

Masked Owl (*Tyto novaehollandiae novaehollandiae*) listed as Vulnerable under the BC Act.

Specific impact

Fauna habitat assessments conducted assessed the likelihood of Powerful Owl and Masked Owl occurring in the study area as moderate. The Proposal will result in the removal of 16 hollow-bearing trees and 2.27 ha of potential habitat for these species which is likely utilised on an intermittent basis as part of a far larger home range of local individuals. No suitable nesting trees in active use were recorded during targeted surveys. Hollow-bearing trees that are of sufficient size and density to provide suitable breeding habitat for the large forest owls were not recorded. As such, the proposed action is likely to be limited to impacts on foraging habitat for this species, and breeding habitat is not considered further.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Approximately 2.27 ha of potential foraging habitat would be affected by the proposed action. Although, the proposal area has habitat attributes which may support a moderate density of prey species, the ability of the proposal area to support these species is not considered likely to be reduced to the extent that a significant adverse effect might be brought to bear upon local Powerful Owl and Masked Owl populations.

It is likely that these two threatened owl species intermittently utilise the proposal area whilst foraging within the greater locality, as such, they would not be reliant on the habitat within the proposal area for local populations to persist.

Although the proposed action will cause a small incremental loss of foraging habitat for these species, it is unlikely that the proposed action will significantly reduce the viability of local populations as breeding habitat was not recorded.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The Proposal will remove approximately 2.27 ha of potential large forest owl foraging habitat, which is considered unlikely to be of significant importance in relation to the large home ranges these species would maintain.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The Proposal will remove approximately 2.27 ha of potential large forest owl foraging habitat, which is considered unlikely to be of significant importance in relation to the large home ranges these species would maintain.

Given the high mobility of these species (some using home ranges up to 1500 ha) and that there is an abundance of similar and higher quality habitat occurring widely in the locality, it is considered unlikely that habitat would become further isolated or fragmented significantly beyond that currently existing in the proposal area and wider locality.

Habitats associated with the proposal area are currently impacted by some fragmentation, due to associated power easements both north and south of Nelson Bay Road. The minimal fragmentation of habitats associated with the proposal area is considered unlikely to significantly diminish access for forest owls, although it is likely to reduce accessibility for their prey species.

It is considered unlikely that the proposed action would significantly further exacerbate existing fragmentation to the point that local populations of either prey species or threatened owls would be significantly affected.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

No breeding habitat will be impacted by the proposed action.

The extent of potential foraging habitat to be removed represents a relatively small proportion of foraging habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat removal (2.27 ha) and the high mobility of these species, the proposed action is unlikely to significantly affect their long-term survival.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Powerful Owl and Masked Owl, the Proposal is consistent with three key threatening processes:

- Clearing of native vegetation (2.27 ha)
- Removal of hollow-bearing trees (16)
- Removal of dead wood and dead trees.

The hollow-bearing trees recorded were considered unlikely to be utilised by Large Forest Owl for breeding, due to limitations in hollow size and densities, and the proximity to the existing road. The extent of native vegetation clearing and foraging habitat removal associated with the proposed action is considered relatively small in terms of the available habitat for large forest owl species within the surrounding landscape.

Conclusion

The home ranges of local Powerful Owl and Masked Owl individuals is considered likely to encompass the proposal area. Habitat within the proposal area is limited to foraging habitat, as breeding opportunities are compromised by limitations in hollow size and numbers, as well as the proximity to the existing roadway. Furthermore, although the proposal area does provide some foraging habitat, the preferred density of hollows of varying size is low reducing the likely availability of prey species. Both species may intermittently utilise the proposal area and its habitats whilst foraging within the greater locality. The impacts to potential habitat for large forest owls will not be significantly impacted by the proposed action and therefore is unlikely to have a significant impact upon these species.

Threatened woodland birds

Status

Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) listed as Vulnerable under the BC Act.

Varied Sittella (*Daphoenositta chrysoptera*) listed as Vulnerable under the BC Act.

Scarlet Robin (*Petroica boodang*) listed as Vulnerable under the BC Act.

Gang-gang Cockatoo (*Callocephalon fimbriatum*) listed as Vulnerable under the BC Act.

Specific Impacts

Fauna habitat assessments conducted, assessed the likelihood of the above species occurring in the study area as moderate or higher. The Proposal will result in the removal of 2.27 ha of potential habitat for these species, that is likely to be utilised on an intermittent basis as part of a far larger home range of local individuals.

Scarlet Robin have been assessed due to its presence in data base searches, as a matter of due diligence, however, in reference to their known distribution locally their chance of occurrence in the vicinity of the study area is unlikely.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Approximately 2.27 ha of potential habitat would be affected by the proposed action. Although, habitat within the proposal area represents potential foraging and breeding habitat attributes for these species, the ability of the proposal area to support such species is not considered likely to be diminished to the extent that a significant adverse effect might be brought to bear upon local populations.

Although the proposed action will cause a small incremental loss of foraging habitat for threatened woodland birds it is unlikely that the proposed action will significantly reduce the viability of populations occurring locally.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposed action will remove approximately 2.27 ha of potential habitat, including habitat suitable for foraging and breeding, although this area of vegetation is considered unlikely to be of significant importance for such species in relation to the abundance of similar and higher quality habitats for these species in the greater locality.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

Given the high mobility these species as well as the fact that similar and higher quality habitat is easily accessible to them in the locality, it is not considered likely that habitat would become

significantly more isolated or fragmented beyond that currently existing in the proposal area and wider locality.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat to be removed represents a relatively small proportion of foraging habitat available within the surrounding landscape. Owing to the relatively small proportion of potential habitat removal and the mobility of these species, the proposed action is unlikely to significantly affect their long-term survival.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the threatened woodland birds, the Proposal is consistent with three key threatening processes:

- Clearing of native vegetation
- Removal of hollow-bearing trees
- Removal of dead wood and dead trees.

The extent of native vegetation clearing and habitat removal associated with the proposal area is considered relatively small in terms of the available habitat for these species within the surrounding landscape. It is unlikely that the proposed action would significantly increase these key threatening processes to the point that local populations are significantly impacted.

Conclusion

Threatened woodland birds are considered to likely utilise habitats within the proposal area. Whilst potential habitat exists in the proposal area, there is an abundance of similar and higher quality habitat in the wider locality. The impacts are not of a magnitude that would significantly diminish the integrity of habitat opportunities in the proposal area's vicinity. Therefore, the proposed action will represent an incremental loss of available local habitat, which is unlikely to have a significant impact upon these species.

Threatened birds of prey

Status

Little Eagle (*Hieraaetus morphnoides*) listed as Vulnerable under the BC Act.

Square-tailed Kite (*Lophoictinia isura*) listed as Vulnerable under the BC Act.

Spotted Harrier (*Circus assimilis*) listed as Vulnerable under the BC Act.

Specific Impacts

The raptors mentioned above were not recorded during surveys. However, approximately 2.27 ha of potential habitat was identified in the proposal area and will be affected by the proposed action. It is likely that the habitat within the proposal area would only be intermittently utilised by these species whilst foraging within the greater locality.

Although the Spotted Harrier is known to occur in the Lower Hunter Region, it is an open grassland frequenting bird for which there is no suitable habitat within the study area. It has been assessed due to its presence in data base searches as a matter of due diligence, however, in reference to its known habitat preferences its chance of occurrence in the vicinity of the study area is unlikely.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Approximately 2.27 ha of potential habitat is likely to be affected by the Proposal. Due to the mobility and large home range of these species, and the linear footprint of this proposal, the proposed action is unlikely to affect their life cycle or ability to forage and breed. Local populations of threatened raptors are unlikely to be restricted to habitat within the proposal area, as similar and higher quality habitat occurs widely in the locality. The impact of 2.27 ha of potential habitat would represent <1% of habitat in the greater locality and the study area would only represent a small part of the home ranges of locally occurring individuals.

Although the proposed action will result in the loss of potential foraging habitat, such habitat would only be a small component of locally occurring resources accessible to these species, and it is unlikely to constitute important habitat that would place threatened birds of prey at a greater risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal is likely to affect approximately 2.27 ha of potential foraging and breeding habitat for these species.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

Habitat connectivity is unlikely to be affected by the proposed action due to the mobility of birds of prey. Vegetation removal will largely be limited to a linear corridor along Nelson Bay Rd. As the proposal area is largely confined to an area which is already impacted by edge effects, the proposed action would not adversely fragment or isolate any previously undisturbed patches of habitat. Furthermore, given these species' high mobility and that habitat of similar and higher quality occurs widely in the locality, it is considered unlikely that habitat would become further isolated or significantly fragmented beyond that currently existing in the proposal area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

A total of 2.27 ha of potential foraging habitat for threatened raptor species will be affected by the proposed action. An abundance of similar and higher quality foraging opportunities will be retained both within the study area and wider locality. Owing to the relatively small proportion of potential foraging habitat impacted and the vast abundance of habitat in the locality, the proposed action is unlikely to significantly affect the long-term survival of threatened bird of prey species, although the loss of native vegetation habitat must be considered to be an incremental loss of local habitat.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the threatened raptors, the Proposal is consistent with one key threatening process being clearing of native vegetation. The extent of native vegetation clearing and habitat removal associated with the proposal area is considered relatively small in terms of the available habitat for these species within the surrounding landscape.

Conclusion

Approximately 2.27 ha of potential habitat will be impacted by the proposed action. Owing to the abundance of land in the locality and the existing disturbances of this habitat (fragmentation) the loss of this foraging habitat is unlikely to adversely affect these species. Although the loss of habitat will represent an incremental loss of potentially suitable habitat, the proposed action is unlikely to have a significant impact upon these species and their local populations.

Threatened blossom nomads

Status

The Grey-headed Flying-fox (*Pteropus poliocephalus*) listed as Vulnerable under both the BC Act and EPBC Act.

Little Lorikeet (*Glossopsitta pusilla*) listed as Vulnerable under the BC Act.

Specific Impacts

During field surveys the Little Lorikeet was recorded within the study area. The Grey-headed Flying-fox was not recorded during the field surveys, however, the species is known to occur within the locality and potential foraging habitat occurs in the study area. The proposed action will affect approximately 2.27 ha of potential foraging habitat for these opportunistic blossom nomads including native vegetation in good condition. Potential foraging habitat was observed in the form of sclerophyll woodland. A total of 16 hollow-bearing trees will be impacted by the proposed action, this may provide breeding habitat for the Little Lorikeet. Breeding habitat (camps) was not recorded within the proposed area for the Grey-headed Flying-fox.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Approximately 2.27 ha of potential habitat is likely to be impacted by the proposed action. The potential habitat to be impacted includes foraging habitat, the study area would only be a small component of locally occurring resources that would be accessible to these species. Thus, the proposed action is not considered likely to impact blossom nomads such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

The Little Lorikeet could possibly utilise the proposal area for breeding, a total of 16 hollow-bearing trees will be impacted by the proposed action. The Grey-headed Flying-fox usually setup roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. No roost camps are located within the proposal area or study area.

The proposed action will remove vegetation along a linear corridor adjacent to Nelson Bay Rd. Considering the mobile nature of these species, this action is unlikely to isolate the species habitat significantly. Given this, it is considered unlikely that the proposed action will have an adverse effect on the life cycle of this species, such that a viable local populations is to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The Proposal will remove approximately 2.27 ha of vegetation that provides potential foraging habitat for the Little Lorikeet and Grey-headed Flying-fox. Hollows potentially suitable for Little Lorikeet breeding purposes were recorded within the proposal area amongst sixteen (16)

hollows recorded in the study area. No breeding camps for the Grey-headed Flying-fox were recorded.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

Habitat connectivity is unlikely to be significantly reduced by the proposed action more than existed in the study area during the time of field assessment. Habitat impacts by the proposed action consist of vegetation removal, largely limited to a linear disturbance corridor. The proposed action would not significantly exacerbate fragmentation to a greater extent than currently exists due to clearing undertaken for the provision of roads, power easements and housing. Furthermore, given that blossom nomad species are highly mobile, the proposed action would not present a significant barrier to these species.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat to be removed represents a small proportion of habitat available within the surrounding landscape. Owing to the relatively small proportion of habitat removal and the mobility of the species, the proposed action is unlikely to affect the long-term survival of either of these species.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the blossom nomads, the proposed action is consistent with two key threatening process under the BC Act, being clearing of native vegetation and removal of hollow bearing trees.

In regard to Little Lorikeet the proposed action is also consistent with an additional key threatening process being, removal of hollow bearing trees. Due to the small extent of impact and the intermittently utilisation of habitat resources within the proposal area, it is unlikely that the removal of hollow-bearing trees would exacerbate this key threatening process to an extent in which the local population would be at risk or be significantly impacted.

The extent of native vegetation clearing and habitat removal associated with the proposed action is considered very small in terms of the available habitat for blossom nomad species within the surrounding landscape.

Conclusion

The extent of native vegetation clearing (2.27 ha), and habitat removal (16 hollow-bearing trees) associated with the proposed action is proportionally small in terms of the available habitat for this species within the surrounding landscape. The potential loss of foraging habitat for the blossom nomads is not considered to be important in regard to the maintenance of this species locally, and therefore the proposed action are not likely to have a significant impact upon these species, which might lead to their extinction locally.

EPBC Act Significance assessment – Grey-headed Flying-fox

The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013a). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Grey-headed Flying-foxes occur across a range of wooded habitats where their favoured food, eucalypt blossom occurs. They set up roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

The proposal area and study area does not contain suitable habitat for roosting camps and no significant roosting camps occur within its close vicinity. Therefore, a population of Grey-headed Flying-foxes in the proposal area is not considered to be important, as no roost sites would be affected by the proposed action.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

Not applicable. Grey-headed Flying-foxes occurring in the in the proposal area would not form part of an important population.

Reduce the area of occupancy of an important population

Not applicable. Grey-headed Flying-foxes occurring in the in the proposal area would not form part of an important population.

Fragment an existing important population into two or more populations

Not applicable. Grey-headed Flying-foxes occurring in the in the proposal area would not form part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed action will remove 2.27 ha of potential habitat, which represents potential foraging habitat for this species. As this species is highly mobile, with individuals foraging up to 50 km from roost sites, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, this would not meet the above criteria.

Disrupt the breeding cycle of an important population

Not applicable. Grey-headed Flying-fox occurring in the proposal area is not part of an important population.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Not applicable. Grey-headed Flying-foxes occurring in the in the proposal area would not form part of an important population.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the proposed action.

Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

Interfere substantially with the recovery of the species

Due to the small proportion of foraging habitat likely to be affect by the proposed action and as no roost camps are located in the vicinity of the proposal area, the proposed action is not likely to interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing (2.27 ha) and habitat removal associated with the proposed action proportionally small in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Grey-headed Flying-fox is considered to be an incremental loss of suitable habitat locally, the proposed action is not likely to have a significant impact upon available resources for flying-foxes in the vicinity of the proposal area or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the Grey-headed Flying-fox.

Threatened ground-dwelling mammals

Status

Spotted-Tailed Quoll (*Dasyurus maculatus maculatus*) listed as Vulnerable under BC Act and Endangered under the EPBC Act

New Holland Mouse (*Pseudomys novaehollandiae*) listed as Vulnerable under the EPBC Act

Specific Impacts

The Spotted-Tailed Quoll and New Holland Mouse were not recorded during field surveys. Approximately 2.27 ha of potential habitat for this species will be impacted by the proposed action.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Spotted-Tailed Quoll was not recorded during field investigations, however individuals have been recorded as occurring within similar habitats to those where the species has been recorded in the wider region. The Spotted-Tailed Quoll is carnivorous and is forages on small to medium sized animals, including invertebrates, reptiles, birds, mammals and carrion.

The proposed action will affect approximately 2.27 ha of potential habitat. This habitat occurs in linear strips parallel to Nelson Bay Road and is subject to existing edge effects and fragmentation.

An abundance of similar or higher quality foraging opportunities occur in the wider locality of the proposal area. Impact to 2.27 ha is a small proportion of available habitat within locality as such the proposed action is unlikely to significantly diminish the functional integrity of Spotted-Tailed Quoll habitat within locality.

The loss of potential habitat for the Spotted-Tailed Quoll is considered unlikely to have a significant adverse effect on its life cycle such that a viable local population will be placed at a greater risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposed action will impact approximately 2.27 ha of potential habitat for Spotted-Tailed Quolls.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The potential habitat for the Spotted-Tailed Quoll recorded exists as linear strips parallel to Nelson Bay Road and is subject to existing edge effects and fragmentation. The removal of this habitat is unlikely to significantly exacerbate existing levels of fragmentation.

Despite the impact of 2.27 ha, associated remnant vegetation will be retained in the study area (approximately 17 ha) that will continue to provide linkages to surrounding habitat. It is unlikely that habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, although existing fragmentation will be incrementally increased.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposed action will impact approximately 2.27 ha of potential habitat for Spotted-Tailed Quoll. Although the proposed action will add incrementally to habitat loss locally it is considered unlikely that onsite impacts will significantly impact populations of Spotted-Tailed Quoll that would significantly reduce the long-term viability of local populations.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposed action is consistent with two key threatening processes under the BC Act:

- Clearing of native vegetation
- Removal of dead wood and dead trees.

The extent of native vegetation clearing and habitat removal associated with the proposed action is considered relatively small in terms of the available habitat for these species within the surrounding landscape, although it is an incremental loss of suitable habitat locally.

Conclusion

The proposed action will affect approximately 2.27 ha of potential habitat for Spotted-Tailed Quoll. An abundance of similar or higher quality habitat occurs in the wider locality. Therefore, the loss of this potential habitat is considered unlikely to have a significant adverse effect on the life cycle of this species such that a viable local population will be placed at a greater risk of extinction.

EPBC Act Significance assessment – Spotted-tailed Quoll and New Holland Mouse

The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013a). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Neither the Spotted-tailed Quoll or New Holland Mouse was recorded during field surveys, the species has been recorded in the locality and potential habitat was recorded in the proposal area.

Locally, the proposal area does not contain habitat that is likely to be inhabited by quolls or the New Holland Mouse on a permanent basis. This is partly due to its proximity to Nelson Bay Road and linear nature. Although this area may intermittently be utilised by the species whilst they forage in the greater locality, it is unlikely that the proposal area would sustain populations in the absence of larger areas of higher quality and unfragmented habitat, such as the extensive forests associated with the national parks to the west and east of the proposal area.

While not likely to be necessary for maintaining source populations, the habitat does represent movement corridors, which may play a part in the maintaining of genetic diversity from source populations.

The location of the proposal area is not at or near the limit of the species' range. Therefore, the proposal area cannot be considered to support quolls that are an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

Not applicable. Spotted-Tailed Quolls or New Holland Mice in the proposal area would not form part of an important population.

Reduce the area of occupancy of an important population

Not applicable. Spotted-Tailed Quolls or New Holland Mice in the proposal area would not form part of an important population.

Fragment an existing important population into two or more populations

Not applicable. Spotted-Tailed Quolls or New Holland Mice in the proposal area would not form part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The Proposal would remove approximately 2.27 ha of suitable foraging habitat for these species. Whilst the proposal area provides potential foraging habitat, there is large areas of

suitable foraging resources that are accessible in the adjacent remnant vegetation and are higher in quality (i.e. not adjacent to busy roads). Therefore, this would not meet the above criteria.

Disrupt the breeding cycle of an important population

Not applicable. Spotted-Tailed Quolls or New Holland Mice in the proposal area would not form part of an important population.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Not applicable. Spotted-Tailed Quolls or New Holland Mice in the proposal area would not form part of an important population.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Spotted-Tailed Quoll or New Holland Mouse would become further established as a result of the proposed action.

Introduce disease that may cause the species to decline

The proposed action is unlikely to introduce a disease that may cause the Spotted-tailed Quoll or New Holland Mouse to decline.

Interfere substantially with the recovery of the species

Due to the potential foraging habitat likely to be affected by the proposed action (2.27 ha) and the abundance of higher quality habitat in the adjacent remnant vegetation, the proposed action is not likely to interfere with the recovery of these species.

Conclusion

Although the Spotted-Tailed Quoll and New Holland Mouse were not recorded in the proposal area during field investigations, the proposal area provides potential habitat for these species. The proposed action would affect approximately 2.27 ha of potential habitat. The proposal area is situated within a disturbed environment and onsite habitat is continuous with large areas of higher quality habitat found within adjacent remnant vegetation. It is likely that the proposed action would not act as important habitat for the species due to its location, conditions and limited extent. Therefore, it is unlikely that the proposed action will have a significant impact upon these species.

Threatened arboreal mammals

Status

Squirrel Glider (*Petaurus norfolcensis*) listed as Vulnerable under BC Act.

Brush-tailed Phascogale (*Phascogale tapoatafa*) listed as Vulnerable under the BC Act.

Koala (*Phascolarctos cinereus*) listed as Vulnerable under the both BC Act and EPBC Act.

Specific Impacts

The Squirrel Glider, Brush-tailed Phascogale and Koala were not recorded in the during field surveys. Approximately 2.27 ha of potential habitat for these species will be impacted by the proposed action.

In regards to the Koala, no core Koala habitat will be impacted by the proposed action, all habitat within and surrounding the proposal area is mapped within the Port Stephens Koala Habitat Planning Map as supplementary habitat. All native vegetation associated within the site is considered functional as dispersal habitat for the Koala (2.27 ha). Detailed vegetation surveys within the proposal area identified 0.11 ha of swamp sclerophyll forest containing a known feed tree, Swamp Mahogany (*Eucalyptus robusta*), which represents potential foraging habitat for the Koala. The remaining 2.16 ha is dominated by Blackbutt (*Eucalyptus pilularis*), which represents supplementary habitat for Koalas.

In regards to the Squirrel Glider and Brush-tailed Phascogale, approximately sixteen (16) hollow bearing trees will be impacted by the proposed action, which represents potential breeding and nesting opportunities for these species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The proposal area occurs along the margins of the existing Nelson Bay Road corridor, with a relatively small amount (2.27 ha) of vegetation likely to be impacted. The habitat within the proposal area is linear in nature as the proposed action is essentially a road-widening project. Existing edge effects (such as noise, dust, light pollution) and habitat fragmentation are existing disturbances reducing the functionality of the habitat.

An abundance of higher quality habitat occurs in the adjacent vegetation including National Park/Reserves that is suitable for Squirrel Glider, Brush-tailed Phascogale and Koala habitation.

The impact of 2.27 ha of potential habitat would represent a small proportion of habitat available to these species.

In addition, the removal of sixteen (16) hollow-bearing trees for Squirrel Glider and Brush-tailed Phascogale is likely to be negligible in comparison to the accessible habitat resources within the locality. Consequently, the proposed action is unlikely to have an adverse effect on the life cycle of the Squirrel Glider, Brush-tailed Phascogale or Koala such that a viable local population of these species are likely to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The Proposal will impact approximately 2.27 ha of potential habitat for Squirrel Glider, Brush-tailed Phascogale and Koala, including sixteen (16) hollow-bearing trees.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The habitat affected by the proposal is limited to the immediate proximity of the existing road corridor, it will however represent a small increase in width between roadside habitat patches. Approximately 2.27 ha of Squirrel Glider, Brush-tailed Phascogale and Koala foraging habitat is likely to be affected in the proposal area and vegetation removal will be limited to narrow strips of habitat along the road verge.

Although the proposed action will increase the separation between road side vegetation by a small amount it is unlikely to significantly increasing fragmentation significantly beyond what already exists. Therefore, it is considered unlikely that potential Squirrel Glider, Brush-tailed Phascogale and Koala habitat would become significantly isolated or fragmented from other areas of habitat as a result of the proposed action.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The amount of foraging habitat proposed for removal occurs as a narrow corridor of vegetation along Nelson Bay Road. The habitat within the proposal area is linear in nature as the proposed action is essentially a road-widening project. Existing edge effects (such as noise, dust, light pollution) and habitat fragmentation are existing disturbances relevant to the habitat.

The habitat proposed for removal is small in proportion to the amount of continuous high quality habitat east of the study area in areas associated with the National Park and conservation areas.

In regard to Koala, none of the habitat to be impacted is mapped as 'preferred' Koala habitat in the Port Stephens Koala Habitat Planning Map, but as 'supplementary' habitat. It is likely that the habitat within the proposal area does not provide core habitat for the species nor would it be relied upon by the local population for long-term survival.

In light of the status and condition of the habitat to be removed, it is unlikely that the proposed action would significantly impact important habitat that is important to the long-term survival of local populations of threatened arboreal mammals.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to arboreal mammals, the proposed action is consistent with three key threatening processes under the BC Act:

- Clearing of native vegetation
- Removal of hollow-bearing trees (16)
- Removal of dead wood and dead trees.

The extent of native vegetation clearing and habitat removal associated with the proposed action is considered relatively small in terms of the available habitat for these species within the surrounding landscape, although it is an incremental loss of suitable habitat locally.

Removal of hollow-bearing trees will be minor only, with sixteen (16) hollow-bearing tree likely to be removed. This impact would represent a small proportion of hollow-bearing trees in

higher quality habitat within the locality (contained in national park estates and conservation areas). Where possible hollow-bearing trees will be retained.

Conclusion

The proposal will impact approximately 2.27 ha of potential habitat for Squirrel Glider, Brush-tailed Phascogale and Koala, including sixteen (16) hollow-bearing trees. The habitat to be impacted occurs as a narrow corridor of marginal vegetation along Nelson Bay Road. The habitat that will be impacted would constitute a small extent of available potential habitat within the locality and would likely be utilised intermittently within each species home range. It is therefore unlikely that the proposed action would lead to a significant impact on these species.

EPBC Act Significance assessment – Koala

The Koala listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013a). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

The proposal area falls within the Port Stephens LGA in the NSW North Coast IBRA region. Within this area the Port Stephens Koala population is classified as an important population. The Port Stephens CKPoM has divided up the region into Koala management units, of which, the proposal area occurs within the Fullerton/Stockton Bight Management Unit. Although not recorded within the proposal area, the species has been recorded in the locality and the proposal area is designated as 'supplementary' habitat within the Port Stephens Koala Habitat Planning Map.

The Port Stephens population acts as a key source for breeding and dispersal and necessary for maintaining genetic diversity. Any individuals that may potentially occur within the proposal area would be considered part of an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

The impact of approximately 2.27 ha of 'supplementary' Koala habitat would represent a small proportion (0.07%) of potential 'supplementary' habitat within the locality of the proposed action. Approximately 3941 ha of mapped 'supplementary' Koala habitat occurs within the Fullerton/Stockton Bight Management. Majority of this habitat would be accessible to individuals, with a large continuous extent of high-quality habitat occurring to the east of the proposal area within National Park. The vegetation to be impacted by the proposed action occurs on the margins of a larger more continuous extent of potential koala habitat to the east and does not include any mapped or recorded 'core koala habitat' or "preferred" habitat. It is likely that vegetation within the proposal area would be very intermittently utilised by individuals during their movements within their home range. It is unlikely that the removal of 2.27 ha of Koala habitat (representing <1% of habitat) would significantly lead to a long-term decrease in the size of this important population.

Reduce the area of occupancy of an important population

The impact of approximately 2.27 ha of Koala habitat would represent <1% of potential habitat within the locality of the proposed action. The vegetation to be impacted by the proposed action occurs on the margins of a larger more continuous extent of potential koala habitat to the east and does not include any mapped or recorded 'core koala habitat'. It is unlikely that the impact of 2.27 ha of Koala habitat would significantly reduce the area of occupancy for the local population.

Fragment an existing important population into two or more populations

Habitat connectivity would be affected by the proposed action by increasing the current width of the existing Nelson Bay Road by a small extent, however, the proposed action will not significantly exacerbate fragmentation that which already exists within the locality due to existing roads, easements and urban development.

Koala movement corridors have been identified previously within the Port Stephens LGA (Biolink Ecological Consultants, 2018, Land Use Planning Sustainable Planning Group, 2007). Research by Biolink (2018) have identified that movements of Koala's generally occur between patches of 'preferred' Koala habitat. Majority of Koala movements have been identified to occur to the west of the study area from Tilligerry - Salt Ash to the high-density population hub of Anna Bay. Koala's were found to use these 'preferred' habitat patches to the

west of the proposal area as 'stepping-stones' to move generally in a north-south direction (Biolink 2018).

Due to the proposal area containing 'supplementary' habitat, and a paucity of Koala records proximate to the proposed action, it is unlikely that individuals regularly use the proposal area as a corridor to move throughout the greater locality. It is unlikely that the proposal area acts as an important koala corridor for the local population. It is unlikely that the removal of 2.27 ha of habitat on the margins of the existing roadway would fragment the existing population into two or more populations.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The Proposal would remove approximately 2.27 ha of 'supplementary' Koala habitat for this species. Whilst the proposal area provides potential foraging habitat, there are large areas of habitat of similar or greater quality within adjacent remnant vegetation. Therefore, this would not meet the above criteria.

The EPBC Act Referral Guidelines for Koalas (Department of the Environment, 2014) states that impact areas that score >5 contain habitat critical to the survival of the Koala. Based on proposal area vegetation, past occurrences, connectivity and threats, it was assessed that the proposal area does not contain critical habitat for Koala. The proposal area does not contain critical habitat due to:

- Evidence of one or more Koala's within 2 km of the edge of the impact area within the last 5 years (1)
- Has forest or woodland with 2 or more known koala food tree species (Swamp Mahogany - *Eucalyptus robusta* recorded in small numbers and Blackbutt - *Eucalyptus pilularis* throughout the proposal area) (2)
- Habitat connectivity and available habitat area is part of a contiguous landscape >500 ha (2)
- Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present (1)
- Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1 (1)

Under the EPBC Act Referral Guidelines for Koalas a score of 7 was obtained and as such the vegetation and habitat within the proposal area would be considered as habitat critical to the survival of the Koala.

Nevertheless, the distribution of Koala records in the Bionet Atlas, show that the nearest 'preferred' Koala habitat, as mapped in the Port Stephens Koala Habitat Planning Map, exhibits no Koala records within the last 30 years. The key driver of a lack of Koala records in significant patches of Swamp Mahogany on the flats associated with the western extremity of the proposal area is the separation of these habitat patches from other patches of 'preferred' Koala habitat by a dominance of 'supplementary' habitat, which is dominated by tree species that are not strongly associated with 'preferred' Koala habitation. Studies undertaken to ascertain local Koala movements in the Port Stephens LGA suggest that the location of the proposal area is not currently a significant impediment to Koala movements. Koala movement corridors have been identified previously within the Port Stephens LGA (Biolink Ecological

Consultants, 2018, Land Use Planning Sustainable Planning Group, 2007). Research by Biolink (2018) have identified that movements of Koala's generally occur between patches of 'preferred' Koala habitat. The majority of Koala movements have been identified to occur to the west of the study area from Tilligerry - Salt Ash to the high-density population hub of Anna Bay. Koala's were found to use these 'preferred' habitat patches to the west of the proposal area as 'stepping-stones' to move generally in a north-south direction (Biolink Ecological Consultants, 2018). The north-south direction between Tilligerry/Salt Ash and Anna Bay should perhaps be more functionally described as a west-east movement, if the significant movement impediment of the Tilligerry Creek estuary is taken into account. The paucity of recent records through this area, which is dominated by large areas of cleared land and traversed by a busy road, suggests that current linkages between the western end of the Tilligerry Creek estuary in Salt Ash and Bob's Farm is likely to have limited functionality.

Although a small number (5) of Swamp Mahogany feed trees were observed within the study area, they are not indicative that extensive areas of such habitat may extend beyond the study area. Woodland surrounding the site is dominated by Blackbutt/Smooth-barked Apple associations, which do not contain Koala feed tree species that Koalas prefer locally, according to studies completed in the preparation of the Port Stephens Comprehensive Koala Plan of Management (Port Stephens Council, 2002). As a consequence, it is considered unlikely that Koalas frequently traverse the study area to source preferred foraging habitats. Therefore, the proposal area habitat is considered supplementary and impact is not considered likely to lead to a significant impact on the Koala species or local Koala populations.

These findings are consistent with those of Roads and Maritime Services (Transport for NSW, 2013) which provided specialist advice for the Commonwealth referral of Koalas for the Nelson Bay Road Upgrade (located several kilometres up Nelson Bay Road and several kilometres from the proposed action). Given the proximity of habitats assessed in this specialist advice, connectivity to proposal area of the habitats assessed and larger impact of the Nelson Bay Road Upgrade (approximately 5 ha of supplementary habitat) this approach is considered appropriate.

Disrupt the breeding cycle of an important population

Majority of habitat being impacted (representing <1% of potential 'supplementary habitat) occurs on the margins of more continuous habitat to the southeast. Due to the proposal area containing 'supplementary' habitat, and the few records of individuals in proximity to the study area, it is unlikely that individuals regularly use the proposal area as a corridor to move throughout the greater locality. As the proposal area is unlikely to act as an important koala corridor for the local population, it is unlikely that the impact of the proposed action would significantly disrupt the breeding and movement of individuals in the locality.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposal would impact approximately 2.27 ha of habitat occurring on the margins of Nelson Bay Road. No Koala activity was recorded during field investigations, despite comprehensive surveys to detect potential Koala activity. The proposal area does not contain 'preferred' or 'core' Koala habitat, but instead consists predominately of 'supplementary habitat in the form of Blackbutt/Apple dominated communities, which are unlikely to attract Koalas due to the lack of preferred habitat. As a result of the lack of preferred habitat; lack of records within the proposal area and lack of important movement corridors, the impact of 2.27 ha of habitat is unlikely to significantly remove or isolate the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Koala would become further established as a result of the proposed action.

Introduce disease that may cause the species to decline

The proposed action is unlikely to introduce a disease that may cause the Koala to decline.

Interfere substantially with the recovery of the species

The National Koala Conservation and Management Strategy (Department of the Environment, 2009) identifies a number of recovery actions for Koala's, the proposed action will not interfere significantly with any of the identified recovery actions.

The Recovery plan for the Koala addresses the need for further ecological research on the species and the conservation and protection of habitat and identification of specific breeding requirements.

Specific objectives of the Koala recovery plan include:

- Conserving koalas in their existing environment
- Rehabilitating and restoring koala habitat and populations
- Developing a better understanding of the conservation biology of koalas
- Ensuring the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale
- Managing captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care
- Managing over browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat; and
- Coordinating, promoting of implementation, and monitoring of the effectiveness of the NSW Koala Recovery Strategy across NSW.

Within each objective a number of recovery actions have been established. It is considered likely that the proposed action would be inconsistent with the first and second objective as it will add incrementally to the loss of supplementary Koala habitat. However, the habitat to be removed is considered marginal, exhibiting some fragmentation due to existing residential properties, power easements, roadways and its immediate proximity to the existing road corridor on the edges of more continuous habitat. Based on studies of Koala movement in the locality it is unlikely that habitat being impacted is of vital importance to the long-term survival of local Koala population. With the implementation of mitigation measures it is likely the local Koala population will still be conserved within their existing habitat. Therefore, the proposed action is unlikely to adversely interfere with the recovery of this species.

Conclusion

The proposal will impact approximately 2.27 ha of supplementary Koala habitat. The habitat to be impacted occurs as a narrow corridor of marginal vegetation along Nelson Bay Road. The habitat that will be impacted would constitute <1% of available potential habitat within the locality (10km) and would likely be utilised intermittently within the species home range. It is unlikely that the impact of supplementary habitat for Koala in the proposal area will have a significant impact on the local Koala population.

Hollow-dwelling Microchiropteran bats

Status

Eastern Coastal Freetail-Bat (*Micronomus norfolkensis*) is listed as Vulnerable under the BC Act.

Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) is listed as Vulnerable under the BC Act.

Greater Broad-nosed Bat (*Scoteanax rueppellii*) is listed as Vulnerable under the BC Act.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is listed Vulnerable under the BC Act.

Specific Impacts

The proposed action would remove approximately 2.27 ha of potential habitat, in the form of all native vegetation communities with foliage foraging opportunities. In addition to vegetation to be cleared, approximately sixteen (16) hollow-bearing trees are expected to be impacted by the proposed action. Habitat to be impacted provides foraging, roosting and breeding resources for these species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Approximately 2.27 ha of vegetation to be impacted provides foraging and roosting for microchiropteran bats, sixteen (16) hollow-bearing trees will be removed as part of the proposed action and avoidance has been made where possible.

The habitat to be impacted include native vegetation communities that occur as a linear corridor along the existing Nelson Bay Road. As such, this habitat is subject to edges effects (including noise, dust and light spill) and fragmentation.

An abundance of high quality roosting opportunities occur in the wider locality (National Parks and conservation areas). The removal of 2.27 ha would represent <1% of available habitat for these species. The removal of sixteen (16) hollow-bearing trees is likely to constitute only a small amount of breeding habitat for these species.

While vegetation to be removed represents foraging and breeding opportunities for hollow-dwelling microchiropteran bats, it is considered unlikely that the removal of this vegetation will significantly affect locally occurring microchiropteran bat populations, due to quality of the habitat to be impacted (roadside vegetation), the retention of similar vegetation within the study area (approximately 17 ha) and presence of higher quality habitat adjacent to the proposal area and in the wider locality.

The action proposed is unlikely to have an adverse effect on the life cycle of hollow-dwelling microchiropteran bats to the point where these species are likely to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

Approximately sixteen (16) hollow-bearing trees and 2.27 ha of vegetation representing potential habitat for these species is likely to be affected by the proposed action.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

Habitat connectivity is not likely to be affected by the proposed action. The habitat to be impacted occurs as roadside vegetation along Nelson Bay Road. Approximately 2.27 ha of vegetation is likely to be affected in the proposal area and vegetation removal will be limited to vegetation adjacent to the existing roadside. Consequently, it is considered unlikely that the proposed action would significantly isolate or fragment potential habitat beyond which currently exists within the proposal area. As the proposed action will result in disturbance to linear corridors and given the species high mobility, the proposed action is unlikely to represent significant increases to habitat isolation and or fragmentation.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

Although the proposed action will add incrementally to habitat loss within the locality it is unlikely to exacerbate fragmentation at local or regional scales that would prevent these species from foraging or roosting within the locality. Given the proportion of available habitat to be impacted, the mobile nature of these species, and the availability of suitable habitat in the wider locality, the loss of a very small amount of potential foraging and roosting habitat is unlikely to affect the long-term survival of these species.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The proposal area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the threatened hollow-dwelling microbats, the Proposal is consistent with three key threatening process:

- Clearing of native vegetation
- Removal of hollow-bearing trees sixteen (16)
- Removal of dead wood and dead trees.

The extent of native vegetation clearing, and habitat removal, associated with the proposed action is considered relatively small in terms of the available habitat for these species within the surrounding landscape. It is unlikely that the proposed action would significantly increase these key threatening processes to the point that local populations are significantly impacted.

Conclusion

Approximately 2.27 ha of potential habitat in the form of remnant woodland containing hollow-bearing trees (16) would be impacted by the proposed action. This habitat may be used by these species for foraging and roosting purposes. Habitat to be impacted occurs as a corridor of vegetation along Nelson Bay Road and is subject to existing edge effects and fragmentation. As the proposal will result in disturbance to linear corridors and given the high mobility of assessed species, the proposed action is unlikely to represent significant increases to habitat isolation and or fragmentation. The habitat is not considered critical habitat to long term survival of these species within the locality. Given this, the proposed action is considered unlikely to lead to a significant impact on these species their habitat.

Cave-dwelling Microchiropteran bats

Status

Large-eared Pied Bat (*Chalinolobus dwyeri*) is listed as Vulnerable under both the BC Act and EPBC Act.

Little Bentwing-bat (*Miniopterus australis*) is listed as Vulnerable under the BC Act.

Large Bentwing-bat (*Miniopterus orianae oceanensis*) is listed as Vulnerable under the BC Act.

Eastern Cave Bat (*Vespadelus troughtoni*) is listed as Vulnerable under the BC Act.

Specific Impacts

The proposal will impact approximately 2.27 ha of potential foraging habitat in the form of dry sclerophyll woodland on the verges of the existing Nelson Bay Road. No significant breeding or roosting habitat (i.e. caves or artificial structures) will be impacted by the proposed action.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

No roosting opportunities for cave-dwelling microchiropteran bat species were identified during field investigations. Significant roost sites used by cave-dwelling microchiropteran bats are often large with deep connecting tunnels or crevices; have restricted airflow to maintain humidity and have the presence of standing water (Department of Environment and Conservation, 2004a). No significant roost sites were identified in the proposal area.

There are foraging opportunities for these species associated with remnant vegetation, throughout the proposal area and in the wider locality. Approximately 2.27 ha of foraging habitat would be affected by the proposed action. These species often prefer to forage along the ecotonal edges between open and wooded habitats and these types of foraging opportunities will continue to exist throughout the proposal area and further abroad. An abundance of available occurs within the locality (National Parks and reserves), the impact of 2.27 ha would represent a loss of <1% of potential habitat for these species.

Therefore, the proposed action is unlikely to cause significantly adverse effects upon cave-dwelling microchiropteran bat species, due to the relatively small proportion of available habitat removed and absence of any significant cave-dwelling roosts (breeding habitat).

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

Potential foraging habitat for cave-dwelling microchiropteran bat species was recorded within the proposal area during field surveys. Approximately 2.27 ha of foraging habitat is likely to be affected by the proposed action. No significant roosting habitat will be impacted.

- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The proposed action will impact vegetation which occurs in linear strips adjacent to Nelson Bay Road. Vegetation impacted has edges due to the existing breaks in remnant vegetation which may provide potential foraging habitat.

As the proposed action will result in disturbance to linear corridors in association with Nelson Bay Road, and given the species high mobility, the proposed action is unlikely to significant increase habitat isolation and or fragmentation.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal area provides a relatively small amount of potential foraging habitat for these species. The removal of 2.27 ha of potential foraging habitat will present <1% of available habitat for these species. Foraging opportunities occurring within the proposal area, such as ecotonal zones, will continue to exist and an abundance of similar and potential higher quality foraging opportunities will remain available the wider locality. The proposed action would not impact habitat considered critical to the long-term survival of populations in the locality.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to cave-dwelling microchiropteran bats, the proposed action is consistent with one key threatening process under the BC Act, being clearing of native vegetation.

The removal of potential foraging habitat associated with the proposed action (2.27 ha) is considered to represent a small proportion of available higher quality habitat in the locality and adjoining the proposal area. Although the proposed action will represent a small loss of potential foraging habitat, such habitat only represents a very small component of locally occurring resources accessible to these species.

Conclusion

The proposed action will impact approximately 2.27 ha, representing a very small amount of potential foraging habitat for these species. Whilst potential habitat exists within the proposal area, the extent of habitat removal associated with the proposed action is considered relatively small in terms of available local habitat for these species. Although the loss of habitat will represent a small incremental loss of cave-dwelling microchiropteran bat habitat, the proposed action is unlikely to have a significant impact upon these species.

EPBC Significance Assessment – Large-eared Pied Bat

The Large-eared Pied Bat is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013b). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Large-eared Pied Bats occur across a range of wooded habitats in association with sandstone escarpments which contain their preferred cave roosting habitat sources.

The proposal area does not contain suitable habitat for roosting locations for Large-eared Pied bats with no significant escarpment habitats within its close vicinity.

There are no areas in the vicinity of the proposal area which are known locations for aggregations of this species, so local individuals are unlikely to be necessary for maintaining genetic diversity.

Individual Large-eared Pied Bats occurring within the proposal area are not at or near the limit of the species' range.

Therefore, a population of Large-eared Pied Bat in the proposal area is not considered to be important part of an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

Not applicable. Large-eared Pied Bats occurring in the in the proposal area would not form part of an important population.

Reduce the area of occupancy of an important population

Not applicable. Large-eared Pied Bats occurring in the in the proposal area would not form part of an important population.

Fragment an existing important population into two or more populations

Not applicable. Large-eared Pied Bats occurring in the in the proposal area would not form part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed action will remove 2.27 ha of potential habitat, which represents foraging habitat for this species. This species is highly mobile, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, foraging habitat impacted by the proposed action would not meet the above criteria as critical habitat.

Disrupt the breeding cycle of an important population

Not applicable. Large-eared Pied Bats occurring in the in the proposal area would not form part of an important population, although impacts associated with the proposal area will not affect the breeding cycle of this species.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The foraging habitat for the Large-eared Pied Bat impacted by the proposed action occurs as roadside vegetation. Within locality of the proposal area large tracts of vegetation which represent higher quality foraging habitat occur in national parks and conservation areas. As such, the habitat to be impacted represents a small proportion of available habitat locally. As such, the available or quality of habitat is unlikely to be impacted to the extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Large-eared Pied Bat would become further established as a result of the Proposal.

Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

Interfere substantially with the recovery of the species

Due to the limited foraging habitat likely to be affect by the proposed action (2.27 ha) and absence of breeding habitat within or adjacent to the proposal area, the proposed action is not likely to interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing and habitat removal associated with the proposed action (2.27 ha) represents a small proportion of available higher quality habitat in the locality and surrounding landscape. Although the loss of foraging habitat for Large-eared Pied Bat is considered to be an incremental loss of suitable habitat locally, the proposed action is not likely to have a significant impact upon available resources for cave-dwelling bats in general in the vicinity of the proposal area or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the Large-eared Pied Bat.



transport.nsw.gov.au



contactus@transport.nsw.gov.au



Customer feedback
Transport for NSW
Locked Bag 928,
North Sydney NSW 2059



Transport
for NSW

Appendix D

Aboriginal Cultural Heritage Assessment



Nelson Bay Road Upgrade - Section 1

Aboriginal Cultural Heritage Assessment Report
FINAL

Prepared for Transport for NSW
October 2020





Servicing projects throughout Australia and internationally

SYDNEY

Ground Floor, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE

Level 3, 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE

Level 1, 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

ADELAIDE

Level 1, 70 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE

Ground Floor, 188 Normanby Road
Southbank VIC 3006
T 03 9993 1905

PERTH

Suite 9.02, Level 9, 109 St Georges Terrace
Perth WA 6000
T 02 9339 3184

CANBERRA

Level 8, 121 Marcus Street
Canberra ACT 2600

Nelson Bay Road Upgrade - Section 1

Aboriginal Cultural Heritage Assessment Report

Report Number

H200127 NBR Section 1 - ACHA

Client

Transport for NSW

Date

30 October 2020

Version

v3 Final

Prepared by

Approved by



Morgan Wilcox
Senior Archaeologist



Ryan Desic
Associate Archaeologist

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

Executive Summary

ES1 Overview

Transport for New South Wales (Transport for NSW) proposes to upgrade Nelson Bay Road to provide dual carriageway between Williamtown and Bobs Farm, NSW.

In 2019, EMM Consulting Pty Limited (EMM) was engaged by Transport for NSW to complete an archaeological survey report for Section 1 of proposed upgrades to Nelson Bay Road (the proposal). The archaeological assessment confirmed project impacts to registered Aboriginal midden site OFOC1 (AHIMS 38-4-1600).

Transport for NSW have engaged EMM to prepare an Aboriginal Cultural Heritage Assessment (ACHA) for the proposal to support an Aboriginal Heritage Impact Permit (AHIP) for impacts to OFOC1 (AHIMS 38-4-1600).

An Aboriginal Cultural Values Assessment (CVA) for the proposal has also been undertaken by Waters Consultancy which is summarised herein and provided as Appendix C.

ES2 Assessment methods

This assessment has been completed in accordance with the following documents:

- *Stage 3 of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (Roads and Maritime 2011);
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b);
- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (DECCW 2011); and
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs) (DECCW 2010c).

The proposal will be assessed via a Review of Environmental Factors (REF) under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Transport for NSW will be the determining authority.

ES3 Aboriginal consultation

The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010c) were used for the project. The process of consultation with Aboriginal stakeholders for the project has been undertaken and managed by Transport for NSW. Thirteen Aboriginal parties registered their interest in the project and are referred to as registered Aboriginal parties (RAPs). RAPs were invited to provide cultural information about the study area, provided with Stage 2 archaeological assessment and proposed ACHA and cultural values methods for review, and kept updated about the project via an Aboriginal Focus Group (AGF) consultation meeting, letters, and emails.

EMM and Transport for NSW, EMM and Waters Consultancy have worked closely with RAPs in formulating appropriate management measures for the Aboriginal cultural heritage values identified during the ACHA and CVA, which are outlined in Section 8 of this report.

ES4 Archaeological assessment

EMM completed an archaeological assessment of the proposal in 2019 in accordance with PACHCI Stage 2 (Roads and Maritime 2011). This assessment included archaeological survey of the study area conducted on 8 May 2019 with support of Worimi Local Aboriginal Lands Council (LALC) representatives.

Shell fragments likely associated with previously recorded Aboriginal midden site OFOC1 (AHIMS 38-4-1600) were identified within the study area. OFOC1 is a very low density and low integrity shell scatter located within a highly disturbed context, consisting of four shell fragments less than 2 cm in diameter removed from their original depositional context as a result of disturbance (Umwelt 2013, p.7.5).

A Smooth-bark Apple eucalyptus was identified by the Worimi LALC representative as a possible women's tree. The tree in question is located outside of the study area boundary and will not be impacted by proposed works.

No additional Aboriginal sites or areas of potential archaeological deposit (PAD) were identified by this assessment.

ES5 Cultural values assessment

A Cultural Values Assessment (CVA) for the proposal was prepared by Waters Consultancy for EMM on behalf of Transport for NSW, with the aim of assessing the potential impact of the proposal on intangible Aboriginal cultural heritage values. The assessment of Aboriginal cultural heritage values was undertaken collaboratively with RAPs and thirteen identified Aboriginal knowledge holders.

Detailed interviews and discussions with identified knowledge holders provided cultural and historical information on the broader cultural landscape of the region. This information has informed the assessment process in relation to the cultural heritage values and significance of the broader region.

Three cultural values were identified within the Section 1 study area, including:

- **West-East Movement Corridor.** A movement corridor running from Tilligerry Creek to the beach front. This movement corridor has high significance to the local Aboriginal community as the patterns of movement hold cultural value for their association with resource use, community gatherings and ceremonial cycles;
- **North-South Movement Corridor.** A movement corridor running from Tomaree south to Fullerton Cove. This movement corridor has high significance to the local Aboriginal community as the patterns of movement that occurred across this zone hold cultural value for their association with resource use, community gatherings and ceremonial cycles; and
- **Sand Doubletail Orchid (*Diuris Arenaria*).** An endangered orchid species that is present in the study area. Orchids were utilised as a traditional food source and hold cultural value for that association. This orchid has medium significance to the local Aboriginal community for its use as a food source.

Aboriginal cultural heritage safeguards for Section 1 recommended by the CVA include:

- Preparation of an Aboriginal Heritage Management Plan (AHMP) should be prepared and implemented as part of the Construction Environmental Management Plan (CEMP), including a requirement for notification of the identified knowledge holders within 48 hours of any discovery of potential archaeological Aboriginal skeletal remains during the proposed works;
- Aboriginal cultural heritage awareness training of all contractor(s) and maintenance personnel involved in the construction works as part of the site induction; and
- Development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist on the cultural values and historical records relating to the cultural landscape of the Section 1 study area with a focus on the three values identified above.

It is noted that the RAPs and the knowledge holders also place cultural value on any material cultural objects identified during the project.

ES6 Significance assessment

OFOC1 (AHIMS 38-4-1600) is assessed as being of overall low archaeological/scientific significance. While such sites symbolise Aboriginal presence in the landscape through their very existence, they can tell us little else, or little further than what is already known and established in archaeology. Notwithstanding the limited information potential, the site is of cultural significance to the Aboriginal community.

ES7 Impact assessment

The extent of developing practical measures to avoid harm must be weighed against the significance of the Aboriginal sites or places that are likely to be harmed by the proposal. The study area is highly developed which has led to widespread disturbance of the ground and sub-surface. To minimise the risk of harm, Transport for NSW have restricted proposed works to within the existing road corridor, with majority of proposed construction occurring on top of imported fill.

The proposal will impact what remains of Aboriginal site OFOC1 (AHIMS 38-4-1600).

Authorised unmitigated partial impacts to OFOC1 within the boundary of the current study area have previously occurred in accordance with AHIP 1132343 for installation of an Optus fibre optic cable. As such, any remnant material associated with OFOC1 to be impacted by the proposal is assessed as negligible.

Aboriginal objects have potential to occur sporadically within the study area in an unpredictable pattern representative of background scatter, however if present they are likely to be of very low density in highly disturbed locations divorced from their original depositional context.

ES8 Management recommendations

- An AHIP is required for proposed impacts to Aboriginal site OFOC1 (AHIMS 38-4-1600).
 - An AHIP is proposed for 10 years to allow for the proposed development to be completed.
 - The AHIP should be limited to the existing road corridor, inclusive of partial impacts to OFOC1 (AHIMS 38-4-1600).
 - The AHIP conditions should allow for unmitigated impacts to any unidentified Aboriginal objects (excluding human skeletal remains) within the proposed AHIP boundary. It is anticipated that any such objects are likely to be highly disturbed and of similarly low significance as the known OFOC1 (AHIMS 38-4-1600).
 - OFOC1 (AHIMS 38-4-1600) was previously impacted in accordance with AHIP 1132343 with no salvage activities completed prior to impacts. What remains of the site within the study area is a scatter of four small shell fragments less than 2 cm in diameter located within a highly disturbed context. The remaining shell fragments are not of archaeological or educational merit warranting mitigation via surface collection. As such, no salvage activities are proposed prior to impacts to OFOC1 (AHIMS 38-4-1600).
 - An Aboriginal Site Impact Recording Form (ASIRF) must be submitted to Heritage NSW and AHIMS to document impacts to the site in accordance with AHIP conditions.
- All land-disturbing activities must be confined to within the existing road corridor. Prior to commencement of construction activities, the perimeter of the proposal area should be fenced with high visibility curtilage to prevent inadvertent impacts outside of the area assessed including to the possible women's tree.

- Completion of cultural heritage awareness training will be a requirement of the Construction Environmental Management Plan for all employees and contractors during project construction.
- In the event that known or suspected human skeletal remains are encountered within the study area, the immediate vicinity will be secured and the find reported to the environmental manager, the police and the state coroner on the same day of the find (as required for all human remains discoveries). Additionally:
 - the environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material; and
 - If it is determined that the skeletal material is ancestral Aboriginal remains, Heritage NSW will be contacted for advice, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains and the site will be recorded in accordance with the *National Parks and Wildlife Act 1974* and Heritage NSW guidelines.

Table of Contents

Executive Summary	ES.1
Abbreviations	1
1 Introduction	1
1.1 Overview	1
1.2 Project background	1
1.3 Project description	1
1.4 Study area	2
1.5 Scope and objectives	2
1.6 Legislative context	4
1.7 Approval pathway and assessment method	5
1.8 Limitations	5
2 Aboriginal consultation	6
2.1 Statutory basis	6
2.2 Stage 1 — notification and registration of Aboriginal parties	6
2.3 Stages 2 and 3 — presentation of information and gathering cultural information	8
2.4 Stage 4 — review of draft ACHA	11
3 Background information	12
3.1 Environmental context	12
3.2 Archaeological context	15
3.3 Predictive model	20
4 Archaeological assessment	22
4.1 Investigation	22
4.2 Methods	22
4.3 Survey limitations	22
4.4 Results	23
4.5 Discussion	25
5 Cultural values assessment	26
5.1 Overview	26
5.2 Methods	26
5.3 Consultation	26

5.4	Results	27
5.5	CVA recommendations	27
6	Significance assessment	28
6.1	General	28
6.2	OFOC1 (AHIMS 38-4-1600) - statement of significance	29
7	Impact assessment	30
7.1	Project impacts	30
7.2	Measures to minimise harm	30
7.3	Aboriginal heritage impact	30
7.4	Intergenerational loss/ equity	31
8	Recommendations	32
8.1	AHIP boundary details	32
8.2	AHIP duration	32
8.3	Conditions	32
	References	35
	Glossary	37

Appendices

Appendix A	Aboriginal consultation	A.1
Appendix B	Archaeological assessment	B.1
Appendix C	Cultural values assessment	C.1

Tables

Table 2.1	Registered Aboriginal Parties for the Williamtown to Bobs Farm Nelson Bay Road Upgrade	7
Table 2.2	Stage 2/3 summary of RAP comments and responses	9
Table 2.3	Summary of responses to the ACHA	11
Table 3.1	AHIMS extensive search results (as of 23 April 2019)	17
Table 4.1	Survey participation	22
Table 6.1	A summary of criteria used to assess the cultural significance (DECCW 2011 pp. 8–10)	28
Table 6.2	Summary of significance	29

Figures

Figure 1.1	Location of the study area	3
Figure 3.1	Topography and hydrology of the study area	13
Figure 3.2	Geology and soils of the study area	14
Figure 3.3	AHIMS sites and the study area	16
Figure 4.1	Survey coverage and results	24
Figure 8.1	AHIP application area	34

Plates

Plate 4.1	Shell fragments associated with Aboriginal site OFOC1 (AHIMS 38-4-1600)	23
Plate 4.2	Possible women's place marker tree	23

Abbreviations

AAC	Australian Agricultural Company
ACH	Aboriginal Cultural Heritage
ACHA	Aboriginal Cultural Heritage Assessment
ACHCRs	Aboriginal Consultation Requirements for Proponents
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ASIRF	Aboriginal Site Impact Recording Form
BP	Years before present
c.	circa
cm	centimetres
CVA	Cultural Values Assessment
DECCW	Department of Environment Climate Change and Water, now DPC
DPC	Department of Premier and Cabinet
DPIE BCD	Department of Planning, Industry and Environment Biodiversity and Conservation Division (formerly OEH)
EMM	EMM Consulting Pty Ltd
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
ha	hectare
Heritage NSW	Heritage NSW Aboriginal Cultural Heritage Regulation Team of the Department of Premier and Cabinet (formerly DPIE)
LALC	Local Aboriginal Lands Council
LEP	Local Environmental Plan
LGA	Local Government Area
m	metres
m ²	square metres
Mm	millimetres
NNTT	National Native Title Tribunal
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	Office of Environment and Heritage
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential archaeological deposit
RAP/s	Registered Aboriginal Party/Parties
REF	Review of Environmental Factors
SHR	State Heritage Register
SU	Survey unit

1 Introduction

1.1 Overview

Transport for New South Wales (Transport for NSW) proposes to upgrade Nelson Bay Road to provide dual carriageway between Williamstown and Bobs Farm. EMM Consulting Pty Ltd (EMM) has been engaged by Transport for NSW to undertake an Aboriginal Cultural Heritage Assessment (ACHA) of Section 1 of proposed upgrades to Nelson Bay Road (the proposal).

Objectives of the proposal are to reduce peak period congestion (including seasonal peaks) along Nelson Bay Road corridor; improve road safety for all road users; and improve travel route reliability for all road users (including commuter, tourism, commercial, agricultural and Newcastle Airport precinct).

1.2 Project background

In 2019, EMM completed an archaeological assessment for Section 1 of the proposed Nelson Bay Road Upgrade in accordance with Stage 2 of the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI; Roads and Maritime 2011).

The assessment identified previously recorded Aboriginal site OFOC1 (AHIMS 38-4-1600) would be impacted by proposed works. As such, an ACHA is required to support an Aboriginal Heritage Impact Permit (AHIP) application to seek approval for proposed impacts.

1.3 Project description

Key features of the proposed works include:

- a new dual carriageway (1 kilometre (km)) providing two lanes in each direction with:
 - 3.5 metre (m) travel lanes;
 - 2.5 m wide shoulders to improve safety and cyclist access;
 - 100 km hour posted speed limit;
 - 110 km per hour design speed; and
 - median separation barrier;
- two retaining walls on the northern side of the road to prevent property impacts;
- installation of a fauna exclusion fence on the southern boundary of the road corridor; and
- relocation of public utilities.

The eastern extent the proposal would tie in with the Nelson Bay Road Sand Hills Stage 1 Second Carriageway dual carriageway which was completed in May 1996. All proposed ground disturbance will be confined to within the existing road corridor, and the majority of proposed construction will be on top of imported fill.

Proposed works will involve:

- vegetation clearing of up to 15 m on northern side and up to 10 m on southern side of Nelson Bay Road;

- import of fill material;
- excavation of up to 600 mm below existing road surface;
- excavation for one retaining wall up to 4 m at its deepest point; and
- excavation and post-driving for the installation of the fauna exclusion fence.

1.4 Study area

Section 1 of the proposal is located in the Port Stephens Local Government Area (LGA) and falls within the boundary of the Worimi Local Aboriginal Land Council (LALC), within the locality of Salt Ash approximately 20 km south-west of Port Stephens, and approximately 22 km north-east of the city of Newcastle.

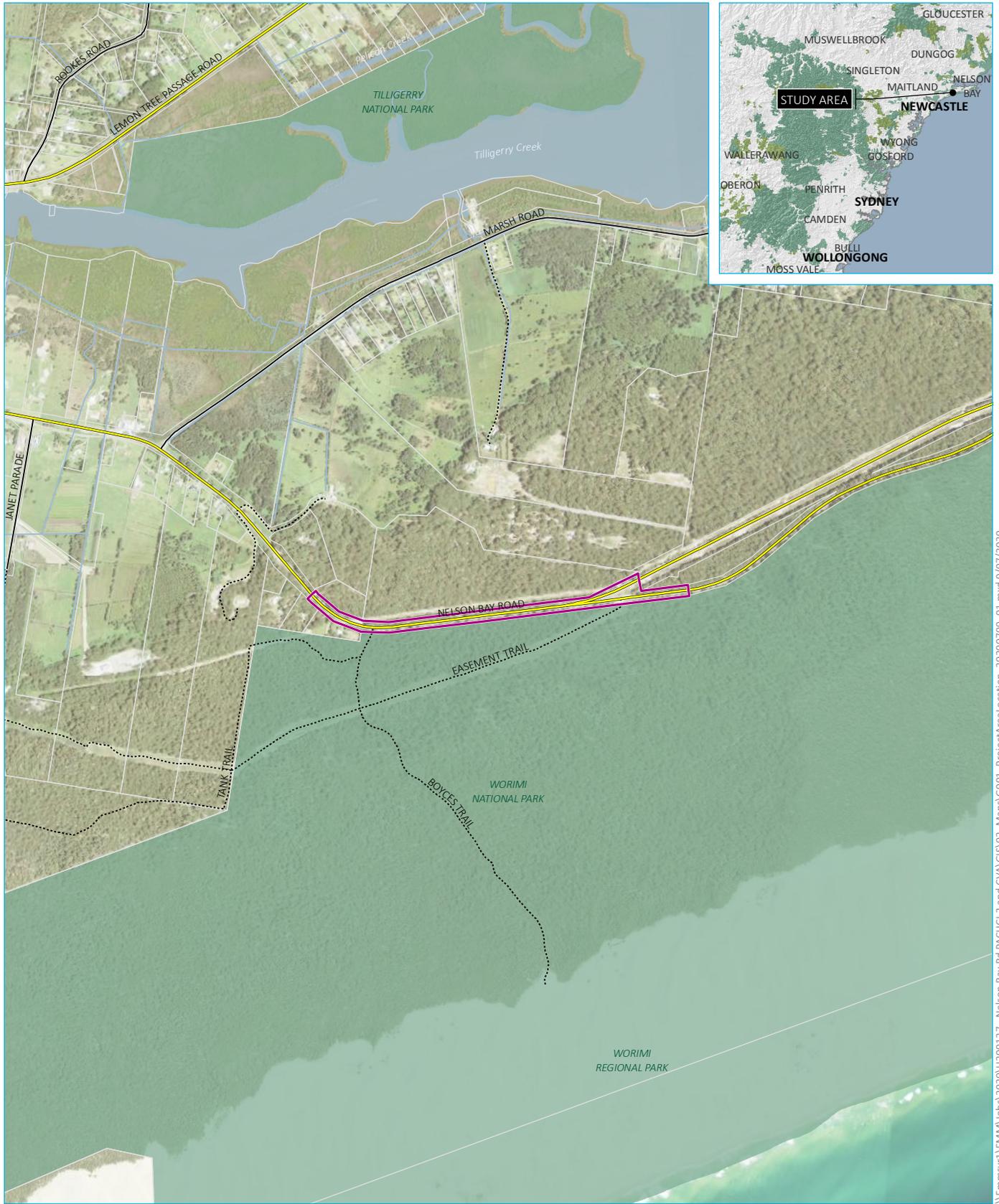
As shown on Figure 1.1, the study area is 1.4 km in length, starting from approximately 250 m west of Boyce's Trail to meet with the existing duplicated section of Nelson Bay Road in the east. The study area is contained within the existing road corridor and is bounded by Worimi National Park to the south and undeveloped bushland to the north which is owned by the Worimi LALC. Semi-rural low-density housing surrounds the study area to the west, with Tilligerry Creek and estuary to the north and Stockton Beach located to the south.

1.5 Scope and objectives

This ACHA describes the results of archaeological investigation which was undertaken to identify the extent and significance of any physical remains of past Aboriginal occupation within the subject area.

The principle objectives of the ACHA were to:

- liaise and consult with key Aboriginal community members and knowledge holders to identify areas and places of cultural value within or in the vicinity of the project area;
- compile a review of existing environmental, historical and archaeological information for the study area, by identifying and summarising known and previously recorded Aboriginal heritage places, cultural values areas and landforms of archaeological interest in its immediate surrounds;
- determine if any Aboriginal objects, places, cultural values areas, or areas of archaeological potential are present (or are likely to be present) within the study area, as well as areas of existing disturbance, through ground-truthing;
- identify the type, nature, and extent of any Aboriginal sites, objects, archaeological deposits, potential archaeological deposits, and cultural values areas within the project area;
- map the locations of known and potential Aboriginal sites, objects and deposits and cultural values areas identified;
- assess the archaeological and cultural significance of the project area;
- assess and identify heritage constraints and opportunities and the potential impacts of the project; and
- identify and recommend measures to mitigate any heritage impacts and risks to the project.



Source: EMM (2020); DFSI (2017); GA (2011); ASGC (2006)



- KEY**
- Study area
 - Main road
 - Local road
 - Unsealed access track
 - Watercourse/drainage line
 - Waterbody
 - Cadastral boundary
 - NPWS reserve

Location of study area

Nelson Bay Road Upgrade - Section 1
Aboriginal cultural heritage assessment
Figure 1.1



\\Emmsvr1\EMM\Jobs\2020\H200127 - Nelson Bay Rd PACHT 3 and CVA\GIS\02_Maps\G001_ProjectArea\Location_20200709_01.mxd 9/07/2020

1.6 Legislative context

Aboriginal objects and places are protected in New South Wales (NSW) under the Part 6 of the *National Parks and Wildlife Act 1974* (NPW Act). Section 90 of the NPW Act requires an Aboriginal Heritage Impact Permit (AHIP) for harm to an Aboriginal object or Aboriginal place. Significant penalties are in place for harm to Aboriginal objects or places or regardless of whether the harm was committed knowingly or not. Defences against prosecution include impacts in compliance with an AHIP, acting in accordance with specified codes of practice or the conduct of certain low impact activities. The NPW Act defines an Aboriginal object as:

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains.

Harm is defined as:

any act or omission that: (a) destroys, defaces or damages the object or place, or (b) in relation to an object—moves the object from the land on which it had been situated, or (c) is specified by the regulations, or (d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c), but does not include any act or omission that: (e) desecrates the object or place, or (f) is trivial or negligible, or (g) is excluded from this definition by the regulations.

1.6.1 National Parks and Wildlife Regulation 2009

The *National Parks and Wildlife Regulation 2009* (NPW regulation) is subsidiary legislation made under its parent act, the NPW Act. The NPW regulation provides codes of practice, documents and guidelines that relate to the NPW Act.

The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010a) is adopted by the NPW Regulation under Clause 80A. Compliance with the due diligence guidelines provide a defence for harming Aboriginal objects and places in certain circumstances.

Section 80D of the NPW Regulation requires a cultural heritage assessment report to be completed to accompany any AHIP application. The *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (DECCW 2011) sets out the information required to support an AHIP.

The *Aboriginal Consultation Requirements for Proponents 2010* (ACHCRs; DECCW 2010c) set out the consultation requirements for proponents seeking an AHIP. These requirements are under section 80C of the NPW regulation.

The *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (the Code; DECCW 2010b) has been adopted by clause 3A of the NPW Regulation. Acts carried out in accordance with the Code are excluded from the definition of harm.

1.6.2 Procedure for Aboriginal cultural heritage consultation and investigation

The PACHCI (Roads and Maritime 2011) has the following aims:

- assist Transport for NSW to meet its legislative responsibilities regarding consultation and investigation of the potential impacts of Transport for NSW projects on Aboriginal cultural heritage;
- ensure that Transport for NSW projects likely to affect Aboriginal cultural heritage receive the appropriate level of assessment and community involvement;
- ensure that a suitable and consistent standard of cultural and archaeological assessment and reporting is met by Transport for NSW and its consultants on projects across NSW;

- achieve best practice management associated with Aboriginal cultural heritage; and
- enable Transport for NSW to establish a due diligence defence for the strict liability offence of harming an Aboriginal object under the *National Parks and Wildlife Act 1974*.

1.7 Approval pathway and assessment method

The proposal will be assessed via a Review of Environmental Factors (REF) under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Transport for NSW will be the determining authority.

This ACHA has been completed in accordance with the following documents:

- *Stage 3 of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (Roads and Maritime 2011);
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b);
- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (DECCW 2011); and
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs).

1.8 Limitations

This report is based on existing and publicly available environmental and archaeological information (including AHIMS data) and reports about the study area. The background research did not include any independent verification of the results and interpretations of externally sourced existing reports (except where the ground-truthing was undertaken). The report further makes archaeological predictions based on these existing data and targeted ground-truthing, and which may contain errors depending on the accuracy of these third party studies and the extent of ground-truthing (constrained to surface) investigations.

This report does not consider historical (non-Aboriginal) or built heritage unless specifically indicated.

2 Aboriginal consultation

2.1 Statutory basis

The process of consultation with Aboriginal stakeholders for the project has been undertaken and managed by Transport for NSW.

The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010c) were used for the project. The stages of consultation and their outcomes are provided in the headings below. Each private Aboriginal organisation or individual who requested to be registered for consultation within the timeframes of the requirements is referred to as a *registered Aboriginal party* (RAP).

Consultation documentation is provided in Appendix A of this report.

2.2 Stage 1 — notification and registration of Aboriginal parties

2.2.1 Agency contact

Transport for NSW issued a letter to government agencies on 25 March 2020 requesting advice on which Aboriginal parties to invite for consultation. The agencies contacted are listed below:

- Heritage NSW Aboriginal Cultural Heritage (ACH) Regulation Team of the Department of Premier and Cabinet (formerly Department of Planning, Industry and Environment Biodiversity and Conservation Division [DPIE BCD]);
- Port Stephens Council;
- Worimi Local Aboriginal Land Council (LALC);
- Hunter Local Land Service (former Catchment Management Authority);
- National Native Title Tribunal (NNTT);
- The Office of the Registrar of Aboriginal Owners; and
- Native Title Services.

2.2.2 Native title considerations

The response from the NNTT to the agency request, as per Section 2.2.1, noted that no native title determination applications, determinations of native title, or indigenous land use agreements over the identified area.

As per Section 3.2.2, a search of the NNTT *Register of Native Title Applications, Registration Decisions and Determinations* identified no active or determined claims over the project area.

As per Section 3.2.2, a search of the NNTT *Register of Indigenous Land Use Agreements* identified no registered land use agreements over the project area.

2.2.3 Newspaper advertisement

A notification was placed in a local newspaper detailing the project name, proponent, project location, project details and a request for Aboriginal knowledge holders to register interest in the project. The advertisement was placed in:

- Koori Mail on 10 April 2019;
- National Indigenous Times on 10 April 2019;
- Port Stephens Examiner on 11 April 2019; and
- Newcastle Herald on 13 April 2019.

Copies of the advertisements is included in the consultation documentation provided in Appendix A.

2.2.4 Aboriginal group invitation to register

On 13 May 2019 Aboriginal parties identified by the government agencies were invited to register their interest in the project. Registrations were requested by 7 June 2019.

2.2.5 Registered Aboriginal Parties

A total of 13 Aboriginal parties registered their interest in the project and are listed in Table 2.1.

Table 2.1 Registered Aboriginal Parties for the Williamtown to Bobs Farm Nelson Bay Road Upgrade

Name	Representative
Worimi LALC	Andrew Smith and Jamie Merrick
Nur-Run-Gee	Lennie Anderson
Mur-Roo-Ma Inc	Anthony Anderson and Rebecca Young
Didge Ngunawul Clan	Paul Boyd and Lilly Carroll
Murra Bidgee Mullangari	Ryan Johnson
Merrigan	Shaun Carroll
Karuah Indigenous Corporation	Dave Feeney
Worimi Traditional Owners Indigenous Corporation	Candy Towers
Divine Diggers Aboriginal Cultural Consultants	Deidre Perkins ¹
Muragadi	Jesse Johnson
Gomerioi Namoi Cultural Consultants	Steve Talbott
Widescope Indigenous Group	Steven Hickey
Worimi Guringai Conservation Lands	Robert Syron

¹ Divine Diggers Aboriginal Cultural Consultants was contacted by Transport for NSW on 30 March 2020 regarding the AFG. Deidre stated that she had no comment on the project and documents and declined further involvement.

2.3 Stages 2 and 3 — presentation of information and gathering cultural information

2.3.1 Project information and methodology review

On 4 March 2020, all RAPs were provided with:

- an overview of the project;
- the PACHCI Stage 2 archaeological assessment (EMM 2019);
- the proposed Aboriginal Cultural Heritage Assessment Report (CHAR) methodology; and
- the proposed Cultural Values Assessment (CVA) methodology.

Comments from RAPs were initially requested by 3 April 2020, however on the 31 March 2020 all RAPs were advised of the comment period would be extended to 17 April 2020.

2.3.2 Aboriginal Focus Group Meeting

All RAPs were invited to attend an Aboriginal Focus Group (AFG) meeting to be held on 24 March 2020 at Murrook Cultural Centre. Due to constraints surrounding the COVID-19 pandemic, all RAPs were advised on 19 March 2020 that the AFG would need to be rescheduled as a safety precaution.

Transport for NSW contacted all RAPs on 30 March via phone or email to discuss the possibility of hosting the AFG digitally via videoconference.

On 1 April 2020, all RAPs were informed that the AFG had been rescheduled to 8 April 2020 and would be hosted digitally via the Zoom videoconferencing platform. Minutes from the AFG are provided in Appendix A.

The AFG was attended by Transport for NSW, Heritage NSW, EMM Consulting, Waters Consulting, and the following RAPs:

- Worimi Conservation Lands Board of Management (Graeme Russell);
- Worimi Guringai Conservation Lands (Robert Syron);
- Karuah Indigenous Group (David Feeney); and
- Widescope Indigenous Group (Steven Hickey).

This meeting provided an opportunity to present an overview of:

- the proposed Nelson Bay Road (Williamtown to Bobs Farm) Upgrade and Section 1;
- the PACHCI Stage 2 Archaeological assessment (EMM 2019); and
- proposed CHAR and Cultural Values Assessment (CVA) methodologies.

Key comments/questions raised at the AFG relating to the archaeological assessment included:

- Transport for NSW confirmed that the proposed works will not impact outside of the existing road corridor;
- RAPs advised they were satisfied with the findings of the archaeological report;

- EMM confirmed that the current assessment is for Section 1 of the project only. An archaeological assessment of the remainder of the project, currently in strategic design phase, will be undertaken at a later date and would involve survey and likely test excavation dependent upon impact areas; and
- RAPs asked if cultural heritage monitoring would be used proposal construction:
 - EMM noted that based on the results of the assessment, monitoring is not required on an archaeological basis but can be noted as a community request;
 - Transport for NSW noted that cultural heritage monitoring is not required by Transport for NSW policy;
 - Heritage NSW noted they would not support site monitoring as part of the AHIP conditions; and
 - RAPs concurred that cultural heritage monitoring would not add value due to the lack of materials in the area.

2.3.3 Responses

A summary of the RAP comments and project responses received during Stages 2 and 3 is provided in Table 2.2.

Table 2.2 Stage 2/3 summary of RAP comments and responses

RAP name	Summary of comments	Response summary
Rebecca Young Mur-Roo-Ma Inc	<ol style="list-style-type: none"> 1. Difficult to comment on “women’s area” identified by male LALC representative when Mur-Roo-Ma has not been on site. 2. Acknowledges archaeological potential as low but notes significant cultural sensitivity of the area. 3. Reinforced that cultural heritage training for all employees is imperative. 4. The recommendations and methodologies of the draft report meet our requirements as Traditional knowledge holders of this area and maintain the protection and best options for our local Aboriginal sites. 	<ol style="list-style-type: none"> 1. Noted. The possible women’s tree (SU1 POI 3) identified by Worimi LALC will not be impacted by proposed works. 2. Noted. In conjunction with the ACHA, a Cultural Values Assessment has been prepared by Waters Consultancy to document cultural values of the study area (refer to Section 5). 3. Noted. Completion of cultural heritage awareness training will be a requirement of the Construction Environmental Management Plan for all employees and contractors during project construction. 4. Noted.
Lennie Anderson Nur-Run-Gee Pty Ltd	<ol style="list-style-type: none"> 1. Objected to other knowledge holders beyond the LALC not being involved in the archaeological assessment. 2. Requested opportunity to undertake a site walkover. 	<ol style="list-style-type: none"> 1. The proposal is being undertaken in accordance with Stage 2 of the PACHCI as per all Transport for NSW (former Roads and Maritime) projects. Stage 2 involves engaging only the LALC for archaeological survey. 2. Lennie participated in a site walkover with Kate Waters as part of the CVA process (refer to Section 5).

Table 2.2 Stage 2/3 summary of RAP comments and responses

RAP name	Summary of comments	Response summary
Candy Towers Worimi Traditional Owners Indigenous Corporation	<ol style="list-style-type: none"> Does not agree with the recommendations of the 2019 survey. Notes high potential for Aboriginal objects to be present within the project area. The project will have a drastic impact on the cultural value of the one site recorded in the project area. Requests test excavation. 	<ol style="list-style-type: none"> Noted. Recommendations have been made in consideration of the low archaeological significance of the site and high levels of disturbance within the study area. The study area and immediate surroundings is known to have been utilised by Aboriginal peoples in the past, however extensive disturbance has had a significant impact upon the archaeological potential and integrity of the study area and has likely removed any significant traceable archaeological material. Aboriginal objects have potential to occur sporadically within the study area in an unpredictable pattern representative of background scatter, however if present they are likely to be of very low density in highly disturbed locations divorced from their original depositional context (refer to Section 4.5). Noted. The proposal will directly impact OFOC1 which whilst assessed as having low archaeological significance is acknowledged as being of cultural significance to the Aboriginal community. However, during consultation no socio-cultural or historical information was provided which related specifically to the site or study area. The site’s cultural significance relates to the tangible link with the objects only. Proposed impacts are necessary for the proposal to continue and no feasible alignment alternatives are available. It is likely other proposed alignments extending beyond the existing road corridor would have greater archaeological and cultural impacts than this alignment that is in a disturbed area. By reason of the significant levels of disturbance and landform modification within the study area, no areas of PAD or areas suitable for test excavation as per Section 3.1 of the Code of Practice (DECCW 2010b:24) have been identified by this assessment (refer to Section 4.5).
Dave Feeney Karuah Indigenous Corporation	<ol style="list-style-type: none"> Found the reports to be good. Requests test excavation. 	<ol style="list-style-type: none"> Noted. By reason of the significant levels of disturbance and landform modification within the study area, no areas of PAD or areas suitable for test excavation as per Section 3.1 of the Code of Practice (DECCW 2010b:24) have been identified by this assessment (refer to Section 4.5). This matter was discussed directly with Dave at the AFG (refer to Section 2.3.2), and after the assessment outcomes and anticipated project impacts were further clarified he then concurred test excavation or monitoring is not required.

2.4 Stage 4 — review of draft ACHA

2.4.1 Distribution of draft report

A draft version of this report was issued to all RAPs on 4 September 2020. Comments or questions on the draft ACHA were requested by 7 October 2020. Follow up phone calls were made to all RAPs from whom a response had not been received on 9 October 2020¹.

Responses to the ACHA are outlined in Table 2.3

Table 2.3 Summary of responses to the ACHA

Party name	Response to ACHA	EMM response
Lennie Anderson Nur-Run-Gee Pty Ltd	Advised that he is happy with the reports (via phone call 9 October 2020).	Noted.
Diedre Perkins Divine Diggers	Advised that she is happy with the reports (via phone call 9 October 2020).	Noted.
Rebecca Young Mur-Roo-Ma Inc	<ol style="list-style-type: none"> Mur-Roo-Ma have read and fully understands the ACHA report for the proposed project. We agree with both these reports including the cultural discussions and values assessment and recommendations within the ACHA. Mur-Roo-Ma wish to identify a possible unexpected finds procedure – possibly a contact system to the RAP’s or archaeologists if anything is identified once work starts (as part of the Cultural Heritage training given) and then the ability to go back in and salvage this if possible. The recommendations and methodologies for impacts within this draft ACHA report meets our requirements as Traditional Owners and knowledge holders of this area and maintains protection and best options for our local Aboriginal sites. 	<ol style="list-style-type: none"> Noted. The assessment concludes low density and highly disturbed Aboriginal objects have the potential to occur sporadically within the study area. Significant in situ cultural deposits are considered highly unlikely. All proposed ground disturbance will be confined to within the existing road corridor, and the majority of proposed construction will be on top of imported fill. The extent of measures to avoid harm must be weighed against the significance of the Aboriginal objects with the potential to be harmed. Salvage of Aboriginal objects (if identified) during the active construction phase of proposed works would result in untenable delay and financial implications for the project. As such, the proposed AHIP conditions include unmitigated impacts to any unidentified Aboriginal objects (excluding human skeletal remains) within the proposed AHIP boundary. Noted.
Robert Syron Worimi Guringai Conservation Lands	No comment on the ACHA. Additional information provided for inclusion in the CVA (Appendix C).	Noted.

¹ Voicemail messages were left with the following people: Andrew Smith (Worimi LALC), Candy Towers (Worimi Traditional Owners Indigenous Corporation) and Graeme Russell (Worimi Conversation Lands Board of Management). Contact could not be made with Dave Feeney (Karuah Indigenous Corporation) as the listed phone number was no longer correct.

3 Background information

This section provides a brief summary of the environmental and archaeological context of the study area. For a comprehensive review please refer to the archaeological assessment (Appendix B).

3.1 Environmental context

The environmental context is used to predict the spatial distribution, preservation and likelihood of archaeological material. Landscape features were an important factor for the choice of camping, transitory and ceremonial areas used in the past by Aboriginal people. Natural resources, linked to the topography, hydrology, geology and soil types, would have provided food, tools and materials. Additionally, natural and cultural (human-made) site formation processes influence the present location of archaeological material along with its preservation and archaeological integrity.

3.1.1 Topography

The study area is located within the Sydney Basin Bioregion and Coastal Barriers mesoregion. Coastal barriers are accumulations of wave, tide, and wind deposited sands and similar material. Barrier systems fronting coastal environments are called outer barriers, whilst inland barriers are called inner barriers. The study area is situated in the inter-barrier depression between an inner barrier formed in the Pleistocene (approximately 120,000 years ago) and an outer barrier formed in the Holocene (approximately 10,000-6,000 years ago) when current sea levels stabilised after the last glacial maximum. The study area is comprised of an undulating terrain of low dunes and swales situated within a relatively flat and featureless corridor.

The study area is wholly comprised of the Sydney to Newcastle Barriers and Beaches landscape unit (Mitchell 2002, p. 109; refer to Figure 3.1). This landscape unit is characterised by sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons (Mitchell 2002, p. 109). Topography within this landscape unit is minimal with general elevation ranging from 0–30 m above sea level and local relief of less than 10 m.

3.1.2 Hydrology

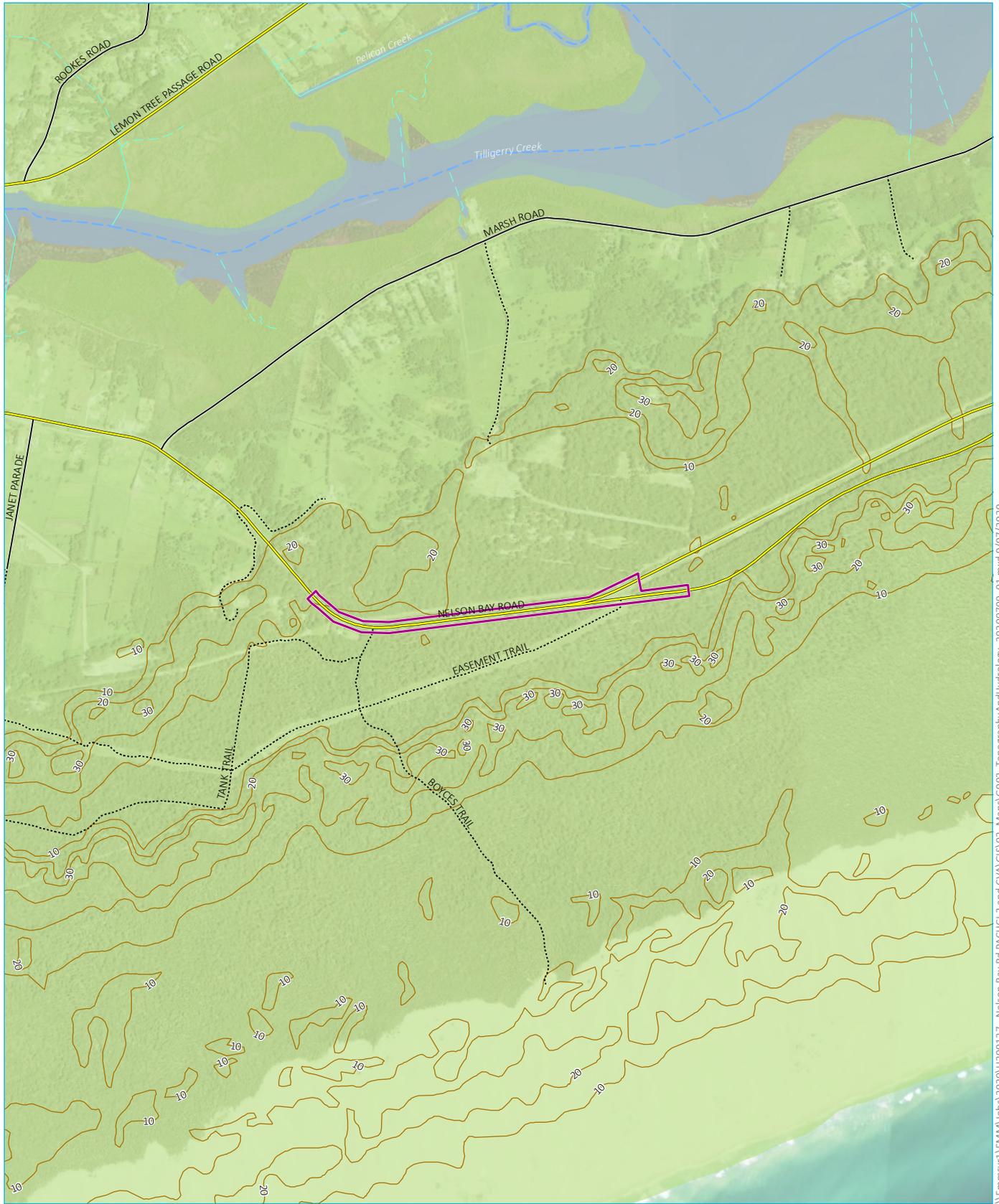
The study area is situated within the Hunter–Central Rivers catchment. The study area is situated between Stockton Beach, located 2.2 km to the south, and Tilligerry Creek, located 1.6 km to the north (Figure 3.1).

3.1.3 Geology and soils

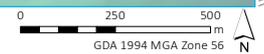
The study area is dominated by the Hawks Nest soil landscape with small sections of the Boyce Track soil landscape as derived from OEH Soil Landscapes of the Newcastle 1:100,000 Sheet (Matthei 1995).

The Hawks Nest soil landscape is characterised by stable, gently undulating, Holocene, sandsheets and low transgressive dunes, with low sandy dunes and swales present as the dominant landform elements (Matthei 1995). Sedimentology consists of up to 150 cm of bleached loose sand A horizon topsoils. Subsoil B horizons can range between 30–100 cm, overlying with a subsoil C horizon of over 300 cm. Swampy swales can include small areas of acid peats, as well as very poorly drained acid peat/siliceous sand intergrades. The Hawks Nest soil landscape is subject to high wind erosion, high water tables and seasonal waterlogging, and soils are typically moderately acidic.

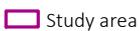
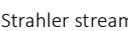
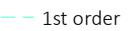
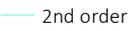
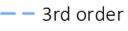
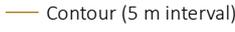
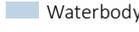
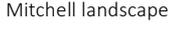
The Boyce Track soil landscape is characterised by transgressive dunes separated by the low relief sand plain of the Hawks Nest soil landscape (Matthei 1995). Sedimentology consists of up to 100 cm of A horizon, which overlies up to 50 cm of B horizon subsoils and up to 500 cm of C horizon. The Boyce Track soil landscape is subject to high wind erosion and soils range from moderately acidic to neutral.



Source: EMM (2020); DFSI (2017); OEH (2017); DPI (2015)



KEY

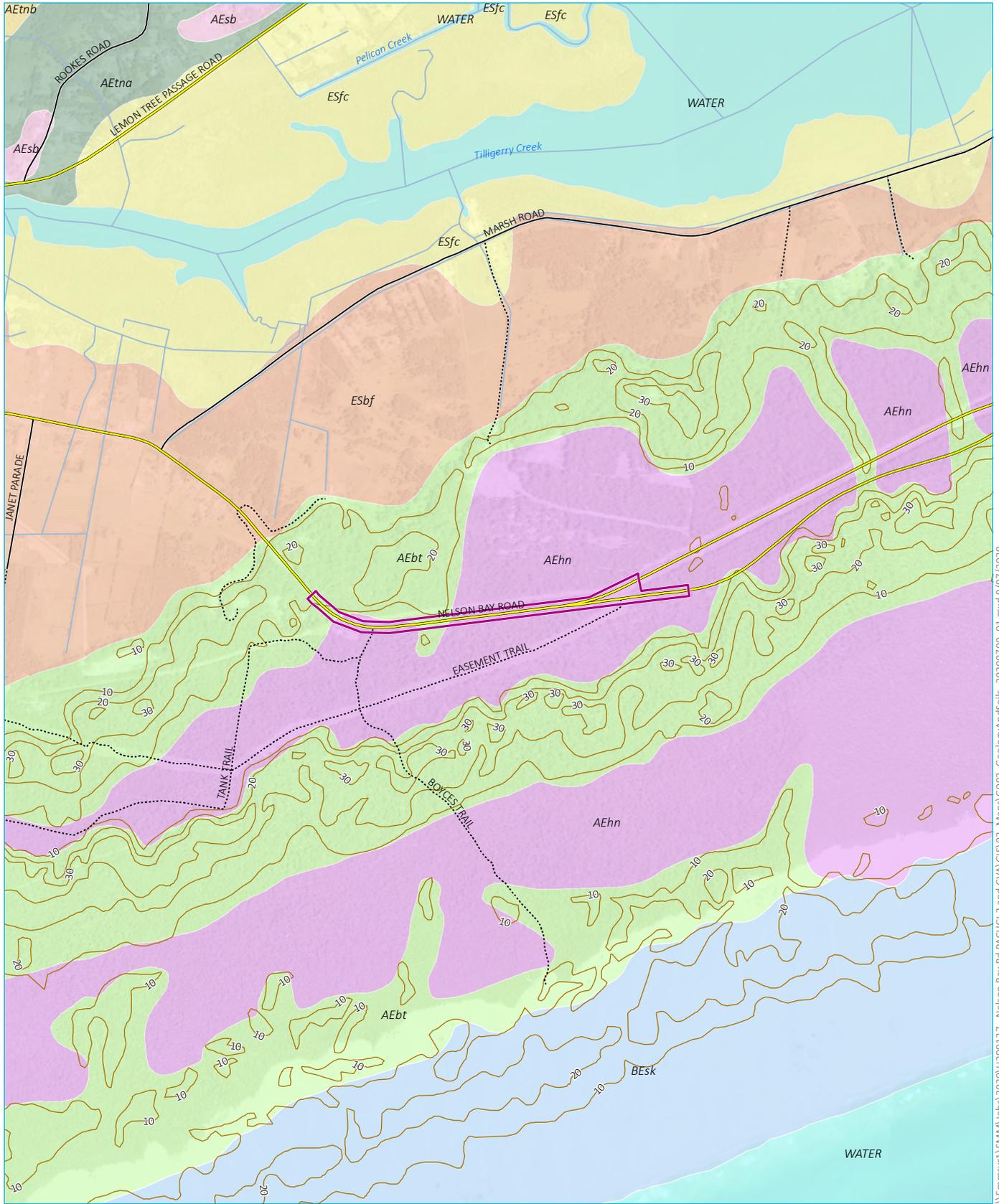
- | | |
|---|---|
|  Study area |  1st order |
|  Main road |  2nd order |
|  Local road |  3rd order |
|  Unsealed access track |  4th order |
|  Contour (5 m interval) | |
|  Waterbody | |
|  Mitchell landscape | |
|  Sydney - Newcastle Barriers and Beaches | |

Topography and hydrology of the study area

Nelson Bay Road Upgrade - Section 1
 Aboriginal cultural heritage assessment
 Figure 3.1



\\Emmsvr1\EMM\Jobs\2020\H200127 - Nelson Bay Rd PAC\CI 3 and CVA\GIS\02_Maps\G002_TopographyAndHydrology_20200709_01.mxd 9/07/2020



Source: EMM (2020); OEH (2018); DFSI (2017)



KEY

- Study area
 - Main road
 - Local road
 - Unsealed access track
 - Watercourse/drainage line
 - Contour (5 m interval)
- | | |
|---|--|
| <ul style="list-style-type: none"> Boyces Track (AEbt) Hawks Nest (AEhn) Shoal Bay (AEsb) Tea Gardens variant a (AEtna) | <ul style="list-style-type: none"> Tea Gardens variant b (AEtnb) Stockton Beach (BEsk) Bobs Farm (ESbf) Fullerton Cove (ESfc) Water |
|---|--|

Geology and soils of the study area

Nelson Bay Road Upgrade - Section 1
 Aboriginal cultural heritage assessment
 Figure 3.2



\\Emmsvr1\EMM\Jobs\2020\H200127 - Nelson Bay Rd PAC\CI 3 and CVA\GIS\02 - Maps\G003_GeologyAndSoils_20200709_01.mxd 9/07/2020

3.1.4 Flora and fauna

The vegetation of the Hawks Nest and Boyces Track landscapes have a distinct zonation of vegetation with increasing soil development from the beach to the inland dunes (Matthei 1995). Vegetation of outer barrier systems fronting coastal environments where there is minimal soil development is typically limited to spinifex and coast wattle. Towards inner barrier systems, swampland and estuaries support heathland and open scrub, including Swamp Oak, tea-tree and common reed. Within the inter-barrier depression, where the study area is located, the vegetation consists predominantly of open woodland. Common species include Smooth-Barked Apple and banksia with an understorey of bracken and wattle.

Located in the intermediary area between coastal and swamp and estuarine environments, the study area would have provided Aboriginal people with an abundant source of floral and faunal resources, particularly bird and reptile species.

3.1.5 Land use and disturbance

European agricultural practices have occurred throughout much of the locality, and present land uses include agriculture, horse and cattle grazing, hobby farms and low-density housing, as well as recreational and industrial businesses.

Historical records from the northern end of Stockton Beach indicate that when this area was settled by small farmers in the 1870s, sand stretched only 50 m from the beach and was backed by dense heathland. The area was extensively cleared for farming, however the area was largely abandoned within 30 years due to sand mobilisation related to vegetation removal (Jones 1990, p. 37). Vegetation within the road corridor has been cleared to varying widths of 6–20 m from the edge of pavement.

The study area has been subject to a moderate to high level of disturbance associated with vegetation clearance and construction of Nelson Bay Road. Underground utilities are present within the road corridor on both the northern and southern verges which will have associated levels of disturbance, in addition to an overhead powerline located immediately north of the study area.

3.2 Archaeological context

3.2.1 Ethno-historical context

A comprehensive review of the ethno-historical context of the study area is provided in Section 2.2.1 of the archaeological assessment provided in Appendix B.

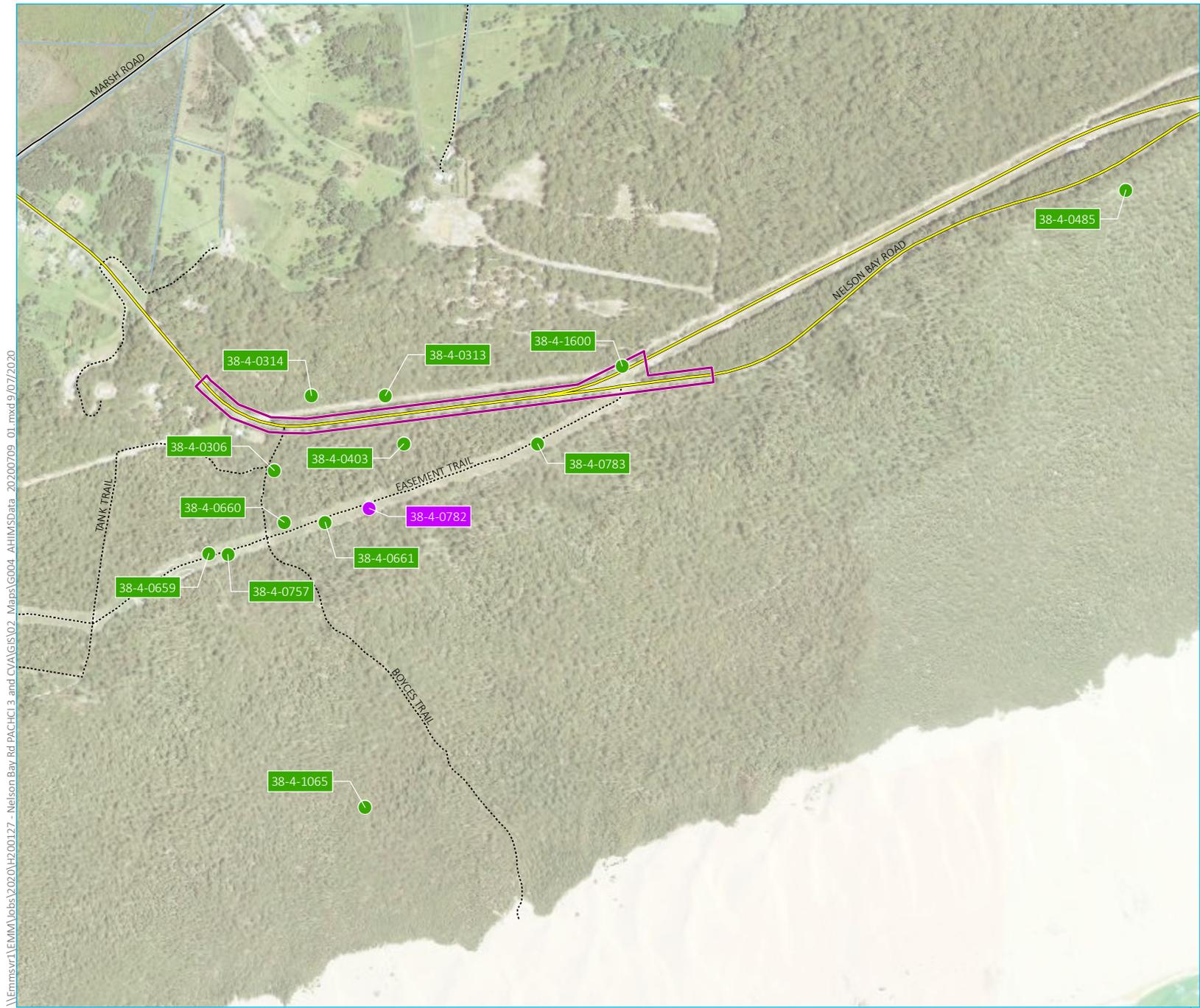
Detailed ethnographic research was completed as part of the CVA provided in Appendix C.

3.2.2 Register searches

Aboriginal Heritage Information Management System

A search of the Aboriginal Heritage Information Management System (AHIMS) database was completed 23 April 2019 (ID 416509) over a 12 km² area centred on the study area.

The search identified 13 AHIMS registrations shown with relation to site type in Table 3.1 and in proximity to the study area on Figure 3.3.



- KEY**
- Study area
 - Main road
 - Local road
 - Unsealed access track
 - Watercourse/drainage line
- AHIMS site type**
- Artefact
 - Shell

\\Emmsvr1\EMM\Jobs\2020\H200127 - Nelson Bay Rd PACHCI 3 and CVA\GIS\02_Maps\G004_AHIMS\data_20200709_01.mxd 9/07/2020

Source: EMM (2020); OEH (2019); DFSI (2017)



AHIMS sites and the study area

Nelson Bay Road Upgrade - Section 1
 Aboriginal cultural heritage assessment
 Figure 3.3



Table 3.1 AHIMS extensive search results (as of 23 April 2019)

Site Type	Number of sites	Representation (%)
Shell middens	12	92
<10 shell fragments	3	23
20–50 shell fragments	2	15
Small scatter (number of shell pieces not specified)	7	54
Isolated find (stone artefact)	1	8
Total	13	100

Shell middens represent the dominant site type for the area; however, it is important to note that no stone artefacts were identified in association with any shell material registered as middens and several site descriptions comment that the shell material may be naturally occurring.

One midden site, “OFOC1” (AHIMS 38-4-1600), falls within the study area boundary located on an unsealed easement for the overhead powerline north of the Nelson Bay Road. This site and previous investigations in the vicinity of the study area are discussed further in Section 3.2.3.

Birubi Point Aboriginal Place, gazetted under Section 84 of the NPW Act, is a traditional Aboriginal ceremonial and burial site located approximately 12 km north-east of the study area.

Local Environmental Plan

The study area is located within the Port Stephens LGA. There are no declared Aboriginal places, archaeological sites or heritage conservation areas listed in Schedule 5 Environmental Heritage of the Port Stephens Local Environmental Plan (LEP) 2013 within the study area.

The ‘Stockton Beach Dune System’ (Schedule 5, Item 34), listed in the LEP as locally significant, is located immediately adjacent to the study area, south of the current road corridor within the Worimi National and Regional Parks.

Native title claims and indigenous land use agreements

A search of the National Native Title Tribunal Register of Native Title Applications, Registration Decisions and Determinations completed 2 May 2019 identified no determined native title or land claims over the study area.

3.2.3 Previous archaeological investigations

A large number of Aboriginal heritage investigations have been undertaken within and near the study area. Most of the previous investigations have been undertaken in response to industrial and residential developments and public infrastructure projects. The following provides a review of investigations most relevant to the study area.

Report on Newcastle Sites (Dyall 1975)

Dyall (1975) provides a description of middens along the outer margin of the active transgressive dunes extending north from Boyce's track to Biribi Point. Dyall (1975) describes identified middens as "pipi heaps, quite small and generally only a few centimetres thick". Dyall (1975) noted that pilots from the nearby Royal Australian Airforce base had reported finding edge ground axes in shell middens in the area, however at the time of survey only a small number of stone artefacts were located. The midden sites are interpreted as 'dinner-time' or short-term camps.

Newcastle Bight Sand Drift Study (Robson et al. 1985)

Robson (et al. 1985) investigated morphological changes in the transgressive dunes of the Newcastle Bight, examining five cross sections of the frontal dune and inter-barrier depression. The study concluded there has been significant deflation of the basin followed by sand blowing in from the beach berm and frontal dunes to form a localised dune system. Robson et al (1985) specifically discuss the presence of large accumulations of shell material in the inter-barrier depression which is not cultural midden material. Rather this material is attributed to deflation of former water-front foredune deposits leaving natural shell accumulations as a 'lag deposit'.

Newcastle Bight Aboriginal Sites Study (Jones 1990)

In 1990, Pam Dean-Jones completed an archaeological study of Aboriginal sites in the Newcastle Bight to inform future development constraints. The study included a review of ethnographic and archaeological information, targeted survey and consultation with Aboriginal stakeholders.

Sites were classed into 14 iterations of isolated artefacts, shell scatters, middens, and open campsites. Due natural and human-made processes which can disturb shell deposits making it difficult to determine natural or cultural origin, shell deposits were only identified as Aboriginal midden sites if they demonstrated one or all of the below:

- contain packed pipi shell;
- include stone artefacts; and/or
- are associated with a former stable dune surface.

The study recorded 110 Aboriginal sites. For the most part, midden complexes were identified on the outer barrier and open campsites on the inner barrier. Geomorphological data demonstrated that the inner barrier was formed in the Pleistocene (approximately 120,000 years ago) during the last interglacial period of high sea levels, whilst the outer barrier was formed during the Holocene (6,000 years ago) and continues to be modified by natural processes.

The current study area (Section 1) was included in the targeted survey area as 'Tilligerry Creek, Port Stephens shoreline' (Jones et al. 1990, p. 119). Sites identified within this survey area included shell scatter (50%) and open campsites (12.5%), and isolated artefacts (12.5%) (Jones et al. 1990, p. 119). Sites recorded by Jones et al (1990) in proximity to the current study area include M5 (AHIMS 38-4-0313), and M6 (AHIMS 38-4-0314), and BT1 (AHIMS 38-4-0306). M5 and M6 are heavily disturbed very low density and fragmented shell scatters on transgressive dunes within an easement track to the north of Nelson Bay Road. BT1 is a disturbed shell scatter along Boyce's Trail which at the time of recording was regularly utilised by 4WD vehicles.

Archaeological survey of the route of MR108 Nelson Bay Road (Byrne 1994)

In 1994, Brayshaw McDonald completed an archaeological survey of an area surrounding the existing Nelsons Bay Road between Salt Ash and Bobs Farm prior to construction of a new dual carriageway (Byrne 1994). The study included survey of the study corridor, approximately 8 km long and 53 m wide. Two shell scatters were identified as a result of the survey; Nelson Bay Road #1 (AHIMS 38-4-0402) and Nelson Bay Road #2 (AHIMS 38-4-0403/AHIMS 38-4-1065²). These sites are noted as the only locations where more than single shell fragments were observed and Byrne (1994, pp. 9–10) notes the shell may be naturally occurring.

Tomago to Tomaree Electricity Upgrade Indigenous Cultural Heritage Assessment (ERM 2003)

In 2003, Environmental Resources Management Australia (ERM) completed an assessment for proposed upgrades to electricity powerlines from Tomago to Tomaree including a construction maintenance road from Tomago to Salt Ash. The assessment area was approximately 40 km long and ranged in width from 15–50 m, which directly intersected the current study area.

A total of 15 Aboriginal sites were identified as a result of the survey, including nine new registrations and six previously recorded sites. ERM revisited site M5 (AHIMS 38-4-0313), previously recorded by Jones et al. (1990). The size of the site was reduced significantly and limited to the southern side of the access road, and the report states “the archaeological integrity [of M5] is highly questionable due to disturbances, consequently providing little information about the size and nature of the original archaeological deposit. Low research potential” (ERM 2003, pp. 35, 44).

The assessment revisited previously recorded midden sites EA Site 2 (38-4-0659) EA Site 3 (38-4-0660) and EA Site 4 (38-4-0661) recorded in 2001 by Steven O’Reilly. EA Site 2 included whole and fragmented shell in an exposure at the base of a large dune, adjacent to a bike trail. No bone or stone artefacts were identified in association and ‘it is possible that this is a natural deposit’. EA Site 3 and EA Site 4, each located on the crest of small dunes, contained shell fragments as well as modern European debris. No artefacts were identified in association with the deposits, however due to the size and representation of edible species the material was recorded as cultural deposit.

ERM reassessed EA Site 2, EA Site 3 and EA Site 4 which were located in an area recently burnt by a bushfire resulting in high ground surface visibility (ERM 2003, p. 37). Shell was assessed as too small to represent edible species, the majority of shells were whole with no associated bone or stone artefacts, and no darker sediment to suggest cultural occupation. ERM concluded that ‘although these sites have been registered, the evidence suggests that they are a natural deposit rather than an anthropogenic deposit’ (ERM 2003, p. 44). ERM also identified numerous small shell scatters during the survey which shared the same attributes as noted above and were assessed as natural deposits.

The assessment identified seven areas of potential archaeological deposit (PAD) along the length of the proposed route. PAD 4, located to the south of Nelson Bay Rd approximately 200 metres from the current study area, was subject to subsurface investigation undertaken by Umwelt (2004) with representatives from the Worimi LALC. A total of ten auger holes completed at 2 m intervals between proposed power pole locations identified an isolated brown silcrete flake (AHIMS 38-4-0782) and six shell fragments (AHIMS 38-4-0783). Both sites were impacted under an approved Section 87 Permit (#2025).

Archaeological Assessment Report, Fibre Optic Cable Route: Campvale to Nelson Bay, NSW (Umwelt 2013)

In 2013, Umwelt completed an archaeological assessment of a proposed fibre optic cable route extending from Campvale to Nelson Bay, which incorporates the full length of the current study area identified as ‘Area 3’. The survey, completed with Worimi LALC and RAPs for that project, inspected two previously recorded sites and identified five new sites including a scarred tree and four shell scatters including OFOC1 (AHIMS 38-4-1600).

² Duplicate AHIMS registrations for Nelson Bay Road 2.

OFOC1 is located within the current study area (refer to Figure 3.3), on the northern verge of the northbound lane of the existing duplication of Nelson Bay Road. The site is described as a very low density, highly disturbed scatter of shell located within a truncated dune surface extending into the power easement (Umwelt 2013, p.7.5). The site consists of two exposures; one containing two fragments of shell and another containing one shell. Umwelt note “the area is highly disturbed, and the shell fragments have been moved from their original depositional context as a result of disturbance associated with the road, power easement and vehicle movements” (2013, p.7.5).

No areas of PAD were identified within the current study area. The nearest area of PAD identified by the Umwelt assessment is approximately 2 km north-east of the current study area which was subject to test excavation. A total of 10 pits were excavated to a maximum depth of 1.1 m. No artefacts were identified and A1 and A2 horizons were absent. The test excavation demonstrated that the upper soil units in all tested locations, which were selected on the basis that they appeared to be the least disturbed, were in fact highly disturbed and in most cases had been entirely truncated (Umwelt 2013, p.9.1).

An AHIP for the entire fibre optic route was obtained which did not require archaeological salvage. OFOC1 as contained within the construction area in the northern verge of Nelson Bay Road has been destroyed.

ii Burials

Two Aboriginal burials have been identified in the mobile dune fields of Stockton Beach, south of the current study area, in 1989 and 1993 (Evans 1989, 1993). The skeletal remains in both instances were fully articulated suggesting a fully extended burial. Analysis suggested both skeletal remains belonged to females in early adulthood who had lived on a traditional diet. Both burials were removed because of the likelihood of further disturbance and reburied at Tanilba Bay, Port Stephens.

3.3 Predictive model

3.3.1 Basis of the predictive model

A predictive model of Aboriginal site location has been devised based on the data presented in the preceding sections. In summary the model has been developed through the analysis of:

- landscape features and disturbance in the study area and its surrounds;
- pre-colonial period ecological conditions;
- ethno-historical information about Aboriginal life and material culture; and
- the type and distribution of Aboriginal sites described in previous reports and AHIMS data.

3.3.2 Predictive model results

- **Middens:** Middens are formed as a result of focused exploitation of shellfish species at a single point on the landscape with forms a feature distinguishable from a natural shell layer through the inclusion of burnt shell and/or bone, charcoal, stone artefacts or hearth stones, and in some instances stratification. Middens can be found along the coast and on the shorelines of estuaries, lakes and rivers. Middens represent the dominant site type recorded in the local area and as such are the most likely to occur within the study area. However, within the modified context of the study area middens are likely to have been disturbed or removed by historical land use.
- **Open artefact sites and isolated finds:** Open stone artefact scatters and isolated finds may occur anywhere in the landscape as background scatter but are most likely to occur close to reliable sources of water. There is only one artefact site identified by AHIMS within the search area surrounding the study area. Although

stone artefact sites may be present, their detection is dependent on favourable ground surface visibility conditions. Further, ground disturbances will have an effect on the accuracy of the predictive model. High sensitivity for open stone artefact sites includes level to gently inclined, elevated landforms reliable sources of fresh water including crests, spurs, terraces, whilst isolated artefacts may occur anywhere. Artefact sites are unlikely to occur within terrain too steep for occupation or on low-lying areas where standing stagnant water or regular inundation would have prevented focussed activities.

- **Burials:** Burials in the Newcastle region are often associated with sand dune systems, specifically, burials have been identified within the sand dunes of the Stockton Bight. Burials are typically identified through accidental exposure. The level of disturbance within the study area in addition to the natural movement processes of dune landforms means it is unlikely that the location of any burial sites will be able to be identified by survey.
- **Modified (scarred or carved) trees:** Modified trees may occur if mature trees of a sufficient age to bear the marks of traditional Aboriginal scarring or carving are present. Vegetation clearance has occurred within the study area, with the road corridor cleared to varying widths of 6–20 m from the edge of pavement. There are areas of vegetation outside of these cleared areas which features Smooth-barked Apple eucalypts which, where mature specimens are present, have the potential to display evidence of cultural modification.
- Sites such as stone arrangements, rock art, shelters and engravings, as well as grinding groove sites are unlikely to occur due to the absence of suitable outcropping geology within the study area as well as vegetation clearance and ground surface disturbances.

4 Archaeological assessment

This section provides a brief summary of the archaeological assessment of the study area (EMM 2019). The archaeological assessment is provided in full in Appendix B.

The following is a summary of detailed information provided in the archaeological assessment.

4.1 Investigation

On Wednesday 8 May 2019, an archaeological survey of the study area was completed with participants as identified in Table 4.1. The main aims of the survey were to identify Aboriginal sites if present and characterise the landscape to aid predictions of subsurface archaeological potential.

Table 4.1 Survey participation

Name	Organisation	Role
Morgan Wilcox	EMM	Senior Archaeologist
Deborah Swan	Transport for NSW	Aboriginal Cultural Heritage Officer
Chad Stockham	Transport for NSW	Project Manager
Brett Chambers	Worimi LALC	Site Officer
Samuel Chaffey	Worimi LALC	Trainee Site Officer

4.2 Methods

The archaeological survey and data collection methods followed Section 2.2 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b), which sets out the required recording methods.

The survey team comprised five people each with a survey coverage width of 5–10 m. The study area was divided into three survey units (SU) to aid description and recording. The survey strategy was to cover the entire study area with a focus on ground surface exposures.

The survey effort was recorded using the *Australian Soil and Land Survey Field Book* (CSIRO 2009) as a guide and using a hand-held non-differential GPS unit (MGA94 Zone 56) with photographs to identify landscape context.

The methodology for identifying and recording Aboriginal sites is in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b), with any sites identified to be recorded using a hand-held non-differential GPS unit (MGA94 Zone 56).

4.3 Survey limitations

Archaeological surveys are inherently limited by ground surface visibility conditions and therefore any survey, despite the intensity of survey effort and spacing of survey transects, is considered to only sample the archaeological landscape.

Calculations of effective survey coverage are presented in the archaeological assessment (EMM 2019; Appendix B).

4.4 Results

The study area contains one previously recorded site, OFOC1 (AHIMS 38-4-1600).

No additional Aboriginal sites or areas of PAD were identified by this assessment.

4.4.1 Aboriginal sites identified

Four small shell fragments likely associated with previously recorded Aboriginal site OFOC1 (AHIMS 38-4-1600) were identified within the study area (refer to Plate 4.1). OFOC1 is a very low density and low integrity shell scatter located within a highly disturbed context, consisting of four shell fragments less than 2 cm in diameter removed from their original depositional context as a result of disturbance (Umwelt 2013, p.7.5).

Additional shell fragments were identified at three other locations within the study area however there is no evidence to suggest that any of the material is cultural and was assessed as naturally occurring.

A Smooth-bark Apple eucalyptus was identified by the Worimi LALC representative as a possible women's tree. The tree in question is located outside of the study area boundary and will not be impacted by proposed works. Due to insufficient information to demonstrate cultural origin, the tree has not been identified by the archaeological assessment as an Aboriginal object. It has however been acknowledged that this item has been identified as being of cultural importance and controls have been recommended to ensure against impacts during construction.

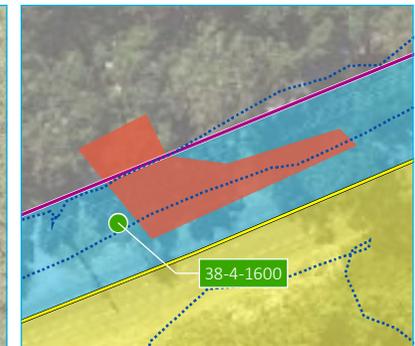
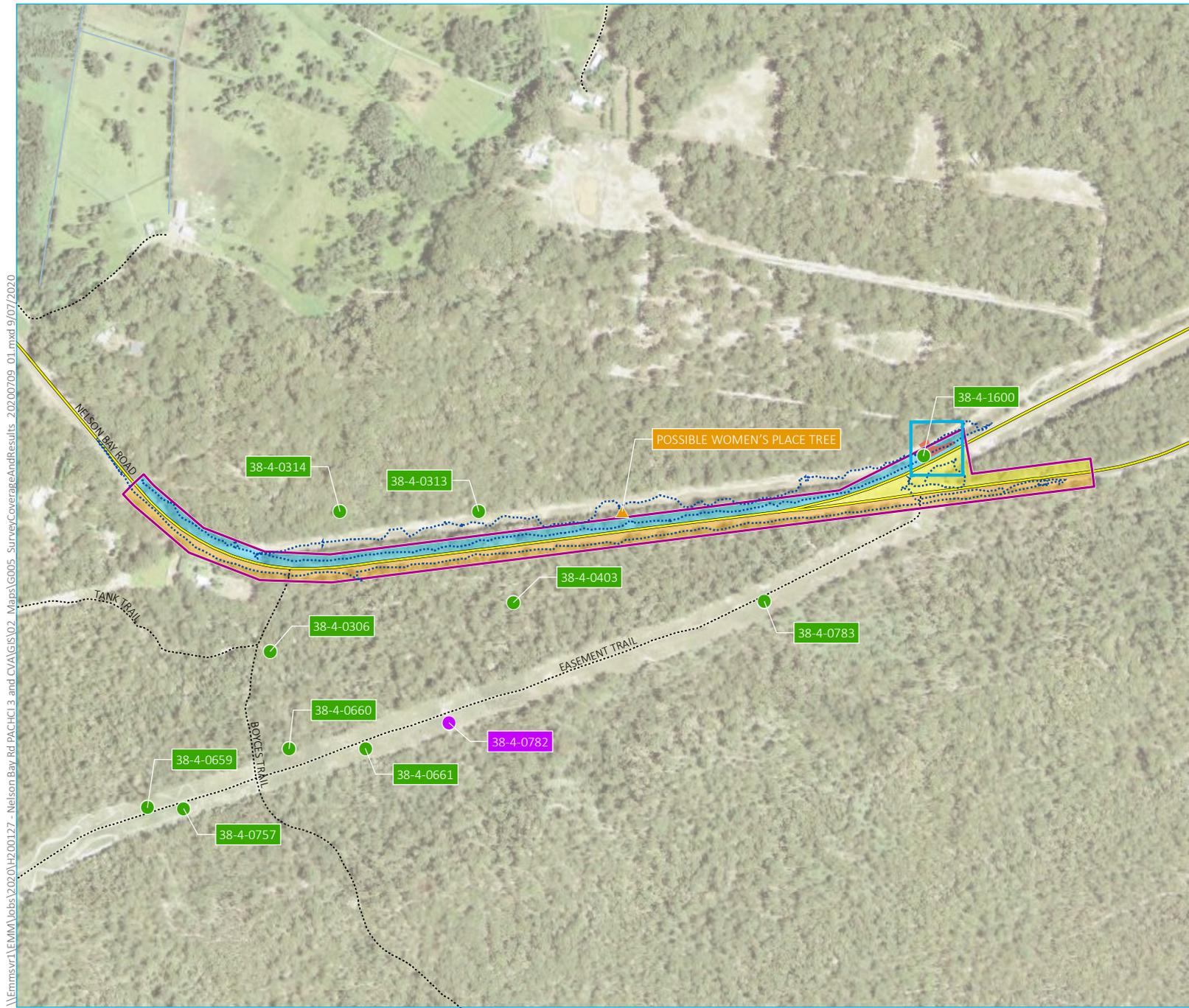


Plate 4.1 Shell fragments associated with Aboriginal site OFOC1 (AHIMS 38-4-1600)



Plate 4.2 Possible women's place marker tree



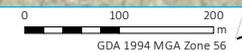


- KEY**
- Study area
 - 38-4-1600 site extent (Source: Umwelt)
 - Main road
 - Unsealed access track
 - Watercourse/drainage line
 - Survey transect
- Survey unit**
- SU1
 - SU2
 - SU3
- AHIMS site type**
- Artefact
 - Shell
- Heritage survey results**
- ▲ Possible women's place marker tree

Survey coverage and results

Nelson Bay Road Upgrade - Section 1
Aboriginal cultural heritage assessment
Figure 4.1

Source: EMM (2020); DFSI (2017)



4.5 Discussion

The study area and immediate surroundings is known to have been utilised by Aboriginal peoples in the past, and this practice continues into the present due to the availability of a range of estuarine, coastal and swamp resources. However, the survey demonstrated that the study area has been subject to extensive disturbance across an undulating terrain of low and moderately sized dunes. Disturbances associated with vegetation clearance and the construction of Nelson Bay Road, as well as underground utilities on both the northern and southern road verges, has had a significant impact upon the archaeological potential and integrity of the study area and has likely removed any significant traceable archaeological material.

Subsurface investigations conducted by ERM (2003) and Umwelt (2013) within the Nelson Bay Road corridor or nearby powerline easements, which targeted areas which appeared to exhibit minimal disturbance, were shown to be highly disturbed as a result of construction and in some cases had been entirely truncated. Where cultural material was identified it was limited to one instance of an isolated stone artefact, or very low-density shell fragments with no evidence of cultural derivation. The proximity of these investigations mean that their interpretations of the limited archaeological potential and low integrity of the area can be reasonably applied to the current study area.

Aboriginal objects have potential to occur sporadically within the study area in an unpredictable pattern representative of background scatter, however if present they are likely to be of very low density in highly disturbed locations divorced from their original depositional context. The predicted location of Aboriginal objects within highly disturbed contexts such as the study area cannot be scientifically modelled.

Areas of PAD, as per the Code of Practice (DECCW 2010b: Requirement 15), are areas which must be able to be differentiated from the surrounding archaeological landscape and are anticipated to be of higher archaeological significance than the continuous distribution of archaeological material in which it exists. Sand dune landforms within the locality of the study area have been demonstrated to contain Aboriginal midden sites. However, the archaeological potential of landforms must consider that disturbance can significantly reduce this potential or in some instances remove it entirely and this must be considered in determining whether an area is identified as a PAD. The extent of disturbance throughout the study area is associated with impacts from road construction and other infrastructure including above and below ground utilities. Modifications to the undulating low to moderate height sand dunes within the study area is visually evident within the study area. Subsurface investigations conducted by ERM (2003) and Umwelt (2013) in the immediate locality demonstrated that deposits within the area have been highly disturbed in some cases had been entirely truncated and contain very low density shell material of indeterminate origin (ie natural or cultural). Due to the transgressive nature of the sand dunes, the presence of large amounts of naturally occurring shell, and a significant level of disturbances, being able to determine the cultural origin of any shell material identified has been highly problematic.

Furthermore, as per Section 3.1 of the Code of Practice (DECCW 2010b:24):

archaeological test excavation is only necessary when (regardless of whether or not there are objects present on the ground surface) it can be demonstrated that sub-surface Aboriginal objects with potential conservation value have a high probability of being present in an area.

By reason of the significant levels of disturbance and landform modification within the study area, no areas of PAD have been identified by this assessment. As such, no areas suitable for test excavation have been identified by this assessment.

5 Cultural values assessment

5.1 Overview

A Cultural Values Assessment (CVA) for the proposal was prepared by Waters Consultancy for EMM on behalf of Transport for NSW (provided in Appendix C). The aim of the CVA is to assess the potential impact of the proposal on intangible Aboriginal cultural heritage values and is designed to be read in association with the ACHA that details the findings of the archaeological cultural heritage investigations.

5.2 Methods

The CVA has been completed in accordance with the following documents:

- *Stage 3 of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (Roads and Maritime 2011); and
- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (DECCW 2011).

The detailed cultural assessment of the study area included:

- archival research was undertaken in a range of national, state, and local institutions to provide the historical and ethnographic context for the assessment;
- analysis of the ethnographic literature and historical record was undertaken to provide a contextual understanding to allow for the interpretation and assessment of the cultural information; and
- consultation, including:
 - the identification of cultural knowledge holders for the project area through consultation with RAPs and other stakeholders; and
 - consultation with the identified knowledge holders regarding the cultural values of the project area.

5.3 Consultation

Consultation for the CVA was undertaken in tandem with consultation for the ACHA as outlined in Section 2 of this report. As noted in Section 2.3.1, all RAPs were provided with the proposed CVA methodology on 4 March 2020 for review and comment. An AFG was hosted via the Zoom videoconferencing platform on 8 April 2020 where Kate Waters (Waters Consultancy) presented the proposed methodology. Telephone and/or email contact was made with the RAPs in the two weeks following the AFG to request the nomination of cultural knowledge holders. As a result of these processes thirteen individuals were nominated as cultural knowledge holders, including (in alphabetical order):

- | | | |
|-------------------------|--------------------|------------------------|
| • Andrew Smith, | • Graeme Russell | • Rebecca Young |
| • Anthony Anderson | • Jackie Henderson | • Robert Syron |
| • Aunty Lorraine Lilley | • Jamie Tarrant | • Uncle Neville Lilley |
| • Aunty Val Merrick | • Justin Ridgeway | |
| • Carol Ridgeway | • Lennie Anderson | |

Detailed interviews were conducted with five knowledge holders³.

Telephone discussions were had with five knowledge holders regarding broad cultural values⁴.

One nominated knowledge holder was spoken with briefly but despite repeated attempts a meeting was unable to be scheduled⁵. Another nominated knowledge holder has not been able to be contacted⁶.

The identified knowledge holders spoken with provided cultural and historical information on the broader cultural landscape of the region. This information has informed the assessment process in relation to the cultural heritage values and significance of the broader region.

5.4 Results

Three cultural values were identified within the Section 1 study area, including:

- **West-East Movement Corridor.** A movement corridor running from Tilligerry Creek to the beach front. This movement corridor has high significance to the local Aboriginal community as the patterns of movement hold cultural value for their association with resource use, community gatherings and ceremonial cycles;
- **North-South Movement Corridor.** A movement corridor running from Tomaree south to Fullerton Cove. This movement corridor has high significance to the local Aboriginal community as the patterns of movement that occurred across this zone hold cultural value for their association with resource use, community gatherings and ceremonial cycles; and
- **Sand Doubletail Orchid (*Diuris Arenaria*).** An endangered orchid species that is present in the study area. Orchids were utilised as a traditional food source and hold cultural value for that association. This orchid has medium significance to the local Aboriginal community for its use as a food source.

It is noted that the RAPs and the knowledge holders also place cultural value on any material cultural objects identified during the project.

5.5 CVA recommendations

Aboriginal cultural heritage safeguards for Section 1 recommended by the CVA include:

- Preparation of an Aboriginal Heritage Management Plan (AHMP) should be prepared and implemented as part of the Construction Environmental Management Plan (CEMP), including a requirement for notification of the identified knowledge holders within 48 hours of any discovery of potential archaeological Aboriginal skeletal remains during the proposed works;
- Aboriginal cultural heritage awareness training of all contractor(s) and maintenance personnel involved in the construction works as part of the site induction; and
- Development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist on the cultural values and historical records relating to the cultural landscape of the Section 1 study area with a focus on the three values identified above.

³ Lennie Anderson, Aunty Lorraine Lilley, Uncle Neville Lilley, Robert Syron and Jamie Tarrant

⁴ Anthony Anderson, Jackie Henderson, Aunty Val Merrick, Graeme Russell, Andrew Smith

⁵ Justin Ridgeway

⁶ Carol Ridgeway

6 Significance assessment

6.1 General

All Aboriginal objects in NSW are protected under the *National Parks and Wildlife Act 1974*. It is recognised that harm to Aboriginal sites may be necessary to allow other activities or developments to occur. In order for the consent authority to make informed decisions on such matters, an important element of cultural resource management is determining the significance of cultural heritage places and objects to understand what may be lost, and how best it can be mitigated.

Cultural significance is outlined in Article 1.2 of the *Burra Charter* as ‘aesthetic, historic, scientific, social or spiritual value for past, present or future generations’ (Australia ICOMOS 2013). These values are reiterated in the NSW guidelines, which outlines cultural significance can be assessed by identifying the values that are present across the subject area and assessing what is important and why (DECCW 2011; refer to Table 6.1). In assessing the scientific significance of sites, aspects such as rarity and representativeness and the integrity must be considered. Generally speaking, a site or object that is rare will have a heightened significance, although a site that is suitable of conservation as ‘representative’ of its type will also be significant. Conversely an extremely rare site may no longer be significant if its integrity has been sufficiently compromised.

Table 6.1 A summary of criteria used to assess the cultural significance (DECCW 2011 pp. 8–10)

Criterion	Definition
Social value —Does the place have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons?	Social (or cultural) value refers to the spiritual, traditional, historical or contemporary associations and attachments the place or area has for Aboriginal people. Social or cultural value is how people express their connection with a place and the meaning that place has for them. Social or cultural value can only be identified through consultation with Aboriginal people.
Historic value —Is the place important to the cultural or natural history of the local area and/or region and/or state?	Historic value refers to the association of a place with a historically important person, event, phase or activity. Historic places do not always have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). They may have ‘shared’ historic values with other (non-Aboriginal) communities.
Scientific (archaeological) value —Does the place have potential to yield information that will contribute to an understanding of the cultural or natural history of the local area and/or region and/or state?	Scientific (archaeological) value refers to the importance of a landscape, area, place or object because of its: <ul style="list-style-type: none"> • Research potential: the potential of a site to the present understanding of society and the human past. • Rarity and representativeness: the frequency of a site type and how the sites relate to wider archaeological record. The results may be due to sites being uncommon because of the related activity or preservation, or they are uncommon now because of ongoing site destruction from more recent development. • Integrity: the level of disturbance or intactness of a site and how this may affect research potential. • Education potential: the potential of a site to be used as an educational tool. This usually includes sites with easily identifiable and accessible characteristics that are good representative examples. Information about scientific values is gathered through archaeological investigation undertaken in this report.

Table 6.1 A summary of criteria used to assess the cultural significance (DECCW 2011 pp. 8–10)

Criterion	Definition
Aesthetic value —Is the place important in demonstrating aesthetic characteristics in the local, regional, and/or State environment?	Aesthetic value refers to the sensory, scenic, architectural and creative aspects of the place. It is often linked with social value, and can consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use. This value is only relevant to archaeological sites on only rare occasions, such as rock shelters that contain art, or culturally modified trees in prominent positions, etc.

6.2 OFOC1 (AHIMS 38-4-1600) - statement of significance

i Social/cultural value

Consultation with RAPs both in the field and during AFG meetings has identified that all Aboriginal cultural heritage values are considered to be of high cultural (social) significance. This site has high social significance at the local level as it provides tangible evidence of the use of the area by Aboriginal people (refer to Section 5.4 and Appendix C).

ii Historic value

The site does not meet this criterion. There are no known written or oral historical references to the site.

iii Scientific (archaeological) value

The significance assessment provided in Table 6.2 for previously recorded site OFOC1 (AHIMS 38-4-1600) is in accordance with Umwelt (2013). OFOC1 (AHIMS 38-4-1600) was impacted in accordance with an AHIP (1132343) as a result of installation of a fibre optic cable with an impact footprint of 3 m wide by 1 m deep, extending for 16 km on the northern verge of Nelson Bay Road. As a result, OFOC1 (AHIMS 38-4-1600) is now listed on AHIMS as partially destroyed.

Table 6.2 Summary of significance

Name (AHIMS ID)	Research potential	Rarity and representativeness	Integrity	Educational potential	Overall archaeological significance rating
OFOC1 (38-4-1600)	Low	Low	Low	Low	Low

iv Aesthetic value

The site has low aesthetic significance as it is located within a cleared road and electrical easement.

v Summary statement of significance

Overall, OFOC1 (AHIMS 38-4-1600) is of low archaeological/scientific significance. While such sites symbolise Aboriginal presence in the landscape through their very existence, they can tell us little else, or little further than what is already known and established in archaeology. Notwithstanding the limited information potential, the site is of cultural significance to the Aboriginal community.

7 Impact assessment

7.1 Project impacts

The project design and construction elements are described in detail in Section 1.3. As noted, all proposed ground disturbance will be contained within the existing road corridor, with majority of proposed construction occurring on top of imported fill. Proposed works will involve:

- vegetation clearing of up to 15 m on northern side and up to 10 m on southern side of Nelson Bay Road;
- import of fill material;
- excavation of up to 600 mm below existing road surface; and
- excavation for one retaining wall up to 4 m at its deepest point.
 - to facilitate safe excavation, a temporary sheet piling wall must be installed between the back of the proposed retaining wall and the cadastral boundary. Two large diameter trees⁷ are situated 10–30 cm outside of the road corridor cadastral boundary, however <50% of each tree canopy overhangs the road corridor. Sheet piling would cut and/or remove a significant portion the root system of both trees which would destabilise the trees and create a safety risk should they fall into the road corridor. Transport for NSW propose to remove both trees at ground level with the stump left in place so as to avoid any ground disturbance. Neither tree has been identified by the archaeological assessment as having archaeological or cultural value.

7.2 Measures to minimise harm

The extent of developing practical measures to avoid harm must be weighed against the significance of the Aboriginal sites or places that are likely to be harmed by the proposal. The study area is highly developed which has led to widespread disturbance of the ground and sub-surface. To minimise the risk of harm, Transport for NSW have restricted proposed works to within the existing road corridor.

Proposed impacts to OFOC1 are necessary for the proposal to continue as no feasible alignment alternatives are available. Alternatives to this alignment would likely present much more significant impacts if natural and undisturbed environments were proposed for impacts, in contrast to the highly disturbed road corridor.

7.3 Aboriginal heritage impact

The proposal will impact what remains of Aboriginal site OFOC1 (AHIMS 38-4-1600) within the road corridor study area. Once project impacts are completed, the site would be considered as ‘partially destroyed’.

Authorised unmitigated partial impacts to OFOC1 within the boundary of the current study area have previously occurred in accordance with AHIP 1132343 for installation of an Optus fibre optic cable. As such, any remnant material associated with OFOC1 to be impacted by the proposal is assessed as negligible.

Aboriginal objects have potential to occur sporadically within the study area in an unpredictable pattern representative of background scatter, however if present they are likely to be of very low density in highly disturbed locations divorced from their original depositional context.

⁷ Trees to be removed for retaining wall sheet piling: TR06(3) (GDA94 Z.56 401253E 6371148S) and TR06(10) (GDA94 Z.56 401284E 6371152S)

7.4 Intergenerational loss/ equity

Intergenerational equity is the principle whereby the current generation should ensure the health, diversity and longevity of the environment for the benefit of future society. For Aboriginal heritage management, intergenerational equity can be considered primarily in terms of the cumulative impacts to Aboriginal objects, sites and/or places. If few Aboriginal objects and places remain (eg due to development impacts), there are fewer opportunities for future generations of Aboriginal people and the broader community to enjoy the cultural benefits. Information about the integrity, rarity and representativeness of the Aboriginal objects, sites and places that may be impacted, and how they inform the past visitation and occupation of land by Aboriginal people, are relevant to the consideration of intergenerational equity and the understanding of the cumulative impacts of a project.

While it is acknowledged that the project will cause impacts to Aboriginal heritage, OFOC1 is a very low density and low integrity shell scatter located within a highly disturbed context which offers no archaeological or educational potential for the enjoyment of future generations. Restriction of project impacts to within the disturbed road corridor is a method to minimise loss as much as practically possible. Outside of the proposed project footprint, substantial local archaeological resources remain including Aboriginal sites of high archaeological and cultural significance associated with the Stockton sand dunes, Tilligerry Creek, and the Newcastle Bight.

8 Recommendations

An AHIP is required for proposed impacts to Aboriginal site OFOC1 (AHIMS 38-4-1600).

8.1 AHIP boundary details

The AHIP should be limited to the existing road corridor, inclusive of partial impacts to OFOC1 (AHIMS 38-4-1600). The proposed AHIP boundary is to cover the entirety of the Section 1 proposal area as shown on Figure 8.1.

All land-disturbing activities must be confined to within the existing road corridor. Prior to commencement of construction activities, the perimeter of the proposal area should be fenced with high visibility curtilage to prevent inadvertent impacts outside of the area assessed including to the possible women's tree.

8.2 AHIP duration

An AHIP is proposed for 10 years to allow for the proposed development to be completed.

8.3 Conditions

8.3.1 No salvage proposed

Authorised impacts to OFOC1 (AHIMS 38-4-1600) within the boundary of the study area have previously occurred in accordance with AHIP 1132343 for installation of an Optus fibre optic cable. No salvage activities were required or undertaken as part of prior authorised impacts.

What remains of OFOC1 within the current study area is a very low density and low integrity shell scatter, comprising of four small shell fragments less than 2 cm in diameter located within a highly disturbed context. The remaining shell fragments are not of archaeological or educational merit warranting mitigation via surface collection. As such, no salvage activities are proposed prior to impacts to OFOC1 (AHIMS 38-4-1600).

8.3.2 ASIRF

An Aboriginal Site Impact Recording Form (ASIRF) must be submitted to Heritage NSW and AHIMS to document impacts to the site in accordance with AHIP conditions.

8.3.3 Potential impacts to unidentified objects

The AHIP conditions should allow for unmitigated impacts to any unidentified Aboriginal objects (excluding human skeletal remains) within the proposed AHIP boundary. It is anticipated that any such objects are likely to be highly disturbed and of similarly low significance as the known OFOC1 (AHIMS 38-4-1600).

8.3.4 Human skeletal remains

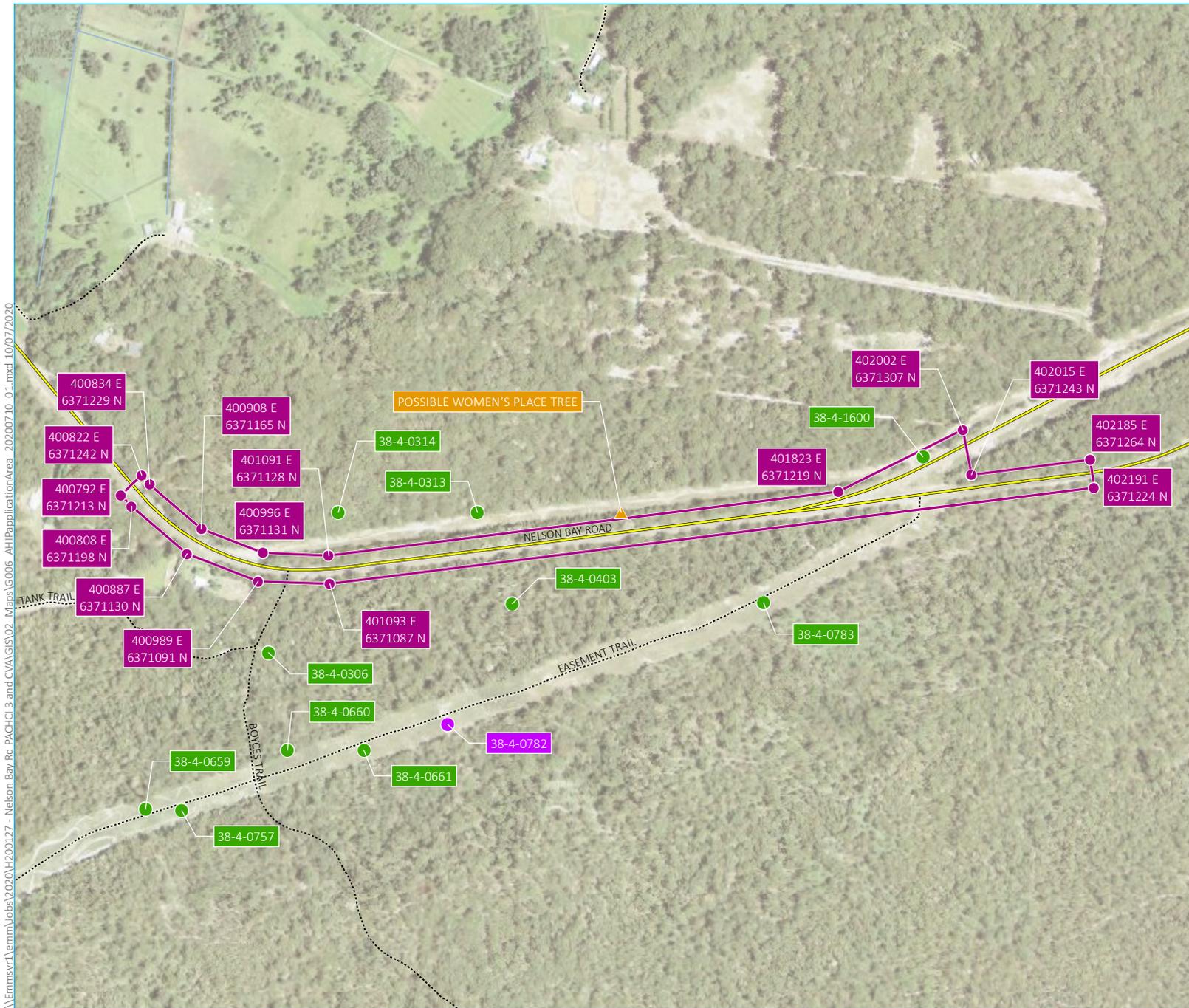
All human remains are exempt from approval to impact under the conditions of an AHIP. The following protocol must be followed in the event that suspected human remains are identified:

- all works in the immediate vicinity must cease;
- unnecessary interference must be avoided;

- the remains will be immediately reported to the work supervisor who will immediately advise the Transport for NSW Project Manager, Environment Manager and/or other nominated senior staff member;
- the Transport for NSW Project Manager or Environment Manager will promptly notify the NSW Police (as required for all human remains discoveries); and
- if the remains are identified as Aboriginal ancestral remains, Transport for NSW will coordinate consultation with Heritage NSW and RAPs to discuss ongoing care of the remains.

8.3.5 Cultural Awareness Training

Completion of cultural heritage awareness training will be a requirement of the Construction Environmental Management Plan for all employees and contractors during project construction.



- KEY**
- AHIP application area
 - Proposed AHIP boundary grid reference (GDA94 MGA zone 56 coordinates)
 - Main road
 - Unsealed access track
 - Watercourse/drainage line
 - AHIMS site type**
 - Artefact
 - Shell
 - Heritage survey results**
 - ▲ Possible women's place marker tree

AHIP application area

Nelson Bay Road Upgrade - Section 1
Aboriginal cultural heritage assessment
Figure 8.1

Source: EMM (2020); DFSI (2017)



References

- Byrne, D 1994, *'Archaeological survey of the route of MR108 Nelson Bay Road, Newcastle Bight, NSW'* A report prepared by Brayshaw McDonald Pty Ltd for Port Stephens Council.
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) 2009, *Australian Soil and Land Survey Field Book*, CSIRO Publishing.
- Department of Environment Climate Change and Water (DECCW)
- 2010a, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*.
 - 2010b, *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*.
 - 2010c, *Aboriginal Consultation Requirements for Proponents 2010*.
 - 2011, *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*.
- Department of Primary Industries 2009, *Appendix F: Stream order and waterway classification system*, Viewed on 25 April 2019 <https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/634621/9.-Appendices-F-toJ.pdf>
- Dyall, LK 1975, *Report on Newcastle Sites*, A report to the Australian Museum.
- ERM 2003, *Tomago to Tomaree Electricity Upgrade Indigenous cultural heritage assessment*, A report prepared for Energy Australia.
- Evans, SL
- 1989, *Human Skeletal Remains Salt Ash, Stockton Beach*. A report prepared for NSW National Parks and Wildlife Service.
 - 1993, *Salvage Report Aboriginal Burial Boyces Track, Stockton Beach, Hunter District*. A report prepared for NSW National Parks and Wildlife Service.
- Jones, P 1990, *'Newcastle Bight Aboriginal Sites Study*, A report prepared for the NSW National Parks and Wildlife Service and National Estate Grants Committee
- Matthei, LE 1995, *Soil Landscapes of the Newcastle 1:100 000 Sheet*. Department of Land and Water Conservation.
- Mitchell, P 2002, *Description for NSW (Mitchell) Landscapes Version 2*, Department of Environment and Climate Change, NSW.
- NSW National Parks and Wildlife Service 2003, *The Bioregions of New South Wales: their biodiversity, conservation and history*, NSW National Parks and Wildlife Service, Sydney.
- Office of Environment and Heritage (OEH)
- 2010, *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.
 - 2013, *Shell Middens: Office of Environment and Heritage Factsheet*, Viewed 29 April 2019, <<https://www.environment.nsw.gov.au/nswcultureheritage/shellmiddens.htm>>.
- Roads and Maritime Services
- 2011, *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*.
 - 2015, *Standard Management Procedure: Unexpected Heritage Items Procedure*.
 - 2019, *Nelson Bay Road: Williamtown to Bobs Farm Preliminary Review of Environmental Factors*.
- Robson, RD, Cox, JR, Killerby, MC, and Bailey JG 1985, *Newcastle Bight Sand Drift Study*, A report prepared for the Soil Conservation Service of New South Wales.

Umwelt (Australia) Pty Limited

- 2004, *Research design and methodology to accompany DEC Section 87 and Section 90 Permit Applications for Stage 2 Investigations and Site conservation works for the Tomago to Tomaree electricity supply upgrade*, A report prepared for Energy Australia.
- 2013, *Aboriginal Cultural Heritage and Archaeological Assessment Report, Fibre Optic Cable Route: Campvale to Nelson Bay, NSW*, A report prepared for Energy Australia.

Glossary

Many of these definitions have been taken from the Code of Practice for archaeological investigation of Aboriginal objects in NSW (DECCW 2010).

Aboriginal object: A physical manifestation of past Aboriginal activity. The legal term is defined in the National Parks and Wildlife Act 1974 section 5 as: any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Typical examples include stone artefacts, grinding grooves, Aboriginal rock shelters which by definition include physical evidence of occupation, midden shell, hearths, stone arrangements and other landscape features which derive from past Aboriginal activity.

Archaeological survey: A method of data collection for Aboriginal heritage assessment. It involved a survey team walking over the land in a systematic way, recording information. Activities are not invasive or destructive.

Aboriginal culturally modified tree: A tree of sufficient age to have been mature at the time of traditional Aboriginal hunter-gatherer life and therefore generally of more than 220 years ago with evidence of bark or cambium wood removal for the purpose of implement manufacture, footholds, bark sheet removal for shelter, or extraction of animals or other food. Care must be taken to distinguish Aboriginal scars from the much more common natural causes of branch tear, insect attack, animal impact, lightning strike and dieback. Culturally modified tree recognition guidelines exist to distinguish these features. Naturally scarred trees are often misidentified as Aboriginal culturally modified trees.

Aboriginal site: The location where a person in the present day can observe one or more Aboriginal objects. The boundaries of a site are limited to the extent of the observed evidence. In the context of this report a 'site' does not include the assumed extent of unobserved Aboriginal objects (such as archaeological deposit). Different archaeologists can have varying definitions of a 'site' and may use the term to reflect the assumed extent of past Aboriginal activity beyond visible Aboriginal objects. Such use of the term risks defining all of Australia as a single 'site'.

Aboriginal stone artefact: A stone object with morphological features derived from past Aboriginal activity such as intentional fracture, abrasion or impact. Artefacts are distinguished by morphology and context. Typically, flaked stone artefacts are distinguished from naturally broken stone by recognition of clear marginal fracture initiation (typically herzian/conchoidal or wedging initiation) on highly siliceous stone types which can often be exotic to the area. Care must be taken to distinguish modern broken stone in machine impacted contexts and therefore context must be carefully considered as well as morphology.

Aggradation: a term used in geology for the increase in land elevation, typically in a river system, due to the deposition of sediment.

AHIMS: Aboriginal Heritage Information Management System — a computer software system employed by the Office of Environment and Heritage to manage many aspects of Aboriginal site recording and permitting. AHIMS includes an Aboriginal sites database which can be accessed via an internet portal.

Archaeological deposit: Aboriginal objects occurring in one or more soil strata. The most common form of archaeological deposit relates to the presence of a single conflated layer of Aboriginal stone artefacts worked into the topsoil through bioturbation.

Backed artefact: A thin flake or blade-flake that has been shaped by secondary flaking (retouch) along one lateral margin. The retouched margin is typically steep and bipolar to form a blunt 'back' in the manner of a modern scalpel blade. Distinctive symmetrical and asymmetrical forms are typically found called geometric microliths and Bondi points respectively. A thick symmetrical form, called an Elouera, is typically the size of a mandarin segment.

Bioturbation: is the reworking of soils and sediments by animals or plants. Its effects include changing texture of sediments (diagenetic), bioirrigation and displacement of microorganisms and non-living particles.

Bipolar flaking: Where the stone to be worked is rested on an anvil or other stone before being hit by the hammerstone. This results in the presence of negative flake scars on both ends of the core.

Bondi point: See backed artefact definition.

Brown podosols: Topsoils have loamy textures. A2 horizons are common. There is a clear boundary onto the B horizon. They have a sandy clay to heavy clay texture (typically occur on upper and mid-slopes).

Chocolate Soils: Soils that are typically formed in a basaltic parent material where slope or bedrock strata influence drainage. Surface horizons comprise loam, clay loam or silty clay loam. There is a gradual boundary to a brown or brownish black B horizon. There is no A2 horizons.

Conchoidal: A term used in relation to fracture surfaces on Aboriginal stone artefacts - bulb-like in the manner of a bulbous protrusion on a bivalve shell.

Elouera: See backed artefact definition.

Erillure scar: The small flake scar on the dorsal side of a flake next to the platform. It is the result of rebounding force during percussion flaking.

Exposure: estimates the area with a likelihood of revealing buried artefacts or deposits, not just an observation of the amount of bare ground.

Geometric microlith: See backed artefact definition.

Grinding grooves: Grinding grooves typically derive from the sharpening of stone hatchet heads on sandstone rock. Grooves appear as elliptical depressions of around 25 cm length with smooth bases. Although mostly occurring in association with water to wash the abraded stone dust away from the groove, such sites have been recorded away from water. Narrow grooves or broad abraded areas may occur less commonly and may be derived from spear sharpening or other grinding activities.

Haematite: a pigment featured in ochre used for tinting with a permanent colour.

Holocene: A period of time generally 10,000 years, which marks the end of the last ice age, to the present.

Igneous: relating to or involving volcanic or plutonic processes.

Indurated mudstone/tuff (IMT): the fine textured, very hard, yellowish, orange, reddish-brown or grey rocks from which stone artefacts are made.

Isotropic: Having a physical property that has the same value when measured in different directions. In relation to stone used for stone tools a fracture path is not hindered by layer boundaries or other favoured plane of cleavage.

Microlith: Very small fragments of flakes retouched into geometric shapes and usually present on tools like barbed spears, arrows and sickles.

Midden: A collection of shells and associated economic remains resulting from Aboriginal food gathering and processing activity. Middens comprise shellfish remains of consistent size in a rich dark earth matrix commonly associated with stone artefacts, fish bone and animal bone although shells are commonly the most obtrusive element.

Keeping place: A room or facility with the express and exclusive purpose of storing Aboriginal cultural heritage materials with accompanying documentation in a secure and accessible manner which protects their cultural heritage values.

Krasnozems: Mainly loams, clay loams and silty clay loams with a clear or gradual boundary to a dark reddish brown B horizon. Clays are typically light to medium and occasionally heavy.

Lithosols: Soils that have little or no profile development. They occur on steep slopes and are usually shallow and are left mainly as uncleared native bushland.

Open stone artefact site/stone artefact site: An unenclosed area where Aboriginal stone artefacts occur – typically exposed from a topsoil archaeological deposit by erosion. Typically the term is used to refer to two or more artefacts although this is an arbitrary distinction. A general ‘rule of thumb’ boundary definition employed by archaeologists is that artefacts or features more than 50 m apart are regarded as separate sites, however there is no theoretical imperative dictating such as rule. (The 50 m separation rule is used for the most part in EMM’s work).

Pirri point: A leaf-shaped stone implement with unifacial retouch extending from the lateral margins to a central keel running the length of the dorsal surface.

Pleistocene: A period of time 2.6 million years ago to 10,000 years ago. Reference to ‘Pleistocene sites’ generally means reference to sites older than 10,000 years.

Podosols: Soils with accumulations of organic matter, iron and aluminium. They are usually sand textured to depth. Yellow and red podosols are generally acid neutral. Yellow podosols have coarse to medium textured A horizons.

Point cluster: A group of GPS points used to identify the locations of individual artefacts in the field.

Potential Archaeological Deposit (PAD): An area where there is an inferred presence of Aboriginal objects in the soil based on the environmental context which is typically associated with discovery of Aboriginal objects in analogous areas. This is not strictly a ‘site’ type, although AHIMS records it as such for the purpose of associating Aboriginal heritage Impact Permits with geographical areas.

Red podosols: Podolsols with a pronounced texture contrast and clear to abrupt boundaries between A and B horizons. A2 is often massive and gravelly.

Retouch: The modification of the edges of a flake or tool by the removal of a series of small flakes.

Siliceous Sands: Sands that are usually found on coarse-grained sandstones and in sandstone colluvium. They are often sandstone outcrops present in the landscape. The topsoil has a loamy sand to light sandy clay.

Scarp: a steep slope characterised by outcropping bedrock. In this report, scarp refers to a combination of landform elements including scarp foot slopes, scarps, and cliff lines where outcropping sandstone is present in the landscape 10% and above.

Spur: the lateral crests of land that descend from the summit of hills or ridges. Spurs typically extend, with decreasing elevation, closer to streams and valley floors than the main crest of a hill.

Taphonomic: the events and processes, such as burial in sediment, leading to the degradation, decomposition or preservation of objects.

Thumbnail scraper: A thumbnail sized thin flake with steep unidirectional retouch or use-wear around a convex working edge.

Transect: A sample unit which is walking line or corridor across the study area.

Upsidence: phenomena that occurs when mining approaches and undermines river valleys. It can result in cracking and buckling of river beds and rock bars and localised loss of water flow.

Visibility: The amount of bare ground on exposures which might reveal artefacts or other archaeological materials.

Yellow earths: predominantly sandy-textured soils with earthy porous fabric, weak profile differentiation and gradual or diffuse boundaries except for the darker A1 horizon.

Yellow podosols: Podosols which typically occur on the upper slopes of steep landscapes and on the mid to lower slopes of others. The A2 soil horizon is present in most profiles and the boundary change to the B horizon is generally clear. The B horizon is typically sandy clay to heavy clay.





Appendix E

Aboriginal Cultural Values Assessment



WATERS
CONSULTANCY

NELSON BAY ROAD UPGRADE (SECTION 1) PROJECT

Aboriginal Cultural Values Assessment DRAFT Report

Prepared for EMM on behalf of Transport for New South Wales

August 2020 (v.4)



HISTORY • CULTURE • HERITAGE

WATERS CONSULTANCY PTY LTD ACN 134 852 314

PHONE 02 9810 6474

EMAIL admin@watersconsultancy.com.au

ADDRESS 66 Balmain Road • Leichhardt NSW 2040

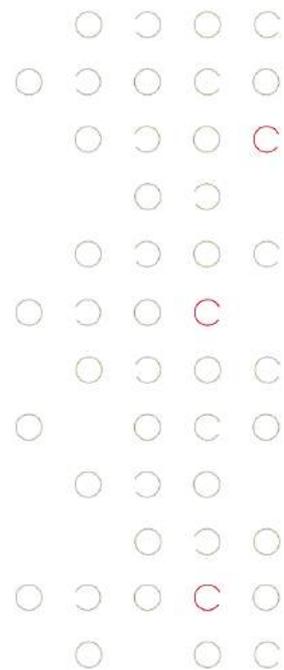


Table of Contents

Note on Photographs of individuals.....5
 Note on language in quotes5

1 Introduction6
 1.1 Overview6
 1.2 The proposed project.....6
 1.3 Aim of assessment7
 1.4 Study area7
 1.5 Summary of results7

2 Methodology13
 3 Consultation Process13
 4 Previous Historical and Cultural Assessment14
 5 What is Cultural Significance?14
 6 The Cultural Landscape of the Study Area16
 7 Overview of Findings and Recommendations48
 8 Detailed Cultural Significance Assessment.....51
 8.1 West-East Movement Corridor52
 8.2 North-South Movement Corridor54
 8.3 *Diuris arenaria* (Sand Doubletail) Orchid55

9 Statement of Impact57

10 Bibliography.....58
 11 Appendix A: Email of 4 March (including draft CVA methodology).....64
 12 Appendix B: AFG 1 Presentation on CVA73
 13 Appendix C: Email of 9 April 202080
 14 Appendix D: Minutes of AFG 182
 15 Endnotes.....88

Maps

Map 1: Extract from 1893 map showing study area.24
 Map 2: Sandy Point Reserve, c.1918.25
 Map 3:1898 Reserve at Karuah.26

Figures

Figure 1: Regional context.....8
 Figure 2: Nelson Bay Road Upgrade (Section 1)9
 Figure 3: Nelson Bay Road Upgrade (Williamtown to Bobs Farm investigation area)10

Figure 4: Nelson Bay Road Upgrade (Williamstown to Bobs Farm area in context) 11
 Figure 5: Nelson Bay Road Upgrade showing Worimi Conservation Lands..... 12

Tables

Table 1: Food species in Birubi Point middens. 43
 Table 2: Summary of Significant Cultural Values in Section 1 48
 Table 3: Recommended Aboriginal Cultural Heritage Safeguards for Section 1 49

Images

Image 1: 'The Coal River or Port of Newcastle' [looking north to the study area], c.1808..... 17
 Image 2: 'Bush scene, Port Stephens', 1849..... 20
 Image 3: 'Entrance to Port Stephens', May 1879. 23
 Image(s) 4: Former wetlands in the study area..... 29
 Image 5: Remnant forest within the Worimi Conservation Lands. 30
 Image 6: 'Corroboree at Newcastle, c.1818'. 32
 Image 7: Unnamed Aboriginal man, Port Stephens, NSW, c.1890..... 37
 Image(s) 8: The study area and surrounds. 40
 Image 9: Gigantic Lily, Newcastle, 1835. 41
 Image 10: An unnamed young Aboriginal woman, Port Stephens district, c.1880-90s. 44
 Image 11: Drawing from William Scott's manuscript. 45
 Image 12: Looking towards Birubi Point, 2020..... 52
 Image 13: Looking north-east from the study area..... 54
 Image 14: Watercolour of a "rare Orchis", 1836..... 55

NOTE ON PHOTOGRAPHS OF INDIVIDUALS

This report contains two photographs from the 1890s of Aboriginal people who are now deceased. It has not been possible to obtain the permission of the descendants of these people for the inclusion of the photographs as the individuals names are not known, and it is not known if they have descendants or, if so, who they may be. The photographs are included here with great respect for these people as individuals who lived through the dispossession of the nineteenth century and yet maintained their culture and community.

NOTE ON LANGUAGE IN QUOTES

There are a number of quotes in this report from documents written by Europeans in the nineteenth and early twentieth centuries. They have been included because of the information they can provide us with about the lives of Aboriginal people. However, please be aware that the language and attitudes of the writers can at times be offensive and distressing.

1 Introduction

1.1 Overview

Transport for New South Wales (Transport for NSW) proposes to upgrade Nelson Bay Road to provide dual carriageway between Williamstown and Bobs Farm. Section 1 of the proposed upgrades (the proposal) would be wholly within the existing road corridor and would involve building approximately one kilometre length of dual carriageway starting from approximately 250 metres west of Boyce's Trail to meet with the existing duplicated section of Nelson Bay Road in the east.

The proposal is required to:

- Reduce peak period traffic congestion.
- Improve road safety of all road users.

The proposal is within the Port Stephens Council local government area. Worimi National Park, part of the Worimi Conservation Lands, is immediately adjacent to the south and privately-owned land is adjacent to the north.

1.2 The proposed project

The proposal would be wholly within the existing road corridor and would involve building approximately one kilometre length of dual carriageway starting from approximately 250 metres west of Boyce's Trail to meet with the existing duplicated section of Nelson Bay Road in the east at Salt Ash. The eastern extent of the proposal would tie in with the Nelson Bay Road Sand Hills Stage 1 Second Carriageway dual carriageway which was completed in May 1996. One ancillary site about 1.5 kilometres east of the proposal area has been identified for use during construction.

Key features of the proposal include:

- One kilometre dual carriageway with:
 - 3.5 metre travel lanes
 - 2.5 metre shoulders
 - 100 kilometre per hour posted speed limit
 - 110 kilometre per hour design speed
 - Median separation barrier
- Two retaining walls
- Utility relocations.

1.3 Aim of assessment

This report assesses the potential impact of the proposed Nelson Bay Road Upgrade (Section 1) on intangible Aboriginal cultural heritage values. This report should be read in association with the ACHAR that details the findings of the archaeological cultural heritage investigations. This report also provides a preliminary overview of the cultural values of the wider Williamstown to Bobs Farm investigation area that will be considered further in a subsequent report. The Williamstown to Bobs Farm investigation area encompasses the potential alignment options for the Salt Ash to Williamstown duplication phase.

1.4 Study area

The study area for Section 1 encompasses the construction footprint (shown on Figure 2 below) with a minimum buffer zone of 200 metres on each side. The study area for the whole Williamstown to Bobs Farm project (shown on Figure 3 below) is a broad area encompassing potential alignment options. The cultural values assessment for the whole Williamstown to Bobs Farm investigation area will assist in the consideration of potential alignments for the duplication.

1.5 Summary of results

Within the Section 1 study area eighteen (18) individual plants have been located of an endangered orchid genus *Diurus arenaria* that is identified as culturally significant. No other locationally specific sites of intangible cultural significance within the Section 1 area were identified during the cultural values assessment process. However, the Section 1 area lies within the zone of traditional patterns of movement between Tilligerry Creek and the beach front and between Tomaree and Fullerton Cove. These patterns of movement were associated with resource collection, community gatherings and ceremonial activities and hold significance as an important element of the cultural landscape.

The surrounding landscape is one that is rich in cultural value with a range of locations identified within it as holding cultural significance including significant resource areas, Story or Dreaming Paths, ceremonial grounds, corroboree grounds, burial places, pathways, and traditional and historical living places.

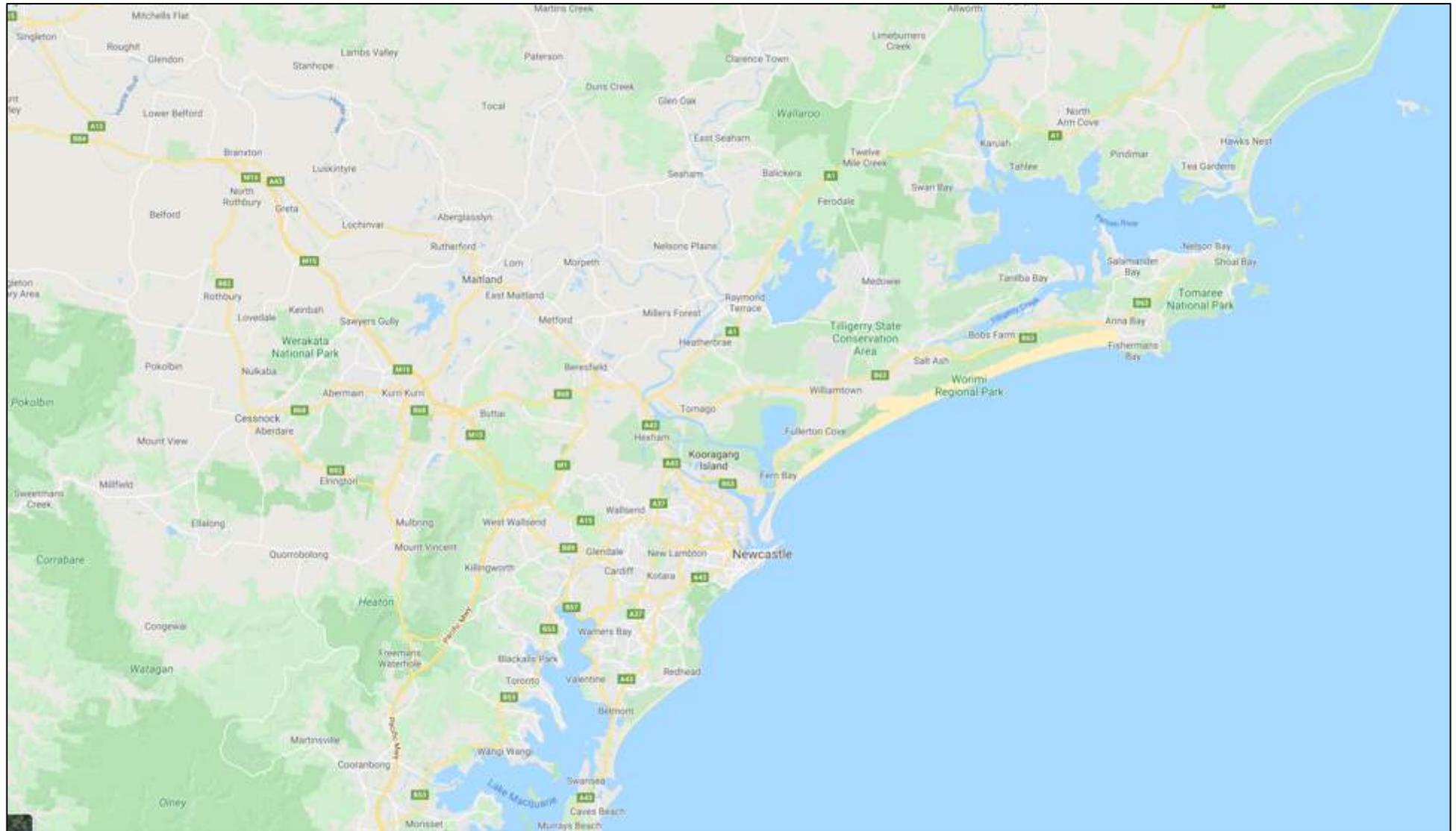


Figure 1: Regional context.



Figure 2: Nelson Bay Road Upgrade (Section 1)

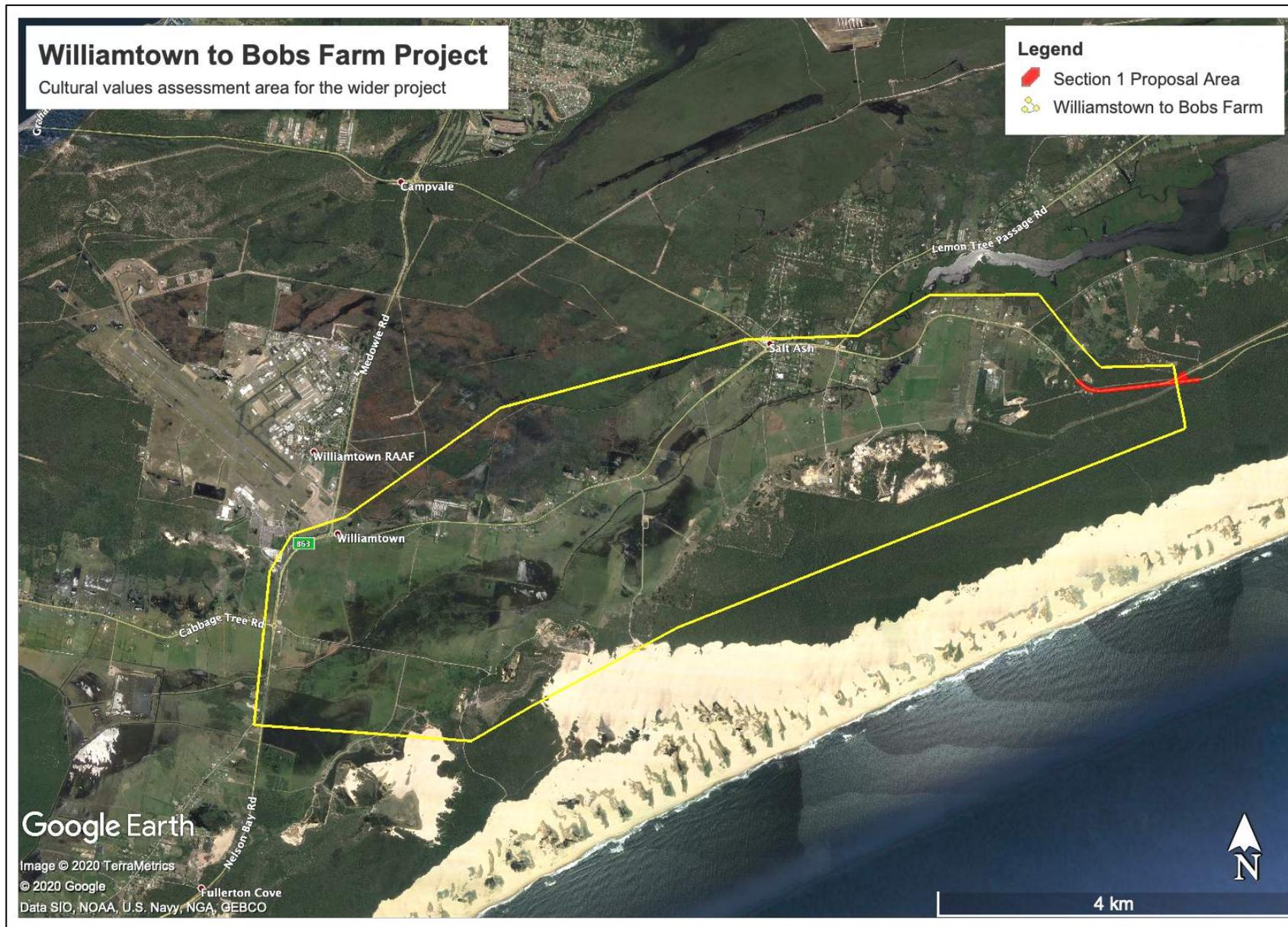


Figure 3: Nelson Bay Road Upgrade (Williamstown to Bobs Farm investigation area – yellow outline; Section 1 – red shading)

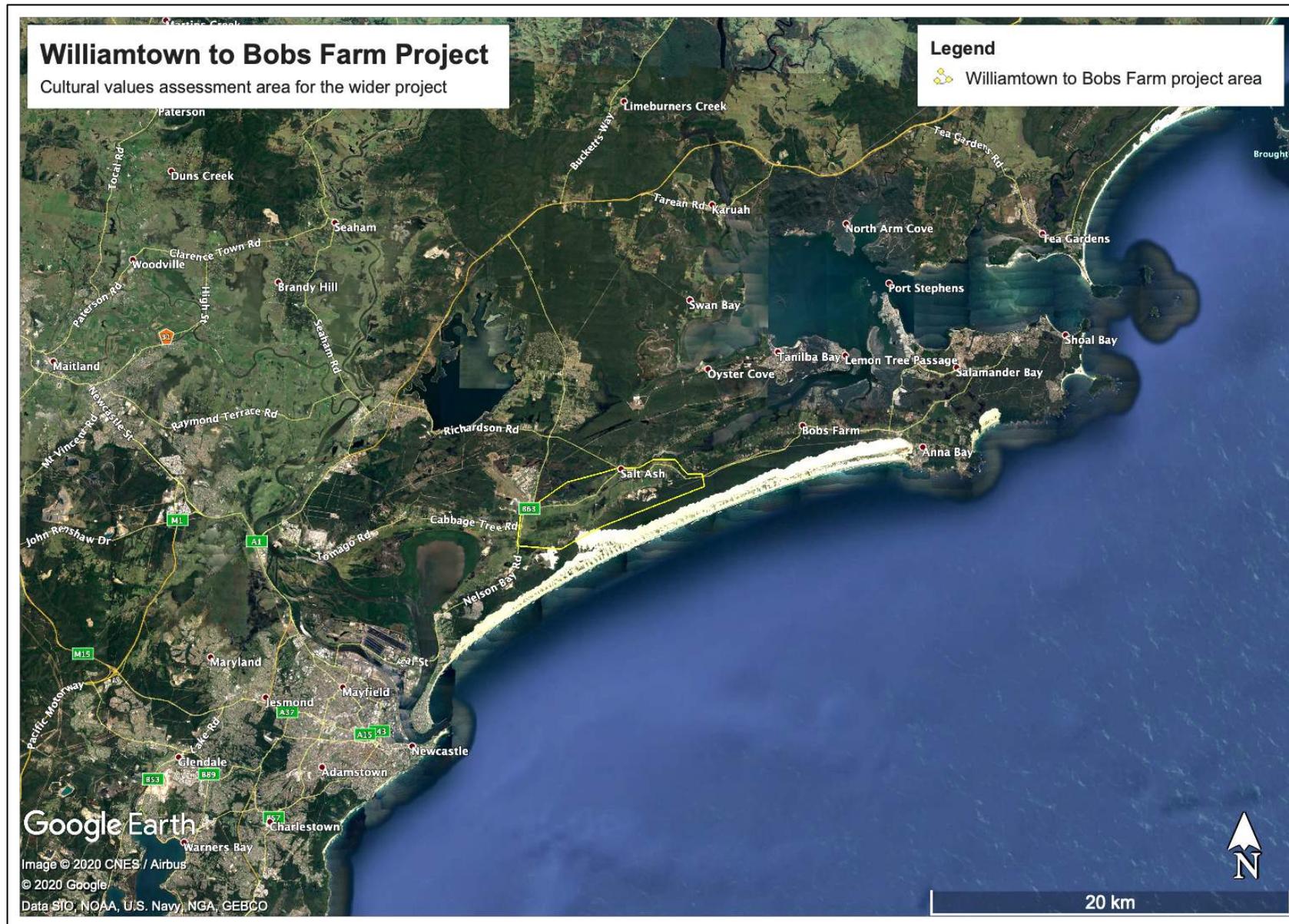


Figure 4: Nelson Bay Road Upgrade (Williamstown to Bobs Farm investigation area in context)



Figure 5: Nelson Bay Road Upgrade (Williamstown to Bobs Farm investigation area - blue outline) showing Worimi Conservation Lands.

2 Methodology

This Aboriginal cultural values assessment has been undertaken through consultation with knowledge holders,ⁱ as identified by the registered Aboriginal parties, regarding historical and cultural values within the study area. Archival research was undertaken in a range of national, state and local institutions to provide the historical and ethnographic context for the assessment. An analysis of the ethnographic literature and historical record was undertaken to provide a contextual understanding to allow for the interpretation and assessment of the cultural information.

Consultation with Aboriginal knowledge holders is a key component to the assessment of Aboriginal cultural heritage values. As stated in the guidelines produced by the International Council on Monuments and Sites (ICOMOS) on the application of the Burra Charter to Indigenous heritage,ⁱⁱ

*Indigenous people are the relevant knowledge-holders for places of Indigenous cultural significance. Their traditional knowledge and experience must be appropriately used and valued in the assessment of places. Advice may need to be sought on who are the relevant knowledge holders.*ⁱⁱⁱ

The assessment of Aboriginal cultural heritage values was undertaken collaboratively with the Aboriginal community and identified Aboriginal knowledge holders as detailed in the following section. This is consistent with the guidelines for the assessment of Aboriginal cultural heritage produced by the Office of Environment & Heritage (OEH).^{iv}

3 Consultation Process

On 4 March 2020 Transport for NSW sent an email to all registered Aboriginal parties that included the proposed cultural values assessment methodology for review and comment by 3 April (Appendix A). As the proposed Aboriginal Focus Group (AFG) meeting for 24 March could not go ahead due to Covid-19 restrictions the comment period was extended to 17 April 2020. On 8 April 2020 an Aboriginal Focus Group (AFG) meeting was held via Zoom at which the draft methodology was discussed, and a verbal invitation was given for the nomination of cultural knowledge holders (Appendix B). On 9 April 2020 a copy of the AFG presentation with an email reminder of review dates was sent to all RAPs (Appendix C) A full copy of the AFG presentation and the minutes of the meeting were provided to RAPs on 15 April 2020 (Appendix D). Telephone or email contact was made with the RAPs in the two weeks following the AFG to request the nomination of cultural knowledge holders. As a result of these processes thirteen individuals were nominated as cultural knowledge holders.^v

Detailed (via Zoom and/or in person) face-to-face interviews have been conducted with four of the knowledge holders^{vi} with one interview occurring via telephone.^{vii} Telephone discussions have occurred with five knowledge holders regarding broad cultural values,^{viii} they have chosen to identify other nominated knowledge holders as appropriate to speak in greater detail (in three instances this was a result of illness). One nominated knowledge holder identified other individuals as more appropriate to be spoken with in this instance, these individuals were amongst the twelve identified knowledge holders.^{ix} One nominated knowledge holder has been spoken with briefly but despite repeated attempts it has not been

possible to meet with them to date,^x while another nominated knowledge holder has not been able to be contacted.^{xi}

The identified knowledge holders spoken with provided cultural and historical information on the broader cultural landscape of the region. This information has informed the assessment process in relation to the cultural heritage values and significance of the broader region.

This draft CVA report will be provided to the RAPs and knowledge holders by Transport for NSW for review concurrently with the Aboriginal Cultural Heritage Assessment Report (EMM 2020). Following this draft review process further consultation will occur with the identified knowledge holders to undertake more detailed cultural mapping of the Williamtown to Bobs Farm investigation area for incorporation in a subsequent report.

It is acknowledged that the archaeological record, that is tangible material objects themselves, hold significant cultural value to Aboriginal people of the region and that this value has been expressed during consultations with the RAPS and the identified knowledge holders. The nature of cultural significance is such that it is an ongoing process that must allow for the attachment of cultural values and significance to emerging archaeological sites. It is noted, however, that this report is specifically concerned with the identification of intangible cultural sites that are not identifiable through archaeological investigation.

4 Previous Historical and Cultural Assessment

No detailed Aboriginal cultural values assessment has previously occurred in relation to the Nelson Bay Road Upgrade.

5 What is Cultural Significance?

The concept of cultural significance encompasses all the cultural values and meanings that could potentially be associated with a place. The cultural and natural values of a place are generally indivisible in the context of Aboriginal cultural heritage. The cultural values and meanings in a place can be both tangible and intangible.

Cultural significance is embodied in the place: in its tangible or physical form, in the wider cultural landscape that it is located in, in the ways in which the place is used or interacted with, and in the associations, stories, and meanings of the place to the people and community it holds significance for,

Aboriginal cultural heritage consists of any places and objects of significance to Aboriginal people because of their traditions, observances, lore, customs, beliefs and history. It provides evidence of the lives and existence of Aboriginal people before European settlement through to the present... For Aboriginal people, cultural heritage and cultural practices are part of both the past and the present and that cultural heritage is kept alive and strong by being part of everyday life.^{xii}

The concept of cultural significance is used in Australian heritage practice and legislation to encompass all of the cultural values and meanings that might be recognised in a place. Cultural significance is often defined as the sum of the qualities or values that a place has with particular reference to the five values – aesthetic, historic, scientific, social and spiritual – that are listed in the *Burra Charter*.

The three key values in relation to Aboriginal cultural heritage assessments are the social, spiritual and historic. Social or cultural value refers to the associations that a place has for a particular community or cultural group and the resulting social or cultural meanings that it holds for them. It can encompass traditional, historical or contemporary associations. Spiritual value is often subsumed within the category of social or cultural value. It refers more specifically to the intangible values and meanings embodied or evoked by a place to a specific cultural group and that relate to that group's spiritual identity or traditional practices. Historic values refer to the associations of a place with an individual person, event, phase or activity that has historical importance to a specific community or cultural group.

Consultation with identified Aboriginal knowledge holders is a key component to the assessment of Aboriginal cultural heritage values. The assessment of Aboriginal cultural heritage values must be undertaken collaboratively with the Aboriginal community and identified Aboriginal knowledge holders. This is consistent with the guidelines for the assessment of Aboriginal cultural heritage produced by the Office of Environment and Heritage^{xiii} and the practice notes produced by the ICOMOS on the application of the Burra Charter to Indigenous heritage.^{xiv}

6 The Cultural Landscape of the Study Area

The study area is located on the coastal zone in the southern part of the broader Port Stephens region and sits within the Country of the Worimi people. The traditional social structures of Aboriginal peoples were (and are) complex and through the web of kinship ties people came together in various ways ranging from small localised groups through to large scale ceremonial networks, in accordance with the activity being undertaken.

One of the earliest detailed accounts of Aboriginal people in the Port Stephens region is that published by Robert Dawson in 1831. In 1822 the colonial government had made the decision to move the Newcastle penal settlement further north to Port Macquarie, allowing the Hunter River area to be opened up to 'free' European settlement.^{xv} Dawson had arrived in the colony as the chief agent of the Australian Agricultural Company (AAC). The AAC were granted 1,000,000 acres that Dawson took up on their behalf on the north side of Port Stephens in 1826.^{xvi} Dawson summarised what he understood of the size and range of localised Aboriginal groups in the area. He commented on the absence of any chiefs, or hereditary hierarchy, in the region; in doing so he avoided a common mistake of European observers who misunderstood the nature of Elders authority,

It has generally been supposed that chieftainship exists amongst the natives of Australia. I can, however, confidently assert that it was not mentioned amongst any of the people with whom I was acquainted. Each tribe is divided into independent families which acknowledge no chief, and which inhabit in common a district within certain limits, generally not exceeding above ten or twelve miles on any side. The numbers of each tribe vary very much, being greater on the coast, where they sometimes amount to two or three hundred, and I have known them in other quarters not to exceed one hundred.^{xvii}

While it is beyond the scope of this report to assess fully the literature relating to group identities in the region it is of interest to note what the amateur ethnographer W.J. Enright wrote regarding the Aboriginal people of the Port Stephens area. Enright's articles are based on what he learnt from a number of Aboriginal men, including a senior man named Tony, on visits to the area from the late 1890s.^{xviii} In an article published in 1900 Enright distinguished a number of smaller groups within the region that he labelled as 'tribes',

The Kut'-thung [Gathang] dialect is spoken amongst the Aborigines living along the southern bank of the Karuah River and the south shore of Port Stephens. It was at one time spoken amongst the tribes lying between Port Stephens, West Maitland and Paterson, but with the exception of the Kutthung, they are now extinct. The adjoining tribes were the Gummigingal, inhabiting the territory on the north shore of Port Stephens and the Karuah; the Warringal, living between Telegraphy and Pipeclay Creeks; the Warrimee, living between Telegraphy Creek, Port Stephens, the Sea Shore and the Hunter River; the Garawrigal, between the Myall River and the sea shore; the Yeerunggal, about the Myall Lakes; the Birrimbai, in the neighbourhood of Bungwall Flat; and the Birroonggal, on the Myall River.^{xix}

It appears that the name Worimi as an overarching term for the people of the wider Port Stephens area first appeared in print in articles by Enright and A.P. Elkin following their joint

visit to the area in the 1930s to speak with senior Aboriginal people.^{xx} In his 1932 article Enright wrote that he had incorrectly understood the term Kutthung (Kattang) to refer to a 'tribe', and that it in fact referred to the language the people spoke,

In the course of my enquiries I was given, what I believed through my ignorance of their social organizations, the names of various neighbouring tribes. Further investigations have clearly shown that the Gummipingal, Yeerung-gal, and Birroong-gal were but hordes of the Kattang-speaking tribe called the Worimi. The suffix "gal" or "kal" means a division, clan or horde... Investigations made recently in company with Dr. Elkin at Port Stephens lead me to believe that the Maiangal lived along the sea-shore south of Port Stephens, and westward as far as Teleghery Creek; that the Garuagal occupied country adjoining Teleghery Creek and along the lower Hunter, and their territory joined that of the Buraigal, who lived on [the] right bank of Karuah up to Stroud. The northern side of Port Stephens and left bank of Karuah was occupied by the Gamipingal. All four were hordes of the Worimi."^{xxi}

On the basis of a detailed analysis of language material the linguist Jim Wafer has formed the opinion that the people referred to as Worimi (Warrimay) and those referred to as the Gringai (Guringay) both spoke a dialect of what they term the Lower North Coast (LNC) language. Meanwhile the people at Lake Macquarie spoke a dialect of what they term the Hunter River-Lake Macquarie (HRLM) language. He argues that the language referred to as Geawegal (Kayawaykal), which he locates within the Hunter River valley around Glendon, is on the limited available evidence probably a dialect of the Hunter River-Lake Macquarie (HRLM) language.^{xxii}



Image 1: 'The Coal River or Port of Newcastle' [looking north to the study area], c.1808.^{xxiii}

Captain Cook sailed past the area in May 1770 and named Point Stephens, from which the name of the bay comes. Cook recorded in his journal the presence of smoke that he took to be from the fires of Aboriginal people,

... a low rocky point which I named Point Stephens... at the entrance lay 3 small Islands two of which are of a tolerable height and on the Main near the shore are some high round hills that make at a distance like Islands... We saw several

smooks [smoke] alittle way in the Country upon rise up from the flat land by this I did suppose that there were Lagoons which afforded subsistance for the natives such as shell fish & C^a for we as yet know nothing else they live upon...^{xxiv}

The first Europeans recorded entering into Port Stephens were those on board the convict ship *Salamander*, which entered the bay in 1791 on its way from Port Jackson to Norfolk Island, and after which Salamander Bay was named.

In February 1795 Deputy Surveyor Charles Grimes arrived at Port Stephens on the schooner *Francis* and briefly explored the bay and some miles up the Karuah River. David Collins, the Judge Advocate of the colony, stated that on his return Grimes reported that,

... he went into two fresh-water branches, up which he rowed, until, at no very great distance from the entrance, he found them terminate in a swamp. He described the land on each side to be low and sandy, and had seen nothing while in this harbour which in his opinion could render a second visit necessary. The natives were so very unfriendly, that he made but few observations on them. He thought they were a taller and a stouter race of people than those about this settlement [Port Jackson], and their language was entirely irreverent. Their huts and canoes were something larger than those which we had seen here; their weapons were the same. They welcomed him on shore with a dance, joined hand in hand, round a tree, to express perhaps their unanimity; but one of them afterwards, drawing Mr. Grimes into the wood, poised a spear, and was on the point of throwing it, when he was prevented by young Wilson, who, having followed Mr. Grimes with a double-barrelled gun, levelled at the native, and fired it. He was supposed to be wounded, for he fell; but rising again, he attempted a second time to throw the spear, and was again prevented by Wilson. The effect of this second shot was supposed to be conclusive, as he was not seen to rise any more.^{xxv}

By the mid 1790s the British colonists were aware of the coal and timber resources that stretched along the Hunter Valley coast. In the second half of the 1790s a number of official and unofficial parties visited the area, extracting coal and timber. In March 1804, Governor King made the decision to establish a penal settlement at Newcastle.^{xxvi} By September of that year the non-Indigenous population of Newcastle was 128, approximately 100 being convicts. Newcastle remained relatively constant in population until 1812 when it began to grow rapidly, reaching a non-Indigenous population of 846 by 1819.^{xxvii}

By 1816 applications were being made to cut cedar at Port Stephens and late that year one ship, the *Mary*, took on 10,816 feet of cedar at Port Stephens. Cedar cutters rapidly moved into the area and,

... in the years that followed, many ships plied between Sydney and Port Stephens, being in ballast or with men and supplies on the northern voyage and returning to Sydney loaded with cedar: some even set sail for overseas ports with their cargoes of red gold.^{xxviii}

Much of the cedar was originally cut on the Myall River and its tributaries. The extent of the trade, and the dramatic impact it must have had on the Country, is clear in the figures. In 1818 two separate ships took out 40,000 super feet of cedar while in 1820 one ship took out 120,000 feet in one load. While cedar was the main focus these ships were also removing rosewood, bluegum, and grasstree gum. Cedar cutters were operating from the Port up into the interior, felling and then transporting timber to the ships in the bay.^{xxix}

Timber getters relied heavily on Aboriginal guides to locate timber stands and frequently on Aboriginal labour in extracting the timber. Conflict between the intruding timber cutters and Aboriginal people was common throughout the region as it was all along the coast. Robert Dawson recorded how on his arrival in the area in 1826 he was told by local Aboriginal people about the violence that they had suffered at the hands of timber cutters,

... very particular enquiries amongst them as to the feelings which they entertained of the parties who had introduced themselves on cedar-cutting speculations up the several rivers and streams which discharge themselves into the harbour. The accounts which they gave were disgusting and even terrible. Several boys and women were shown to me whose fathers and husbands had been shot by these marauders for the most trifling cause: one, for instance, for losing a kangaroo dog, which had been lent him for the purpose of supplying the white savages with game. It was reasonable to suppose that such conduct as this would prevent their further intercourse with the white people, and that they would seek revenge, either openly or otherwise, for such injuries; but the conduct which followed my treatment of the old man and his family, and the invitation of Tony, accepted by the blacks now about us, proved them to be naturally a harmless people, and desirous to seek rather than to shun the society of white persons, as soon as they saw a disposition to treat them with humanity.^{xxx}

Dawson had more to say regarding the violence of so many of the intruding Europeans,

The natives are a mild and harmless race of savages; and where any mischief has been done by them, the cause has generally arisen, I believe, in bad treatment by their white neighbours. Short as my residence has been here, I have, perhaps, had more intercourse with these people, and more favourable opportunities of seeing what they really are, than any other person in the colony. My object has always been to conciliate them, to give them an interest in cultivating our friendship, and to afford them protection against any injuries or insults from the people on this establishment, or elsewhere, within my jurisdiction. They have usually been treated, in distant parts of the colony, as if they had been dogs, and shot by convict-servants, at a distance from society, for the most trifling causes. There has, perhaps, been more of this done near to this settlement, and on the banks of the two rivers which empty themselves into this harbour, than in any other part of the colony; and it has arisen from the speculators in timber, who formerly obtained licences from the governor to cut cedar and blue gum-wood for exportation, upon land not located.^{xxxi}

The natives complained to me frequently, that “white pellow” (white fellows) shot their relations and friends; and showed me many orphans, whose parents had fallen by the hands of white men, near this spot. They pointed out one white man, on his coming to beg some provisions for his party up the river Karuah, who, they said, had killed ten; and the wretch did not deny it, but said he would kill them whenever he could. It was well for him that he had no white man to depose to the facts, or I would have had him off to jail at once. ^{xxxii}

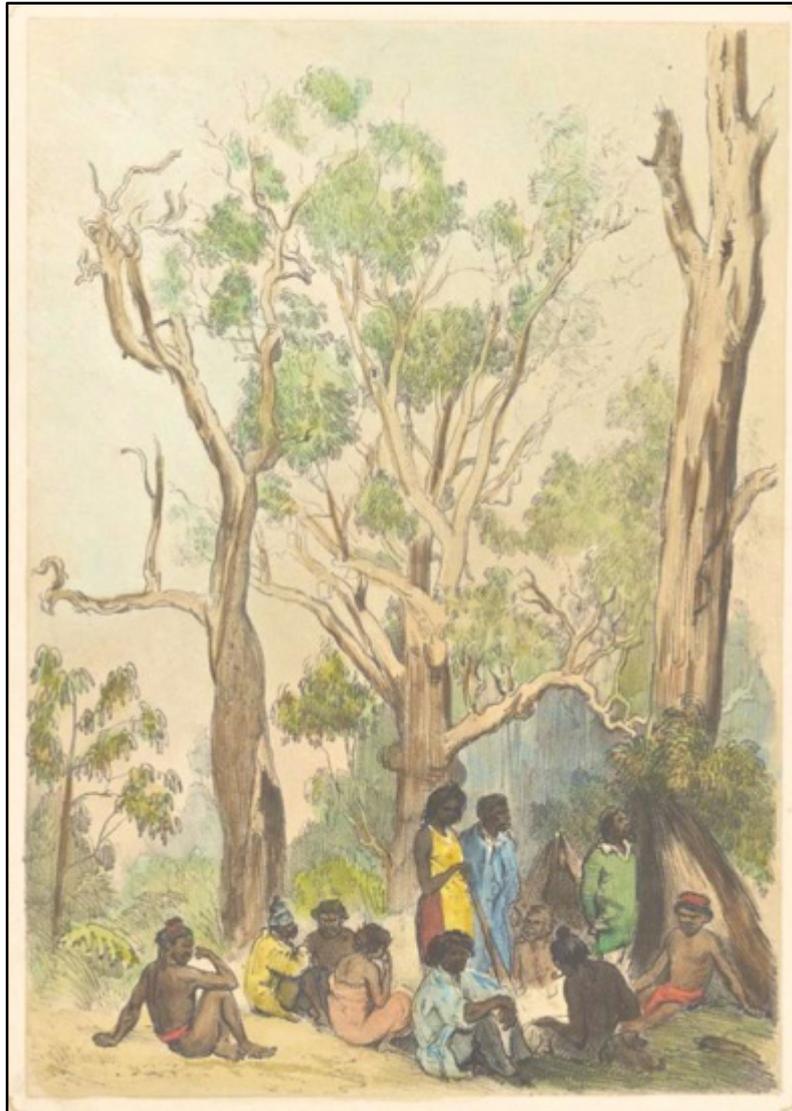


Image 2: 'Bush scene, Port Stephens', 1849. ^{xxxiii}

Timber cutters' camps were present inland on the rivers and the bay itself was visited by ships and their crews. However, there was no permanent European settlement at Port Stephens prior to the arrival of the AAC in 1826 other than the garrison established at Soldiers Point to capture runaway convicts. In an 1822 report on the colony by Commissioner Bigge he commented on the key role of Aboriginal people in capturing escaped convicts at Port Hunter [Newcastle] and Port Stephens,

The native blacks that inhabit the neighbourhood of Port Hunter and Port Stephens have become very active in retaking the fugitive convicts. They accompany the soldiers who are sent in pursuit, and by the extraordinary strength of sight that they possess, improved by their daily exercise of it in pursuit of kangaroos and opossums, they can trace to a great distance, with wonderful accuracy, the impressions of the human foot. Nor are they afraid of meeting the fugitive convicts in the woods, when sent in their pursuit, without the soldiers; by their skill in throwing their long and pointed wooden darts they wound and disable them, strip them of their clothes, and bring them back as prisoners, by unknown roads and paths, the Coal River. They are rewarded for these enterprizes by presents of maize and blankets, and notwithstanding the apprehensions of revenge from the convicts whom they bring back, they continue to live in Newcastle and its neighbourhood, but are observed to prefer the society of the soldiers to that of the convicts.^{xxxiv}

Aboriginal people were not only involved in tracking and capturing convicts, there are also accounts from the wider region that show the reliance by escaping convicts and stranded seafarers on Aboriginal people's knowledge of country, both in surviving away from the small European settlements and in finding their way back to those settlements.

Dawson established the AAC headquarters at Carrington in 1826 and remained with the AAC until 1828 when he returned to England.^{xxxv} Dawson was interested in the local Aboriginal people and established good relations with them, relying on them in many ways. It should not be ignored that despite these positive aspects to his interactions he was nonetheless acting for the AAC in the active dispossession of Aboriginal people of their Country.

Dawson arrived at Newcastle in January 1826 and immediately arranged for an Aboriginal man to guide him along the beach north to the garrison at Soldiers Point,

He informed me that he had only been upon a visit to Newcastle, and that he belonged to the south side of the harbour of Port Stephens; (in fact, the very place to which we were going;) but that he had left Nanny, his gin, (wife) behind him [at Newcastle]. It was therefore settled that he should return for her whenever he pleased, as soon as he had conducted us; that she was to have a gown and cap, &c.; and that both of them were to come and live with me always...

The day was very fine: all our party were in good spirits, and as we travelled on the beach, I was highly amused with the good-natured chattering of our sable companion, the more so from his being the first I had an opportunity of freely conversing with. After proceeding about twenty miles along the beach, we struck across the country, in the direction of a place called Soldiers' Point, lying on the south side of the inner harbour of Port Stephens.

As soon as our native guide, whom I named Ben, had led us to a spring of water, we halted and took our dinner under the shade of some trees adjoining to it. Some of our party on foot by this time begun to feel the effects of a long walk over an unusually soft, sandy beach: the refreshment and relief, therefore,

which this cool shady rest, and the meal of fried bacon and tea afforded, will I have no doubt be long remembered by them, as among the first of the agreeable impressions which occurred in this distant land. It was the first repast of the kind which I had partaken of, and I shall always recollect it with pleasure. Ben also had a feast of tea and biscuit, which was succeeded by the favourite pipe of tobacco, but the bacon was too fat and too salt for him to partake of it. Not long after we had resumed our journey, a call or cooe was heard at a short distance from us in the forest. Ben was instantly alive to it, and observed to me, in a quick and animated matter: "Your hear, Massa? Black pellow cooe." With this he bounded forward with his musket on his shoulder, to seek his friend, whose voice he well knew. In a few minutes they met, when I immediately saw Ben liberally bestowing his tobacco and pipe upon his friend, who was an elderly man, perfectly naked.

When I came up to them, Ben said, "Brodder belonging to me, massa: sit (sit) down here always." I was much amused at this meeting, and above all delighted at the prompt and generous manner in which this wild and untutored man conducted himself towards his wandering brother. If they be savages, thought I, they are very civil ones; and with kind treatment we have not only nothing to fear, but a good deal to gain from them. I felt an ardent desire to cultivate their acquaintance, and also much satisfaction from the idea that my situation would afford me ample opportunities and means for doing so.

Before we arrived at Soldiers' Point darkness came on, and as the road over the rocks near the shore was both difficult and dangerous for our loaded pack-horses, Ben ran forward to the Point, and brought to our assistance the corporal and two soldiers of the 57th regiment, who were stationed with three others at that solitary spot, to intercept the runaway convicts, on their passage from the penal settlement of Port Macquarie to Newcastle and Sydney. ^{xxxvi}

The following day at Soldiers Point Ben was given a tomahawk and a suit of clothes by Dawson, as had been promised in return for his labour in guiding them there. On receiving the items Ben stated that,

... all the harbour and country adjoining belonged to him. "I tumble down pickaninny here," he said, meaning that he was born there. "Belonging to me all about, massa: pose you sit down here, I gib it to you". "Very well," I said: "I shall sit down here." "Budgerr," (very good,) he replied, "I gib it to you;" and we shook hands in ratification of the friendly treaty. ^{xxxvii}

Ben's statement that he would 'give' Dawson the land is likely to be more properly understood as him offering Dawson the right to camp and utilise resources in a reciprocal exchange for the clothing and tomahawk. All Aboriginal societies are based on reciprocity, where relationships involve mutual exchange and not one-way transactions.

Dawson's interactions with people around Port Stephens were largely friendly and he was clearly concerned with maintaining good relations with the people whose Country it was. He displayed a clear understanding of the importance of Aboriginal people's skills and labour for

the European settlement he was establishing. From the start Dawson was assisted by local Aboriginal people, in guiding him and in stripping bark for the huts for the new settlement that would become Carrington,

Ben and Tony being now the only natives present, they could not do all that was required; and the former, therefore, made an offer to go in search of the tribe and bring them to me, promising to return in two days with such a number as would soon finish all our huts. This promise he faithfully kept by bringing, with the prescribed time, a dozen good-natured, able-bodied friends, who having received each a small hatchet, set to work in good earnest, and brought such a quantity of bark in two or three days as would have taken our party a month to procure.... I felt no ordinary degree of pleasure and relief on experiencing such prompt and effective assistance from the natives; and the more so as I had been warned, when at Sydney, against the savage and treacherous conduct of the tribes, who were said to be more ferocious and mischievous in this spot than in any other known part of the colony.^{xxxviii}

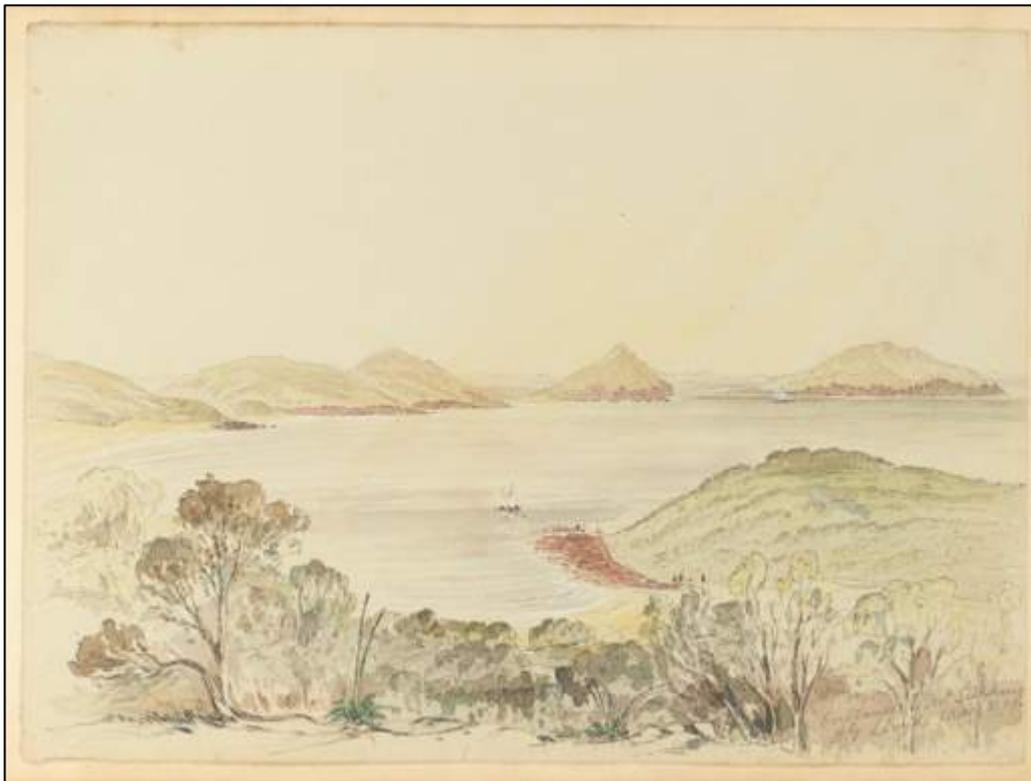


Image 3: 'Entrance to Port Stephens', May 1879.^{xxxix}

The importance of Aboriginal people to the AAC as guides to Country and resources and as labourers continued in the following decades. Aboriginal people are described as undertaking a wide range of domestic and labouring tasks including carrying water, collecting firewood, supplying fish, washing clothes, building washpools for the sheep, cleaning wool, collecting shell for lime burning, crewing on the boats, acting as messengers between Port Stephens and Newcastle, as domestic servants, guides, and stripping bark.^{xi}

Oyster farming began in NSW around 1870 with Port Stephens developing into one of the centres for the industry.^{xii} In the late nineteenth and early to mid-twentieth century the

timber trade and oyster farming were important local industries. Nancy Phillips, who was born in 1921 and was the grandchild of one of the early European settlers at Pindimar on the north side of Port Stephens, recalled that her family,

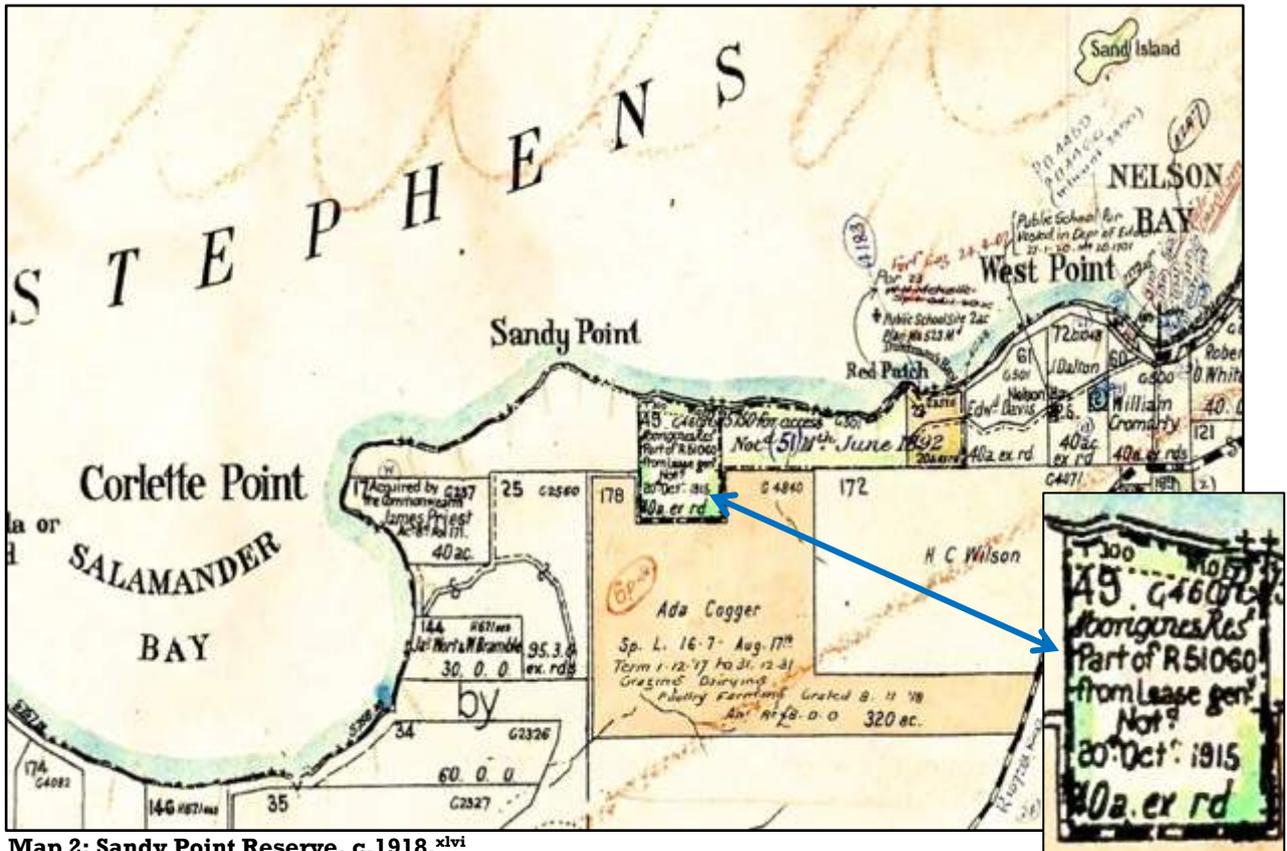
... had the monopoly on oyster farming in the Port, their other business interests were timber, cattle and agistment of cattle. Large ships from various parts of the world – Russia, China, Britain, and New Zealand came and anchored about mid-harbour. These ships were loaded with timber from droghas.... Bullock teams were used for the logging and my father would engage the labour of full blood Aborigines from Soldiers’ Point Mission. They were transported by drogha to Pindimar and for the duration of their employment on the Estate, they were housed in comfortable huts in the Myall Streets Pindimar North area.^{xlii}

In the second half of the nineteenth century small scale European settlement increased with agricultural farms and townships stretching across the region. A map from 1893 shows the outlines of the properties that had been taken up all along the Tilligerry Creek and behind the dunes. The dunes are labelled as “wind swept sand hills” with *Bight Swamp* and *The Little Swamp* sitting behind them.^{xliii}



Map 1: Extract from 1893 map showing study area.^{xliv}

Aboriginal people became increasingly restricted in where they could live in the Port Stephens area, although the community managed to maintain access to the coast and its resources. Prior to 1884 the gazettal of reserves specifically for use by Aboriginal people occurred in response to Aboriginal and missionary demands rather than as the result of any clear government policy. One such area was at Sandy Point. In 1873 Willie Price tried to get some form of secure tenure on land at Nelson Bay and was able to get a permissive occupancy lease on 40 acres at Bagnalls Beach. The Lands Department treated the acres as being reserved for use by Aboriginal people generally. In 1892 the Aborigines Protection Board wrote to the Department of Lands regarding the status of the permissive occupancy and was told that, "... the land was still available for Aboriginal purposes."^{xlv}



Map 2: Sandy Point Reserve, c.1918.^{xlvi}

The Sandy Point area is also the location of a women’s ritual fertility site that was described briefly by Enright in 1937,

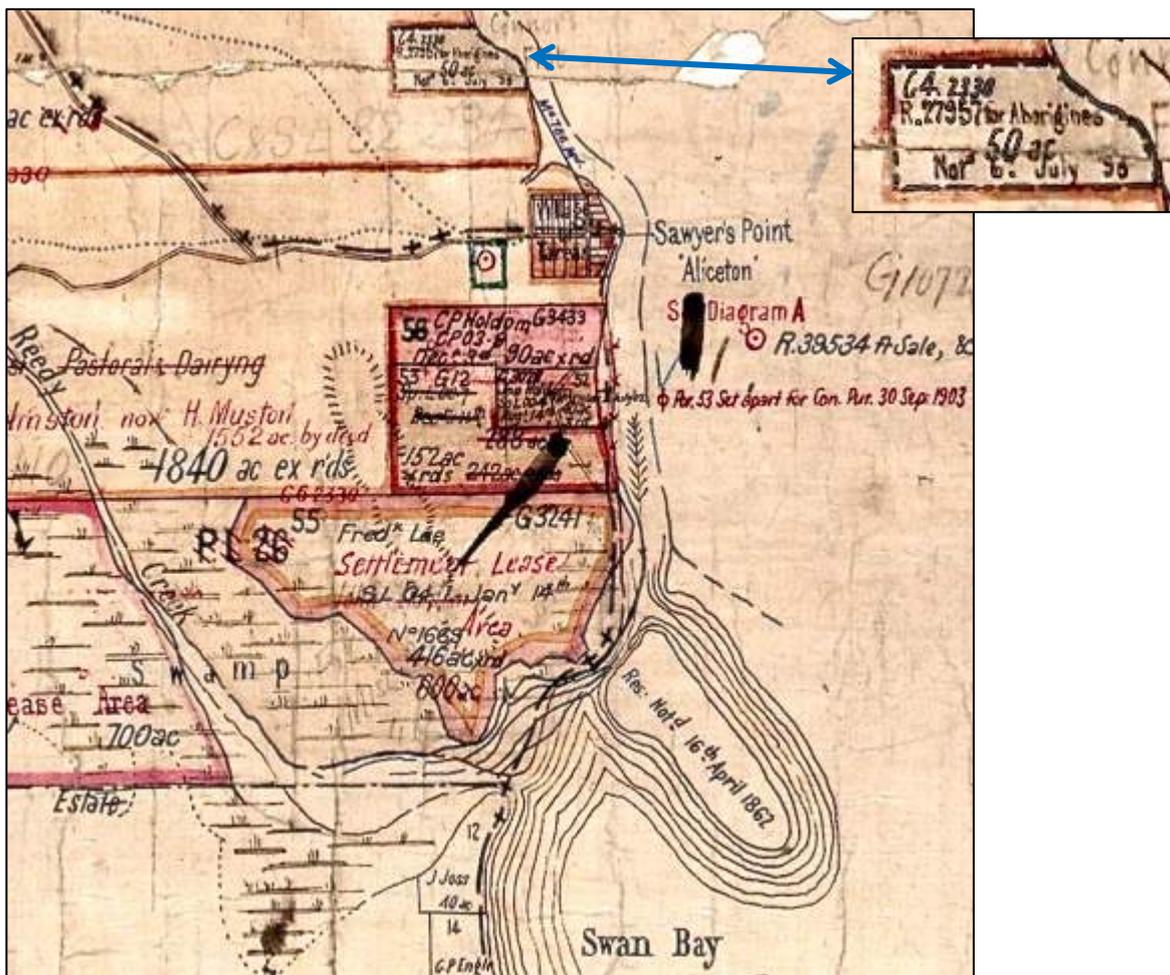
When any woman of the Worimi tribe residing about Port Stephens, New South Wales, desired to have a child, she would go to a big fresh-water hole near Sandy Point; there she would express her wish to have a child, and then completely immerse herself in water. No further rites were performed.^{xlvii}

In an article published two years later Enright wrote of how,

Fourteen or fifteen years ago [c.1924-25], Billy Ridgeway saw a figure of a woman near a deep waterhole close to Salamander Bay. That hole is forty to fifty feet deep. They thought she was a goingun (a female spirit) and they

decided to go down to burn some fat with a view of attracting her, but when they went down a fortnight later it was found to be absolutely dry. It had never been known to be dry before or since. This is the hole to which women reported to perform increase ceremonies.^{xlviii}

The Aborigines Protection Board (APB) had emerged in the 1880s and soon developed into an agency of government control over the lives of Aboriginal people in New South Wales. The APB's role initially involved overseeing the distribution of blankets, rations and various other goods to 'destitute' Aboriginal people. In later years, the formation and management of reserves became a major part of the APB's functions.^{xlix} From 1882 onwards the APB increasingly intruded into the lives of the Aboriginal communities of New South Wales, dramatically increasing the regulations and limitations governing Aboriginal people's lives.



Map 3:1898 Reserve at Karuah.¹

The APB largely took control of any existing reserves in addition to being instrumental in the creation of new reserves and in the later revocation of many Aboriginal reserves.^{li} In 1898 at the request of the APB a 50-acre reserve "for the use of Aborigines" was gazetted at Karuah.^{lii} The reserve was located just to the north of the town now known as Karuah but was previously referred to as Sawyer's Point, Aliceton and Tarean.^{liii} The Karuah Mission reserve

was not revoked until 1975; this revocation occurred during the handover of former reserve lands to the newly formed Aboriginal Lands Trust.^{liv}

At the time that the reserve was gazetted to the north of town there was already an established Aboriginal community at the Sawyer's Point township itself. A third important living place was on the south side of the bay at Soldiers Point. Aboriginal people utilised this area traditionally and in the 1800s it became an important Aboriginal living place. These three communities were closely linked with families moving between them over the following decades.

In 1908 William 'Billy' Ridgeway, an important Worimi Elder, wrote a letter from his home at Soldiers' Point arguing for the formation of a single large government reserve or mission station for the Aboriginal people of the wider region,

I have been right up the country as far as Darlington Mission, and I see that they are made comfortable by the Government. They have cows and horses, wagons and sheep, and a store with goods in it for the natives, and I think it is very nice for them to be so comfortable as they are. I was thinking that this place could be made the same for these natives here.... I would like to be a King over all my people that speak the one language. They are so scattered abroad, and it would be nice to get them all together. It would all amount to the one thing if they were all together. There are Forster, Taree, and Port Stephens; they all speak the one language, and I think that if they were all brought together to live on one big reserve it would be far better off. Forster, they are trying to take the land from them there, and Kurriah [Karuah] Reserve the same by many of the white people, and I want to see if the Government would allow it and see if the Government would help them with houses and cattle and other things, like they are in other places; and I think it would be nice if they were all living together. The children would get schooling, and we would have a Government managed to look after the mission station, and we would have the missionaries to do their work amongst them and make them good people.^{lv}

It is clear that William Ridgeway's suggestion is in the context of the attempts to push Aboriginal people off the existing reserves and a call for higher levels of government support.

In 1915 a visitor from Sydney recorded what he was told of the Aboriginal community at Soldiers Point,

... there is a settlement of aborigines, who live contented and happy. They build their own gunyahs, their own boats, and live by fishing and a little cultivation. Their boats at the last regatta in the harbour, manned by themselves, won two races against the fishermen of Nelson's Bay. Jack Broughton, our guide to the fishing grounds, said that the blacks led a pure and clean life. They will not tolerate swearing or bad language. Should any visitor misbehave himself in that way, he is told: "Go away, bad man! You hurt the Great Spirit, the Good God, by language and swearing."^{lvi}

He also recorded his impressions of the country between Stockton to Salt Ash, describing an agricultural and pastoral landscape that had previously been dominated by rich wetlands,

Hedges of sweet briar, blackberry, and lantana lined the road to some distance. Behind them there were farms where ploughing and harrowing were in progress. Large fields of corn and sorghum appeared ready for harvesting. Dairy farms were numerous. There were specimens of fine fat cattle in some of the paddocks up to their knees in grass. There was plenty of grass fresh and green, not parched or dried up, as in most places about Sydney and suburbs.^{lvii}

The following year, 1916, the Commonwealth moved to acquire all the land at Soldiers Point and Salamandar Bay with the intention to build a naval base there, the base did not go ahead though initial land clearing and construction works occurred between 1916 and 1922.^{lviii} As a result of this the Aboriginal families at Soldiers Point were forced to leave, many moving up to Karuah.^{lix}

In interviews for the current project Aunty Lorraine Lilley spoke of how both her and her husband Uncle Neville Lilley's grandparents were amongst the families who were forcibly removed from Soldiers Point,

Neville's family and my family, our grandparents, were taken from Soldiers Point because the government needed that area for a soldier's garrison. They were taken up the river to Karuah where they had the reserve or sometimes called the mission. The Aborigines Inland Mission were ministering there at that time. So that's where my grandparents and Neville's grandparents lived.^{lx}

Many Aboriginal families returned to the area in the following decades, either as permanent residents or regular visitors.^{lxi} In 2006 Soldiers Point was gazetted as an Aboriginal Place under the *National Parks and Wildlife Act (1974)*. The gazettal recognises its significant cultural values including its long history as an Aboriginal living place, the historic burials in the area and a men's initiation ceremonial area.^{lxii} In the early 1920's Sawyer's Point was one of many towns in NSW where European residents exerted widespread pressure to remove Aboriginal settlements and push Aboriginal people away from the townships.^{lxiii} ¹

¹ This is referred to in a number of documents as involving the revocation of a reserve at Sawyer's Point, however, the reserve referred to in the early records of the APB as the Sawyer's Point reserve is the 50 acres to the north of town commonly referred to as the Kaurah Mission. No record has been located of any Aboriginal reserve having existed at Sawyer's Point itself.

Image(s) 4: Former wetlands in the broader study area.^{lxiv}



As the quote above indicates, while the APB was the agency of direct government intervention in the lives of Aboriginal people, missionary groups were also active in many Aboriginal communities in the same period. The Aborigines’ Inland Mission were the most active missionary organisation in the Port Stephens and Hunter Valley regions. In 1904 the missionary journal the *NSW Aborigines Advocate* reported,

Port Stephens had been laid on our hearts. For over six years we had longed to visit the district and many an urgent call had reached us... On Saturday at 6 a.m. we left by the S.S. Dauntless... [on] Sunday morning [I] was landed at my desired haven, Sawyer’s Point, Karuah River. After a short search I came on the Aborigines Settlement, and soon was welcomed as if I had been a long lost daughter. The people, with two or three exceptions, were quite strangers to me.... There are 45 Aborigines at and about Sawyer’s Point, living in four nice cottages, and several bark camps.^{lxv}

The Aborigines’ Inland Mission (AIM) were active in the Port Stephens region, holding services at both Karuah and Soldiers Point from the early 1900s.^{lxvi} The AIM was notable for their acceptance and encouragement of Aboriginal people’s involvement as workers with the Mission.^{lxvii} The Australian Indigenous Ministries, still active today, emerged from the original AIM.^{lxviii}



Image 5: Remnant forest within the Worimi Conservation Lands.^{lxix}

The understanding and perception of the landscape expressed by the knowledge holders, and by the community more broadly, is as an area traversed by an interconnecting network of physical, social and spiritual meanings. The term ‘associative cultural landscape’ has come to be used within the international heritage profession to refer to such complex understandings

of landscape. The World Heritage Convention of UNESCO defines an associative cultural landscape as one that has, "*powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.*"^{lxx} Mythological sites and beings are imprinted in the topography of the landscape and the energy or sentience of the mythological being is understood as remaining in the physical environment. In this sense the mythological beings, and their pathways, are seen as animating the landscape. This belief system is common to all totemic Australian geographies.^{lxxi}

This inscription of meaning onto the landscape applies not only to the actions of mythological beings but also to the actions of the ancestors and events in historical time.^{lxxii} The inscription of meaning onto the landscape, a process captured in the term Dreaming, is not restricted to a distant and mythological past but is a continuous cultural process, "... *a way of 'pre-understanding' that 'signs and topographises' the land, provided a culturally conditioned conceptual framework within which people are empowered to create new meanings.*"^{lxxiii}

The cultural values that are created through the actions of people, in the deep past and historical memory, is evident in Aunty Lorraine Lilley's description, during interviews for the current project, of the tracks that link Tilligerry Creek to the beachfront,

Neville [Lilley] and his younger sister Val [Merrick], remember vividly as little children walking from the end of Tilligerry Creek and walking across the trails that were used by our people over thousands of years, they're still being used and they're actually roadways now which is interesting. So they have personal stories which are still in their memory which is tremendous.^{lxxiv}

As is the case throughout Australia the tracks through Country used by the earlier Europeans, which developed into formal roads, frequently followed traditional Aboriginal pathways. This reflects both the nature of the landscape and the key role that Aboriginal people played in guiding early Europeans through Country.

Pathways link together nodes in the landscape that are related to resource-rich areas, mythological movement patterns, and places of ceremonial and spiritual importance. The cultural understanding of individual sites situates them within this complex interlinked series of pathways and places created by the patterns of movement of mythological beings and Aboriginal people.

Songlines or storylines refer to the pathways formed by mythological beings in their travel through the landscape and carry ritual and ceremonial meaning. Songlines/storylines are themselves pathways that join key sites along a Dreaming Track. In interviews for the current project Jamie Tarrant spoke of how his grandmother, Nan Gwen Russell,

... always talked about a spirit corridor from Sugarloaf Mountain [near Newcastle] through the Worimi Conservation Lands then up the coast along that beautiful stretch of sand, along Anna Bay and through to Tomaree Mountain and then continues along that path north. The spirit corridor runs right up the east coast of Australia, north and south.^{lxxv}

Pathways extend through the country of neighbouring groups, linking people and places together in a complex network of social and ceremonial links. The Dreaming Track or ‘spirit corridor’ that Jamie Tarrant describes, running from Mount Sugarloaf north to Tomaree Mountain, fits within the expected range of a local ritually important pathway,

One aspect of the permeability of boundaries is the cultural tendency in Aboriginal societies to configure land not in blocks but in pathways with nodes. Pathways formalize the passage into and through areas, passage to ceremonial sites and large-scale meetings areas... Pathways that stretch over vast areas are the most difficult to get information about as this extensive interconnected travelling of Aboriginal people and large meetings drawn from well separated areas was one of the first things destroyed by colonialism. In field work I have found there are two pathway lengths about which there is still extant knowledge: the locally ritually important one stretching approximately 30 miles, and the one inclusive of immediately neighbouring groups stretching approximately 200 miles. As with dialect chains these pathways link into adjoining pathways extending right along the coast.^{lxxvi}

Lennie Anderson spoke of how the project area is linked to significant cultural places to the north and south, including ceremonial places at Birubi Point and two other corroboree grounds to the south,

... the corroboree ground at Stockton, where the dancing happened... and at the Williamtown RAAF Base, there was another corroboree parade ground.^{lxxvii}



Image 6: 'Corroboree at Newcastle, c.1818'^{lxxviii}

The men’s initiation ceremonial areas at Birubi Point and Soldiers Point have both been recognised in their gazettal as Aboriginal Places under the *National Parks and Wildlife Act (1979)*.^{lxxix} The corroboree ground at Stockton is recalled in European oral histories of the

area, “*Old Mr Cox I think it was who lived in Chester Street he said his father told him that they [Aboriginal people] used to come down and have their corroborees and that roundabout where Lynn Oval is.*”^{lxxx} Hugh Kerry who came to Stockton as a young child in the late 1850s stated that he could, “*... recall a corroboree by 60 aborigines on Rees’s Hill.*”^{lxxxii} Rees’s Hill is not recorded on maps but the Rees family were a prominent European family in Stockton in the second half of the nineteenth century.^{lxxxii}

The ethnologist R.H. Mathews spoke with many Aboriginal people around New South Wales, including in the Port Stephens region. In common with many European observers he was particularly interested in the ceremonial aspects of culture. Mathews constructed an understanding of cultural regions based on shared initiation ceremonies. He located the Port Stephens region within the *Keepara* region, an initiation type that he states runs from the Hunter River north almost to the Macleay River.^{lxxxiii}

The *Keepara* ceremony, as Mathews referred to it, was a large-scale initiation ceremony involving multiple groups coming together. Mathews stated that once the large inter-group ceremony is completed, “*Each tribe take their own novices away with them, and put them through the remaining stages of initiation in their own country.*”^{lxxxiv} It is likely that the men’s ceremonial areas at Soldiers Point and Birubi Point were part of these localised initiation stages.^{lxxxv}

In his 1904 work the anthropologist A.W. Howitt applied the term Gringai to the people associated with the Paterson River, Williams River, and Dungog. He also lists William Scott as an informant for the Gringai; as the only information he includes from Scott relates to Port Stephens the implication is that the name also applies to that region. However, as Howitt himself makes clear, he was only provided with the name Gringai by J.W. Boydeell and that was specifically in relation to the Dungog area. Howitt has simply chosen to use that name to indicate other groups that he understood as closely associated with the people in the Dungog area.^{lxxxvi} William Scott was born at Carrington in 1844 where his father worked for the AAC. Scott remained at Port Stephens until 1873 and his reminiscences provide some valuable details on the lives and culture of Aboriginal people in the region.² Scott and his sister appear to have spent a considerable amount of their childhood with local Aboriginal children and both learnt to speak the local language to some degree,

The lads of the tribe were my playfellows. I learned to speak their language with a certain degree of fluency as did my sister to a greater extent – and we mastered those difficult labials and gutturals that few white men have been able to catch correctly, as is evidenced by the discordant corruption of many beautifully euphonious native names.^{lxxxvii}

In the published version of Scott’s reminiscences, the Port Stephens people are referred to as part of the “Gringai tribe”. However, in Scott’s manuscript material there is no reference to any group name only the identification of his information as relating to the “*Port Stephens tribe*”.^{lxxxviii} It is highly probable that the use of the name Gringai in the introduction to Scott’s published account is a result of Howitt’s attribution rather than Scott himself.

² Although Scott’s reminiscences were not published until 1929, he says in them that he wrote down much of the information in 1873 when he left the area for Queensland.

In his accounts William Scott referred to initiation ceremonies around Port Stephens. Scott distinguished two levels of initiation rites, the lower-level rites that Europeans were sometimes allowed to witness, and the higher-level rites that were strictly secret. He described what he learnt of the higher-level initiation ceremony,

At Port Stephens it was the custom, when some of the boys had reached that stage of adolescence that their admission to the full privileges and prerogatives of the adult men of the tribe was deemed advisable by the older wisecracks, to segregate them for preparation for the ceremonies. What this initiatory preparation was I never learned, for the boys maintained a strict silence on the subject. But there were ceremonies in the bush, wherefrom the women were rigidly excluded. The men would decorate themselves with pipe-clay and ochre, painting fantastic patterns about their faces and bodies, and they would wear head-dresses of weird and wonderful designs. While the ceremonies were in progress, there would be an incessant noise of the bull-roarers, flat notched sticks whirled at the end of a cord to drive off “debbil-debbils,” keep the women at a distance, and impart the correct amount of terror to the trembling lads who were soon to become men.^{lxxxix}

Scott described how around 1855 he and his father and sister were allowed to watch part of one of the lower-level initiation ceremonies that occurred near Carrington on the north shore of Port Stephens,

Of the ceremonies that they did permit white people to see, I was the fortunate spectator on one occasion, when I was about eleven years of age. At Port Stephens they called it the “poombit” though generally it is spoken of as the “bora.” Walking with my father and sister to a scrubby flat, about two miles distant from our home at Carrington, we reached the poombit ground. Although the men made it a hard and fast rule to exclude the females from most of their ceremonies, on this occasion an exception was made in favor of my sister ...^{xc}

Scott also gave an account of a ceremony that occurred at “a much later date”,^{xcii} suggesting it was probably in the second half of the 1860s, again in the vicinity of Carrington,

On another occasion, at a much later date, I came across another initiation ceremony when proceeding through the bush, I had been riding over the hills after kangaroos, and at a spot about a mile from where the ceremony previously described took place, I saw that a number of blacks were camped at the foot of a hill, the camp being in the form of a half circle, round an oval cleared space some 30 or 40 feet in area. The edges of the space were raised about nine inches. This cleared space was connected with the top of a hill, and another cleared space by a narrow path. The women were not allowed to go up this path nor to approach the top of the hill at all. When going to the creek for water they were careful to look in some other direction. When riding past the camp I heard the most extraordinary noises proceeding from the top of the hill, - a bellowing, or booming sound, continuing for a long time, then

diminishing in volume to a low humming monotone, from which it would gradually swell again into a terrifying crescendo of dissonance. As some of the blacks to whom I addressed questions as to the cause of the noise refused to furnish me with any satisfactory explanation, I made up my mind to investigate for myself.^{xcii}

This description of the layout with the two connected larger and smaller circles confirms it as an initiation ceremonial site. Scott goes on to briefly describe seeing a central fire and men painted up and performing ceremony. When he was spotted watching the ceremony, “... there was a sudden hush. The men remained as though they had suddenly been turned into stone. But presently there were angry murmurs and I realised that my intrusion was deeply resented.”^{xciii} He was spotted by one of the local Aboriginal men who was willing to have him watch but said that,

... the visiting blacks, who were strangers to me, refused to proceed with the ceremony as long as I remained in the neighbourhood. In deference to the very evident wish of my friend that I should depart, I rode away. A few days later this same black approached me, and apparently as some reward for my acquiescence to his wishes on the former occasion, extended an invitation to me to witness the great finishing ceremony.^{xciv}

Later in this account he refers to the visitors as “up-country blacks”.^{xcv} The large network of groups that came together for these ceremonies can be seen in the comment by Enright that,

During my association with the tribes living on the coast district north of the Hunter River, I learnt that the Kamilroi visited the Worimi of Port Stephens when a Keeparra (initiation) was being held, and after the conclusion of the ceremony exchanged gifts with them.^{xcvi}

Scott described that part of the ‘finishing’ ceremony that he was permitted to observe,

.. some two hundred leaping blackfellows appeared over the brow of the hill. They were painted grotesquely, and armed with boomerangs, shields, and spears, which they clashed together in a barbaric rhythm as they ran. They were formed in two divisions, and kept crossing and re-crossing the path, interlacing as they met at the run, and descending the hill rapidly, all the time yelling at the top of their voices... Arriving at the foot of the hill the men threw down their weapons on the ground, and springing on to the cleared space, danced on the fire with their bare feet until it was extinguished. In their midst, throughout the duration of this fantastic dance, remained the youths who were being made “poombit.” The women were covered as in the other ceremony before mentioned. They were always so covered while the fire dancing was on.^{xcvii}

People from the Port Stephens area were amongst the groups who used an initiation ceremonial ground near Gresford. James Boydell, who grew up on the Allyn River where his father had held land since the 1830s, told R.H. Mathews in 1895 that,

The last Bora was held on the ground you visited here – about 12 years ago... I cannot say for certain how many Boras were held there in my life time – distinctly remember three (3). I remember the ground for at least (30) thirty years. The tribes that met ours there came principally from Gloucester & Port Stephens & Maitland on the Hunter. I do not remember any coming from Scone. I remember seeing fully (100) one hundred Blacks assembled more than once – men women & children.^{xcviii}

Scott commented on the decline in the practice of large-scale initiation ceremonies in the mid 1800s,

When I was about to leave Port Stephens in the early seventies the bora ceremonies had practically died out. The tribe did not multiply as it must have done in earlier times. There were few young boys growing into adolescence, and the attenuated “poombits” attempted on a few occasions were poor affairs. The boys initiated were very young; the pomp and ceremony of former occasions had disappeared. Such was the influence of civilisation. But when I was a lad such was not the case, and the initiation of the novices was a memorable and important event. The young boys on whom the mantle of manhood was to be bestowed were carefully instructed by the elders of the tribe for long periods before the actual ceremonies began..... their period of probation must have been a trying one indeed. When they would emerge from the ordeal eventually, they would be haggard, thin and worn. Their hair would be closely cropped; they would be covered with grease and charcoal, and their whole appearance would be as though they had indeed undergone some tremendous mental and physical strain. Perchance they had in all truth.^{xcix}

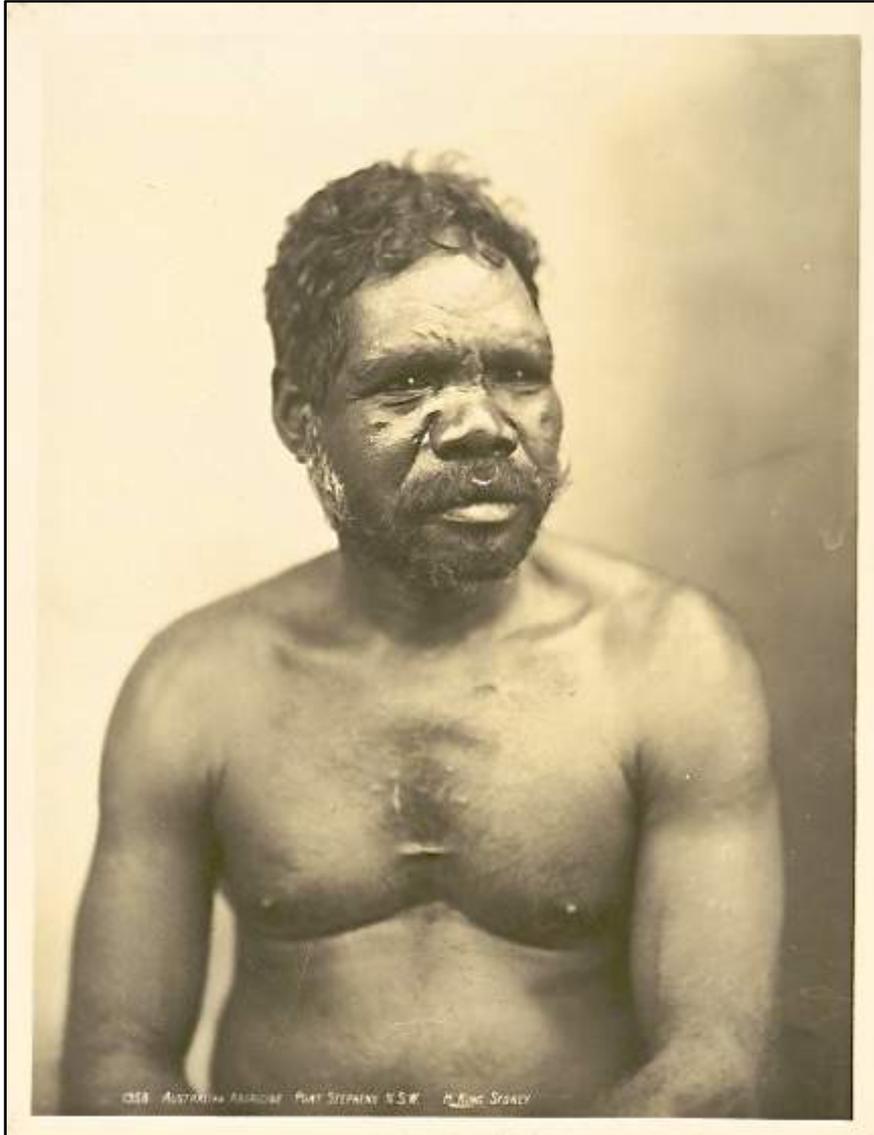


Image 7: Unnamed Aboriginal man, Port Stephens, NSW, c.1890.^c

Though it was increasingly difficult to hold full ceremonies, in his discussion of the *Keepara* type of initiation ceremony, Mathews recorded that one was held on the Manning River in 1889.^{ci} In the mid 1890s Enright was told that some form of ceremony was occurring at Forster,

In December 1896 and again in December 1897 I sojourned among the remnant of the Kutthung tribe at Port Stephens without being able to elicit from them anything more valuable than the reluctant admission that at the present time the youths were initiated at Forster.^{cii}

Around 1898 Enright returned to the Sawyer’s Point community accompanied by R.H. Mathews,

I mentioned the difficulties I encountered in obtaining particulars of their secret ceremonies to my friend Mr. R.H. Mathews, from whom I have always received encouragement and assistance in all ethnological work, and on his

next visit to Maitland he drove out with me to the native camp at Sawyer's Point on the Karuah River. He was personally known to some of the men present there, and was at once received by them as one of the initiated. I remained in the camp "with the women and children," as they jocularly expressed it, while Mr. Mathews took all the initiated men into a secluded place in the bush near by, where a Winggerah ["secret council of initiates"] was held, at which he explained that he had told me all the secrets of the keeparra and had imposed upon me the usual obligations of secrecy. As soon as they were satisfied, I was summoned and shown the sacred goonanduckyer ["Bullroarer used in the keeparra"] and was formally admitted as a member of the tribe entitled to all the privileges of an initiate.^{ciii}

Enright described, based on what he was told at the Sawyers Point camp, the ceremony at Forster, including the ceremonial ground, the various stages of the ceremony and the varied roles of women, initiates and initiated men.^{civ}

As occurred throughout Australia the intrusion of the British into the Port Stephens region resulted in a loss of autonomy and a loss of access to Country. The British intrusion led to a decline in the Aboriginal population as a result of the impact of multiple factors including conflict, resource depletion, sexual violence, alcohol, and introduced diseases. Aboriginal people, communities and social structures all suffered from the impacts of these interrelated factors. Scott, writing of the late 1840s or early 1850s, recalled the impact of a measles outbreak at Port Stephens,

... a very terrible time in my youth, when an outbreak of measles decimated the tribe in a most tragic manner. The congestion, the insanitary conditions that obtained, and an entire lack of appreciation of the necessity for isolation caused the disease to spread with disturbing rapidity. It wrought great havoc, the mortality being exceedingly heavy."^{cv}

He estimated that when he, "... departed from Port Stephens in 1873 to go to Queensland the tribe had dwindled to about fifty members. Perhaps there were fewer than that."^{cvi}

One of the many results of these impacts of colonisation was that it became impossible to continue the full inter-group large-scale initiation ceremonies,

... in January 1899, they were not able to get a sufficient number of aborigines together to enable them to celebrate the ceremony. Many of those I have met along the coast had never gone through the keepaara (sic), but had been merely initiated into the dhalgai, a sister ceremony, much shorter however than the keeparra, and needing for its practice no assemblage of adjoining tribes nor any prepared ground; in fact it requires but a half dozen men who have passed through the keeparra, and the use of a goonanduckyer, to enable the youth to be initiated.^{cvi}

Nonetheless, despite the many limitations and difficulties Aboriginal people in the region managed to continue with the more localised elements of the initiation ceremonies through to the early twentieth century.

Prior to the impacts of European intrusion high level ceremonies brought people together from a wide area utilising the cultural network of pathways and storylines/songlines. These gatherings were dependent on the availability of sufficient resources to support large groups of people. The study area is located within a resource rich coastal environment able to support such gatherings,

Coastal areas are particularly rich in resources as they have ocean, littoral, riverine and bush resource ecologies within a small area that people are able to draw on. The result is a higher person to area ratio throughout the seasons compared to inland areas where resource levels fluctuate more through the seasons. This led to a less mobile existence over a smaller area of land. Nevertheless, influx of people for major sea harvests for certain season is also a feature of coastal areas. There was usually a trade system for exchanging inland to coastal items as well as the wider ranging trade systems of valuables and items of non-physical culture.^{cvi}

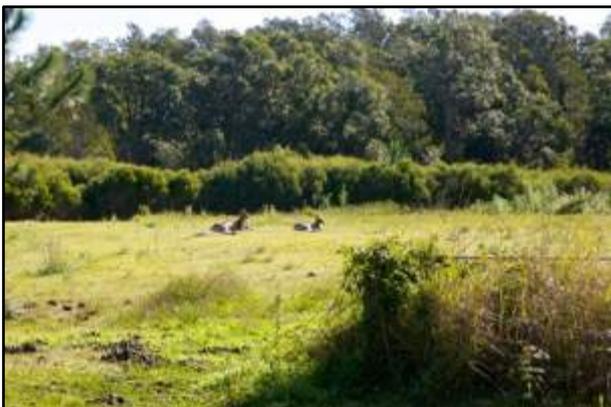
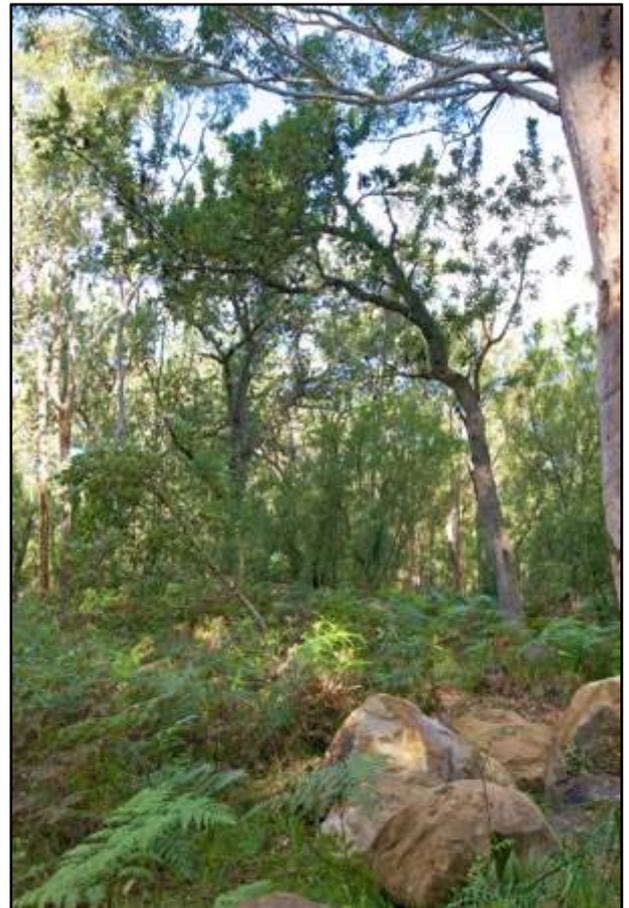
Writing of the late 1820s Dawson described large resource-based gatherings in the Port Stephens area,

The families belonging to a tribe meet together upon occasions of festivals at certain seasons, and also to consult upon all important occasions. But although they have a community of interests at such meeting, still each family has its own fire and provides its own subsistence; except in a general kangaroo hunt, where the game is impounded and taken in large quantities, when it is fairly divided.

Their festivals are very similar in their intentions to the wakes or feasts which exist in many parts of England. Their objects are to feast and dance together for several days, and it is here that the painted bodies, the garnished and mop-like heads, and the harlequin step, are to be seen in perfection at their corrobories. At one season of the year they assemble at a place where they can all procure oysters, and sometimes they meet, as they say, to “patter bungwall,” or fern-root; at other times they meet where they can all feast upon menmy, or gigantic lily, when in season, or upon the kangaroo. Upon these occasions it would be difficult to prevail upon any to absent themselves, and there are some who would not be induced to stay away by any persuasions or bribes that could be offered, more especially the younger members and the children.^{cix}



Image(s) 8: The broader study area and surrounds.^{cx}



Dawson noted that there was trade between coastal and inland groups,

I understood from our natives, that exchanges of articles sometimes took place between the coast-natives and those residing in the interior. Iron tomahawks, sea-shells, with which they scrape and sharpen their spears, and pieces of glass, which they use for that purpose whenever they can get them, were thus frequently exchanged for opossum skins, and sometimes for the belts of yarn ready manufactured, as well as a small opossum band of net-work, which they wear on their foreheads when in full dress. This article is beautifully manufactured, and appears the more extraordinary, when it is considered that it is done entirely with the fingers, without the aid of needle or mesh. The opossums are more numerous inland than they are near the coast, and this is the reason why such an exchange takes place.^{cxix}

Writing of the 1850s and '60s William Scott also referred to opossum cloaks in the Port Stephens area, noting that people continued to prefer them to the government issued blankets,

The rugs they used were made of animals' skins, principally those of opossums. They were very neatly made and provided both warmth and protection from rain when occasion arose. Blankets they obtained from the Government from time to time but they preferred their own homemade coverlets usually.^{cxii}

Traditionally people's patterns of movement and the timing of large-scale gatherings were based around the seasonal availability of key resources. The gigantic (gynea) lily was mentioned by Dawson as one of these resources. William Scott recorded how at Port Stephens, "The young stalk of the gigantic lily was also roasted and eaten after having been soaked in water for some time."^{cxiii}



Image 9: Gigantic Lily, Newcastle, 1835.^{cxiv}

The Quaker missionary James Backhouse visited the Lake Macquarie settlement to the south of Newcastle in 1836 and recorded how the lily was prepared,

Many of the open places in the forest, abounded with Gigantic-lily; the flower stems of which rise from 10 to 20 feet high. These stems are roasted, and eaten by the Aborigines, who cut them for this purpose, when they are about a foot and a half high, and thicker than a man's arm. The Blacks also roast the roots, and make them into a sort of cake, which they eat cold...^{cxv}

William Scott's reminiscences provide a strong sense of the richness of the Port Stephens region,

At Port Stephens the tribe was happily situated in the matter of provender. The waters of the bay teemed with fish of every description, easily taken at all times. The foreshores were covered with oysters, which formed a staple part of the diet. The bush abounded with game in the form of kangaroos, wallabies, 'possums, emus, flying-foxes, wild duck, swans, parrots, pigeons. There were edible roots in the gullies, wildfruits in the brushes. It required but little effort to keep the communal larder filled to repletion.^{cxvi}

Oysters were to be had for the gathering, and the blacks appreciated the succulent shell-fish mightily. But very seldom did they eat them raw. They would knock them off the rocks, or carry the rocks away, and roast the oysters over a fire. Very often as a lad I would sit on the foreshore opening the bivalves for my own refreshment, to be warned on every occasion by some sable friend that "bad eat too many raw. You cook 'em." I have often wondered since then just why they found the oysters better roasted than au naturel.^{cxvii}

When it became necessary to change the fish diet, the blacks had a wide expanse of bush wherever to forage, a territory at that time teeming with game of all descriptions. Marsupials were in abundance among the ridges and on the flat lands; there were birds in the trees and on the swamps. It was really a land of plenty. Even the casual white man, uninitiated into the ways of the chase, could have gleaned living with little difficulty in that land of milk and honey.^{cxviii}

Amongst the many land-based foods that people in the region utilized Scott refers to kangaroos, opossums, snakes, cobra [worms], birds, flying-foxes, yams, gigantic lily stalks, vine fruits, and honey.^{cxix}

In an interview for the current project Lennie Anderson spoke of the importance of the wider study area as a resource rich landscape,

... all swamp land, resource strong, very rich. They would have used canoes all through here. They camped on the rises and came down into the flat areas for resources including water-fowl, snake, cockle shells, wallabies, not roos here. Pippies and other bivalve molluscs. Tilligerry Creek used to come up to the river and connect up into

Fullerton Cove, if you walk down there now you'd only get from here to that car before you were up to your knees in water.^{cxxi}

Jamie Tarrant also discussed the richness of the resources that would have traditionally been available in the wider study area,

You get these swamp lands on the back edge of the Worimi Conservation Lands, into the mangroves and Tilligerry Creek, the bird life and such in the swamps along, they would have been such a rich resource, all this land, and then there's the beach.^{cxxii}

The resource richness of the area was understood by all the knowledge holders spoken with as holding cultural value because it underlay Aboriginal people's use of the area, for day to day life and to support large-scale gatherings, over many many generations.

The material evidence of this richness, in middens and artefacts, was discussed by Jamie Tarrant in relation to the swale and high dunes closer to the beach but also the older dunes, *"All through the old vegetated dunes there is cultural material, the majority is on private property."*^{cxxiii} These material cultural remains are valued by all the knowledge holders and the RAPs as evidence of Aboriginal people's presence and use of Country and as a tangible connection to previous generations.

Archaeological excavation of middens at Birubi Point in the late 1970s identified a wide range of marine foods, along with a number of land-based animals, that were utilised by Aboriginal people in the region.^{cxxiiii}

Fish	Shellfish
Black bream	Pippies
Black drummer	Limpits
Estuary catfish	Nerites
Estuary cod	Cartrut
Flathead	Chiton
Groper	Turban
Jewfish	Triton
Kelpfish	mussel
Leather-jacket	
Mullet	Other Marine Life
Port Jackson shark	Sea-urchin
Red Rock cod	Crustacea
Salmon trout	Whale
Snapper	
Sweep	Terrestrial Life
Tailor	Bandicoots
Tarwhine	Lizards
Toado	Dogs
Trevally	Macropods
Whiting	Small marsupials
Wirrah Cod	Short-tailed shearwater
Wrasse	

Table 1: Food species in Birubi Point middens.^{cxxiv}

In 2007 Birubi Point was gazetted as an Aboriginal Place under the *National Parks and Wildlife Act (1974)*. The gazettal recognised the significance and cultural values of Birubi Point as an

important burial place and a men’s ceremonial site. There is also substantial material culture including middens and artefacts.^{cxxv}



Image 10: Unnamed young Aboriginal woman, Port Stephens district, c.1890s.^{cxxvi}

All along the coast the sea mullet was one of the key resources that could support large-scale gatherings when the runs occur in late autumn and early winter. Scott described how the fishing spears were made and how the women and men worked together to fish for mullet in the Port Stephens bay,

The mooting or fish spear consisted of three parts – Four prongs of iron bark, the main shaft made from the dead stem of the gigantic lily, and a third piece, of the thinner stem of the flower of the grass tree. The weight and strength were regulated to the purpose for which the spear was intended. The heaviest was used for spearing the big sea-mullet which appeared in schools at certain periods of the year. The wood for the prongs was first of all shaped in the rough

and then allowed to lie in some saltwater pool for a time, to get rid of the sap and toughen it, and at the same time make it easier to scrape down to the required thickness. The blacks soon found out the superiority of a scraper made from a broken bottle, over the shell scraper formerly in use. An indispensable thing in this work of spearmaking was the gum of the grass tree, a good big lump of this was always kept on hand.

It was interesting to watch the spearing of the sea mullet. The schools used to travel from west to east close inshore on the northern side of the harbour, at high water, and it was a great time of feasting for the blacks who consumed large quantities of the fish, never seeming to tire of it. The camp was made near the shore and the women were posted to give notice of the approach of a school and at the signal the fishermen, generally about half a dozen at once, would rush into the water up to their middles, with spears and womerahs all poised ready, then when the school was within striking distance the leading fisherman would give the word "mirli" (now) and the spears would all be launched together, and it was seldom any failed to strike a fish.^{cxxvii}

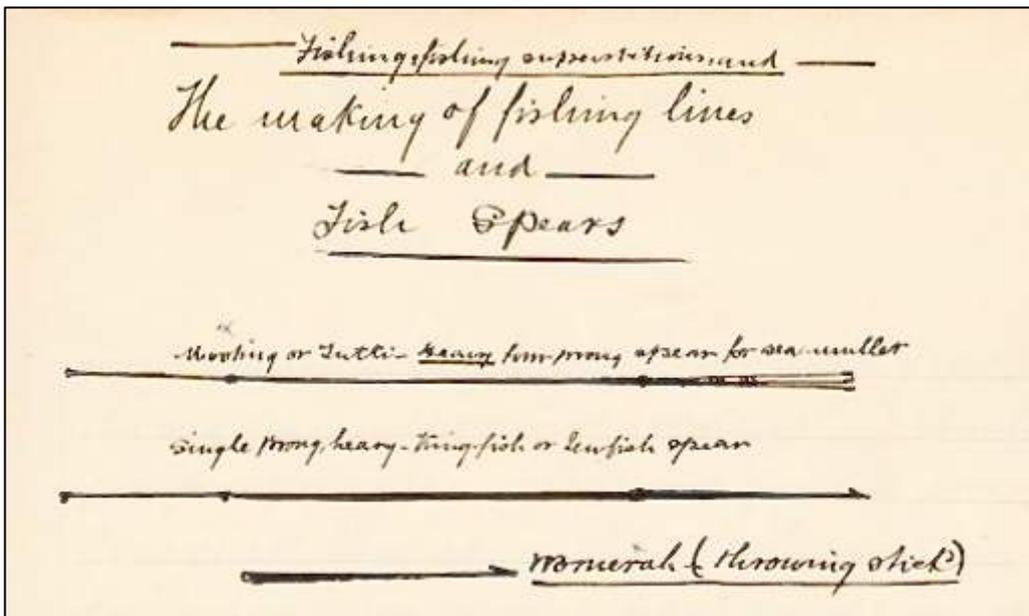


Image 11: Drawing from William Scott's manuscript.^{cxxviii}

Scott spoke of the importance of fishing to the people of Port Stephens,

The business of fishing was perhaps the most important of all to the natives. In the piscatorial art they were highly proficient, using both lines and spears. Fishing lines were cleverly made from the inner bark of young kurrajong trees, the finished article being of extraordinary strength and capable of landing the heaviest of edible fish. I verily believe that they would have held a shark... While the women used the lines, the men mostly fished with the spear, and they were extraordinarily skilful.^{cxxix}

Fishing was, and still is, an important cultural activity in the region. Despite the massive impacts of European intrusion, well into the twentieth century these coastal zones continued to provide,

... substantial tracts of coastline which remained unsettled and hence more or less available to Aboriginal people as places to camp and visit, places to obtain seafood and enjoy the coastal lifestyle. Along with the bush covered hill country, these were places where white surveillance could largely be avoided. They were areas that were marginal to the settler agricultural economy and they remained unsegregated insofar as they were freely available to both Aboriginal and white people, both of whose activities there remained largely uncontrolled by white authorities.^{cxxx}

Mullet is just one of many marine foods that have continued to be an important food source for Aboriginal people in the region. In a 2004 publication based on interviews with six Aboriginal women from the Port Stephens area their memories of childhood have a strong focus on the coast and its resources. Aunty Viola Brown recalled how, “Nan used to take us out to get bush food. She’d take us oystering and fishing. Other times we’d go down ourselves. We’d go down to the rocks and we’d take a tin and some matches, we’d collect periwinkles and cook them ourselves, we’d eat them down there.”^{cxxxi}

Aunty Val Merrick recalled how when she was young the family would smoke fish for the winter,

My dad used to have a smoke hut – to smoke the fish, mainly mullet. And it was lovely too. My brothers and everyone helped with the smoking. We had to clean the fish and hang it up for so many days, then salt it down. That got us through the winter.^{cxxxii}

Aunty Gwen Russell also spoke of the mullet run and smoking for the winter,

Around here in October, they’ll catch black fish, brim, and whiting. When it’s getting close to Easter, around April, it’s the mullet that run. So you get mullet and you follow that to the brim. It just goes around. It’s the mullet that you smoke. You just open them up and take out all the gut. Salt them down with that strong salt, that rock salt, and let it sit for awhile. After awhile you hang them up and let all the salt drip off, then you hang them in the open fireplace for smoking.... My grandmother loved the mullet and the taylor; she used to do it like that...^{cxxxiii}

The importance of fishing and the core cultural value of sharing resources are both evident in Aunty Gwen Russell’s statement that,

All the community people fished. And when you got a big catch of fish, you shared it. Sharing was a big part of life. They still do that sort of thing now. You know, if someone went out and got a feed of fish, and if it were more than they needed, they’d share it with everyone in the community. The fish was there to have. It was the same with the prawns; same with whatever we’d get.^{cxxxiv}

In an interview for the current project Aunty Lorraine Lilley spoke of how her father-in-law,

... talked about how they used to walk across [to the dunes] and take all the family for the day, to collect the pippies when they were ready in season. He must have done [it when he was a kid] because he knew exactly where to go and where the pippies were.^{cxxxv}

Uncle Neville Lilley, in an interview for the current project, shared this story of one of these family trips to the dunes that happened around 1940s when he was nine or ten years old,

We travelled from Karuah by boat to the very end of Tilligerry Creek. My dad, being a clever fisherman knew the tides and how long it would take to get up the creek, ensuring we would get to the end of the creek on high tide. Leaving the boat moored in the creek, we would then walk through the bush until we reached the sand dunes and the beautiful beach at Birubi. We would spend the day swimming and gathering pippies to take back home. We had a great time finding the pippies hiding in the sand. Most times we would find the pippies with our feet or we would spot them as they were sucking in food when the waves were going out. When it was time to leave Birubi we would make the long trek back to the boat that was moored in Tilligerry Creek. We would each have a bag of pippies to carry.^{cxxxvi}

Uncle Neville Lilley spoke of how he understood that his father was passing on to his generation something that he had done when he was young with his own father, "... well he knew exactly where to go, what paths to take going from Tilligerry Creek across to the sand dunes. He must have walked them many times when he was younger."^{cxxxvii}

The Worimi people of the study area continue to teach their children, strengthen their communities, and walk their Country.

7 Overview of Findings and Recommendations

Within the Section 1 study area eighteen (18) individual plants have been located of an endangered orchid genus identified as culturally significant. No other locationally specific sites of intangible cultural significance within the Section 1 area were identified during the cultural values assessment process. However, the Section 1 area lies within the zone of traditional patterns of movement between Tilligerry Creek and the beach front and between Tomaree and Fullerton Cove. These patterns of movement were associated with resource collection, community gatherings and ceremonial activities and hold significance as an important element of the cultural landscape. A detailed discussion of these cultural values is provided in the following section (**Detailed Cultural Significance Assessments**).

Table 2: Summary of Significant Cultural Values in Section 1

Item	Description	Cultural significance	Impact Yes/No
West-East Movement Corridor	A movement corridor running from Tilligerry Creek to the beach front.	This movement corridor has High Significance to the local Aboriginal community as the patterns of movement hold cultural value for their association with resource use, community gatherings and ceremonial cycles.	Yes
North-South Movement Corridor	A movement corridor running from Tomaree south to Fullerton Cove.	This movement corridor has High Significance to the local Aboriginal community as the patterns of movement that occurred across this zone hold cultural value for their association with resource use, community gatherings and ceremonial cycles.	Yes
Diuris arenaria Orchid	An endangered orchid species that is present in the study area.	The <i>Diuris</i> are a genus of the orchid family <i>Orchidaceae</i> and are endemic to Australia. Orchids were utilised as a traditional food source and hold cultural value for that association. This orchid has Medium Significance to the local Aboriginal community for its use as a food source.	Yes

A range of overarching and site-specific actions and mitigation measures have been recommended for implementation; these are designed to protect Aboriginal cultural heritage values within the project footprint from unintended impacts and to provide appropriate mitigation measures to record and respect Aboriginal cultural heritage values where impact will occur. These are set out in Table 2 below as safeguards requiring implementation. These recommendations have been developed in consultation with the knowledge holders.

Table 3: Recommended Aboriginal Cultural Heritage Safeguards for Section 1

Impact	Safeguard for Section 1	Timing
Aboriginal cultural heritage	An Aboriginal Heritage Management Plan (AHMP) should be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). The AHMP should provide specific guidance on measures and controls to be undertaken to avoid and mitigate impacts on Aboriginal cultural heritage during construction. This should include protection measures to be applied during construction, including but not limited to the recommendations set out in this table, as well as contractor training in general Aboriginal cultural heritage awareness and management of Aboriginal heritage values.	Pre-construction and construction.
Aboriginal cultural heritage	An Aboriginal cultural heritage awareness training package should to be delivered as part of the site induction for all contractor(s) and maintenance personnel involved in the construction works. The training package to be developed by a cultural heritage specialist in consultation with the RAPs and Knowledge Holders. The training package should at a minimum ensure awareness of the cultural significance of the project area, the requirements of the AHMP and relevant statutory responsibilities, and the identification of unexpected heritage items and appropriate management procedures.	Pre-construction and construction.
Aboriginal cultural heritage	The development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist on the cultural values and historical records relating to the cultural landscape of the Section 1 study area with a focus on the three values identified in Table 2. The report to be produced as a full colour booklet for distribution to local libraries and educational institutions. The content of the booklet to be developed in consultation with the RAPs and Knowledge Holders.	Pre-construction.
Aboriginal cultural heritage	The AHMP should provide for an addition to the <i>Unexpected Heritage Items Procedure 2015</i> to require the notification of the identified knowledge holders within 48 hours of any discovery of potential archaeological Aboriginal skeletal remains during the proposed works.	As required

Impact	Safeguard for Section 1	Timing
Aboriginal cultural heritage	If there is a confirmed discovery of archaeological Aboriginal human remains it is recommended that consultation occur with the RAPS and Knowledge Holders in relation to: the development of a Management Plan for proposed works in the relevant area; cultural ceremonies in relation to the human remains and the site of their occurrence; and, repatriation of the human remains.	As required

8 Detailed Cultural Significance Assessment

The larger Williamstown to Bobs Farm study area includes on its eastern edge parts of the Worimi Conservation Lands (which include the Worimi National Park, the Worimi Regional Park, and the Worimi State Conservation Area). The Worimi Conservation Lands Plan of Management includes as one of its vision statements,

The Worimi Conservation Lands IS a Worimi cultural landscape that we want to protect for future generations.^{cxxxviii}

In interviews for the current project Aunty Lorraine Lilley and Uncle Neville Lilley jointly emphasised the importance of the area,

The dunes are important places, absolutely... The conservation lands is just loaded with cultural sites and is very valuable to the Worimi people.^{cxxxix}

It is evident from discussions with RAPs and knowledge holders, and from a consideration of the documentary record, that cultural landscape of value and significance is not limited to the conservation lands but extends into the wider Williamstown to Bobs Farm study area. Lennie Anderson spoke of the project area as linked to significant cultural places to the north and south, including corroboree grounds, ceremonial sites and burials.^{cxl} As Jamie Tarrant stated it is important to understand that,

It is not just one spot that is significant, I believe the whole lot, the whole area, is connected. Even though we might see each bit as this little thing, it's that bigger picture that it feeds into, that's important, the cultural landscape and the cultural value.^{cxli}

The cultural landscape that the Williamstown to Bobs Farm study area sits within is one that is rich in cultural value and includes significant resource areas, Story or Dreaming Tracks, ceremonial grounds, corroboree grounds, burial places, pathways and pathway markers, and traditional and historical living places. The Murrook Cultural Centre on Nelson Bay Road holds cultural value as a contemporary cultural gathering place and for its association with an adjacent culturally significant landscape feature. The Williamstown to Bobs Farm report will provide further detail of the elements of these cultural values that lie specifically within the Williamstown to Bobs Farm study area.

The knowledge holders and the RAPs have identified their concerns regarding the impact of works on the ecosystems of the project corridor and beyond. Knowledge of country includes knowledge of landforms, waterways, plants, and animals and the ways in which these all come together to form specific local ecosystems. These elements all hold cultural value for their links to cultural activities, including resource gathering, and to the cultural stories that act to preserve and transmit cultural knowledge. This knowledge links the environment to spiritual, ethical and community values and is “... an integral part of people’s life and knowledge systems.”^{cxlii} In the words of Jamie Tarrant it is all about, “Country, culture and community”.

8.1 West-East Movement Corridor

Description: A culturally significant movement corridor running from Tilligerry Creek to the beach front.

Significance: This zone is part of a broad movement corridor within which Aboriginal people traditionally, and historically, moved between Tilligerry Creek and the beach front. Aunty Lorraine Lilley spoke during the current project of how traditionally people travelled to the beach dunes when specific resources were ready,

... going across to the dunes was something that our people did periodically when seasonal food in the beach area was abundant.^{cxliii}



Image 12: Looking towards Birubi Point, 2020.^{cxliiv}

In interviews for the current project Jamie Tarrant spoke of the dense middens on the beachfront running from Birubi Point south,

... all along the beachfront, from that hill going south down to around Tin City and Boyces Trail, there's middens all through that. It blows me away to see how the [old people] all came there. I believe they would have come across from Tilligerry. You can see mud whelks from Tilligerry in the middens.^{cxlv}

The Section 1 project area lies within this movement zone between Tilligerry Creek and the coastline. This movement corridor has **High Significance** to the local Aboriginal community as the patterns of movement hold cultural value for their association with resource use, community gatherings and ceremonial cycles.

Impact: Yes.

Recommended Actions: None

Mitigation Recommendations: The development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist in consultation with the RAPs and Knowledge Holders on the cultural values of the Section 1 study area. The booklet to include specific discussion of the cultural values of the West-East Movement Corridor within the context of the cultural landscape. The booklet to be produced in full colour for distribution to local libraries and educational institutions.

8.2 North-South Movement Corridor

Description: A culturally significant movement corridor running between Tomaree and Fullerton Cove, it forms one part of a larger north-south movement corridor.

Significance: This zone is a movement corridor within which Aboriginal people traditionally moved between Tomaree and Fullerton Cove. This movement corridor has **High Significance** to the local Aboriginal community as the patterns of movement hold cultural value for their association with resource use, community gatherings and ceremonial cycles.

Impact: Yes.

Recommended Actions: None.

Mitigation Recommendations: No site-specific mitigation is recommended in relation to the North-South Movement Corridor in relation to the Section 1 impacts. However, it is recommended that the cultural values and significance of this movement corridor be considered within the booklet recommended in relation to the West-East Movement Corridor and the *Diuris arenaria* impacts.



Image 13: Looking north-east from the study area.^{cxlvi}

8.3 *Diuris arenaria* (Sand Doubletail) Orchid

Description: A culturally significant endangered orchid, *Diuris arenaria*, has been recorded within the proposed construction footprint of Section 1.



Image 14: “A rare Orchis, Newcastle region”, 1836.^{cxlvii}

Photograph to right is of a *Diuris arenaria* flower.

The *Diuris* are a genus of the orchid family *Orchidaceae* and are endemic to Australia. The *Diuris arenaria* (Sand Doubletail) is endemic to the Tomaree Peninsula. Populations have also been located along a powerline easement within the Worimi National Park adjacent to the Section 1 study area.^{cxlviii} The *Diuris arenaria* is listed as an endangered species under the NSW *Biodiversity Conservation Act 2016*.^{cxlix}

The *Diuris* orchids are amongst those whose small tubers were utilised as a traditional food source^{cl} and hold cultural value for that association. Jamie Tarrant recalled his Grandmother Gwen Russell speaking of how the tubers were used as a food source,

There’s a rare and threatened species of orchid that’s along the power easement near there, I don’t know the specific value but Nan always spoke about the bulbs at the base of the orchids, like a little potato ball that runs along the root line, and how it was a food traditionally.^{cli}

Significance: This orchid has **Medium Significance** to the local Aboriginal community as an endangered plant that was a traditional food source.

Impact: A total of eighteen (18) individual plants of the *Diuris arenaria* are located within the Section 1 study area.

Recommended Actions: None

Mitigation Recommendations: The development of a booklet (in a format appropriate for local publication) by a cultural heritage specialist in consultation with the RAPs and Knowledge Holders on the cultural values of the Section 1 study area. The booklet to include specific discussion of the cultural values of the *Diuris arenaria* within the context of the cultural landscape. The booklet to be produced in full colour for distribution to local libraries and educational institutions.

9 Statement of Impact

The wider region that the Section 1 study area sits within is a rich cultural landscape that includes significant resource areas, Story or Dreaming Tracks, ceremonial grounds, corroboree grounds, burial places, pathways and pathway markers, and traditional and historical living places, and a contemporary gathering place.

Within the Section 1 study area itself three intangible cultural values have been identified. The only locationally specific site is the eighteen (18) individual plants of an endangered orchid genus, identified as culturally significant, that have been located within the study area. In addition a culturally significant movement corridor running from Tilligerry Creek to the beach front is partially located within the Section 1 study area. The study area is also located within the zone of a larger north-south movement corridor running from Tomaree to Fullerton Cove. It is noted that the RAPs and the knowledge holders also place cultural value on any material cultural objects identified during the project.

The development of a booklet, in consultation with the RAPs and knowledge holders, has been recommended to record the cultural values impacted in the Section 1 study area; this to be undertaken as one project referencing all three identified cultural values.

10 Bibliography

Backhouse, James *A Narrative of a Visit to the Australian Colonies*, London, Hamilton, Adams, and Co., 1843.

Bairstow, Damaris 'With the best will in the world: some records of early white contact with the Gampignal on the Australian Agricultural Company's Estate at Port Stephens', *Aboriginal History*, Vol.17, No.1/3, 1993.

Bell, Stephen & Colin Driscoll, *Vegetation of the Worimi Conservation Lands Port Stephens, New South Wales: Worimi NP, Worimi SCA & Worimi RP*, Eastcoast Flora Survey, report to Department of Environment, Climate Change & Water, November 2010.

Bigge, Commissioner *Report of the Commissioner of Inquiry into the state of the Colony of New South Wales*, London, House of Commons, 1822.

'Birubi Point Aboriginal Place', State Heritage Register, New South Wales Department of Planning, Industry and Environment.

Blyton, Greg 'Aboriginal guides of the Hunter Region 1800-1850: A case study in Indigenous labour history', *History Australia*, Vol 9, No. 3, Dec 2012, pp.89-106.

Byrne, Denis & Maria Nugent, *Mapping Attachment: A spatial approach to Aboriginal post-contact heritage*, Department of Environment and Conservation, Sydney, 2004.

Cahir, Fred Ian D. Clark, Philip A. Clarke, *Aboriginal Biocultural Knowledge in South-eastern Australia: Perspectives of early colonists*, CSIRO Publishing, 2018.

Chesterman, John & Brian Galligan, *Citizens without rights: Aborigines and Australian Citizenship*, Melbourne, Cambridge University Press, 1997.

Collins, David *An Account of the English Colony in New South Wales: With Remarks on the Dispositions, Customs, Manners, etc, of the Native Inhabitants of that Country*, A.H. & A.W. Reed in association with The Royal Australian Historical Society, Sydney [edited by Brian H. Fletcher, original edition 1798], 1975.

Cook, Captain James, *James Cook's Journal of Remarkable Occurrences aboard His Majesty's Bark Endeavour, 1768-1771*, transcription by the National Library of Australia (Manuscript 1 page 234, 2004), <http://nla.gov.au/nla.cs-ss-jrnl-cook-17700511>.

Cribb, A.B. & J.W. *Wild Food in Australia*, Collins Books, Sydney, 1974.

Dawson, Robert *The Present State of Australia; a description of the country, its advantages and prospects, with reference to emigration: and a particular account of the manners, customs, and condition of its Aboriginal inhabitants*, Smith, Elder & Co., London, 1831.

Djenidi, Valerie *State and Church Involvement in Aboriginal Reserves, Missions and Stations in New South Wales, 1900-1975: and a translation into French of John Ramsland, Custodians of the Soil: A History of Aboriginal-European Relationships in the Manning Valley of New South Wales*, Taree: Greater Taree City Council, 2001, Newcastle, University of Newcastle, PhD, 2008.

Dunn, Mark, *A Valley in a Valley: Colonial struggles over land and resources in the Hunter Valley, NSW 1820 – 1850*, PhD Thesis, University of New South Wales, Sydney, 2015.

Dyall, L.K. 'Aboriginal Fishing Stations on the Newcastle Coastline, New South Wales', in Sandra Bowdler (ed.), *Coastal Archaeology in Eastern Australia: Proceedings of the 1980 Valla Conference on Australian Prehistory*, Australian National University, 1982, pp.57-59.

Elkin, A.P. 'Notes on the social organization of the Worimi, a Kattang-speaking people', *Oceania*, Vol.2, No.3, March 1932, pp.359-363.

English, Anthony *The sea and the rock gives us a feed: Mapping and managing Gumbaingirr wild resource use places*, National Parks and Wildlife Service (NSW), August 2002.

Enright, W.J. 'The initiation Ceremonies of the Aborigines of Port Stephens, N.S. Wales', *Journal and Proceedings of the Royal Society of New South Wales*, Vol.33, 1899.

Enright, W.J. 'The Language, Weapons and Manufactures of the Aborigines of Port Stephens, N.S.W.', *Journal and Proceedings of the Royal Society of New South Wales*, Vol. XXXIV, 1900.

Enright, W.J. 'That Kattang (Kutthung) or Worimi: An Aboriginal Tribe', *Mankind*, Vol.1, No.4, March 1932.

Enright, W. J. 'Notes on the Aborigines of the North Coast of New South Wales', *Mankind*, Vol.2, No.4, June 1937.

Enright, W.J. 'Notes on the Aborigines of the North Coast of New South Wales', *Mankind*, Vol.2, No.7, September 1939.

Enright, W.J. 'Notes on the Aborigines of the North Coast of N.S.W.', *Mankind*, Vol.2 No.9, October 1940.

Flowers, E. 'Dawson, Robert (1782-1866)', *Australian Dictionary of Biography*, National Centre of Biography, Australian National University, Volume 1, 1966.

Godwin, L. & J. Weiner, 'Footprints of the ancestors: The convergence of anthropological and archaeological perspectives in contemporary Aboriginal heritage studies', in B. David, B. Barker & I. McNiven (eds), *The Social Archaeology of Australian Indigenous Societies*, Canberra, Aboriginal Studies Press, 2006.

Goodall, Heather *Invasion to Embassy: Land in Aboriginal Politics in New South Wales, 1770-1972*, Allen & Unwin, St Leonards (NSW), 1996.

Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, 2011, Office of Environment and Heritage (NSW).

Howitt, A. W. *The Native Tribes of South East Australia*, London, MacMillan & Co, 1904.

Inkpin, Cathleen *Making their gospel known: the work and legacy of the Aboriginal Inland Mission 1905-1938*, BA (Hons) Thesis, University of Sydney, 2011.

Jervis, James 'The Hunter Valley: A Century of its History', *Journal and Proceedings of the Royal Australian Historical Society*, Vol. 34, Pt.3, 1953, pp.98-103.

Mathews, R.H. 'The Keeparra Ceremony of Initiation', *Journal of the Anthropological Institute of Great Britain and Ireland*, Vol.26, 1897.

Mathews, R.H. 'Initiation ceremonies of Australian tribes.' *American Philosophical Society*, 1898, Vol.37, pp. 54-73.

Munn, Nancy 'Excluded Spaces: The Figure in the Australian Aboriginal Landscape', *Critical Inquiry*, Vol.22, No.3, Spring 1996, pp.446-465.

Nell, John A. 'The History of Oyster Farming in Australia', *Marine Fisheries Review*, Vol. 63 (3), January 2001.

Norman, Sue 'The New South Wales Aboriginal Lands Trust and its place in history', *Australian Aboriginal Studies*, 2011, Vol.2, pp.88-101

Perry, T. M., *Australia's First Frontier: The spread of settlement in New South Wales 1788-1829*, Melbourne University Press, Carlton (VIC), 1965 (1963).

Phillips, Nancy 'Memories of Pindimar from the 1920s', *Nota*, 21 March 1992.

Practice Note: The Burra Charter and Indigenous Cultural Heritage Management, Version 1: November 2013, Australia International Council on Monuments and Sites.

Read, Peter *The Stolen Generations: The Removal of Aboriginal Children in New South Wales 1883 to 1969*, NSW Department of Aboriginal Affairs, 1996.

Riebe, Inge *Summary of anthropological material for Nelson Bay Road Upgrade Project*, produced for Waters Consultancy, June 2020.

'Remembering the Mission Days: Stories from the Aborigines' Inland Mission', *Australian Institute of Aboriginal and Torres Strait Islander Studies*, <http://www.aiatsis.gov.au/collections/exhibitions/missions/background.html>, 2013.

Rose, Deborah Bird *Totemism, Regions, and Co-management in Aboriginal Australia*, Conference Paper at "Crossing Boundaries", British Columbia, Canada, 1998.

Schilling, Kath *Aboriginal Women's Heritage: Port Stephens*, Department of Environment and Conservation (NSW), Sydney, June 2004.

Scott, William *The Port Stephens Blacks: Recollections of William Scott. Prepared by Gordon Bennett*, Chronicle Office, Dungog NSW, 1929.

'Soldiers Point Aboriginal Place', State Heritage Register, New South Wales Department of Planning, Industry and Environment.

Strehlow, T. 'Geography and the totemic landscape in central Australia: a functional study', *Australian Aboriginal Anthropology*, R. Berndt (ed.), University of Western Australia Press, 1970.

Tamasari Franca & J. Wallace, 'Towards an Experiential Archaeology of Place: From Location to Situation Through the Body', in Bruno David, Bryce Barker & Ian J. McNiven (eds), *The Social Archaeology of Australian Indigenous Societies*, Canberra, Aboriginal Studies Press, 2006.

The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance, 2013), Australia International Council on Monuments and Sites.

Vader, John *Red Cedar: The Tree of Australia's History*, Reed Books, Sydney, 1987.

Wafer, Jim 'Placenames as a guide to language distribution in the Upper Hunter, and the landnam problem in Australian toponomastics', in Ian D. Clark, Luise Hercus & Laura Kostanski (eds.), *Indigenous and Minority Placenames: Australian and International Perspectives*, Canberra, ANU Press, 2014.

Worimi Conservation Lands Plan of Management, NSW National Parks & Wildlife Service, Office of Environment & Heritage, 2015.

Archival Material

- Aboriginal Protection Board Register of Reserves, File 2/8349, Reel 2847, State Records of New South Wales.

Craig, Ross interviewing Jess Walker and Friends about Stockton NSW, n.d. [c.1990s], *Pat and Ross Craig Oral History Archive*, Cultural Collections, Auchmuty Library, University of Newcastle.

Scott, William *Notes on Aborigines, 1871-1928*, Accession No: B 756, Mitchell Library, State Library of New South Wales.

Snowball, Ralph 'Photograph: Cambrian House, Evan Rees' Draper, Grocer, and Ironmonger store, Mitchell Street, Stockton, NSW', Photograph, Norm Barney Photographic Collection, University of Newcastle Library.

Legislative Acts

Biodiversity Conservation Act 2016 No 63 (NSW).
National Parks and Wildlife Act (1974) (NSW).

Newspapers & Journals

Freeman's Journal
Newcastle Morning Herald and Miners' Advocate
Newsletter: An Australian Paper for Australian People
N.S.W. Aborigines' Advocate

Maps

Parish of Tomaree, County of Gloucester, 11th Edition, c.1967, Parish and Historical Maps, Land Registry Services (NSW).
Town of Stockton, Parish of Stockton, 1893, Parish and Historical Maps, Land Registry Services (NSW).

Government Papers

Government Gazette of the State of New South Wales
Votes & Proceedings of the Legislative Assembly

Maps (reproduced)

Map 1: Parrott, Major T.S. 'Map of the country around Newcastle N.S.W., 15 March 1893, Sydney, Government Printing Office, ID: 1729018, National Library of Australia.

Map 2: *Parish of Tomaree, County of Gloucester, 1918, Parish and Historical Maps, Land Registry Services (NSW).*

Map 3: *Parishes of Tarean and Karuah, 1888, Parish and Historical Maps, Land Registry Services (NSW).*

Images (reproduced)

Image 1: 'The Coal River or Port of Newcastle New South Wales', possibly by John William Lewin, ID: SAFE/PSX 942/2, Mitchell Library, State Library of New South Wales.

Image 2: Harden S. Melville, 'Bush scene, Port Stephens', 1849, ID No: 2770507, Rex Nan Kivell Collection, NK942, National Library of Australia.

Image 3: H. Grant Lloyd, 'Entrance to Port Stephens', May 1879, Call No: DL PX 43, Dixon Library, State Library of New South Wales.

Image 6: Joseph Lycett, '[Corroboree at Newcastle, ca.1818]', Oil Painting DG 228, State Library of New South Wales.

Image 7: 'Aboriginal man, Port Stephens, NSW, c.1890', Henry King, Image Accession: 1358/6610824, National Library of Australia.

Image 9: Dorothy English Paty, 'Doryanthes excelsa or Gigantic Lily, Newcastle, New South Wales, November 6th, 1835', ID No: 2249212, National Library of Australia.

Image 10: Henry King, 'Australia: an Aboriginal woman', Port Stephens district, c.1890s, ID No: 534164i, Wellcome Library Collection.

Image 11: Drawing from William Scott, *Notes on Aborigines, 1871-1928*, Accession No: B 756, Mitchell Library, State Library of New South Wales, p.43.

Image 14: Dorothy English Paty, 'A rare Orchis, Newcastle region, New South Wales, 10 January 1836', watercolour, ID 2249136, National Library of Australia.

Images 4, 5, 8, 12 & 13: Korey Moon & Kate Waters, Waters Consultancy Pty Ltd, June 2020.

11 Appendix A: Email of 4 March (including draft CVA methodology)



4 March 2020

To the email recipient

Invitation to participate in the heritage assessment process for the proposed Nelson Bay Road Section 1 Upgrade including attending Aboriginal Focus Group meeting 1 and participating in a Cultural Values Assessment

Transport for NSW (Transport) proposes to upgrade Nelson Bay Road from one kilometre east of Marsh Road to two kilometres east of Marsh Road at Salt Ash.

Transport believes that the project may have an impact on Aboriginal cultural heritage. As a consequence, Transport may require approvals under *National Parks & Wildlife Act 1974* and/or the *Environmental Planning & Assessment Act 1979* for this project.

As part of the consultation process, Transport is seeking cultural information to identify:

- any Aboriginal objects of cultural value to Aboriginal people in the area of the proposed project.
- any places of cultural value to Aboriginal people in the area of the proposed project. This includes places of social, spiritual and cultural value, historic places with cultural significance, and potential places/areas of historic, social, spiritual and/or cultural significance.

Transport will be holding an Aboriginal Focus Group meeting to discuss the management of Aboriginal cultural heritage for this project as follows:

Time: 9:30am to 1:00pm
Date: Tuesday 24 March
Venue: Murrook Cultural Centre, Worimi Local Aboriginal Land Council 2163 Nelson Bay Road, Wiliamtown NSW 2318.

A light lunch will be provided.

An agenda for the meeting is attached. Also attached for you review and comment are the following:

- draft PACHCI Stage 2 archaeological assessment (**note sent electronically only due to size**)
- proposed Cultural Heritage Assessment Report (CHAR) methodology
- proposed Cultural Values Assessment methodology.

All comments on the cultural values of the study area, the archaeological assessment and draft Cultural Values Assessment methodology must be received by **3 April 2020**. Comments can be provided in writing, by phone or at the Aboriginal focus group meeting.

Please advise Transport whether any specific disability assistance is required to assist in your attendance at the meeting including wheelchair access, hearing loops or dietary requirements.

Please note that travel expenses will not be reimbursed for attendance at focus group meetings and site visits for this project.

To register your interest in attending the Aboriginal focus group meeting, you should write, email or phone: Kate Hagan, Senior Project Development Officer, Level 7 266 King Street Newcastle 2300, email: kate.hagan@transport.nsw.gov.au, phone: 02 4908 7534.

We look forward to your participation in the assessment of this project.

Yours sincerely



Kate Hagan
Senior Project Development Officer

Attachments (5)

- (1) Nelson Bay Road, Williamtown to Bob's Farm, Proposal area boundary
- (2) Preliminary Agenda
- (3) Proposed Cultural Heritage Assessment Report (CHAR) methodology
- (4) Cultural Value Assessment methodology. For comment
- (5) PACHCI Stage 2 Archaeological Assessment Williamtown to Bobs Farm – Stage 1. August 2019. **Note – Sent electronically only due to size.**



Figure 2 Approximate study area (Yellow shaded area) for proposed Cultural Values Assessment for Nelson Bay Road Upgrade, Williamtown to Bob's Farm.



DRAFT AGENDA

Meeting : Aboriginal focus group meeting for the proposed
Date and Time : 24 March 2020 9:30 am to 13:00
Venue: Murrook Cultural Centre, Worimi Local Aboriginal Land Council
2163 Nelson Bay Road, Wiliamtown NSW 2318

Draft Agenda

1. Welcome to country/acknowledgement
2. Introductions and apologies
3. The proposal
4. Stage 2 PACHCI Archaeological assessment
5. Proposed Cultural Heritage Assessment Report (CHAR) methodology
6. Proposed Cultural Values Assessment (CVA) methodology.
7. Nominated parties for CVA
8. Questions / any other matters
9. Other

Proposed Cultural Heritage Assessment Report methodology

The following methodology has been prepared in accordance with clause 60 of the National Parks and Wildlife Regulation 2019 and to support an AHIP application for impacts associated with Stage 1 of the Williamtown and Bobs Farm proposal involving the construction of a one kilometre section of dual carriageway at Bobs Farm.

The following methodology is being provided to all Registered Aboriginal Parties (RAPs) in accordance with Sections 4.3.1 and 4.3.2 of DPIEs Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010a). As such, the below methodology is provisional pending consultation with Aboriginal stakeholders.

Assessment Objectives

- identify the Aboriginal cultural heritage values of the study area by way of background research and consultation with Traditional Owners, Registered Aboriginal Parties (RAPs) and the Worimi Local Aboriginal Land Council
- assess the potential impact of the proposal on the identified Aboriginal cultural heritage values of the study area
- to provide an appropriate management strategy to avoid or minimise potential harm to the identified Aboriginal cultural heritage values of the study area
- Prepare an ACHAR in accordance with clause 61 of the National Parks and Wildlife Regulation 2019, Transport's PACHCI and the relevant provisions of DPIE's Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH, 2011).

Proposed Aboriginal Cultural Heritage Assessment Report methodology

The proposed assessment methodology will include the following steps:

1. Review of background information including reviewing data relating to the environmental, historical and archaeological context of the study area
2. Consultation with Aboriginal stakeholders, including seeking information from cultural knowledge holders on whether there are any Aboriginal objects or places of cultural value to the stakeholders within the study area
3. A dedicated cultural values assessment to document the social/cultural values of the study area (see specific methodology below)
4. Assessing harm, including identifying the nature and extent of the proposed activity and assessing if there is the potential for the proposal to harm on any identified Aboriginal objects and places within the study area and what effect these impacts might have on their heritage value
5. Consideration of measures to avoid or reduce harm
6. Preparation of an Aboriginal Cultural Heritage Assessment Report detailing the results of the above. All registered Aboriginal stakeholders will be provided with a draft copy of this report for review and comment and all feedback and comments received will be considered in the final document. The ACHAR will include a copy of submissions on the proposed methodology and draft report.

Nelson Bay Road Duplication: Draft Methodology for Aboriginal Detailed Cultural Values Assessment Process

Produced by: Waters Consultancy Pty Ltd

Date: 24 February 2020

The proposed approach would involve consultation with the identified knowledge holders within a context of historical and ethnographic research into the cultural values of the project area and the wider region within which it is located. Following the identification and assessment of the cultural values of the project area consideration would be given to the future management of the identified values.

The proposed approach to undertaking a detailed cultural assessment of the study area would be multi pronged:

- The identification of cultural knowledge holders for the project area through consultation with the registered stakeholders and other parties;
- Consultation with the identified knowledge holders regarding the cultural values of the project area;
- Historical research in documentary and audiovisual holdings of relevance to the cultural heritage of the project area;

Consultation would be initially undertaken with all registered stakeholders and other parties, including representatives of the Worimi Conservation Lands registered Aboriginal Owners, to identify those individuals who are regarded as holding cultural knowledge for the country within which the project area is located. Identified cultural knowledge holders may or may not be registered stakeholders.

All identified cultural knowledge holders would be contacted and their participation in the assessment process would be requested. All identified cultural knowledge holders who were willing to participate in the project would be interviewed in order to gather oral histories, and undertake detailed cultural mapping, relevant to the study area. It is recognised that information may be gender sensitive and a male and female consultant will be available to conduct consultations as appropriate. Interviews would be conducted with participants either in their own homes, at a location of their choice, or during field visits to the study area. Where a field visit does not occur, cultural mapping would be facilitated through the use of satellite imagery and maps.

Cultural information management would be undertaken in collaboration with the cultural knowledge holders to ensure sensitive information is treated appropriately. Consultation would be undertaken with the cultural knowledge holders in relation to appropriate management of any identified cultural values and cultural items within the project area.

It is envisaged that potential sources of historical and ethnographic information would include: archival land records; historical manuscripts; ethnographic accounts; newspaper accounts; field recordings; site records; and photographic evidence. The documentary and audiovisual holdings of the following institutions would be investigated:

- University of Newcastle Archives.
- SRNSW archival land records.

- National Library of Australia.
- Mitchell Library of NSW historical manuscripts.
- AIATSIS documentary and audiovisual material.
- Newcastle Regional Library.
- OEH site and assessment records.

The research and heritage significance assessment would be undertaken in line with the ICOMOS guidelines (as provided for by the Heritage Council of NSW)¹ and the Aboriginal cultural heritage assessment guidelines produced by the Office of Environment & Heritage (NSW).²

¹ See *The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance, 2013)* and *Practice Note: The Burra Charter and Indigenous Cultural Heritage Management*.

² See *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*, OEH (NSW).

12 Appendix B: AFG 1 Presentation on CVA



6. Cultural Values Assessment

Kate Waters / Waters Consultancy / March 2020

What is a Cultural Values Assessment?

- Identification and assessment of places of cultural significance that may not have any material or archaeological presence.
- Undertaken in consultation with the Aboriginal people who hold cultural knowledge for the area (knowledge holders).

(Intangible) Places of Cultural Value

(Intangible) places that hold cultural value can include:

- ✧ Story sites
- ✧ Pathways
- ✧ Ancestral/mythological figures in the landscape
- ✧ Traditional resource and camping areas
- ✧ Historical residential areas

Cultural Values Assessment Process

- Consultation with Aboriginal cultural knowledge holders.
- Identification and mapping of cultural sites.
- Historical and ethnographic research and analysis.
- Conservation and mitigation recommendations.
- Draft report for comment from knowledge holders and RAPs.

Cultural Knowledge Holders

- Cultural knowledge holders are those who have cultural knowledge of the specific project area and the country it sits within.
- Cultural knowledge holders are nominated by the RAPs but do not have to be RAPs themselves.
- Consultation undertaken with clear protocols to protect and respect cultural information.



Questions?

Nominations for knowledge holders

13 Appendix C: Email of 9 April 2020

From: Nelson Bay Road Corridor NelsonBayRoad@rms.nsw.gov.au 
Subject: Nelson Bay Road, Williamtown to Bobs Farm upgrade - Aboriginal Focus Group presentation
Date: 9 April 2020 at 10:51 am
To: Nelson Bay Road Corridor NelsonBayRoad@rms.nsw.gov.au, Kate Hagan Kate.Hagan@transport.nsw.gov.au
Cc: Kym McNamara Kym.McNamara@environment.nsw.gov.au, Nicole.Davis@environment.nsw.gov.au, Morgan Wilcox mwilcox@emmconsulting.com.au, Kate@watersconsultancy.com.au, Damien Grace Damien.P.GRACE@transport.nsw.gov.au, Deborah Swan deborah.swan@transport.nsw.gov.au

Hi all

Thank you for those who attended the AFG yesterday. For those who were unable to attend, please find attached a copy of the presentation.

We will finalise the meeting minutes and distribute them next week. If anyone would like a hard copy, please email kate.hagan@transport.nsw.gov.au with the address you would like them posted to.

Just a reminder that comments are due Friday 17th April on the :

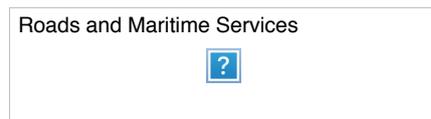
- Archaeological assessment (attached)
- Cultural heritage assessment report (CHAR) methodology (attached)
- Cultural values assessment (CVA) (attached)

And to register an interest to participate in the CVA process. Kate Waters is working on behalf of Transport for NSW. Kate will also be contacting persons individually to discuss the CVA process.

Have a great Easter and stay safe.

Cheers

The Nelson Bay Road project team



Before printing, please consider the environment

IMPORTANT NOTICE: This email and any attachment to it are intended only to be read or used by the named addressee. It is confidential and may contain legally privileged information. No confidentiality or privilege is waived or lost by any mistaken transmission to you. Roads and Maritime Services is not responsible for any unauthorised alterations to this email or attachment to it. Views expressed in this message are those of the individual sender, and are not necessarily the views of Roads and Maritime Services. If you receive this email in error, please immediately delete it from your system and notify the sender. You must not disclose, copy or use any part of this email if you are not the intended recipient.



200407 NBR
Sect 1...ion.pdf

14 Appendix D: Minutes of AFG 1



MINUTES

Nelson Bay Road, Williamtown to Bobs Farm – Aboriginal Focus Group

Date	8 April 2020		
Time	2:00 pm		
Venue	Zoom		
Chairperson	Damien Grace / Deb Swan		
Attendees	Graeme Russell	GR	Worimi Conservation Lands Board of Management
	David Feeney	DF	Karuah Indigenous Group
	Bob Syron	BS	Worimi Guringai Lands
	Steven Hickey	SH	Widescope Indigenous Group
	Damien Grace	DG	Transport for NSW (Transport)
	Deb Swan	DS	Transport
	David Nalder	DN	Transport
	Kate Hagan	KH	Transport
	Chad Stockham	CS	Transport
	Phil Davidson	PD	Transport
	Brooke Egger	BE	Transport
	Kym McNamara	KM	Department Planning Infrastructure and Environment (DPI&E)
	Morgan Wilcox	MW	EMM Consulting
	Ryan Desic	RD	EMM Consulting
	Kate Waters	KW	Waters Consultancy
Apologies:	Andrew Smith	AS	Worimi Local Aboriginal Land Council
	Lennie Anderson	LA	Nur-Run-Gee
	Anthony Anderson	AA	Ma-Roo-Ma
	Bec Young	BY	Ma-Roo-Ma
	Candy Towners	CT	Traditional Owners Indigenous Corporation
	Nadine Russell	NR	Worimi Conservation Lands Board of Management
	Nicole Davis	ND	Department Planning Infrastructure and Environment (formerly OEH)

Damien Grace, Project Development Manager commenced the zoom meeting by sharing his screen with the meeting attendees.

1.	Acknowledgement to County
1.1	Deb Swan (DS) asked if anyone would like to do an Acknowledgement to Country. Uncle Graeme (GR) said an Acknowledgement to Country.
2.	Introductions
2.1	The Registered Aboriginal Parties introduced themselves. Damien Grace introduced the Transport project team. Kym McNamara introduced herself and gave an overview of her role. Question: GR asked for clarification if an invitation for the AFG was sent to Worimi Local Aboriginal Land Council. DG advised that an invitation had been sent. DG noted that all RAPs had been sent the same information via email.
3.	The proposal Nelson Bay Road, Williamtown to Bobs Farm (W2BF) overview Damien Grace
3.1	DG gave an overview of the W2BF project which is upgrading approximately 9 kilometres of Nelson Bay Road. The project is in the strategic design stage and an alignment has not been confirmed.
3.2	The Cultural Values Assessment (CVA) is for the entire project study area ie W2BF.
3.3	The archaeological assessment will commence for W2BF once an alignment has been determined.
4.	The proposal (Section 1) Damien Grace
4.1	Section 1 is the first part of the W2BF project.
4.2	The Review of Environmental Factors (REF) is currently being prepared and determination is expected around December 2020.
4.3	EMM Consulting have been engaged by Transport to undertake the archaeological assessment and ACHAR for Section 1.
4.4	The proposal consists of upgrading Nelson Bay Road to 4 lanes with a central median. It includes 2 retaining walls on the northern side.
4.5	No property acquisition is required for Section 1.
4.6	Question: GR asked if the 1km section will commence at the existing dual carriageway at Bobs Farm and head west. DG: Yes. The tie-in location at the western end of Section 1 is dependent on the alignment of W2BF.
4.7	Duplication of Section 1 involves construction of an additional 2 lanes on the northern side of the existing road. Clearing on the northern side could be up to 15 metres. Clearing on the southern side could be up to 10 metres.
4.8	There are 2 cut retaining walls on the northern side of the project. There will be small retaining walls in fill.
4.9	DG explained the locations of the retaining walls. The length of the retaining wall in cut is approximately 50 metres. Excavation for this retaining wall could be up to 4 metres. (Refer to slides on page 13 – 15 of the AFG presentation)

4.10	<p>Question: GR asked about the clearing extents. DG – the clearing extents detailed on page 15 of the AFG presentation are maximum clearing limits. The project will be fully constructed within the existing road boundary. The retaining walls are required in order to avoid the project encroaching on adjacent properties.</p>
4.11	<p>Comment: GR advised he was happy with the archaeological report.</p>
5.	<p>Archaeological Assessment for the proposal (Section 1) Morgan Wilcox (MW), EMM Consulting</p>
5.1	<p>MW shared her screen with the attendees to show the presentation. Morgan relayed that this presentation isn't an in depth comprehensive assessment as per the archaeological report.</p>
5.2	<p>MW gave an overview of the involvement in the project (Section 1) including the draft archaeological report. The report was prepared in accordance with the RMS Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) guidelines and the Code of Practice for archaeological investigation of Aboriginal Objects (Code of Practice).</p>
5.3	<p>MW gave an overview of the land formation, hydrological features and soil profiles for the study area for Section 1. (Refer to the slide on page 18 of the AFG presentation)</p>
5.4	<p>The study area is fully contained within the existing road boundary. The study area has a high level of disturbance due to previous road construction and utility installations.</p>
5.5	<p>Background MW gave a summary of the AHIMs database search for the study area and surrounds. (Refer to the slide on page 19 of the AFG presentation) MW presented an overview of previous archaeological assessments for the study area. (Refer to the slide on page 21 of the AFG presentation) MW gave an overview of previous archaeological excavation works within the study area. (Refer to the slide on page 22 of the AFG presentation)</p>
5.6	<p>MW provided an overview of the archaeological assessment for the study area. A site inspection was undertaken by Transport, EMM Consulting and representatives from Worimi LALC. During the archaeological survey, shell material was identified at 4 locations. There was nothing to indicate that the shell was of cultural origin. A women's tree was identified as part of the site walk over. The tree is outside of the project boundary and it will not be impacted by the work. The project boundary will be fenced during construction to ensure construction is contained within the site. (Site photos can be found on pages 25 and 26 of the AFG presentation) Note: additional photos are in the archaeological report.</p>
5.7	<p>MW presented a summary of the assessment results. The results of the assessment is that the study area is likely to have low cultural value due to previous disturbance (road and utility construction). No areas of potential archaeological deposit (PAD) has been identified within the study area. The study area does not meet the Code of Practice's criteria to undertake test excavation. (Refer to the slide on page 27 of the AFG presentation)</p>
5.8	<p>MW summarised the recommendations of the assessment. (Refer to the slide on page 29 of the AFG presentation)</p>
5.9	<p>Question: GR – Is the study area only for Section 1 of the W2BF project? MW – Yes, the study area is only for Section 1. An archaeological assessment of the broader W2BF project will be undertaken at a later date and would involve archaeological survey and likely test excavation dependent upon impact areas. The CVA is being undertaken for the entire W2BF project to inform the strategic design.</p>
5.10	<p>An AHIP is required for Section 1 based on the previously recorded site – OFOC1 (AHIMs 38-4-1600).</p>

	(Refer to the slide on page 29 of the AFG presentation) Consultation with Registered Aboriginal Parties (RAPs) will be undertaken on the AHIP.
5.11	Question: DF – are we still going to have cultural people on site? MW – are you referring to cultural heritage monitoring? DF – Yes. MW – Based on the assessment results, monitoring is not required. DG – Site monitors are not required as part of Transport policy. KM – Gave a perspective from DPI&E. Monitoring is not supported unless there is a high probability of skeletal remains being found. A thorough archaeological assessment removes the need for site monitoring. DPI&E would not support site monitoring as part of the AHIP. DS – PACHCI has replaced monitoring.
5.12	Question: GR – Would work stop if cultural items were found? DF – Who would determine if the items found were cultural? KM – Aboriginal Heritage Awareness training is undertaken by construction teams. DG – Transport has an Unexpected Finds procedure which stops work in the event that items or skeletal remains area found. This is a standard procedure in Transport contracts.
5.13	Comment: GR: Lennie Anderson was a site office for the recent Fullerton Cove estate works. DG: That project may not have been a Transport project – likely private works. DF: It is part of the Fern Bay Estate. DG: The Aboriginal Participation in Construction (APIC) policy applies to Transport projects which encourages Aboriginal employment.
5.14	Comment: BS – There was a Raymond Terrace Road project about 6 years ago that had site monitors. MW – Where projects impact greenfield areas monitoring is sometimes undertaken, although this is not an approach used by Transport. Section 1 for this project is not greenfield, and is within a highly disturbed study area. The request from RAPs for site monitoring will be documented in the ACHAR but will not be noted as an archaeological recommendation.
5.15	Comment: SH – Site monitoring would not add value due to the lack of materials in the area.
5.16	Note: Transport have documented the request to have site monitors.
6.	Proposed Cultural Values Assessment (CVA) methodology Kate Waters (KW), Waters Consultancy
6.1	KW discussed her role in the project. KW is yet to do the CVA so the presentation is an overview of the proposed methodology.
6.2	There will be 2 CVAs: 1. Section 1 2. W2BF study area
6.3	KW discussed the role of Cultural Knowledge Holders (CKH). They can provide information regarding intangible places that may not be identified by an archaeological assessment.
6.4	KW gave an overview of the CVA process. KW will consult with the CKH to identify sites. These sites will then be mapped. Historical and ethnographic research will also be undertaken to give the sites context.
6.5	A draft CVA report will go to the RAPs and CKH for feedback.

6.6	CKH can be nominated by the RAPs. A CKH does not need to be a RAP. KW acknowledged that not all CKH wish to share their knowledge as it may be culturally sensitive. KW will discuss with CKH what knowledge they wish to share and / or have include in the CVA report.
6.7	Question: GR – What is the process for nominating knowledge holders? Understands that there is a Worimi knowledge holders group consisting 8 or 9 knowledge holders. KW – can contact the knowledge holder group if nominated by RAPs. All RAPs can nominate knowledge holders and she will contact them all to ask if they are willing to participate.
6.8	Comment: GR – told a story that was passed onto him by his Uncle Noel. There was a campsite near Tilligerry Creek where Uncle Noel's mother was born. KW – These are the types of stories she would like to hear as part of the CVA.
6.9	KW advised that she will contact all of the RAPs to ask for knowledge holder nominations.
7.	Next Steps Damien Grace (DG)
7.1	Minutes from this AFG meeting will distributed in approximately 1 week.
7.2	Feedback on reports are due 17 April 2020.
7.3	Site visits are not possible at present due to new social distancing laws.
7.4	An Aboriginal Cultural Heritage Assessment Report will be prepared for Section 1. A Cultural Values Assessment reports will be prepared. (1 report for Section 1 and another report for the W2BF project). These reports will be distributed to RAPs for feedback.
7.5	Note: GR – advised he is working from home and requested a hard copy of the reports. If anyone would like a hard copy of reports, please email Kate.Hagan@transport.nsw.gov.au with details of where you would like the reports posted to.
7.6	The focus of the next AFG would likely be the strategic section ie. W2BF.
8.	Meeting Conclusion
8.1	MW acknowledged that in person AFG meetings are a good way to learn through informal conversations. As we are unable to do that at present, MW would like RAPs to call her if they would like to discuss reports. (Mob: 0400 264 916)
8.2	KW reiterated MW's comment. KW is happy for RAPs to ring her to discuss the project.
8.3	DS thanked the RAPs for attending.
8.4	GS also thanked the RAPs for attending.
	Meeting End 3:40pm

15 Endnotes

ⁱ The nominated knowledge holders included: Anthony Anderson, Lennie Anderson, Jackie Henderson, Aunty Lorraine Lilley, Uncle Neville Lilley, Aunty Val Merrick, Carol Ridgeway, Justin Ridgeway, Graeme Russell, Andrew Smith, Robert Syron, Jamie Tarrant, Rebecca Young. See Section 3 for further discussion on knowledge holder engagement.

ⁱⁱ See *The Burra Charter* (The Australia ICOMOS Charter for Places of Cultural Significance, 2013), Australia International Council on Monuments and Sites.

ⁱⁱⁱ *Practice Note: The Burra Charter and Indigenous Cultural Heritage Management*, Version 1: November 2013, Australia International Council on Monuments and Sites.

^{iv} See Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, 2011, Office of Environment and Heritage (NSW).

^v The nominated knowledge holders included: Anthony Anderson, Lennie Anderson, Jackie Henderson, Aunty Lorraine Lilley, Uncle Neville Lilley, Aunty Val Merrick, Carol Ridgeway, Justin Ridgeway, Graeme Russell, Andrew Smith, Robert Syron, Jamie Tarrant, Rebecca Young.

^{vi} Lennie Anderson, Aunty Lorraine Lilley, Uncle Neville Lilley, Jamie Tarrant.

^{vii} Robert Syron.

^{viii} Anthony Anderson, Jackie Henderson, Aunty Val Merrick, Graeme Russell, Andrew Smith.

^{ix} Rebecca Young.

^x Justin Ridgeway.

^{xi} Carol Ridgeway. Note that although nominated by a number of RAPs none of the RAPs or nominated knowledge holders were able to provide current contact details. An attempt has been made to contact her via publicly available email details but no response has been received to date.

^{xii} See Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, 2011, Office of Environment and Heritage (NSW).

^{xiii} See Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, 2011, Office of Environment and Heritage (NSW).

^{xiv} See *The Burra Charter* (The Australia ICOMOS Charter for Places of Cultural Significance, 2013) and *Practice Note: The Burra Charter and Indigenous Cultural Heritage Management*, Version 1: November 2013, Australia International Council on Monuments and Sites.

^{xv} T. M., Perry, *Australia's First Frontier: The spread of settlement in New South Wales 1788-1829*, Melbourne University Press, Carlton (VIC), 1965 (1963), p.60; Mark, Dunn, *A Valley in a Valley: Colonial struggles over land and resources in the Hunter Valley, NSW 1820 – 1850*, PhD Thesis, University of New South Wales, Sydney, 2015, p.12; James Jervis, 'The Hunter Valley: A Century of its History', *Journal and Proceedings of the Royal Australian Historical Society*, Vol. 34, Pt.3, 1953, pp.98-103.

^{xvi} E. Flowers, 'Dawson, Robert (1782-1866)', *Australian Dictionary of Biography*, National Centre of Biography, Australian National University, Volume 1, 1966.

^{xvii} Robert Dawson, *The Present State of Australia; a description of the country, its advantages and prospects, with reference to emigration: and a particular account of the manners, customs, and condition of its Aboriginal inhabitants*, Smith, Elder & Co., London, 1831, p.326.

^{xviii} W.J. Enright, 'That Kattang (Kutthung) or Worimi: An Aboriginal Tribe', *Mankind*, Vol.1, No.4, March 1932, p.75.

^{xix} W.J. Enright, 'The Language, Weapons and Manufactures of the Aborigines of Port Stephens, N.S.W.', *Journal and Proceedings of the Royal Society of New South Wales*, Vol. XXXIV, 1900, p.104.

^{xx} Enright, *op.cit.*, March 1932, pp.75-77; A.P. Elkin, 'Notes on the social organization of the Worimi, a Kattang-speaking people', *Oceania*, Vol.2, No.3, March 1932, pp.359-363.

-
- ^{xxi} Enright, op.cit., March 1932, p.75.
- ^{xxii} Jim Wafer, 'Placenames as a guide to language distribution in the Upper Hunter, and the landnam problem in Australian toponomastics', in Ian D. Clark, Luise Hercus & Laura Kostanski (eds.), *Indigenous and Minority Placenames: Australian and International Perspectives*, Canberra, ANU Press, 2014.
- ^{xxiii} 'The Coal River or Port of Newcastle New South Wales', possibly by John William Lewin, ID: SAFE/PSX 942/2, Mitchell Library, State Library of New South Wales.
- ^{xxiv} Captain James Cook, Entry for 11 May 1770, *James Cook's Journal of Remarkable Occurrences aboard His Majesty's Bark Endeavour, 1768-1771*, transcription by the National Library of Australia (Manuscript 1 page 234, 2004), <http://nla.gov.au/nla.cs-ss-irnl-cook-17700511>.
- ^{xxv} David Collins, *An Account of the English Colony in New South Wales: With Remarks on the Dispositions, Customs, Manners, etc, of the Native Inhabitants of that Country*, A.H. & A.W. Reed in association with The Royal Australian Historical Society, Sydney [edited by Brian H. Fletcher, original edition 1798], 1975, Volume I, p.342.
- ^{xxvi} Greg Blyton 'Aboriginal guides of the Hunter Region 1800-1850: A case study in Indigenous labour history', *History Australia*, Vol 9, No. 3, Dec 2012, pp.91-93.
- ^{xxvii} Perry, op.cit., 1963 (reprinted 1965), p.58.
- ^{xxviii} Garland & Wheeler quoted in John Vader, *Red Cedar: The Tree of Australia's History*, Reed Books, Sydney, 1987, p.61.
- ^{xxix} Vader, op.cit., 1987, pp.61-63.
- ^{xxx} Dawson, op.cit., 1831, pp.20-21.
- ^{xxxi} Dawson, op.cit., 1831, pp.58-59.
- ^{xxxii} Dawson, op.cit., 1831, pp.58-59.
- ^{xxxiii} Harden S. Melville, 'Bush scene, Port Stephens', 1849, ID No: 2770507, Rex Nan Kivell Collection, NK942, National Library of Australia.
- ^{xxxiv} Commissioner Bigge, Report of the Commissioner of Inquiry into the state of the Colony of New South Wales, London, House of Commons, 1822, p.117.
- ^{xxxv} Flowers, op.cit.
- ^{xxxvi} Dawson, op.cit., 1831, pp.9-11.
- ^{xxxvii} Dawson, op.cit., 1831, p.11.
- ^{xxxviii} Dawson, op.cit., 1831, p.19.
- ^{xxxix} H. Grant Lloyd, 'Entrance to Port Stephens', May 1879, Call No: DL PX 43, Dixon Library, State Library of New South Wales.
- ^{xl} Damaris Bairstow, 'With the best will in the world: some records of early white contact with the Gampignal on the Australian Agricultural Company's Estate at Port Stephens', *Aboriginal History*, Vol.17, No.1/3, 1993, pp.9-11.
- ^{xli} John A. Nell, 'The History of Oyster Farming in Australia', *Marine Fisheries Review*, Vol. 63 (3), January 2001, p.15, *passim*.
- ^{xlii} Nancy Phillips, 'Memories of Pindimar from the 1920s', *Nota*, 21 March 1992, p.8.
- ^{xliii} Major T.S. Parrott, 'Map of the country around Newcastle N.S.W., 15 March 1893, Sydney, Government Printing Office, ID: 1729018, National Library of Australia.
- ^{xliv} Extract from Major T.S. Parrott, 'Map of the country around Newcastle N.S.W., 15 March 1893, Sydney, Government Printing Office, ID: 1729018, National Library of Australia
- ^{xlv} 'Parish of Tomaree, County of Gloucester', Aboriginal Protection Board Register of Reserves, File 2/8349, Reel 2847, State Records of New South Wales.
- ^{xlvi} Extract from *Parish of Tomaree, County of Gloucester*, 1918, Parish and Historical Maps, Land Registry NSW.
-

-
- ^{xlvi} W. J. Enright, 'Notes on the Aborigines of the North Coast of New South Wales', *Mankind*, Vol.2, No.4, June 1937, p.90.
- ^{xlviii} W.J. Enright, 'Notes on the Aborigines of the North Coast of New South Wales', *Mankind*, Vol.2, No.7, September 1939, p.195.
- ^{xliv} John Chesterman & Brian Galligan, *Citizens without rights: Aborigines and Australian Citizenship*, Melbourne, Cambridge University Press, 1997, pp.133-139; Heather Goodall, *Invasion to Embassy: Land in Aboriginal Politics in New South Wales, 1770-1972*, Allen & Unwin, St Leonards (NSW), 1996, Chapter 10 & 11. : Peter Read, *The Stolen Generations: The Removal of Aboriginal Children in New South Wales 1883 to 1969*, NSW Department of Aboriginal Affairs, 1996, p.10 : 'Minute of Colonial Secretary re Protection of the Aborigines', dated 26th February, 1883, *Votes & Proceedings of the Legislative Assembly*, 1883, Vol.3, p.919.
- ⁱ Extract from '*Parishes of Tarean and Karuah*', 1888, NSW Land Registry Services.
- ⁱⁱ Goodall, op.cit., pp.84-87.
- ⁱⁱⁱ Sawyer's Point, Parish of Tarean, County of Gloucester, Aboriginal Protection Board Register of Reserves, File 2/8349, Reel 2847, State Records of New South Wales.
- ⁱⁱⁱⁱ Extract from *Parishes of Tarean and Karuah*, 1888, NSW Land Registry Services.
- ^{lv} Sawyer's Point, Parish of Tarean, County of Gloucester, Aboriginal Protection Board Register of Reserves, File 2/8349, Reel 2847, State Records of New South Wales; 'Revocation of Reserves from Sale, Lease, Etc', *Government Gazette of the State of New South Wales*, Vol.31, 7 February 1975, p.437; Sue Norman, 'The New South Wales Aboriginal Lands Trust and its place in history', *Australian Aboriginal Studies*, 2011, Vol.2, pp.88-101.
- ^{lv} Letter from King Billy Bridgway [Ridgeway], Soldiers' Point, 16 October 1908 in 'Australian Aboriginal King's Letter: an interesting screed from Native Royalty', *Newsletter: An Australian Paper for Australian People*, 7 November 1908.
- ^{lvi} C.B., 'Three Waltonians in Pursuit', *Freeman's Journal*, 8 April 1915, p.6.
- ^{lvii} C.B., 'Three Waltonians in Pursuit', *Freeman's Journal*, 8 April 1915, p.6.
- ^{lviii} *Parish of Tomaree, County of Gloucester*, 11th Edition, c.1967, Parish and Historical Maps, Land Registry NSW.
- ^{lix} See for example the accounts in: Kath Schilling, *Aboriginal Women's Heritage: Port Stephens*, Department of Environment and Conservation (NSW), Sydney, June 2004.
- ^{lx} Interview with Aunty Lorraine Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{lxi} See for example the accounts in: Schilling, op.cit., June 2004.
- ^{lxii} 'Soldiers Point Aboriginal Place', State Heritage Register, New South Wales Department of Planning, Industry and Environment.
- ^{lxiii} Goodall, op.cit., 1996, pp.144-145.
- ^{lxiv} Photographs by Kate Waters (Waters Consultancy Pty Ltd), June 2020.
- ^{lxv} 'Sawyer's Point – Port Stephens', *N.S.W. Aborigines' Advocate*, 31 October 1904, pp.3-4.
- ^{lxvi} See: Our Aim: A monthly record of the Aborigines Inland Mission, Mitchell Library, State Library of New South Wales.
- ^{lxvii} Djenidi, op.cit., pp.75-80; Cathleen Inkpin, *Making their gospel known: the work and legacy of the Aboriginal Inland Mission 1905-1938*, BA (Hons) Thesis, University of Sydney, 2011, pp.14-15.
- ^{lxviii} 'Remembering the Mission Days: Stories from the Aborigines' Inland Mission', *Australian Institute of Aboriginal and Torres Strait Islander Studies*, <http://www.aiatsis.gov.au/collections/exhibitions/missions/background.html>, 2013 ; Retta Long bio, ADB.
- ^{lxix} Photograph by Kate Waters (Waters Consultancy Pty Ltd), June 2020.
- ^{lxx} World Heritage Convention, UNESCO, 1996.

^{lxxi} For discussions of totemic geography see for example, T. Strehlow, 'Geography and the totemic landscape in central Australia: a functional study', *Australian Aboriginal Anthropology*, R. Berndt (ed.), University of Western Australia Press, 1970 ; Deborah Bird Rose, Totemism, Regions, and Co-management in Aboriginal Australia, Conference Paper at "Crossing Boundaries", British Columbia, Canada, 1998 ; Nancy Munn, 'Excluded Spaces: The Figure in the Australian Aboriginal Landscape', *Critical Inquiry*, Vol.22, No.3, Spring 1996, pp.446-465.

^{lxxii} L. Godwin & J. Weiner, 'Footprints of the ancestors: The convergence of anthropological and archaeological perspectives in contemporary Aboriginal heritage studies', in B. David, B. Barker & I. McNiven (eds), *The Social Archaeology of Australian Indigenous Societies*, Canberra, Aboriginal Studies Press, 2006 ; Franca Tamasari and J. Wallace, 'Towards an Experiential Archaeology of Place: From Location to Situation Through the Body', in Bruno David, Bryce Barker & Ian J. McNiven (eds), *The Social Archaeology of Australian Indigenous Societies*, Canberra, Aboriginal Studies Press, 2006, p.208.

^{lxxiii} Tamasari & Wallace, *op.cit.*, p.215.

^{lxxiv} Interview with Aunty Lorraine Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.

^{lxxv} Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.

^{lxxvi} Inge Riebe, 'Summary of anthropological material for Nelson Bay Road Upgrade Project', produced for Waters Consultancy, June 2020, p.4.

^{lxxvii} Interview with Lennie Anderson for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), June 2020.

^{lxxviii} Joseph Lycett, '[Corroboree at Newcastle, ca.1818]', Oil Painting DG 228, State Library of New South Wales.

^{lxxix} Gazettal Notice for Birubi Point Aboriginal Place, County of Gloucester, Parish of Tomaree, National Parks and Wildlife Act, 1974, 2 March 2007; 'Birubi Point Aboriginal Place', State Heritage Register, New South Wales Department of Planning, Industry and Environment.

^{lxxx} Ross Craig interviewing Jess Walker and Friends about Stockton NSW, n.d., Pat and Ross Craig Oral History Archive, Cultural Collections, Auchmuty Library, University of Newcastle

^{lxxxi} Anon, 'Early Stockton: Mr. Kerr's Recollections', *Newcastle Morning Herald and Miners' Advocate*, 22 April 1933, p.5.

^{lxxxii} *Town of Stockton, Parish of Stockton, 1893*, NSW Land Registry Service; Ralph Snowball, 'Cambrian House, Evan Rees' Draper, Grocer, and Ironmonger store, Mitchell Street, Stockton, NSW', Photograph, Norm Barney Photographic Collection, University of Newcastle Library.

^{lxxxiii} R.H. Mathews, 'Initiation ceremonies of Australian tribes', *American Philosophical Society*, 1898, Vol.37, pp. 54-73.

^{lxxxiv} R.H. Mathews, 'The Keeparra Ceremony of Initiation', *Journal of the Anthropological Institute of Great Britain and Ireland*, Vol.26, 1897, p.337.

^{lxxxv} Gazettal Notice for Birubi Point Aboriginal Place, County of Gloucester, Parish of Tomaree, National Parks and Wildlife Act, 1974, 2 March 2007; 'Birubi Point Aboriginal Place', State Heritage Register, New South Wales Department of Planning, Industry and Environment.

^{lxxxvi} A.W. Howitt, *The Native Tribes of South-East Australia*, London, Macmillan and Co., 1904, p. xii, 85.

^{lxxxvii} William Scott, *The Port Stephens Blacks: Recollections of William Scott*. Prepared by Gordon Bennett, Chronicle Office, Dungog NSW, 1929, pp.5-6.

^{lxxxviii} William Scott, *Notes on Aborigines, 1871-1928*, Accession No: B 756, Mitchell Library, State Library of New South Wales.

^{lxxxix} Scott, *op.cit.*, 1929, p.25.

^{xc} Scott, *op.cit.*, 1929, pp.25-26.

^{xci} Scott, *op.cit.*, 1929, pp.27-28. A version of this account is also included in Howitt, *op.cit.*, 1904, pp.572-573 where it is attributed to Wm. Scott.

^{xcii} Scott, *op.cit.*, 1929, pp.27-28. A version of this account is also included in Howitt, *op.cit.*, 1904, pp.572-573 where it is

attributed to Wm. Scott.

^{xciii} Scott, op.cit., 1929, p.27.

^{xciv} Scott, op.cit., 1929, p.27.

^{xcv} Scott, op.cit., 1929, p.28.

^{xcvi} W.J. Enright, 'Notes on the Aborigines of the North Coast of N.S.W.', *Mankind*, Vol.2 No.9, October 1940, p.322.

^{xcvii} Scott, op.cit., 1929, p.28.

^{xcviii} James W. Boydell to R.H. Mathews, Camyrallyn Gresford, 27 September 1895, *Papers of R.H. Mathews*, MS 8006, Box 2, National Library of Australia.

^{xcix} Scott, op.cit., 1929, pp.28-29.

^c 'Aboriginal man, Port Stephens, NSW, c.1890', Henry King, Image Accession: 1358/6610824, National Library of Australia.

^{ci} Mathews, op.cit., 1897, p.321.

^{cii} W.J. Enright, 'The initiation Ceremonies of the Aborigines of Port Stephens, N.S. Wales', *Journal and Proceedings of the Royal Society of New South Wales*, Vol.33, 1899, pp.115-116.

^{ciii} Enright, op.cit., 1899, pp.115-116.

^{civ} Enright, op.cit., 1899, pp.115-116.

^{cv} Scott, op.cit., 1929, p.11.

^{cvi} Scott, op.cit., 1929, p.35.

^{cvij} Enright, op.cit., 1899, pp.117-123.

^{cviii} Riebe, op.cit., p.5.

^{cix} Dawson, op.cit., 1831, pp.326-327.

^{cx} Photographs by Kate Waters & Korey Moon (Waters Consultancy Pty Ltd), June 2020.

^{cxii} Dawson, op.cit., 1831, pp.135-136.

^{cxii} Scott, op.cit., 1929, p.8.

^{cxiii} William Scott, *Notes on Aborigines, 1871-1928*, Accession No: B 756, Mitchell Library, State Library of New South Wales, p.17.

^{cxiv} Dorothy English Paty, 'Doryanthes excelsa or Gigantic Lily, Newcastle, New South Wales, November 6th, 1835', ID No: 2249212, National Library of Australia.

^{cxv} James Backhouse, *A Narrative of a Visit to the Australian Colonies*, London, Hamilton, Adams, and Co., 1843, p.380.

^{cxvi} Scott, op.cit., 1929, pp.17-18.

^{cxvii} Scott, op.cit., 1929, pp.28-29.

^{cxviii} Scott, op.cit., 1929, p.16.

^{cxix} Scott, op.cit., 1929, p.16.

^{cxix} Interview with Lennie Anderson for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), June 2020.

^l Interview with Lennie Anderson for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), June 2020.

^{cxxi} Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.

^l Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.

-
- ^{cxxii} Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxxiii} L.K. Dyall, 'Aboriginal Fishing Stations on the Newcastle Coastline, New South Wales', in Sandra Bowdler (ed.), *Coastal Archaeology in Eastern Australia: Proceedings of the 1980 Valla Conference on Australian Prehistory*, Australian National University, 1982, pp.57-59.
- ^{cxxiv} Dyall, op.cit., 1982, pp.57-59.
- ^{cxxv} 'Birubi Point Aboriginal Place', State Heritage Register, New South Wales Department of Planning, Industry and Environment.
- ^{cxxvi} Henry King, 'Australia: an Aboriginal woman', Port Stephens district, c.1890s, ID No: 534164i, Wellcome Library Collection.
- ^{cxxvii} William Scott, *Notes on Aborigines, 1871-1928*, Accession No: B 756, Mitchell Library, State Library of New South Wales, pp.43-45.
- ^{cxxviii} William Scott, *Notes on Aborigines, 1871-1928*, Accession No: B 756, Mitchell Library, State Library of New South Wales, p.43.
- ^{cxxix} Scott, op.cit., 1929, pp.17-18.
- ^{cxix} Denis Byrne & Maria Nugent, *Mapping Attachment: A spatial approach to Aboriginal post-contact heritage*, Department of Environment and Conservation, Sydney, 2004, p.49.
- ^{cxixi} Aunty Viola Brown quoted in Schilling, op.cit., June 2004, p.4.
- ^{cxixii} Aunty Val Merrick quoted in Schilling, op.cit., June 2004, p.22.
- ^{cxixiii} Aunty Gwen Russell quoted in Schilling, op.cit., June 2004, p.46.
- ^{cxixiv} Aunty Gwen Russell quoted in Schilling, op.cit., June 2004, p.44.
- ^{cxixv} Interview with Aunty Lorraine Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxixvi} Interview with Uncle Neville Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxixvii} Interview with Uncle Neville Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxixviii} *Worimi Conservation Lands Plan of Management*, NSW National Parks & Wildlife Service, Office of Environment & Heritage, 2015, p.4.
- ^{cxixix} Interview with Aunty Lorraine Lilley and Uncle Neville Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxli} Interview with Lennie Anderson for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), June 2020.
- ^{cxlii} Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxliii} Anthony English, *The sea and the rock gives us a feed: Mapping and managing Gumbaingirr wild resource use places*, National Parks and Wildlife Service (NSW), August 2002, p.24. See also: Fred Cahir, Ian D. Clark, Philip A. Clarke, *Aboriginal Biocultural Knowledge in South-eastern Australia: Perspectives of early colonists*, CSIRO Publishing, 2018, Introduction.
- ^{cxliiii} Interview with Aunty Lorraine Lilley for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxliiv} Photograph by Korey Moon (Waters Consultancy Pty Ltd), June 2020.
- ^{cxliiv} Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.
- ^{cxlivi} Photograph by Korey Moon (Waters Consultancy Pty Ltd), June 2020.
-

^{cxlvii} Dorothy English Paty, 'A rare Orchis, Newcastle region, New South Wales, 10 January 1836', watercolour, ID 2249136, National Library of Australia.

^{cxlviii} Stephen Bell & Colin Driscoll, *Vegetation of the Worimi Conservation Lands Port Stephens, New South Wales: Worimi NP, Worimi SCA & Worimi RP*, Eastcoast Flora Survey, report to Department of Environment, Climate Change & Water, November 2010, pp.22, 26-27 & Figure 9.

^{cxlix} Schedule 1: Threatened Species (Part 1 Endangered species), *Biodiversity Conservation Act 2016 No 63 (NSW)*.

^{cl} A.B. & J.W. Cribb, *Wild Food in Australia*, Collins Books, Sydney, 1974, p.151

^{cli} Interview with Jamie Tarrant for Nelson Bay Road Upgrade Project, Kate Waters (Waters Consultancy Pty Ltd), July 2020.

Appendix F

Noise and Vibration Assessment

Noise and Vibration Assessment

Nelson Bay Road Upgrade Section 1



Document Information

Noise and Vibration Assessment

Nelson Bay Road Upgrade Section 1

Prepared for: SMEC Australia Pty Ltd

Level 5, 20 Berry Street

North Sydney NSW 2060

Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 262, Newcastle NSW 2300

ABN: 36 602 225 132

P: +61 2 4920 1833

DOCUMENT ID	STATUS	DATE	PREPARED BY	SIGNED	REVIEWED BY	SIGNED
MAC190957RP1V5	Final	4 August 2020	Dale Redwood		Oliver Muller	

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1	INTRODUCTION.....	5
1.1	ASSESSMENT OBJECTIVES.....	6
2	PROPOSAL DESCRIPTION.....	7
2.1	PROPOSAL AREA.....	7
2.2	PROPOSAL BACKGROUND.....	7
2.3	IDENTIFICATION OF SENSITIVE RECEIVERS.....	10
3	EXISTING AMBIENT NOISE ENVIRONMENT.....	13
3.1	UNATTENDED NOISE MONITORING.....	13
4	CONSTRUCTION NOISE AND VIBRATION.....	15
4.1	CONSTRUCTION NOISE CRITERIA.....	16
4.1.1	NOISE MANAGEMENT LEVELS.....	18
4.2	MAXIMUM NOISE LEVEL ASSESSMENT.....	19
4.2.1	MAXIMUM NOISE LEVEL ASSESSMENT CRITERIA.....	20
4.3	NOISE ASSESSMENT METHODOLOGY.....	20
4.4	PROPOSED WORKS AND CONSTRUCTION SCENARIOS.....	21
4.4.1	EARLY WORKS.....	21
4.4.2	CONSTRUCTION PHASE.....	22
4.4.3	FINISHING WORKS AND SITE DECOMMISSIONING.....	23
4.5	CONSTRUCTION ASSESSMENT RESULTS.....	24
4.5.1	CONSTRUCTION COMPOUND.....	24
4.5.2	EARLY WORKS ACTIVITIES.....	25
4.5.3	CONSTRUCTION PHASE ACTIVITIES.....	26
4.5.4	MAXIMUM NOISE LEVEL ASSESSMENT RESULTS.....	27
4.6	CONSTRUCTION NOISE MITIGATION MEASURES.....	28
4.7	ADDITIONAL MITIGATION MEASURES.....	35
4.8	CONSTRUCTION GENERATED ROAD NOISE.....	38
4.9	CONSTRUCTION VIBRATION CRITERIA.....	38
4.10	HUMAN COMFORT – ASSESSING VIBRATION A TECHNICAL GUIDELINE.....	39
4.10.1	CONTINUOUS VIBRATION.....	40

4.10.2	IMPULSIVE VIBRATION	40
4.10.3	INTERMITTENT VIBRATION	41
4.11	VIBRATION ASSESSMENT	42
5	ASSESSMENT OF TRAFFIC NOISE IMPACT	45
5.1	OPERATIONAL ROAD TRAFFIC NOISE CRITERIA	45
5.2	EXISTING TRAFFIC FLOWS	45
5.3	NOISE MODELLING PARAMETERS	46
5.4	OPERATIONAL TRAFFIC NOISE RESULTS	46
5.4.1	MODEL VALIDATION	46
5.4.2	COMPARISON OF EXISTING AND FUTURE ROAD TRAFFIC NOISE LEVELS	47
5.4.3	DISCUSSION OF ROAD TRAFFIC NOISE LEVEL RESULTS	47
5.4.4	OPERATIONAL NOISE ATTENUATION MEASURES	48
5.5	ASSESSMENT OF AUDIO TACTILE LINE MARKINGS	48
6	DISCUSSION AND CONCLUSION	49
APPENDIX A – GLOSSARY OF TERMS		
APPENDIX B – DETAILED DESIGN		
APPENDIX C – BACKGROUND NOISE MONITORING CHARTS		
APPENDIX D – ADDITIONAL MITIGATION MEASURES		
APPENDIX E – TECHNICAL MEMO: AUDIO TACTILE LINE MARKINGS		

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by SMEC Australia Pty Ltd (SMEC) on behalf of Transport for New South Wales (Transport for NSW) to complete an Operational and Construction Noise and Vibration Assessment (OCNVA) for the construction of Section 1 of the duplication of Nelson Bay Road at Salt Ash, NSW (the 'proposal').

This report presents the results, findings and recommendations of the OCNVA and has been prepared to accompany the Review of Environmental Factors (REF) being prepared by SMEC. The assessment has been completed in general accordance with the following standards and guidelines:

- Roads and Maritime Services (2016), Environmental Impact Assessment Procedure: Preparing an Operational Traffic and Construction Noise and Vibration assessment report;
- Roads and Maritime Services (2016), Construction Noise and Vibration Guideline (CNVG);
- Roads and Maritime Services (2015), Noise Criteria Guideline (NCG);
- Roads and Maritime Services (2015), Noise Mitigation Guideline (NMG);
- Department of Environment and Climate Change (2009), Interim Construction Noise Guideline (ICNG);
- Environment Protection Authority (2017), NSW Noise Policy for Industry (NPI);
- AS IEC 61672.1-2019 Electroacoustics – Sound level meters – Specifications;
- Australian Standard – AS 1055:2018 Acoustics- Description and measurement of environmental noise;
- Australian Standard – AS 2436-2010 (R2016) Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- Department of Environment and Conservation (2006), Assessing Vibration: A Technical Guideline; and
- British Standard BS 7385:Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2”.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

1.1 Assessment Objectives

The OCNVA quantifies potential construction noise and vibration impacts and operational road traffic noise intrusion to residential receivers along the proposal alignment.

Primary considerations in this assessment report include:

- Provide a technical document that can support the REF for the proposal;
- Identification of sensitive receivers;
- Quantifying potential operational road traffic noise based on the proposal detailed design and concept design report;
- Quantifying construction noise and vibration impacts from the proposal based on the proposal brief information; and
- Review reasonable and feasible control measures to mitigate noise and vibration emissions with the aim of meeting noise management levels and relevant vibration criteria.

The structure and format of this report has been prepared in accordance with the Transport for NSW (formerly Roads and Maritime Services) document Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2016), with consideration to the Editorial Style Guide (Roads and Maritime, 2019).

2 Proposal Description

2.1 Proposal Area

The proposal area is located about 20km north east of Newcastle, NSW within the Port Stephens Local Government Area (LGA). The study area for the proposal is illustrated in **Figure 1**.

Within the proposal area Nelson Bay Road comprises a single carriageway in each direction with a minimum 1m shoulder on each side of the carriageway. The pavement is generally considered to be in good condition. The signposted speed limit is currently 80km/h, and there are no overtaking zones marked within the proposal area.

2.2 Proposal Background

Transport for NSW propose to duplicate about 1km of Nelson Bay Road, between about 1km east of Marsh Road and 2km east of Marsh Road at Salt Ash, NSW. The proposal duration is anticipated to be up to 12 months with work starting in 2021.

The operational objectives of the proposal include:

- Reduce peak period traffic congestion; and
- Improve road safety of all road users.

The key features included in the proposal design are:

- Construction of new eastbound carriageway comprising:
 - 3.5m travel lanes
 - 2.5m shoulder
 - Median separation barrier of line marked separation zone
- Construction of two retaining walls; and
- Relocation of utilities.

The proposal would be staged, and traffic switches implemented to move traffic from the existing road to the new eastbound carriageway to enable the existing pavement to be stabilised. Temporary traffic detours are not proposed as part of the works.

The construction works would primarily occur during standard construction hours. It is noted that some activities, including works to tie-in the new carriageway with the existing road formation, would likely be completed during out of hours (OOH) work periods to minimise disruptions to traffic flows and ensure worker safety.

The key noise generating activities associated with the proposal include:

- Establish compound site and ancillary facilities;
- Site establishment;
- Site preparation including clearing and grubbing;
- Relocation of utilities;
- Primary earthworks;
- Installation of drainage structures;
- Construction of new carriageway;
- Stabilisation of existing pavement;
- Other works including installation of road furniture and landscaping; and
- Site decommissioning.

Transport for NSW propose the establishment of one compound site (Compound A) within the Nelson Bay Road median, about 1.5km to the east of the proposal site.

The 100% Detailed Design is provided in **Appendix B**.



FIGURE 1
PROPOSAL SITE
REF: MAC190957



KEY	
	SITE LOCATION
	COMPOUND A



*Imagery Source : reamap

2.3 Identification of Sensitive Receivers

The proposal site is located within a rural environment with receivers typically classified as residential dwellings on small acreages. Individual residential receivers located within 600m of the proposal site were identified as per the Noise Criteria Guideline (NCG).

The locality plan identifying the position of the receivers adjacent to the proposal site is provided in **Figure 2**. The receiver locations adjacent to the compound site are provided in **Figure 3**. The residential receivers, Map Grid of Australia zone 56 (MGA 56) coordinates and distance to the proposal are summarised in **Table 1**.

Table 1 Residential Receiver Locations				
Receiver	Address	MGA 56 Coordinates		Distance to Proposal (m)
		Easting	Northing	
Receivers Adjacent to Proposal Site				
R1	2998 Nelson Bay Road	400916	6371093	40
R2	2984 Nelson Bay Road	400787	6371148	160
R3	2972 Nelson Bay Road	400687	6371208	270
R4	2942 Nelson Bay Road	400567	6371198	380
R5	2977 Nelson Bay Road	400770	6371427	350
R6	2941 Nelson Bay Road	400834	6371581	470
R7	2930-2938 Nelson Bay Road	400492	6371554	625
R8	68 Marsh Street	401394	6371683	520
R9	140 Marsh Street	401448	6371771	600
R10	3121 Nelson Bay Road	402049	6371958	670
Receivers Adjacent to Compound Site				
R11	3323 Nelson Bay Road	403869	6372226	380
R12	3325 Nelson Bay Road	403923	6372232	430
R13	3339 Nelson Bay Road	404093	6372220	575
R14	3337 Nelson Bay Road	404064	6372352	620
R15	3343 Nelson Bay Road	404151	6372305	660
R16	372 Marsh Road	403673	6372647	660
R17	294 Marsh Road	403027	6372450	700

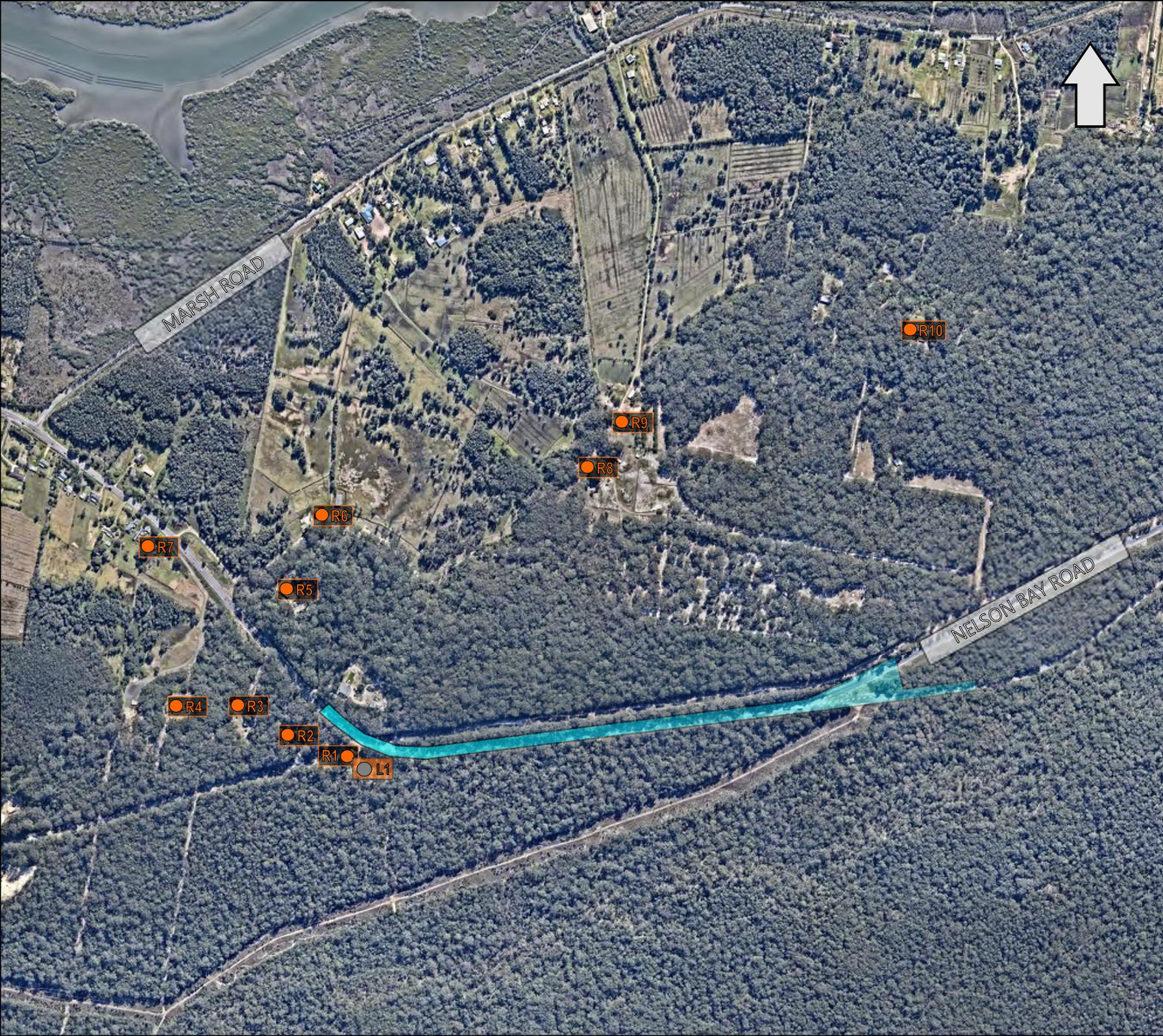


FIGURE 2
RECEIVER MAP
REF: MAC190957



KEY	
	SITE LOCATION
	RECEIVER LOCATION
	MONITORING LOCATION



*Imagery Source : neasmap



FIGURE 3

RECEIVERS (COMPOUND)

REF: MAC190957



KEY	
	COMPOUND SITE
	RECEIVER LOCATION



*Imagery Source : reamap

3 Existing Ambient Noise Environment

The community's reaction to noise from construction may be influenced by the time of day that work is carried out. Residents are potentially more affected by work that occurs during OOH periods (ie evening or night periods). Therefore, it is important to understand the existing noise environment surrounding the proposal to manage and minimise potential noise impact on the environment and local community.

3.1 Unattended Noise Monitoring

To establish the existing background noise environment of the proposal area, unattended noise monitoring was conducted at one location identified as 2998 Nelson Bay Road, Salt Ash, NSW, which is the nearest residential receiver to the proposal site. The monitoring location (L1) is representative of the surrounding noise sensitive receivers to the proposal. The location was selected taking into account ambient noise sources which may influence the readings, existing barriers constructed in the locality, the proximity of assessment locations to the proposal and security issues. The selected monitoring location is shown in **Figure 2**.

Noise measurements were carried out using one Svantek Type 1, Svan 977 noise monitor from Tuesday 10 December 2019 to Thursday 19 December 2019. This period satisfies the minimum one-week period for baseline noise monitoring as per Fact Sheet A of the NPI. The survey was conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise". Observations on-site identified the surrounding locality typical of a rural environment, with traffic noise the dominant audible noise source. Calibration of all instrumentation was checked before and after measurements. Drift in calibration did not exceed ± 0.5 dBA. All equipment carried appropriate and current National Association of Testing Authorities (NATA) (or manufacturer) calibration certificates. Data affected by adverse meteorological conditions have been excluded from the results in accordance with methods provided in the NPI. The results of long-term unattended noise monitoring are provided in **Table 2**. The noise monitoring charts for the background monitoring assessment are provided in **Appendix C**.

Table 2 Summary of Existing Background Noise Levels

Location	Measured background noise level, RBL, dBA			Measured dB LAeq		
	Day	Evening	Night	Day	Evening	Night
	7am to 6pm	6pm to 10pm	10pm to 7am	7am to 6pm	6pm to 10pm	10pm to 7am
L1	55	44	33	62	59	58

Note: Excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology Williamtown RAAF AWS (32.79°S 151.84°E 8m AMSL).

The monitored noise levels at L1 are representative of the ambient noise environment of properties along an arterial or major road. The noise levels are controlled throughout each monitoring period by passing road traffic. The noise levels are lower during the evening and night periods with levels representative of reduced traffic.

4 Construction Noise and Vibration

The assessment and management of noise from construction work is completed with reference to the Construction Noise and Vibration Guideline (CNVG). This guideline outlines the approach Transport for NSW takes when assessing and mitigating construction noise. The guideline provides the detail required to identify feasible and reasonable noise mitigation measures for construction, minor work and maintenance projects and needs to be considered for all Transport for NSW managed projects.

Construction noise impacts and mitigation measures need to be evaluated at various stages of a project to inform the concept design, environmental impact assessment, detail design and construction process.

The guideline describes the principles to be applied when reviewing and assessing construction noise, vibration and construction traffic. It also describes procedures to assist in reviewing noise and vibration mitigation.

The intention in all situations is to meet the following principles:

1. Good engagement with the community will be maintained to facilitate effective project delivery with balanced community impact.
2. Construction noise and vibration levels at sensitive receivers will be minimised where feasible and reasonable.
3. Feasible and reasonable mitigation will reflect the time of day, and/or the degree and duration of the impact.
4. The community will be informed of the dates for the intended work, sequencing and timing of noisy events. Where possible this will include an indicative schedule over a 24 hour period.
5. Minimising construction noise and vibration will be viewed as a continuous improvement exercise that is inclusive of stakeholders where no idea is too small to be considered.
6. Staff and community will be informed of the effort and methods undertaken to reduce noise and vibration for the work.
7. Any operational noise and vibration improvements resulting from the work will be promoted to the community.

4.1 Construction Noise Criteria

In accordance with the CNVG, construction noise management levels are established with reference to the NSW Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to help in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the Environment Protection Authority (EPA) under the Protection of the Environment Operations Act 1997 (POEO Act), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction proposals with typical durations of more than three weeks
- Qualitative, which is suited to short term infrastructure maintenance (for proposals with a typical duration of less than three weeks).

This study has adopted a quantitative assessment approach and includes identification of potentially affected receivers, description of activities involved in the proposal, derivation of the construction noise criteria, quantification of potential noise impacts at receivers and, provides management and mitigation recommendations.

Section 4 of the ICNG details the Noise Management Levels (NML) for noise at noise sensitive receivers, and how they are applied. The NMLs are reproduced in **Table 3** for residential receivers.

Table 3 ICNG Residential Management Levels

Time of Day	Management Level LAeq(15min) ¹	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.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(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 also 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.
	Highly noise affected 75dBA.	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: <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 strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction NML for noise assessment purposes and is the median of the ABL's.

Where the predicted or measured LAeq(15min) noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. For works outside recommended standard hours, where noise levels exceed the noise affected level by more than 5dBA and all reasonable and feasible measures have been applied, additional mitigation measures should be implemented.

The recommended standard hours of construction are summarised in **Table 4**.

Table 4 Recommended Hours for Construction	
Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday – 7am to 6pm
	Saturdays – 8am to 1pm
	Sundays or Public Holidays – No construction

These recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Work conducted outside of standard hours are considered OOH work. OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

Period 1 (evening/low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays – 8am to 6pm.

Period 2 (night/medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays/Sundays – 6pm to 7am (8am on Sunday mornings).

4.1.1 Noise Management Levels

Construction NMLs for residential receivers are established from the prevailing background noise levels of the locality. The NMLs for standard and out of hours work periods are summarised in **Table 5**.

Table 5 Construction Noise Management Levels				
Location	Assessment Period	RBL, dBA	NML	Highly noise affected NML
			dB LAeq(15min)	dB LAeq(15min)
Residential Receivers	Day (Standard Hours)	55	65 (RBL+10dBA)	75 Standard Hours
	Evening (OOH Period 1)	44	49 (RBL+5dBA)	75 Outside Recommended Hours
	Night (OOH Period 2)	33	38 (RBL+5dBA)	75 Outside Recommended Hours

The highly noise affected NML is a hypothetical level that is adopted to ensure the avoidance of strong community reaction. Should this level be exceeded the construction methodology is to be reviewed to reduce the impact on surrounding sensitive receivers.

4.2 Maximum Noise Level Assessment

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages. In assessing the potential for sleep disturbance, the NPI states that:

Where night-time noise levels from a development/premises at a residential location exceed:

- *$L_{Aeq(15min)}$ 40dBA or the prevailing RBL plus 5dB, whichever is the greater, and/or*
- *L_{Amax} 52dBA or the prevailing RBL plus 15dB, whichever is the greater,*

a detailed maximum noise level event assessment should be undertaken.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- How often the events would occur;
- distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

4.2.1 Maximum Noise Level Assessment Criteria

The maximum noise trigger level shown in **Table 6** is based on night time RBLs and trigger values as per Section 2.5 of the NPI.

Table 6 Maximum Noise Trigger Level Assessment			
LAeq(15min)		LAmax	
40dB LAeq(15min) or RBL + 5dB		52dB LAmax or RBL + 15dB	
Trigger	40	Trigger	52
RBL 33+5dB	38	RBL 33+15dB	48
Highest	40	Highest	52

Note 1: As per Section 2.5 of the NPI, the highest of each metric are adopted as the trigger level.

4.3 Noise Assessment Methodology

DGMR (iNoise, Version 2020) noise modelling software was used to quantify noise emissions from typical construction activities. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. The ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

4.4 Proposed Works and Construction Scenarios

Construction activities considered to have the greatest potential noise impact on nearby receivers have formed the basis of this assessment. The work phases and activities are discussed below.

4.4.1 Early Works

The early works of the proposal would involve the following activities:

- Establishment of the compound site;
- Site establishment works, including delineation of the construction areas, installation of initial environmental safeguards, additional surveys, establishment of site facilities and access and installation of temporary traffic controls and line marking;
- Site preparation through vegetation clearing and grubbing and stripping and stockpiling of topsoil for re-use; and
- Relocation of utilities/services.

Typical plant and equipment, along with the fleet sound power level (SWL) for each of the early works activities are provided in **Table 7**. It is anticipated that the early works would primarily be completed during standard construction hours.

Table 7 Construction Scenarios & Fleet Sound Power Levels dB LAeq(15min) – Early Works

Item	SWLs	Activity				
		Compound Site		Site	Corridor	Relocation of
		Establishment	Operation	Establishment	Clearing	Services
Road/Delivery Truck	103	✓		✓		✓
Mobile Crane	110	✓		✓		✓
35T Excavator	110			✓	✓	✓
Elevated Work Platform	98	✓				✓
Backhoe	104		✓	✓		✓
Trencher	108			✓		✓
Hand Tools	96	✓		✓		✓
Truck and Dog	108		✓		✓	
Chainsaw	114			✓	✓	
Mulcher	116				✓	
Lighting plant/generator	103	✓				
Light Vehicles	93	✓	✓	✓	✓	✓
Line Marking Machine	108			✓		
Total Fleet SWL		112	110	117	121	115

4.4.2 Construction Phase

It is anticipated that the construction phase of the proposal would be completed in three stages.

Stage One of the works would involve the construction of the new eastbound carriageway and tie-in at the eastern limit of works. During this stage, construction activities would include primary earthworks to clear and stockpile spoil and unsuitable material along the carriageway alignment, installation of drainage structures and construction of road layers including sub-base, base and surfacing layer.

Stage Two of the works, the existing pavement would be stabilised in-situ and built up to the final road surface level. During pavement stabilisation, the existing road surface would be profiled and a stabilisation binder added to the reclaimed material to form the new road sub-base prior to construction of the base and surfacing layer.

Stage 3 of the construction phase would involve the construction or installation of the median barrier, the construction of the final wearing course, and the installation of road furniture.

Typical plant and equipment, along with the fleet sound power level (SWL) for each of the activities during the construction stages are provided in **Table 8**. It is anticipated that these works would primarily be completed during standard construction hours. It is noted that the tie-in works (asphalt paving) with the existing carriageway would be completed during OOH periods.

Table 8 Construction Scenarios & Fleet Sound Power Levels dB LAeq(15min) – Construction Phase

Item	SWLs	Activity				
		Primary Earthworks	Drainage Works	Asphalt Paving	Pavement Stabilisation	Road Furniture
Road/Delivery Truck	103		✓		✓	✓
Mobile Crane	110		✓			
35T Excavator	110	✓	✓			
Backhoe	104			✓	✓	✓
Trencher	108		✓	✓		
Hand Power Tools	96					✓
Truck and Dog	108	✓	✓	✓	✓	
Bulldozer	115	✓				
Scraper	110	✓				
Grader	113	✓		✓	✓	
Water cart	107	✓		✓	✓	
Compactor	113	✓		✓	✓	
Rollers (20-30t)	109	✓		✓	✓	
Concrete Truck	109		✓	✓		
Paving machine	116			✓		
Pavement Profiler	117				✓	
Pneumatic Tyred Roller	111			✓		
Lighting plant/generator	103			✓	✓	
Light Vehicles	93	✓	✓	✓	✓	✓
Line Marking Machine	108					✓
Total Fleet SWL		120	116	121	121	111
Sleep disturbance assessment (LAmax), Night-time periods (10pm to 7am)						
Bitumen sprayer/paving machine				117		

4.4.3 Finishing Works and Site Decommissioning

The finishing works and site decommissioning will occur throughout and following completion of the proposal to remove temporary work, decommission and restore temporary sites, and clean-up and dispose of waste materials. Plant and equipment used during this activity would include trucks, excavators, backhoes, cranes and hand tools. The fleet SWL for site decommissioning works would be 114dB LAeq(15min).

It is anticipated that site decommissioning would be completed during standard construction hours only.

4.5 Construction Assessment Results

4.5.1 Construction Compound

Noise levels associated with the compound site establishment and operation have been predicted for receivers R11 to R17 and are presented in **Table 9**. The results of the assessment indicate that LAeq(15min) noise levels would remain below the standard and OOH1 NMLs at all receiver locations during the establishment and operation of the compound site. During OOH2, predicted noise levels are anticipated to be above the NML at receiver locations R11 to R15 during compound establishment, and at receiver locations R11 and R12 during operation of the compound site.

It is noted that the NML represents the trigger level for the implementation of standard mitigation measures.

Table 9 Construction Noise Results dB LAeq(15min) – Compound Establishment and Operation			
Receiver	dB LAeq NML Standard/OOH1/OOH2	Predicted dB LAeq Per Activity	
		Compound Establishment	Compound Operation
R11	65/49/38	45	43
R12		44	41
R13		41	38
R14		39	37
R15		40	36
R16		35	32
R17		35	32

Note: Receivers where noise levels exceed the NMLs are displayed as shaded cells and bold text.

4.5.2 Early Works Activities

Predictions have quantified noise levels from each of the early works activities, and are presented in **Table 10**. Predicted levels above the NMLs is displayed as **light grey shading** for OOH2, **dark grey shading** for OOH1/OOH2, and **black shading** for standard/OOH1/OOH2.

Each of the early works activities are anticipated to occur during standard construction hours only. Assessment of potential noise impacts during OOH works has been completed in the event that activities are undertaken outside of standard construction hours

Table 10 Construction Noise Results dB LAeq(15min) – Early Works				
Receiver	dB LAeq NML Standard/OOH1/OOH2	Predicted dB LAeq Per Activity		
		Site Establishment	Corridor Clearing	Relocation of Services
R1	65/49/38	61	66	64
R2		55	58	51
R3		51	55	51
R4		42	46	42
R5		35	39	37
R6		32	36	<30
R7		<30	32	<30
R8		47	51	45
R9		45	49	43
R10		44	46	42

Results of the predictive modelling for early works activities during standard construction hours demonstrate that LAeq(15min) noise levels are likely to marginally (+1dB) exceed the NML at receiver location R1 during corridor clearing works and approach the NML during the relocation of services. It is noted that the predicted exceedance occurs when corridor clearing works occur at the western limit of works only.

If early works activities are completed during OOH periods, the predictive modelling indicates that LAeq(15min) noise emissions would likely be above the OOH1 (evening) and/or the OOH2 (night) NMLs at receiver locations R1 to R5 and R8 to R10 during each of the early works activities.

4.5.3 Construction Phase Activities

Predictions have quantified noise levels from each of the construction phase activities and are presented in **Table 11**. Predicted levels above the NMLs is displayed as **light grey shading** for OOH2, **dark grey shading** for OOH1/OOH2, and **black shading** for standard/OOH1/OOH2.

The construction phase activities would typically occur during standard construction hours only. It is noted that the tie-in of the new carriageway with the existing road formation would be completed as AC correction over a number of sessions as night works. Additionally, isolated night works may be required during short duration asphaltting style activities.

Table 11 Construction Noise Results dB LAeq(15min) – Construction Phase / Decommissioning

Receiver	dB LAeq NML Standard/OOH1/OOH2	Predicted dB LAeq Per Activity					
		Primary	Drainage	Asphalt	Pavement	Road	Decommission
		Earthworks	Works	Paving	Stabilisation	Furniture	Site
R1	65/49/38	64	61	76	76	67	58
R2		57	55	65	64	55	51
R3		54	51	59	59	49	47
R4		45	42	49	49	39	39
R5		38	35	48	48	38	32
R6		35	32	36	36	<30	<30
R7		31	<30	40	40	30	<30
R8		50	47	51	51	41	44
R9		48	45	49	49	39	42
R10		45	44	48	48	38	40

The results of the predictive modelling for construction phase activities demonstrate that LAeq(15min) noise levels would exceed the standard construction hours NML. This represents the trigger level for the implementation of standard mitigation measures, at receiver location R1 during asphalt paving works, pavement stabilisation works and road furniture installation, when undertaken at the western limit of works.

For asphalt paving or pavement stabilisation works, including tie-in works completed during OOH work periods, levels above the NMLs are predicted at receiver locations R1, R2, R3 and R8 for OOH1 (evening), and R1 to R5 and R7 to R10 for OOH2 (night).

It is noted that for pavement works (paving, stabilisation and tie-in works) undertaken at the western limit of works, noise levels are predicted to exceed the highly affected NML of 75dB LAeq(15min) at receiver location R1.

4.5.4 Maximum Noise Level Assessment Results

In assessing maximum noise events, typical LA_{max} noise levels from transient events were assessed to the nearest residential receivers. For the maximum noise assessment, a sound power level of 117dBA for a pavement profiler at the most exposed location to residential receivers was adopted for this assessment with the night-time pavement works scenario adopted for the awakenings assessment.

Predicted noise levels from LA_{eq}(15min) and LA_{max} events for assessed receivers are presented in **Table 12**. Results identify that the LA_{eq}(15min) and maximum noise events from road pavement works would exceed the trigger levels for receivers R1 to R5 and R8 to R10 and are recommended to be managed accordingly. The implementation of reasonable and feasible mitigation measures would significantly reduce received noise levels.

Table 12 Maximum Noise Levels Assessment (Night)¹

Receiver	Predicted Noise Level		Trigger Level		Compliant
	dB LA _{eq} (15min)	dB LA _{max}	dB LA _{eq} (15min)	dB LA _{max}	
R1	76	72			X
R2	65	61			X
R3	59	55			X
R4	49	45			X
R5	48	44			X
R6	36	32	40	52	✓
R7	40	36			✓
R8	51	47			X
R9	49	45			X
R10	48	44			X

4.6 Construction Noise Mitigation Measures

Noise modelling identifies that relevant NMLs for the proposal may be exceeded when construction activities pass the nearest point to the receivers. The CNVG and ICNG outline noise management and mitigation initiatives to minimise the impact and improve the acoustic amenity of receivers potentially affected by road construction proposals. The guideline suggests there are no prescribed noise controls for construction work, instead:

All feasible and reasonable work practices should be put in place to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise.

Seven key strategies in reducing construction noise emissions are outlined in Section 6 of the ICNG that should be applied on a case-by-case basis and include the following:

Strategy 1: Universal Work Practices;

Strategy 2: Consultation and Notification;

Strategy 3: Plant and Equipment;

Strategy 4: Onsite;

Strategy 5: Work Scheduling;

Strategy 6: Transmission Path;

Strategy 7: At residence (treatments) or other sensitive Land Uses (last resort).

In addition, Australian Standard AS 2436-2010 “Guide to Noise Control on Construction, Maintenance and Demolition Sites” sets out practical recommendations to assist in mitigating construction noise emissions.

Recommendations provided in the ICNG and AS2436 include combinations of operational strategies, source noise control strategies, noise barrier controls, and community consultation.

Adopting strategies contained in this standard may result in the following noise attenuation:

- Up to 10dBA where space requirements place limitations on the attenuation options available;
and
- up to 20dBA in situations where noise source noise mitigation measures (silencers, mufflers, etc) can be combined with noise barriers and other management techniques.

The standard mitigation measures are provided in **Table 13**.

Table 13 Standard Mitigation Measures

Action Required	Management Measures	Source
Universal Work Practices		
	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: <ul style="list-style-type: none"> ● relevant noise and vibration mitigation measures ● licence and approval conditions ● permissible hours of work ● limitations on high noise generating activities 	
Pre-Construction / Site Inductions	<ul style="list-style-type: none"> ● location of nearest sensitive receivers ● construction employee parking areas ● designated loading/unloading areas and procedures ● site opening/closing times ● environmental incident procedures. 	CNVG
	Implement a noise monitoring program to quantify noise emissions from construction activities and guide practical reasonable and feasible noise control measures.	CNVG / ICNG
Plan Worksites	Locate compounds away from sensitive receivers and discourage access from local roads.	CNVG
	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	CNVG / ICNG
Site Practices / Behavioural Practices	Conduct toolbox talks pre-shift to communicate awareness regarding the importance of noise emission management.	ICNG
	Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.	ICNG
	Include in tenders, employment contracts, subcontractor agreements and work method statements clauses that require minimisation of noise and compliance with directions from management to minimise noise	ICNG
	Avoid shouting and minimise talking loudly. Avoid dropping materials from height, throwing of metal items and slamming of doors.	CNVG / ICNG
	Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices	CNVG / ICNG
	Encourage workers to operate equipment in a conservative manner.	CNVG / ICNG

Table 13 Standard Mitigation Measures

Action Required	Management Measures	Source
Consultation and Notification		
Notification	Provide information to neighbours detailing work activities, dates and hours, impacts and mitigation measures, work schedule over the night period, any operational noise benefits from the works (where applicable) and contact telephone number.	CNVG / ICNG
	Notifications should be a minimum of 7 calendar days prior to the start of the works.	CNVG
	Use site information board at the front of the site with relevant details about site contacts, hours of operation and regular information updates.	ICNG
Complaints Handling	Have a documented complaints handling procedure with an escalation procedure so that if a complaint is not satisfied, there is a clear path to follow.	ICNG
	Implement all feasible and reasonable measures to address the source of the complaint.	ICNG
	Keep a register of any complaints including all relevant details and provide a quick response to all complaints.	ICNG
Plant and Equipment		
Construction Method	Use quieter and less vibration emitting construction methods where feasible and reasonable (eg bore piles rather than impact driven piles).	CNVG / ICNG
	Select the quietest plant to perform a specific function and consider the noise levels of plant and equipment in rental or purchasing decisions.	CNVG / ICNG
Equipment / Maintenance	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms.	CNVG / ICNG
	Regularly inspect and maintain equipment to ensure that it is in good working order.	CNVG / ICNG
	Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address an annoying character of noise identified.	ICNG
	Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.	ICNG
Site Practices	The offset distance between noisy plant and adjacent sensitive receivers should be maximised and restrict areas that mobile plant can be operated during sensitive times.	CNVG / ICNG
	Maximise shielding between plant and adjacent sensitive receivers by making use of natural landforms, temporary structures and stockpiles, and barriers.	CNVG / ICNG

Table 13 Standard Mitigation Measures

Action Required	Management Measures	Source
	Operate plant in a quiet and efficient manner. Reduce throttle settings and turn off equipment when not being used.	CNVG / ICNG
	Where practicable, avoid the coincidence of noisy plant/machinery working simultaneously in close proximity to sensitive receivers.	ICNG
	Minimise disturbance arising from delivery of goods to construction sites by: <ul style="list-style-type: none"> ● avoid queuing of vehicles where practicable or ensure engines are switched off to reduce their overall noise impacts on receivers ● minimise the use of engine brakes ● fit delivery vehicles with straps rather than chains ● select site access points and roads as far away as possible from sensitive receivers and provide shielding where practicable. 	CNVG / ICNG
Work Scheduling		
	Where feasible and reasonable, construction should be carried out during standard construction hours (daytime period). Work generating high noise and/or vibration should be scheduled during less sensitive time periods.	CNVG / ICNG
	Where very noisy activities cannot be undertaken during standard construction hours, the works should be completed before 11:00pm.	CNVG
Work Scheduling	Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impacts by concentrating noisy activities at one location and move to another as quickly as possible.	CNVG
	Works should be scheduled to avoid periods of major student exams such as before or during the Higher School Certificate.	CNVG / ICNG
	Schedule delivery of materials to occur during the day or early evening periods only.	CNVG / ICNG
	Organise deliveries and access to optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.	ICNG
Transmission Paths		
Physical Methods	Reduce the line-of-sight transmission from noise emissions sources to residences or other sensitive land uses using temporary barriers or mobile screens.	CNVG / ICNG
	Erect temporary noise barriers before work commences to ensure noise is minimised during the entire shift.	ICNG
	Consider the height of mobile screens and barriers to ensure adequate shielding to multistorey dwellings.	ICNG
At Residence or other Sensitive Land Uses		

Table 13 Standard Mitigation Measures

Action Required	Management Measures	Source
Structural Surveys	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be required.	CNVG / ICNG
Temporary Relocation	Examine and implement, where feasible and reasonable, the option of relocating noise-affected occupants for short periods of time, such as when high noise levels from construction occur at night and there are no feasible and reasonable ways of reducing noise levels. For example, the proponent could offer alternative accommodation or other respite measures (such as movie tickets) where mitigation is sought and there are no feasible and reasonable work methods available.	ICNG
Architectural Treatments	Examine and implement, where feasible and reasonable, the option of acoustical treatment to residences affected by construction noise, such as to windows at the building façade. Note that the effectiveness of closing existing windows may be limited by the performance of the window seals.	ICNG

This page has been intentionally left blank

4.7 Additional Mitigation Measures

Standard noise mitigation and management measures in accordance with the ICNG would be implemented for the proposal where practicable.

The CNVG (Roads and Maritime, 2015) outlines a range of mitigation measures which are recommended in order to manage the potential impact. The CNVG additional measures reproduced in **Table 14** will be considered by Transport for NSW of the construction contractor following incorporation of feasible and reasonable mitigation measures for the proposal. **Appendix D** provides a definition of each additional mitigation measure listed below.

Table 14 CNVG Triggers for Additional Mitigation Measures - Airborne Noise				
Perception	Predicted airborne LAeq(15min) noise level at receiver		Additional mitigation measures Type	Mitigation Levels
	dB(A) above RBL	dB(A) above NML		
All hours				
	75dBA or greater		N, V, PC, RO	HA
Standard Hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Holidays (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly Audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML+10
Highly intrusive	> 30	> 20	N, V	NML+20
OOH Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Pub Hol (8am – 6pm)				
Noticeable	5 to 10	< 5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN	NML+25
OOH Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Holidays (6pm – 7am)				
Noticeable	5 to 10	< 5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+15
Highly intrusive	> 30	> 25	AA, V, IB, N, PC, SN, R2, DR	NML+25

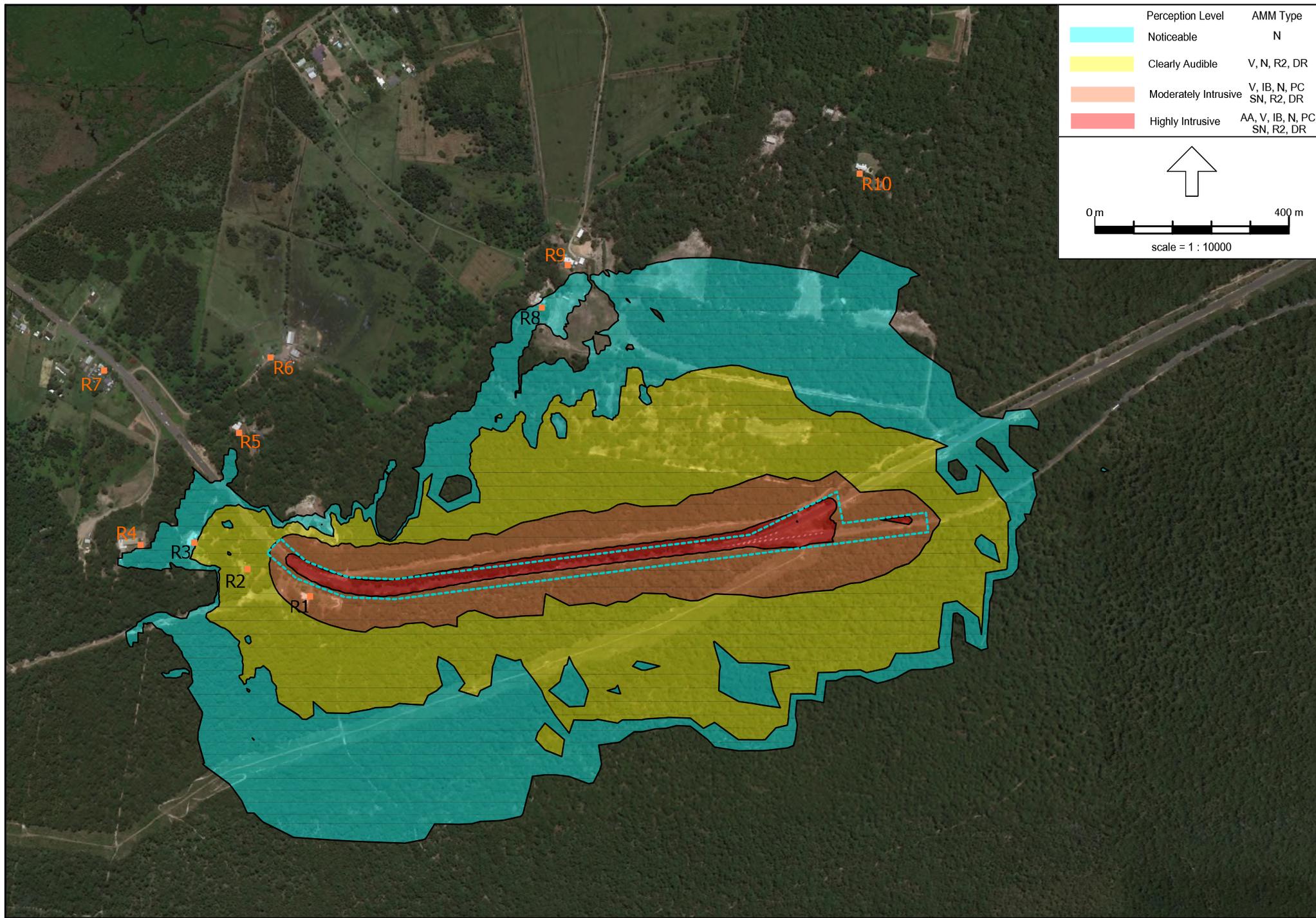
Notes: AA = Alternative accommodation, R1 = Respite Period 1, V = Validation of predicted noise levels (not required for projects less than 3 weeks), PC = Phone calls, IB = Individual briefings (not required for projects less than 3 weeks), SN = Specific notifications, N = Notification, R2 = Respite Period 2, DR = Duration Respite, Perception = relates to level above RBL, NML = Noise Management Level (see Appendix C), HA = Highly Affected (> 75 dB(A) - applies to residences only).

It is understood that the proposed construction activities would primarily be completed during standard construction hours. Upon implementation of standard mitigation measures, noise levels at all residential receiver locations are predicted to remain below the trigger level for the implementation of additional mitigation measures for all works completed during standard construction hours.

Where necessary, Transport for NSW or the construction contractor would undertake activities including tie-in works and asphalt paving activities outside of standard construction hours. Assessment has been completed to determine the potential impact of asphalt paving works following the implementation of standard mitigation measures, and the additional mitigation measures triggered.

Figure 4 presents the noise management zones for asphalt paving works following the application of standard mitigation measures during OOH2 (night) construction hours. The results indicate that following implementation of standard mitigation measures, construction noise levels are anticipated to be 'noticeable' at receivers R1, R2, R3 and R8; 'clearly audible' at receivers R1 and R2; and 'moderately intrusive' at receiver R1, hence implementation of AMMs in accordance with **Table 14** is required.

Figure 4: Asphalt Paving - Trigger for Additional Mitigation Measures Emission Levels (OOH P2)



4.8 Construction Generated Road Noise

Construction road noise levels assessment has been completed assuming a worst case of 80 workers on average per shift. Under the assessed construction road traffic conditions, it is anticipated that the road traffic noise would increase by up to 0.1dB LAeq(15hr) for the day period and up to 0.2dB LAeq(9hr) for the night period. Therefore, road traffic noise impacts from construction work employees are anticipated to be negligible when compared against existing traffic volumes on Nelson Bay Road.

4.9 Construction Vibration Criteria

British Standard BS 7385:Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2", gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage.

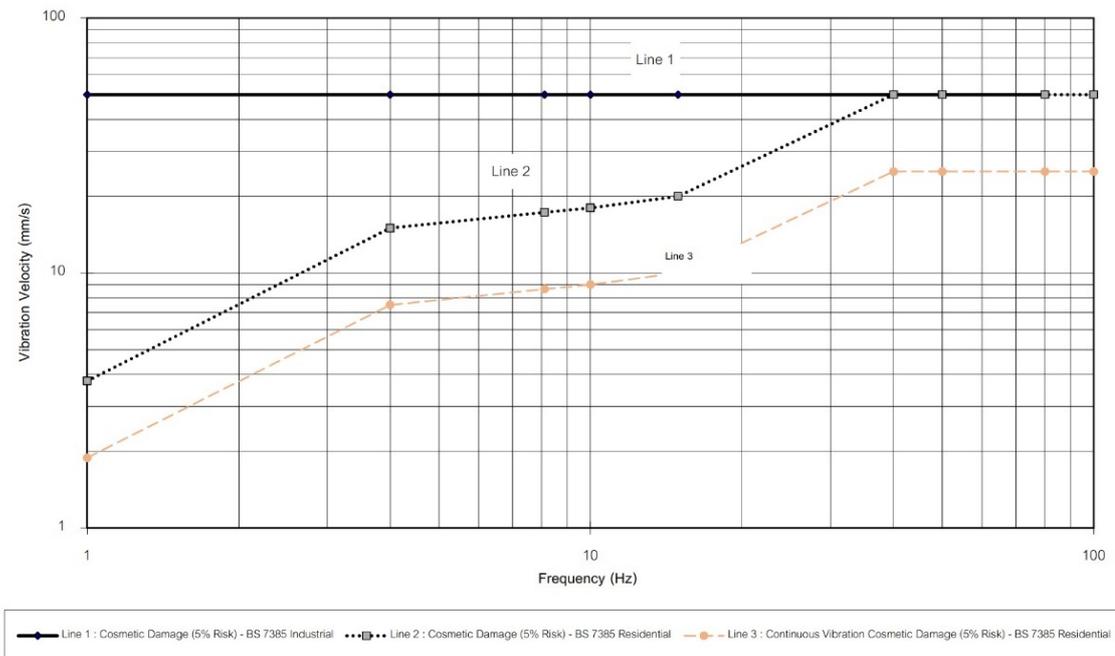
Guide values are set for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to result in a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in **Table 15**, with a visual representation presented in **Figure 5**. Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in **Table 15** should be reduced by 50%, this is especially the case with respect to Peak Particle Velocity (PPV) at lower frequencies.

Table 15 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Figure 5 – Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage



4.10 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in **Table 16**.

Table 16 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990)	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

4.10.1 Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80 Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. **Table 17** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 17 Criteria for Exposure to Continuous Vibration

Place	Time ¹	Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
	Day	0.28	0.56
Residences	Night	0.20	0.40
	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note: rms velocity (mm/s) and vibration velocity value (dB re 10⁻⁹ mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

4.10.2 Impulsive Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to impulsive vibration (1-80 Hz), these criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. Impulsive vibration (as defined in Section 2.1 of the guideline) is generally associated with infrequent activities that create up to three (3) distinct vibration events in an assessment period e.g. occasional dropping of heavy equipment, occasional loading and unloading. **Table 18** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 18 Criteria for Exposure to Impulsive Vibration

Place	Time ¹	Assessment Criteria	
		Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night-time	0.14	0.28
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices	Day or Night-time	18.0	36.0
Workshops	Day or Night-time	18.0	36.0

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

4.10.3 Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1-80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t) dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, $a(t)$ is the frequency-weighted RMS of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in **Table 19**.

Table 19 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration

Location	Daytime		Night-time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
	m/s ^{1.75}	m/s ^{1.75}	m/s ^{1.75}	m/s ^{1.75}
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

4.11 Vibration Assessment

The major potential sources of construction vibration include vibrating rollers. Generally, rolling would take place along the alignment prior to road resurfacing, or when relocation of services has occurred. Peak levels of vibration from rolling typically occurs as the roller stops to change direction and a resonance is created as the roller (and vibrator) is stationary.

Table 20 provides the minimum working distances for the use of various vibration intensive sources to nearby receivers to meet cosmetic damage and human response criteria. It is important to note that the minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions.

For the greatest vibration intensive source (18t vibratory roller), the minimum offset distances to achieve the cosmetic damage and human response criteria are 25m and 100m respectively. A review of aerial photography indicates that the nearest residential receiver (R1) is located about 40m from the proposal site. It is therefore anticipated that construction vibrations would remain below the criteria for cosmetic damage but would likely be above the criteria for human comfort.

Once the final vibratory plant has been selected a review minimum offset distances should be conducted. Where minimum working distances are exceeded, the additional mitigation measures in **Table 21** should be implemented where feasible and reasonable. **Appendix D** provides a definition of each additional mitigation measure listed below.

Table 20 Minimum Working Distances or Vibratory Plant (m)

Plant item	Rating / Description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human response (OH&E Vibration guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

Note: Source, CNVG (Roads and Maritime, 2016).

Table 21 Triggers for Additional Mitigation Measures - Vibration

Construction Period	Additional Mitigation Measures	
	Type	Apply to
Standard Hours	V, N, RP	
OOH1	V, IB, N, RO, PC, RP, SN	All affected receivers
OOH2	AA, V, IB, N, PC, RP, SN	

Notes: AA = Alternative accommodation, V = Validation of predicted levels, PC = Phone calls, IB = Individual briefings, SN = Specific notifications, N = Notification, RO = Project respite offer, SN = Specific notifications.

This page has been intentionally left blank

5 Assessment of Traffic Noise Impact

5.1 Operational Road Traffic Noise Criteria

In accordance with Section 5.5 of the Noise Criteria Guideline (NCG) (Roads and Maritime, 2015), the proposal is classified as minor work. Section 5.5 of the NCG is reproduced below:

Some works may be primarily to improve safety. This may include minor straightening of curves, installing traffic control devices, intersection widening and turning bay extensions or making minor road realignments. These works are not considered redeveloped or new as they are not intended to increase the traffic carrying capacity of the overall road or accommodate a significant increase in heavy vehicle traffic.

Section 6.6 of the NCG outlines that the existing road criteria applies where the minor work increases noise levels by more than 2dBA relative to the existing noise levels at the worst affected receiver.

Although the proposal would result in the duplication of about 1km of carriageway, road traffic volumes are constrained by network features along the length of Nelson Bay Road and feeder roads. It is therefore considered that the proposal would not result in an increase above existing traffic volumes. It is noted that the construction of two new travel lanes would result in a change in the separation distance between the carriageway and the nearest residential receivers. The posted speed limit of the proposal would be 100km/h compared with the existing 80km/h posted speed limit. The single carriageway to the west of the duplication works would remain 80km/h.

5.2 Existing Traffic Flows

Traffic data for existing traffic travelling along Nelson Bay Road was quantified using traffic counters by Matrix Traffic and Transport Data. The data was measured about 250m east of Marsh Road, Salt Ash between Friday 8 March 2019 and Thursday 14 March 2019 for both Eastbound and Westbound traffic. The results of the traffic counts are presented in **Table 22**.

Table 22 Existing Traffic Flows						
Road	Day (07:00 to 22:00)			Night (22:00 to 07:00)		
	Volume Total Vehicles	% Heavy Vehicles	Speed Limit	Volume Total Vehicles	% Heavy Vehicles	Speed Limit
Nelson Bay Road Eastbound	8545	5	80	801	15	80
Nelson Bay Road Westbound	8228	5	80	1179	15	80

5.3 Noise Modelling Parameters

The operational road traffic assessment has been completed utilising the Calculation of Road Traffic Noise (CoRTN) which was developed by the United Kingdom Department of Environment. The modelling methodology is widely accepted in Australia and the preferred method for assessing operational road traffic emissions by the NSW Environmental Protection Agency (EPA) and Transport for NSW.

Brüel and Kjær Predictor Type 7810 (Version 11.10) noise modelling software was used to assess operational traffic noise impacts from the proposal. The model incorporated three-dimensional ground contours and relevant features adjacent to Nelson Bay Road. **Table 23** presents the parameters utilised in the modelling process.

Table 23 Road Traffic Noise Assessment Parameters		
Parameter	Adopted Value	
	Existing Conditions	Proposal Conditions
Road Surface	Standard dense grade asphalt	
Source Height	0.5m cars	
	0.5m truck tyres	
	3.6m truck exhaust	
Speed Limit	80km/h	80/100km/h
Receiver Height	1.5m above ground level	
Receiver Location	1m from building facade	
Receiver Façade Reflection	+2.5dB as per CoRTN	
Receiver Façade Correction	-1.7dB as per ARRB	

5.4 Operational Traffic Noise Results

5.4.1 Model Validation

The noise model was validated using the results of the unattended noise monitor (L1) located at 2998 Nelson Bay Road, adjacent to the proposal site. **Table 24** summaries the results of the validation modelling, outlining the modelled traffic noise levels for existing conditions compared to the measured traffic noise levels at location L1 (free field), with the relevant receiver facade reflection and correction applied as per **Table 23**.

Table 24 Road Traffic Noise Model Validation

Location	dB LAeq,15hr Daytime Noise Level			dB LAeq,9hr Night-time Noise Level		
	Measured	Predicted	Variance	Measured	Predicted	Variance
	Level	Level		Level	Level	
L1 2998 Nelson Bay Road	61.5	62.8	+1.3	57.5	55.6	-1.9

5.4.2 Comparison of Existing and Future Road Traffic Noise Levels

In accordance with the Procedure for Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2016), an assessment of road traffic noise has been carried out for the existing and future road alignment. It is reiterated that the proposal is not expected to increase traffic volumes or change the traffic mix.

Noise levels for existing and future traffic were quantified by direct calculation to each of the nearby sensitive receiver locations. These are noted to be the potentially most affected because of road traffic noise from the proposal. **Table 25** presents the results of the road traffic noise assessment for each scenario.

Table 25 Predicted Road Traffic Noise Levels

Receiver	dB LAeq,15hr Daytime Noise Level			dB LAeq,9hr Night-time Noise Level		
	Existing	Future	Change, dB	Existing	Future	Change, dB
R1	62.8	63.1	0.3	55.6	55.9	0.3
R2	59.8	59.9	0.1	52.6	52.7	0.1
R3	58.3	58.3	0	51.2	51.2	0
R4	55.7	55.9	0.2	48.5	48.6	0.1
R5	58.3	58.4	0.1	51.1	51.1	0
R6	51.9	51.9	0	44.6	44.7	0.1
R7	68.6	68.6	0	61.4	61.4	0
R8	46.7	47.9	1.2	39.5	40.5	1.0
R9	45.7	47.0	1.3	38.5	39.5	1.0
R10	45.9	47.4	1.5	38.5	39.8	1.3

Note: Levels calculated to the most exposed façade, excludes dwelling structure and includes +2.5dB façade reflection and -1.7dB façade correction.

5.4.3 Discussion of Road Traffic Noise Level Results

A comparison of the existing and future (ie post proposal) road traffic noise levels indicate that noise imissions are anticipated to increase by up to 1.5dBA at receiver locations along Marsh Road following the completion of the proposal. The noise level changes are therefore within the 2dBA increase criteria and ameliorative measures are not required.

5.4.4 Operational Noise Attenuation Measures

It is understood that PS311 Annexure C2 2.6.3 requires the preparation of an *Operational Noise Attenuation Measures Report*. As demonstrated in **Section 5.4** above, changes in road traffic noise levels are not predicted to increase by more than the 2dBA increase criteria. It is therefore considered that operational noise attenuation measures are not required for receivers near to the proposal site, and an *Operational Noise Attenuation Measures Report* is not applicable.

5.5 Assessment of Audio Tactile Line Markings

As part of the proposal Transport for NSW intends to install Audio Tactile Line Markings (ATLM) along the centre median on the approach to the new dual carriageway. The closest residence to the ATLM is identified as 2998 Nelson Bay Road (R1) approximately 40m from the start of the ATLM.

Assessment of noise levels from vehicles travelling across the ATLM was undertaken in accordance with the Transport for NSW (2016) Procedure: Preparing and Operational Traffic and Construction noise and Vibration Assessment Report and is provided in **Appendix E** of this report.

The results of the ATLM assessment demonstrate that for the closest residence, the predicted maximum noise level of 57dBA would remain below the relevant criteria of 65dB LA_{max} by about 8dBA. Hence it is expected that no impacts above the maximum noise level criterion would be experienced at any of the nearby residences.

It is noted that the ATLM assessment was based on a sound power level of 109dBA, as measured by MAC for vehicles travelling across ATLM at a similar site to the proposal.

6 Discussion and Conclusion

A Construction and Road Noise and Vibration Assessment has been prepared to quantify potential noise and vibration impacts from the proposed Nelson Bay Road duplication and associated works between 1km east of Marsh Road and 2km east of Marsh Road, Salt Ash, NSW.

Potential noise levels were predicted for the establishment and operation of the compound site located about 1.5km east of the proposal site. The results of the assessment demonstrate that compound related noise emissions would remain below the NMLs for standard and OOH1 construction periods. During OOH2, noise levels are anticipated to be above the relevant NML at the nearest receiver locations.

Construction activities would typically be completed during standard construction hours, with only utility road crossing asphalt paving works to be completed during OOH periods (evening and night) for tie-in works and asphaltting style activities. For works completed during standard construction hours, noise levels are predicted to exceed the NML at receiver location R1 during corridor clearing activities, asphalt paving, asphalt conditioning and road furniture installation. Noise levels during all other construction scenarios are predicted to remain below the standard construction hours NML at all receiver locations.

For asphalt paving or pavement stabilisation works, including tie-in works completed during OOH work periods, noise levels are predicted to be above the relevant NMLs at receiver locations R1 to R5 and R7 to R10. Following implementation of standard mitigation measures, noise levels are predicted to be 'noticeable' at receivers R1, R2, R3 and R8; 'clearly audible' at receivers R1 and R2; and 'moderately intrusive' at receiver R1, hence AMMs are required to be implemented at these locations.

Predictive noise modelling identifies that the sleep disturbance trigger level has the potential to be exceeded at receivers R1 to R5 and R8 to R10 during asphaltting works completed during the night period, however, the implementation of reasonable and feasible mitigation measures would significantly reduce received noise levels.

A review of offset distances to nearby receivers and safe working distances for vibration intensive plant (18t vibratory roller) indicates that construction vibration levels would remain below the criteria for cosmetic damage, but would be above the criteria for human comfort at receiver location R1. Hence, appropriate mitigations should be implemented.

An assessment of operational traffic noise was completed to determine future road noise levels associated with the duplication of Nelson Bay Road in the vicinity of the proposal site. The results of the assessment indicated that future road noise levels at the nearest existing residential receivers would increase by less than 1.5dBA compared with current levels.

An assessment of vehicles travelling across Audio Tactile Line Markings was undertaken to predict maximum noise levels at the nearest residential receivers. The results of the assessment indicated that the predicted maximum noise level of 57dBA at the closest receiver (R1) would remain below the relevant criteria of 65dB LA_{max} by about 8dBA. Hence it is expected that no impacts above the maximum noise level criterion would be experienced at any of the nearby residences.

Appendix A – Glossary of Terms

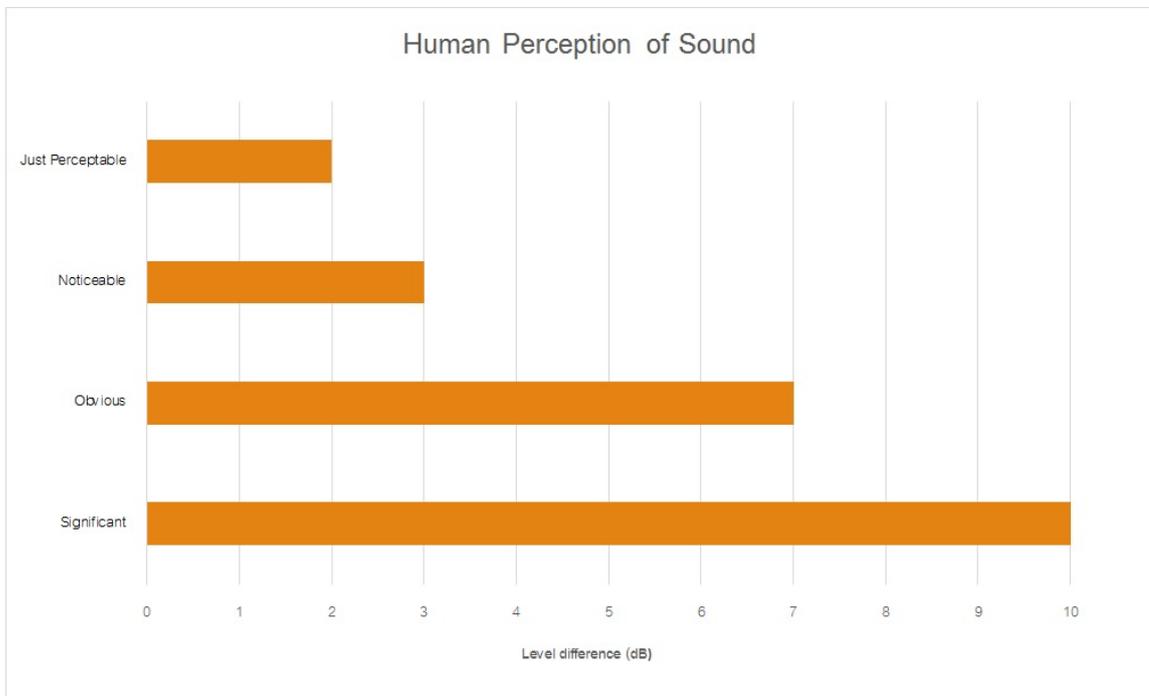
A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities include sources such as construction and holiday period traffic.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmx	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where: W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



This page has been intentionally left blank

Appendix B – Detailed Design



FROM MAYFIELD WEST

TO NELSON BAY



LEGEND

- PROJECT BOUNDARY
- DC EXISTING PROPERTY BOUNDARY
- ROAD DESIGN
- RW RETAINING WALL
- AUDIO TACTILE LINE MARKING

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED FROM AN A3 SIZE ORIGINAL

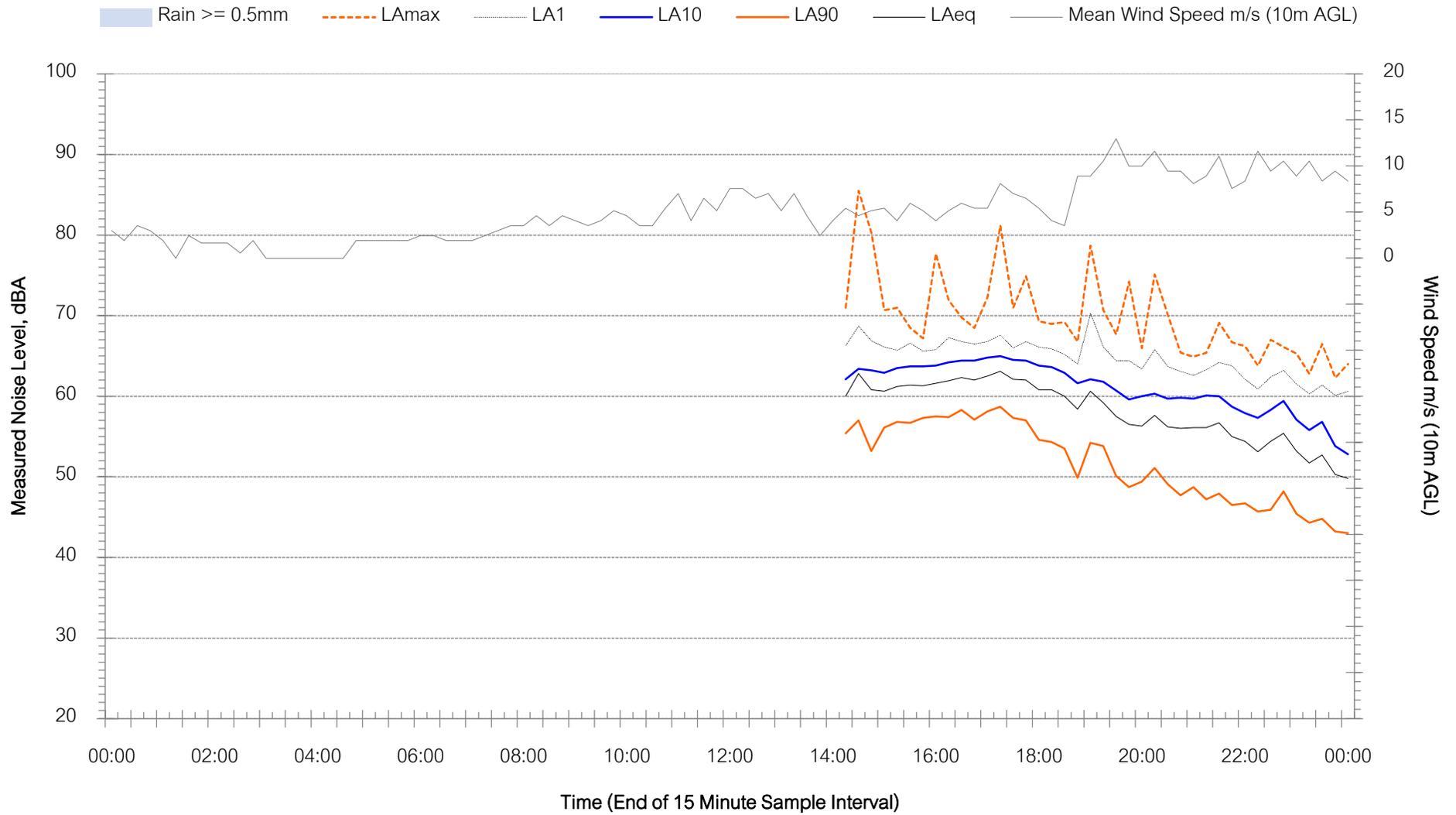
DRAWING FILE LOCATION / NAME C:\Users\14899\Desktop\DS2019-071428-DD-RD-0008.dwg		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLT DATE / TIME 21 Jul 2020 17:39:56	PLT BY LS14869	CLIENT PORT STEPHENS COUNCIL NELSON BAY ROAD WILLIAMTOWN TO BOBS FARM - SECTION 1 GENERAL ARRANGEMENT	A3																																			
EXTERNAL REFERENCE FILES		WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY		SHEET 4 OF 42																																				
<table border="1"> <thead> <tr> <th>REV</th> <th>DATE</th> <th>AMENDMENT / REVISION DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>17.01.20</td> <td>ISSUED FOR 20% CONCEPT DESIGN</td> </tr> <tr> <td>1</td> <td>22.04.20</td> <td>ISSUED FOR 100% CONCEPT DESIGN</td> </tr> <tr> <td>2</td> <td>XX.07.20</td> <td>ISSUED FOR 100% DETAILED DESIGN</td> </tr> </tbody> </table>		REV	DATE	AMENDMENT / REVISION DESCRIPTION	0	17.01.20	ISSUED FOR 20% CONCEPT DESIGN	1	22.04.20	ISSUED FOR 100% CONCEPT DESIGN	2	XX.07.20	ISSUED FOR 100% DETAILED DESIGN	WVR002 WVR021 WVRXXX	CS CS XX	SCALE 1:5000 	 Member of the Surlana Jurong Group 74 HUNTER STREET NEWCASTLE NSW 2300 SMEC PROJECT No 30012877		<table border="1"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DRAWN</td> <td>P.GOLEMA</td> <td>23.04.20</td> </tr> <tr> <td>DRG CHECK</td> <td>S.ORRETT</td> <td>23.04.20</td> </tr> <tr> <td>DESIGN</td> <td>S.ORRETT</td> <td>23.04.20</td> </tr> <tr> <td>DESIGN CHECK</td> <td>S.BURNS</td> <td>23.04.20</td> </tr> <tr> <td>DESIGN MGR</td> <td>S.BURNS</td> <td>23.04.20</td> </tr> <tr> <td>PROJECT MGR</td> <td>C.SUTTON</td> <td>23.04.20</td> </tr> </tbody> </table>		TITLE	NAME	DATE	DRAWN	P.GOLEMA	23.04.20	DRG CHECK	S.ORRETT	23.04.20	DESIGN	S.ORRETT	23.04.20	DESIGN CHECK	S.BURNS	23.04.20	DESIGN MGR	S.BURNS	23.04.20	PROJECT MGR	C.SUTTON	23.04.20	SHEET NO. 2 PART 2	
REV	DATE	AMENDMENT / REVISION DESCRIPTION																																									
0	17.01.20	ISSUED FOR 20% CONCEPT DESIGN																																									
1	22.04.20	ISSUED FOR 100% CONCEPT DESIGN																																									
2	XX.07.20	ISSUED FOR 100% DETAILED DESIGN																																									
TITLE	NAME	DATE																																									
DRAWN	P.GOLEMA	23.04.20																																									
DRG CHECK	S.ORRETT	23.04.20																																									
DESIGN	S.ORRETT	23.04.20																																									
DESIGN CHECK	S.BURNS	23.04.20																																									
DESIGN MGR	S.BURNS	23.04.20																																									
PROJECT MGR	C.SUTTON	23.04.20																																									
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM AHD		RMS REGISTRATION No. DS2019 / 001428		ISSUE STATUS 100% DE TAILED DESIGN		EDMS No. DS2019 / 001428																																			
				ISSUE No. RD-0008 SHEET No. 2		© Roads and Maritime Services																																					

Appendix C – Background Noise Monitoring Charts



Background Noise Levels

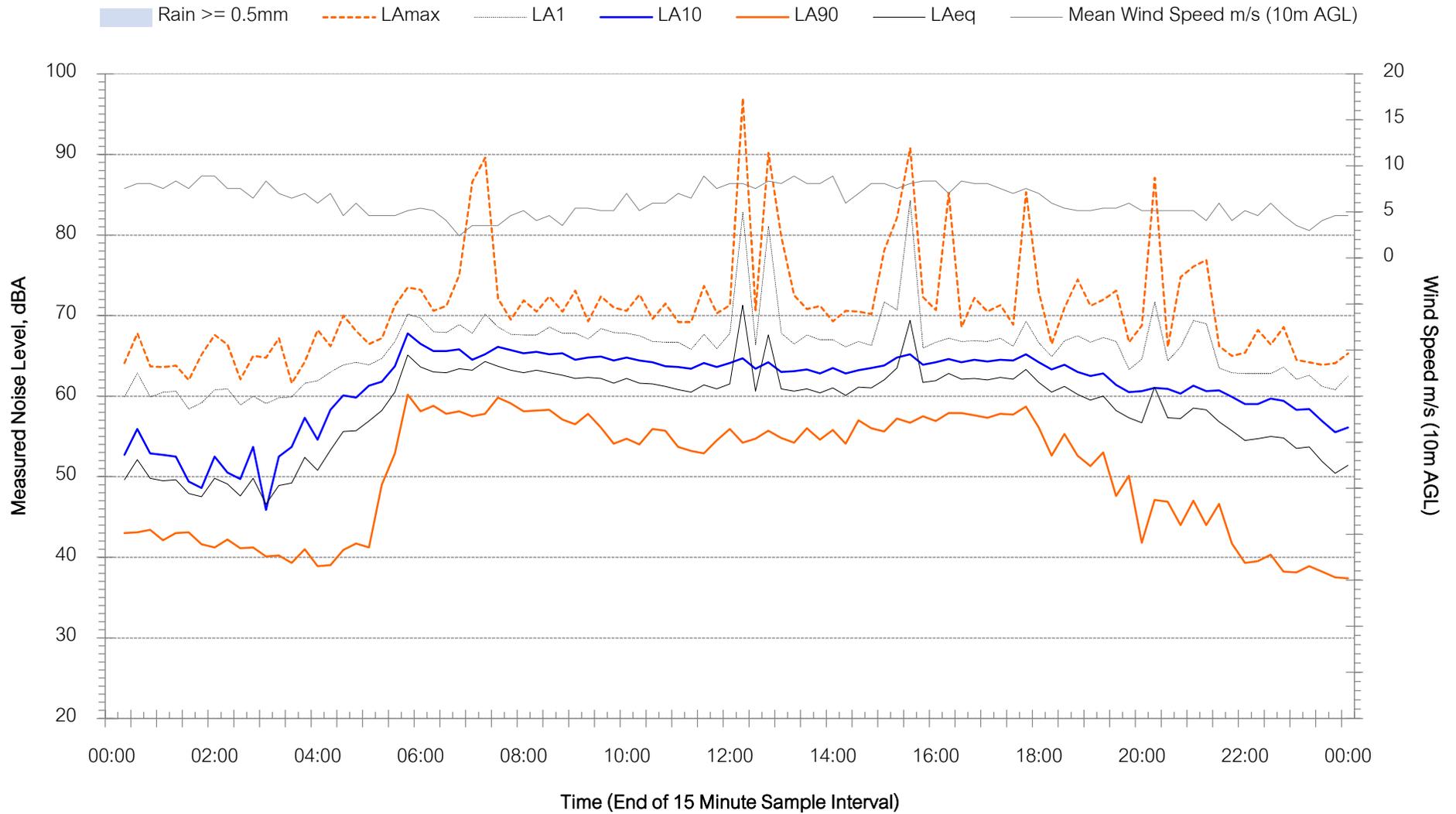
2998 Nelson Bay Road Salt Ash - Tuesday 10 December 2019





Background Noise Levels

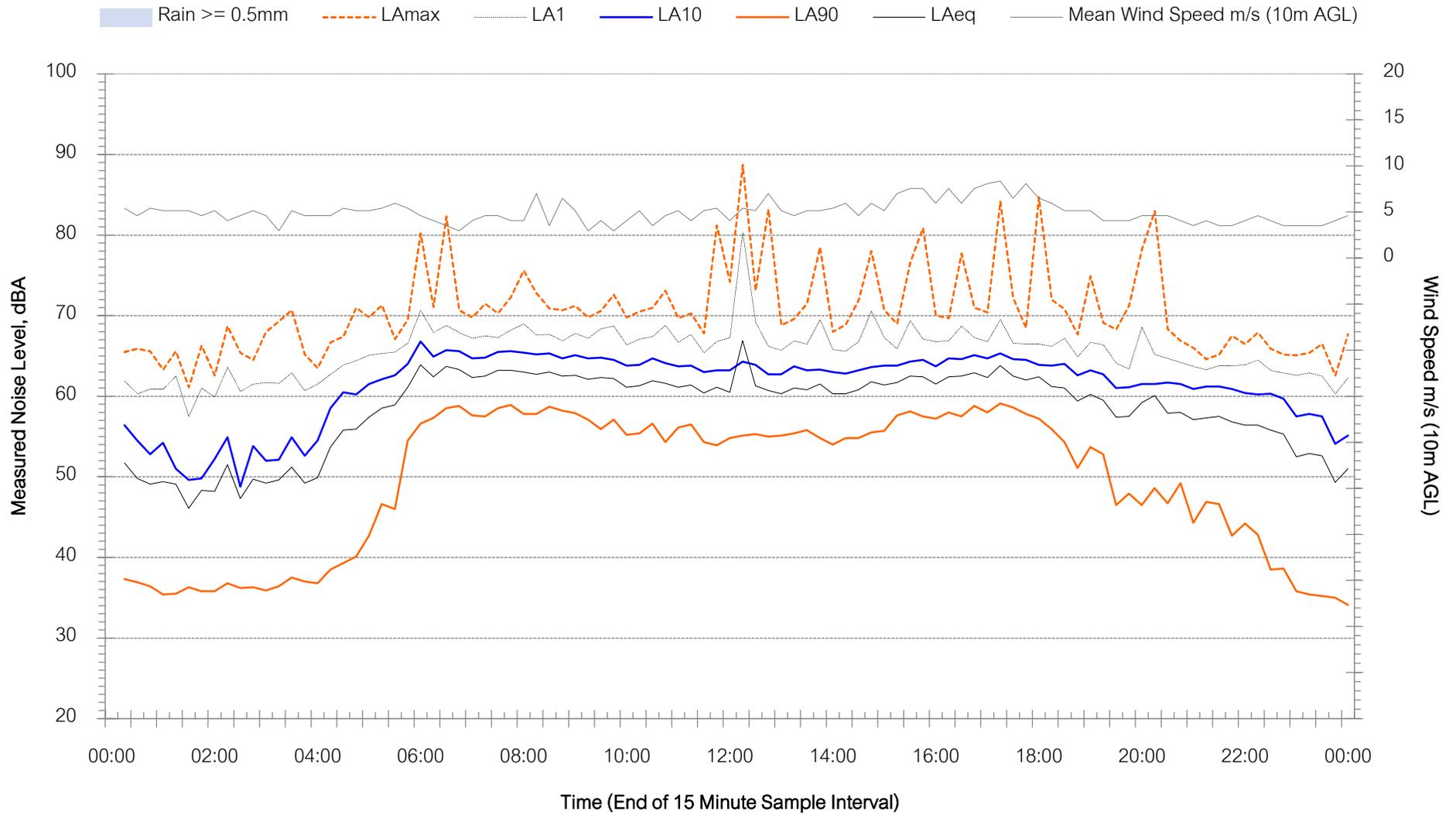
2998 Nelson Bay Road Salt Ash - Wednesday 11 December 2019





Background Noise Levels

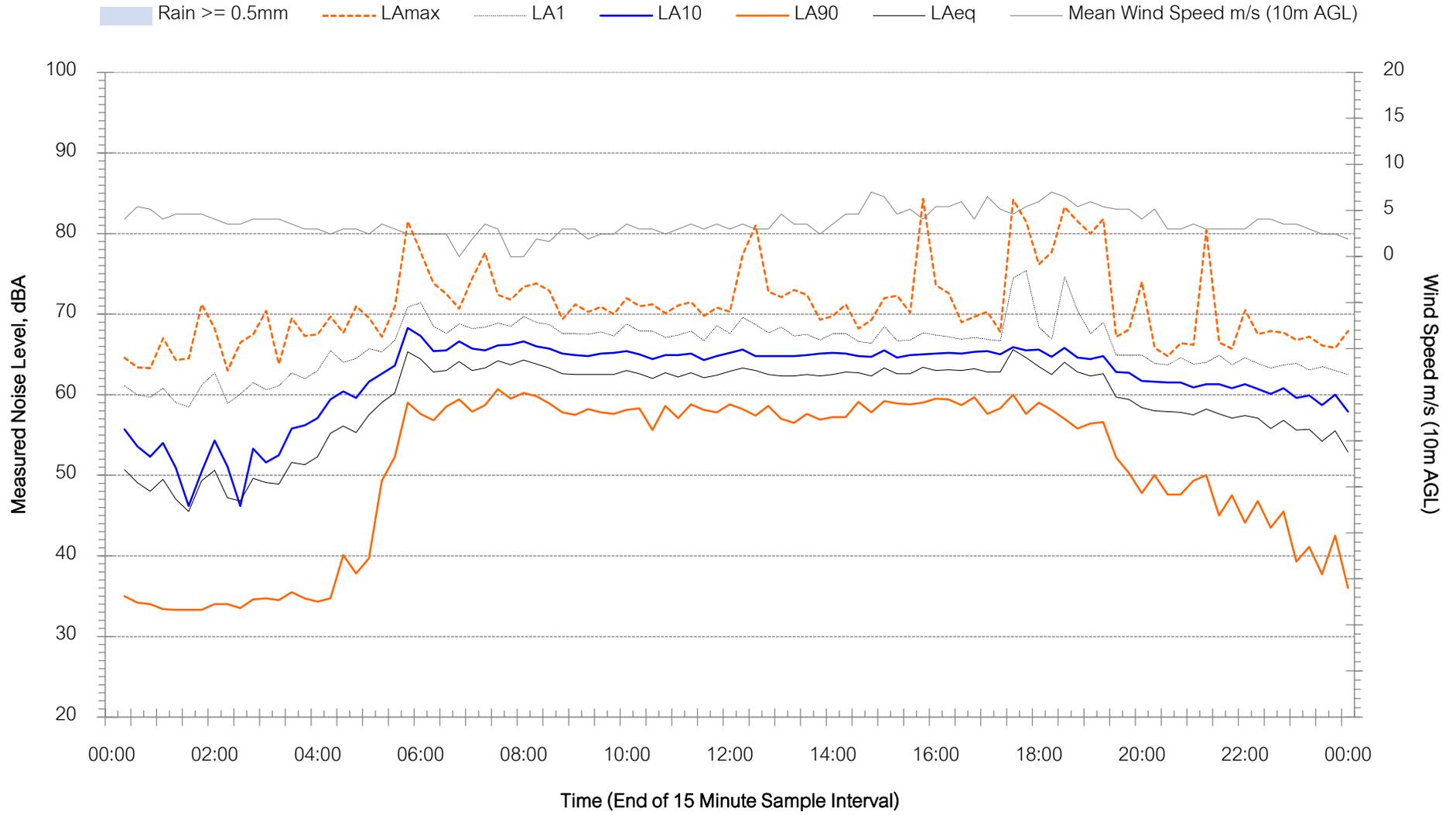
2998 Nelson Bay Road Salt Ash - Thursday 12 December 2019





Background Noise Levels

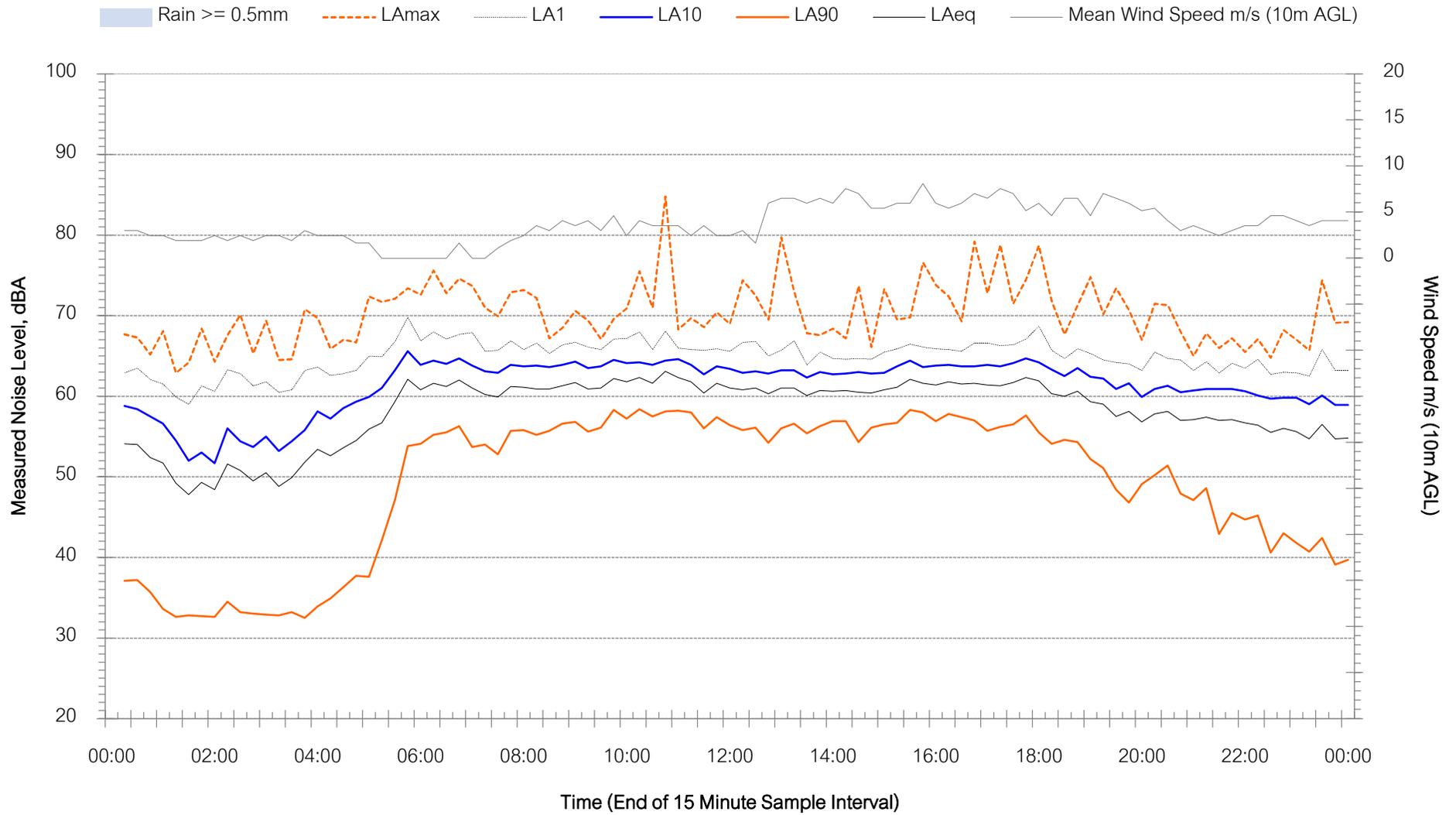
2998 Nelson Bay Road Salt Ash - Friday 13 December 2019





Background Noise Levels

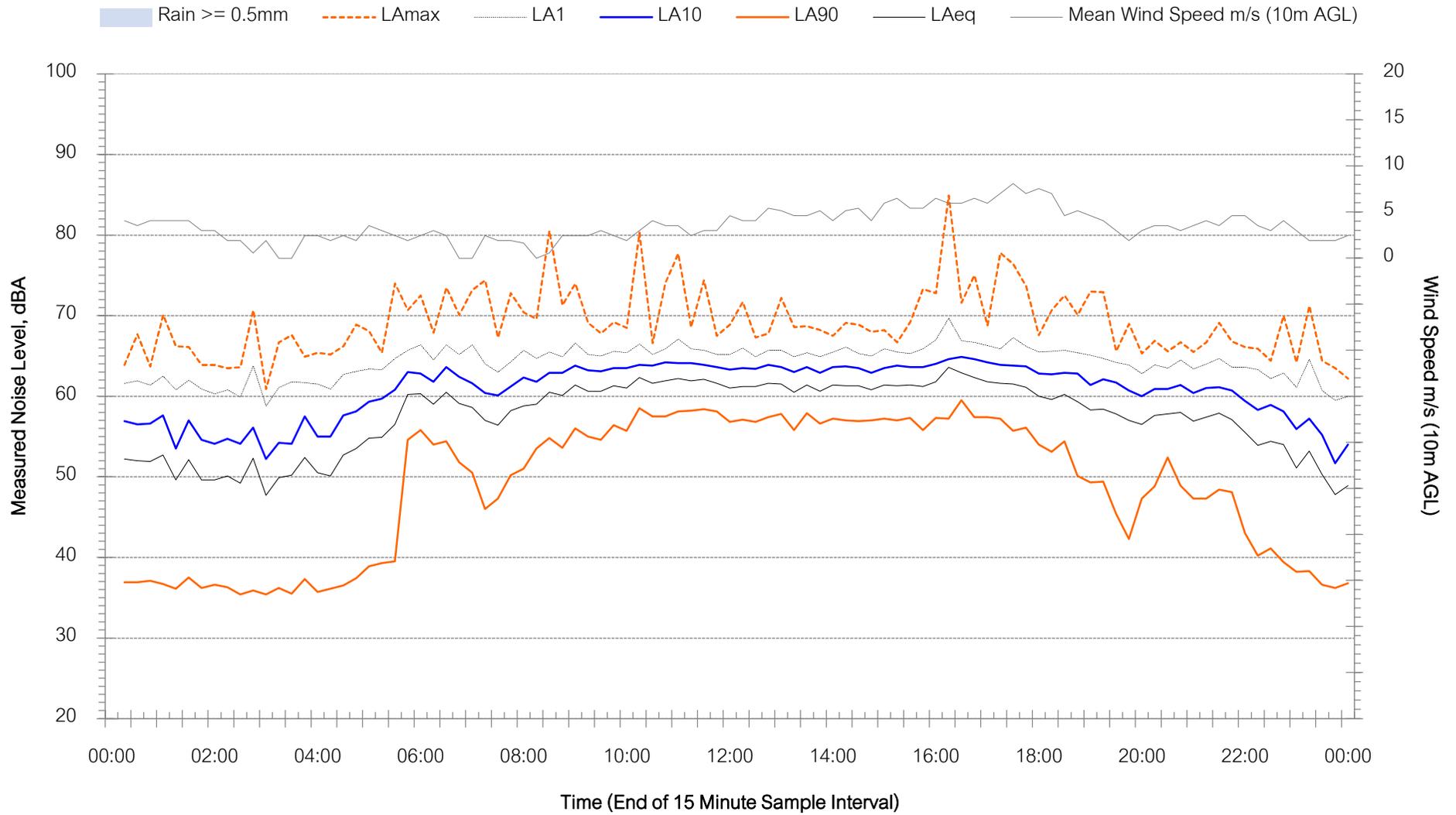
2998 Nelson Bay Road Salt Ash - Saturday 14 December 2019





Background Noise Levels

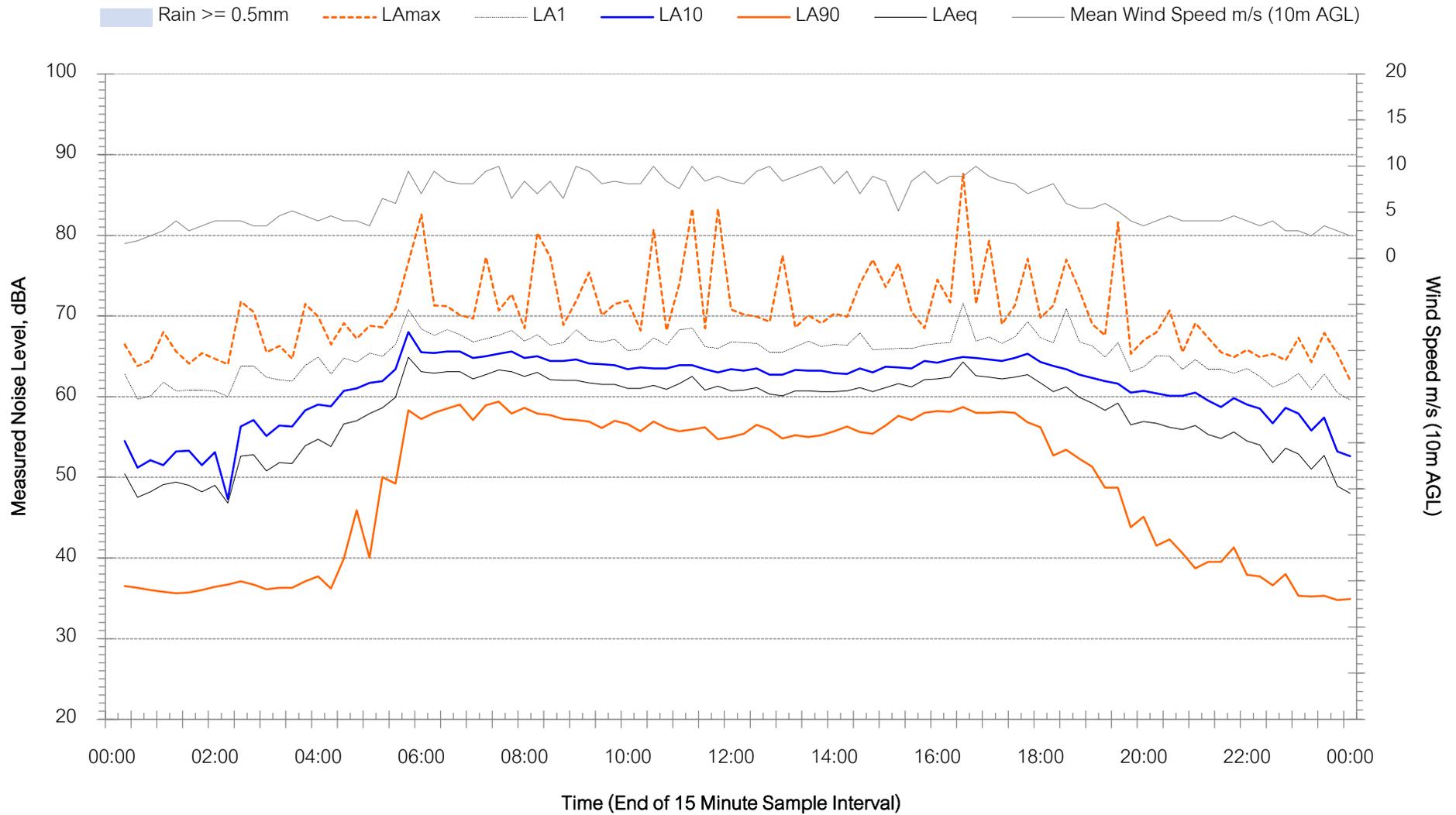
2998 Nelson Bay Road Salt Ash - Sunday 15 December 2019





Background Noise Levels

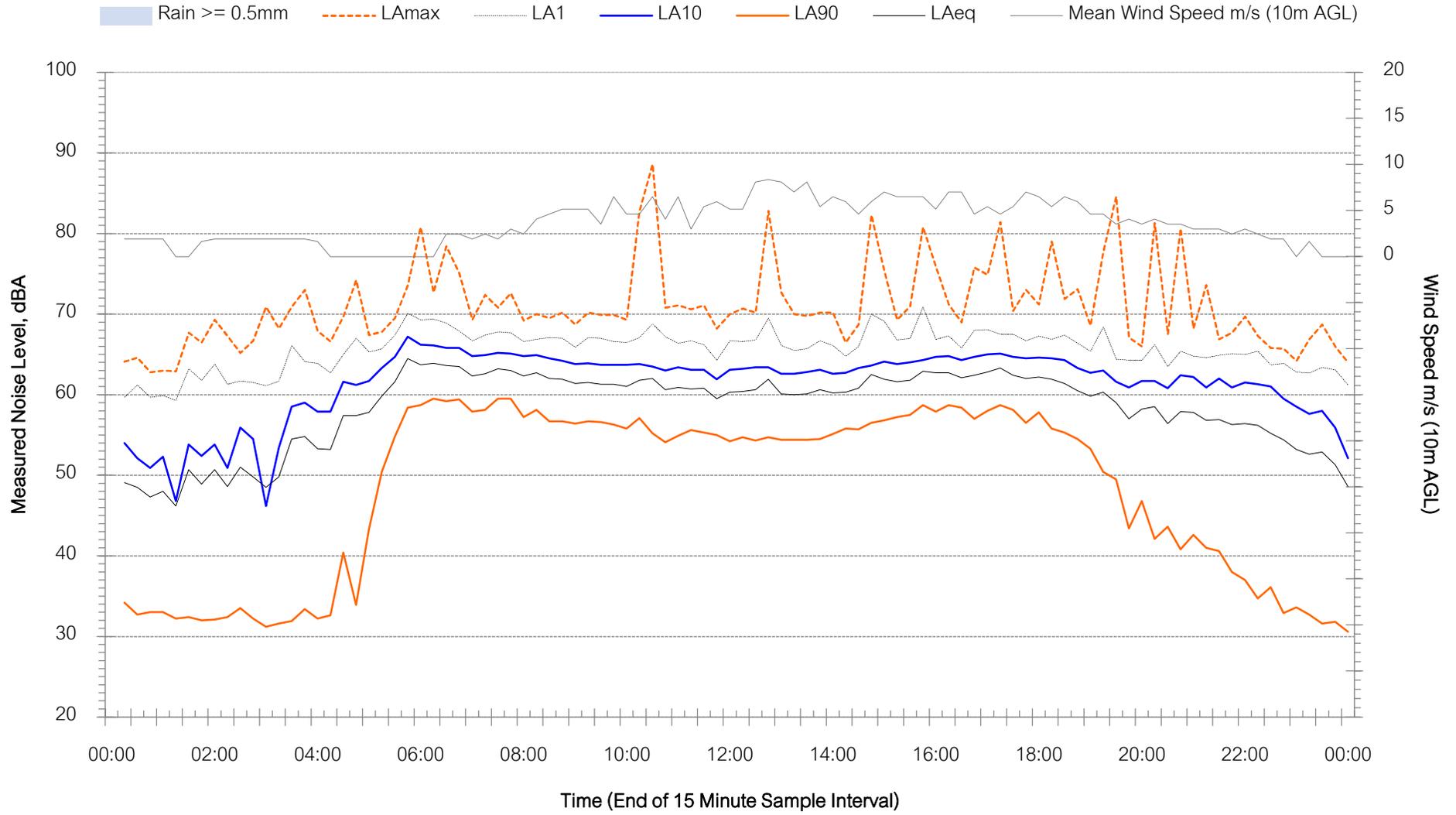
2998 Nelson Bay Road Salt Ash - Monday 16 December 2019





Background Noise Levels

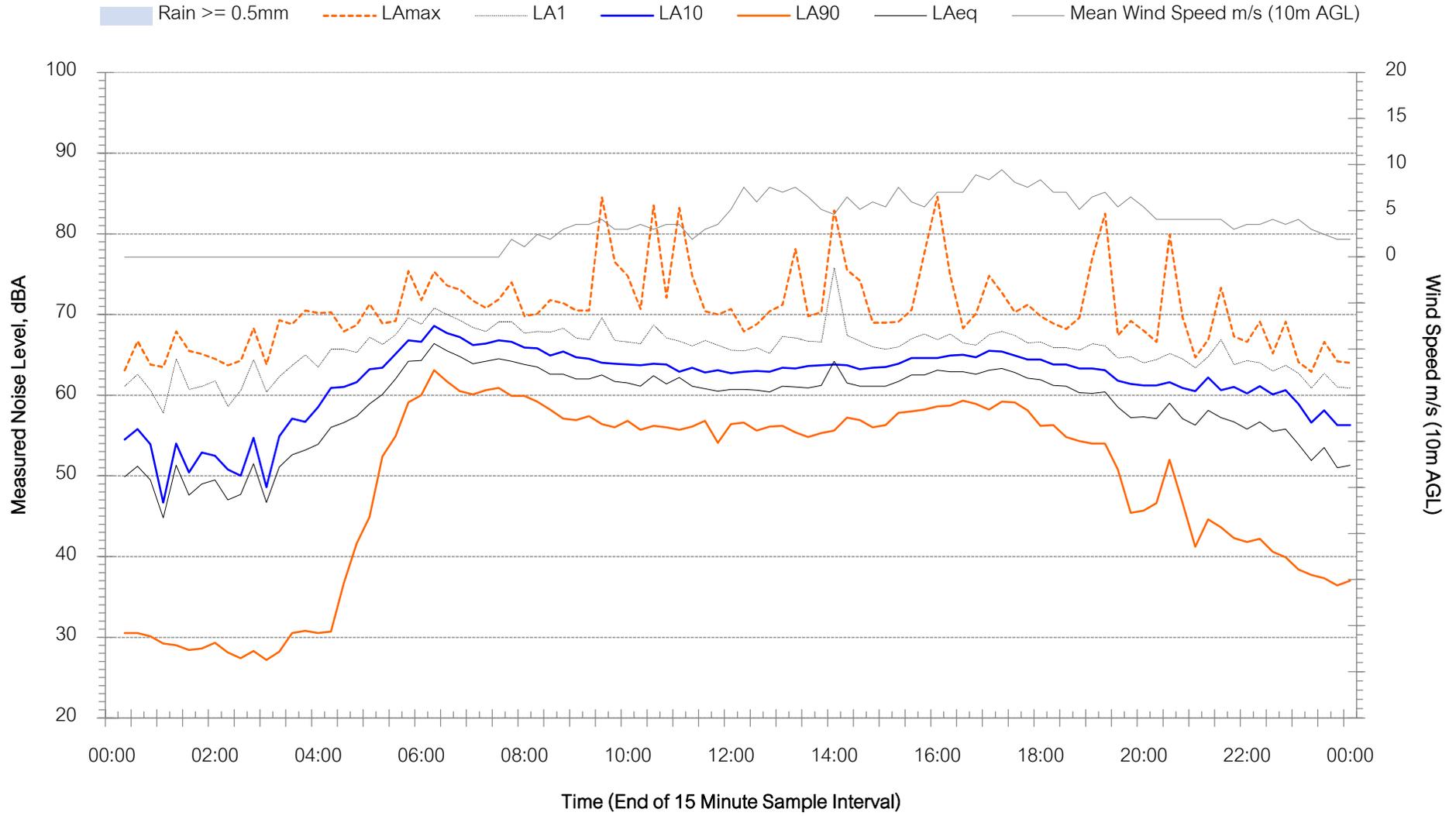
2998 Nelson Bay Road Salt Ash - Tuesday 17 December 2019





Background Noise Levels

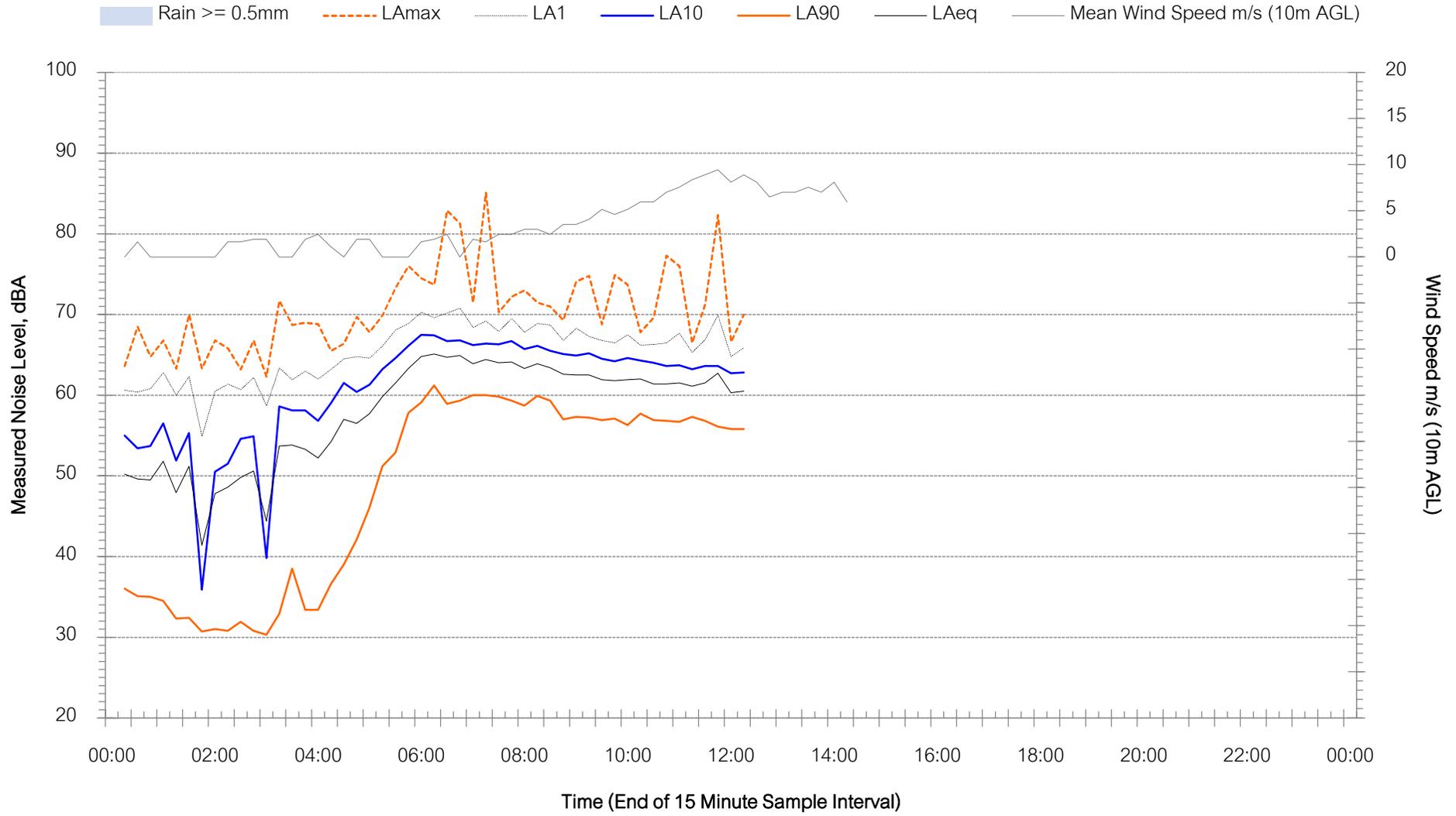
2998 Nelson Bay Road Salt Ash - Wednesday 18 December 2019





Background Noise Levels

2998 Nelson Bay Road Salt Ash - Thursday 19 December 2019



This page has been intentionally left blank

Appendix D – Additional Mitigation Measures

Additional mitigation measures as outlined in Section 11.2.2 of the CNVG (Roads and Maritime, 2015) are summarised below. Many of these measures require communication with the community.

Notifications (letterbox drop or equivalent) (N)

Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.

Specific notifications (SN)

Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (Tables C1 to C3). This form of communication is used to support periodic notifications, or to advertise unscheduled work.

Phone calls (PC)

Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.

Individual briefings (IB)

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the proposal.

Respite Offer (RO)

Respite Offers should be made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.

Respite Period 1 (R1)

Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and no more than 6 evenings per month

Respite Period 2 (R2)

Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month.

Duration Respite (DR)

Respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. In this instance and where it can be strongly justified it may be beneficial to increase the number of evenings or nights worked through Negotiated Respite so that the proposal can be completed more quickly.

Pre-purchased movie tickets or a similar offer may also provide respite for the community while providing provision for additional out of hours work. This measure is determined on a proposal-by-proposal basis, and may not be applicable to all RMS proposals.

The receivers that should be liaised with to gain community support for Negotiated Respite include those where out of hours work exceed the NML.

Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Negotiated Respite.

In instances where there are many receivers above the NML it may not be practical discuss the proposal with every receiver. Instead the community should be proactively engaged so they have an incentive to participate in discussion supporting Negotiated Respite. Support may be demonstrated from surveys, online feedback, contact phone numbers and community events.

Alternative accommodation (AA)

Alternative accommodation options should be provided to residents living in close proximity to construction work that are likely to incur noise levels significantly above the applicable level (Tables C1-C3). The specifics of the offer will be determined on a proposal-by-proposal basis.

Verification

Appendix F of the CNVG provides details about verification of Noise and Vibration levels following complaints and as part of routine checks of noise levels.

This page has been intentionally left blank

Appendix E – Technical Memo: Audio Tactile Line Markings

Technical Memorandum

Project: Nelson Bay Road Upgrade, Section 1
 Subject: Noise Assessment: Audio Tactile Line Markings

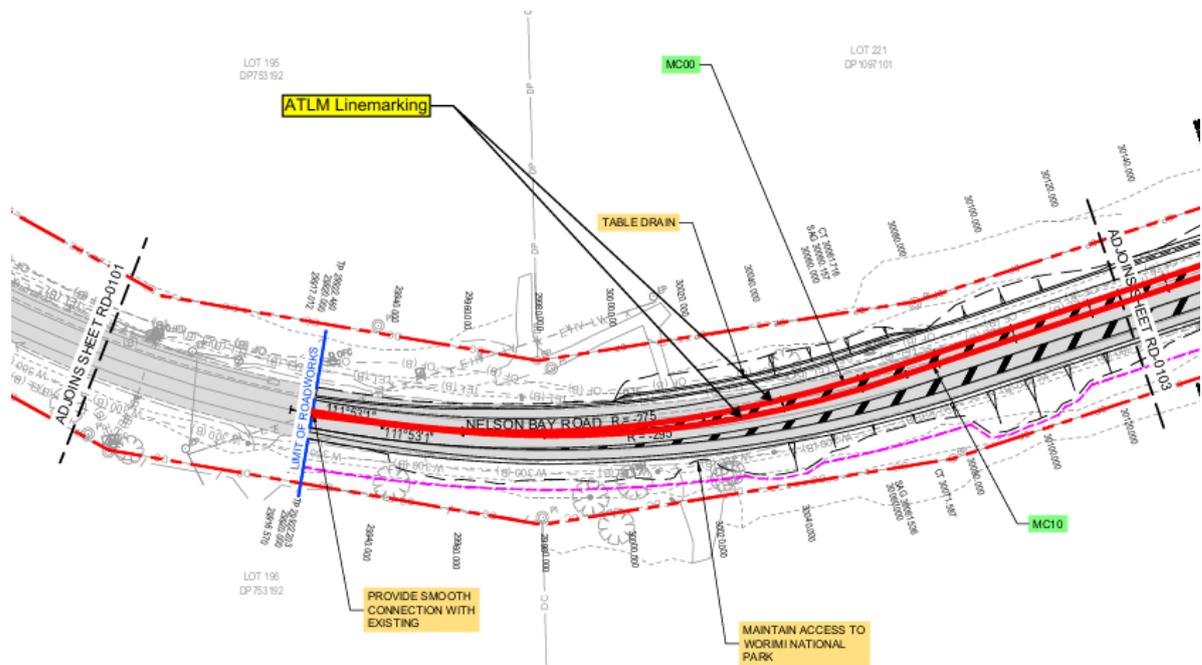
Document ID: MAC190957TM1 Prepared By: Dale Redwood
 Date: 19 June 2020 Reviewed By: Oliver Muller

1 Purpose of this Technical Memorandum

This technical memorandum has been prepared for the Nelson Bay Road Upgrade Section 1 and presents the noise assessment results for vehicles travelling across Audio Tactile Line Markings.

Transport for NSW propose to duplicate about 1km of Nelson Bay Road, between about 1km east of Marsh Road and 2km east of Marsh Road, Salt Ash, NSW. As part of the proposal, Transport for NSW intends to install Audio Tactile Line Markings (ATLM) within the centre median on the approach to the new dual carriageway at the western end of the upgrade. The location of the ATLM is provided in **Figure 1**.

Figure 1: Concept Design and location of ATLM



Source: Transport for NSW, 2020.

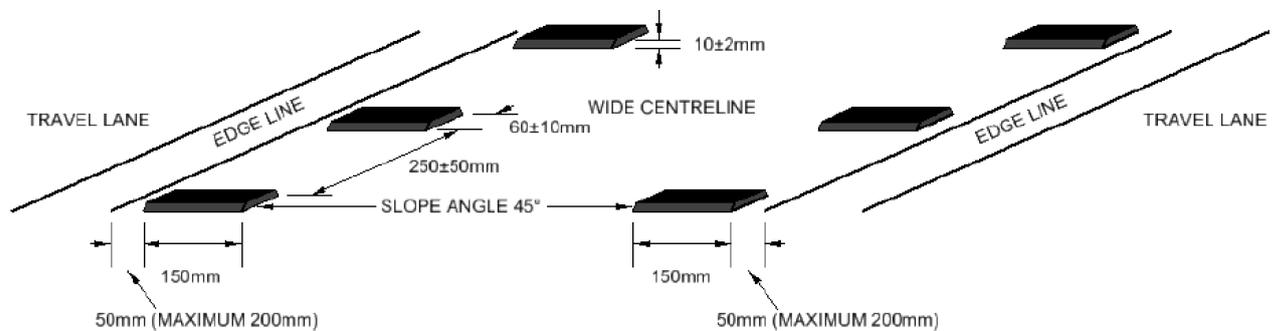
2 Audio Tactile Line Marking Design

Audio Tactile Line Marking is a thermoplastic line consisting of raise ribs at regular intervals. They can be installed on edge lines, lane lines, centre lines and medians of any line-marked road.

The purpose of the ATLM is to reduce 'run-off-road' or cross carriageway crashes by providing a noise (audio) and vibration (tactile) warning to road users who may stray due to fatigue, inattention and/or poor visibility. ATLM is a highly effective road safety countermeasure.

A drawing and photograph of ATLM installed along the centre medium is shown in **Figure 2** and **Figure 3**.

Figure 2: ATLM placement for wide centreline treatments



Source: Transport for NSW, 2020.

Figure 3: Example of ATLM installation



Source: Transport for NSW, 2020.

3 Assessment of Audio Tactile Line Marking Noise

When a vehicle crosses the ATLM, it generates noise from the tyres contacting with the thermoplastic ribs, which may be loud enough to affect residents of dwellings in the vicinity of the ATLM. In such circumstances, the Transport for NSW (2016) Procedure: Preparing and Operational Traffic and Construction noise and Vibration Assessment Report states that the maximum allowable noise level is 65dBA at the potentially affected dwelling.

It is important to note that vehicles crossing the ATLM is an uncommon and brief occurrence. As the ATLM is proposed to be installed within a 500m radius of residential properties, Transport for NSW requires an assessment of potential noise levels at the closest dwellings.

A review of aerial imagery indicates that the closest residential dwellings to the location where the ATLM is proposed to be installed are:

- R1: 2298 Nelson Bay Road – about 40m from the ATLM; and
- R2: 2984 Nelson Bay Road – about 150m from the ATLM.

A 3-Dimensional (3D) predictive noise model has been established to calculate the maximum noise levels from vehicles travelling across the ATLM. The sound power level (SWL) of 109dBA (L_{Amax}) used in this assessment was measured by Muller Acoustic Consulting for vehicles travelling across ATLM at a similar site to the proposal. The SWL represents the source noise level at the contact point between the vehicle tyre and the ATLM not the noise level at the dwelling.

3.1 Noise Assessment Results

The assessment determined that noise levels from errant vehicles travelling across the ATLM would remain below the maximum noise level criterion of 65dB LAmax, with a maximum noise level predicted at the nearest sensitive receiver (R1) of 57dBA. The predicted noise levels at the nearest residential receivers is presented in **Table 1**.

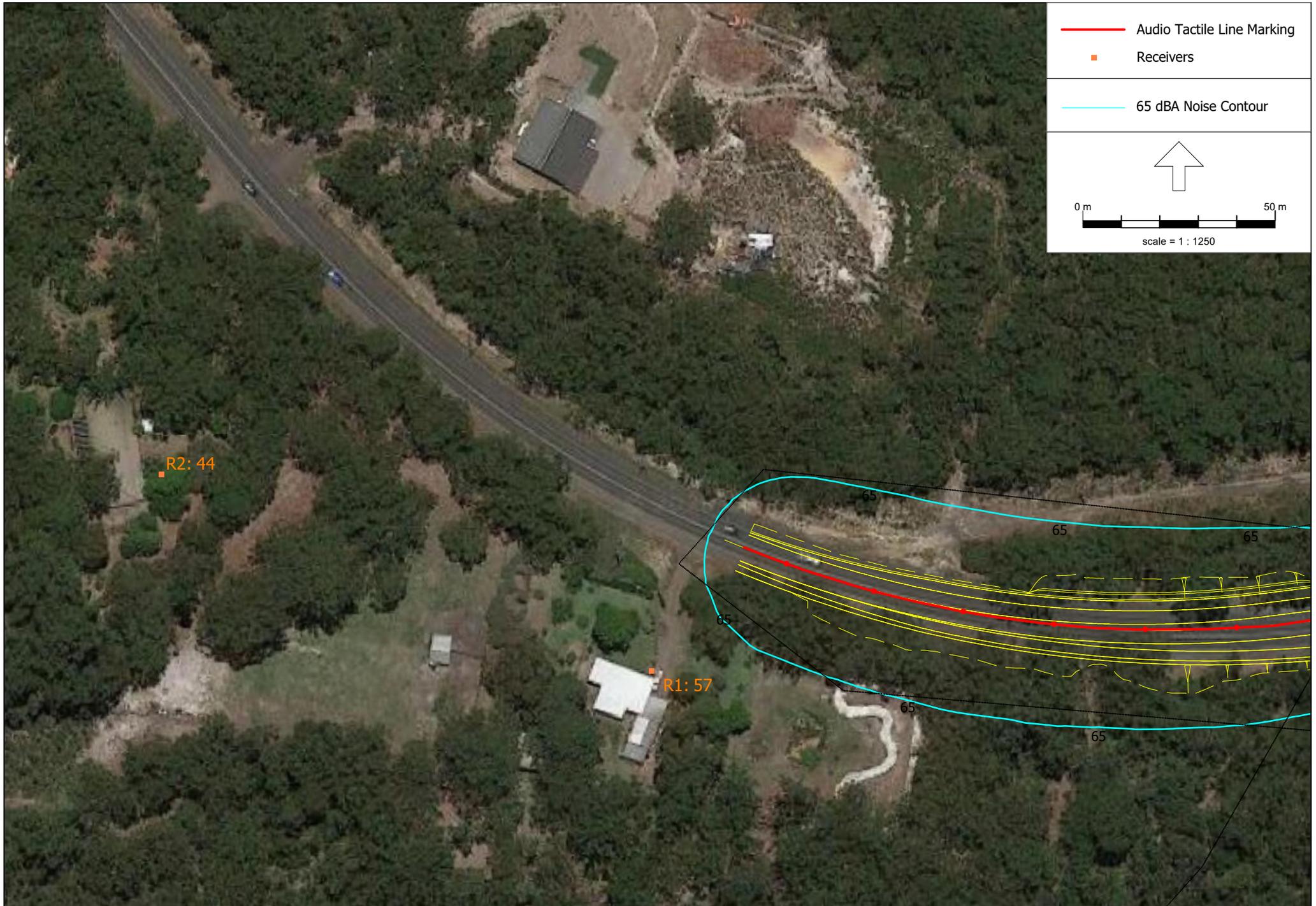
Table 1 Receiver Locations		
Receiver	Address	Predicted Maximum Noise Level (dB LAmax)
R1	2298 Nelson Bay Road	57
R2	2984 Nelson Bay Road	41

Figure 4 (refer below) shows the predicted 65dBA noise contour in blue, which represents the limit of the area that may experience noise levels above the maximum allowable level of 65dBA.

The modelling shows that the noise levels from vehicles travelling across the ATLM would remain at least 8dBA below the threshold, it is expected that no impacts above the maximum noise level criterion would be experienced at any of the nearby residences.

It is important to note that vehicles travelling across the ATLM is a short duration event generally occurring over a period of few seconds. While these events will result in higher instantaneous noise levels, due to their infrequent nature, they are unlikely to result in a long-term increase in overall road traffic noise levels.

MAC190957TM1 - Figure 4: Predicted 65 dBA Noise Contour



4 Conclusion

Transport for NSW propose to duplicate about 1km of Nelson Bay Road between about 1km and 2km east of Marsh Road, Salt Ash, NSW. As part of the proposal, Audio Tactile Line Markings would be installed along the centre median on the approach to the new dual carriageway. This technical memorandum has been prepared for the Nelson Bay Road Upgrade Section 1 and presents the noise assessment results for vehicles travelling across Audio Tactile Line Markings.

When a vehicle crosses the Audio Tactile Line Marking, it generates noise from the tyres contacting with the plastic ribs, which may be loud enough to affect adjacent residents. To assess the potential noise impacts from these events, predictive noise modelling was undertaken to establish predicted noise levels at the nearest residences to the road. The predicted noise levels were then compared to the appropriate maximum noise level criteria of 65dBA (L_{Amax}).

The results of the assessment demonstrate that for the closest residence located about 40m from the start of the Audio Tactile Line Markings, the predicted noise levels (57dBA) would remain below the relevant criteria by about 8dBA. Hence no impacts above the maximum noise level criterion of 65dBA would be experienced at any of the nearby residences.

Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com



Appendix G

Urban Design Report and Landscape and Visual Impact Assessment



NELSON BAY ROAD DUPLICATION

URBAN DESIGN REPORT AND LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

REV	DESCRIPTION	DATE
A	DRAFT REPORT	2020-02-21
B	DRAFT REPORT	2020-02-27
C	FINAL REPORT	2020-07-23
D	FINAL REPORT	2020-07-31
E	FINAL REPORT	2020-08-12
F	FINAL REPORT	2020-10-14

PROJECT NO. 12899.5
DATE: 14 10 2020
REVISION F

NELSON BAY ROAD DUPLICATION

URBAN DESIGN REPORT AND LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

CONTENTS

1.	INTRODUCTION AND BACKGROUND	2
1.1	Introduction.....	2
1.2	Proposed Development.....	2
1.3	Site Characteristics.....	2
2.	PRINCIPLES AND OBJECTIVES	3
2.1	Urban Design Principles and Objectives.....	3
2.2	Urban design strategy.....	3
3.	METHODOLOGY	4
3.1	Landscape Character and Visual Impact Assessment.....	4
3.1.1	Sensitivity.....	4
3.1.2	Magnitude.....	4
3.1.3	Evaluating the impact.....	4
3.2	Landscape Character Impact Assessment Tasks.....	4
3.3	Visual Impact Assessment Tasks.....	5
4.	LANDSCAPE CHARACTER ASSESSMENT	6
4.1	Section 1 – Elevated topography.....	6
4.2	Section 2 – Low lying topography.....	8
4.3	Section 3 – Mild topography.....	10
5.	VISUAL IMPACT ASSESSMENT	12
5.1	Viewpoint Analysis.....	12
5.2	Viewpoint 1.....	13
5.3	Viewpoint 2.....	15
5.4	Viewpoint 3.....	16
5.5	Viewpoint 4.....	17
6.	IMPACT ASSESSMENT	18
6.1	Summary.....	18
7.	REFERENCES	20

FIGURES

Figure 1 – Site Location.....2

Figure 2 – Landscape Character Zones.....5

Figure 3 – Section 1 – Typical Roadside Vegetation.....6

Figure 4 – Section 1 – Typical Section.....7

Figure 5 – Section 2 – Typical Roadside Vegetation.....8

Figure 6 – Section 2 – Typical Section9

Figure 7 – Section 3 – Typical Roadside Vegetation10

Figure 8 – Section 3 – Landscape Mounds.....11

Figure 9 – Attempted Viewpoints12

Figure 10 – View Point 113

Figure 11 – Viewpoint 215

Figure 12 – Viewpoint 316

Figure 13 – Viewpoint 417

Figure 14 – Landscape Character Impacts Summary Plan18

TABLES

Table 1 – Landscape character and visual impact rating matrix.....4

Table 2 – Section 1 – Landscape Character Attributes6

Table 3 – Section 1 – Landscape Character Impact Matrix.....6

Table 4 – Section 2 – Landscape Character Attributes8

Table 5 – Section 2 – Landscape Character Impact Matrix9

Table 6 – Section 3 – Landscape Character Attributes10

Table 7 – Section 3 – Landscape Character Impact Matrix11

Table 8 – Viewpoint 1 – Visual Impact Matrix14

Table 9 – Viewpoint 2 – Visual Impact Matrix15

Table 10 – Viewpoint 3 – Visual Impact Matrix16

Table 11 – Viewpoint 4 – Visual Impact Matrix17

1. INTRODUCTION AND BACKGROUND

1.1 Introduction

Terras has been engaged as part of a multi disciplinary team to deliver an integrated road design based on an understanding of the site in relation to landscape character and visual context. This report aims to assess the landscape character and visual impact within the proposed study area to establish a set of recommendations to inform the design process and develop design objectives and principles. This process would ensure that the constructed outcome fits sensitively into the built, natural and community environment and makes a positive contribution to the public domain.

Information used to guide the framework of this report and the assessment methodology has been sourced from Roads and Maritime Services Urban Design Policy, *'Beyond the Pavement'* and *'Guideline for landscape character and visual impact assessment – Environmental impact assessment practice note EIA-N04'*.

1.2 Proposed Development

The proposal would be constructed within the existing road reserve and would not require any property acquisition. The proposal involves constructing approximately 1km of dual carriageway from approximately 1km east of Marsh Road to 2km east of Marsh Road at Bobs Farm, see Figure 1 below. This proposal would tie in with the Anna Bay to Bobs Farm duplication project that was completed in 2015.



Figure 1: Site Location

Source: Google Maps, Accessed February, 2020

Features of the proposal include:

- Road widening
- Retaining walls (cut and fill walls)
- Vehicle barriers (fill walls)
- Roadside barriers
- Median barriers
- Revegetation
- Vegetation clearing
- Fauna fence
- Access track behind fauna fence

1.3 Site Characteristics

Generally the landscape character can be defined as vegetated forest aligning a two laned road corridor. This creates an enclosed woodland character along Nelson Bay Road.

2. PRINCIPLES AND OBJECTIVES

The overall project objectives established in the proposal include:

- Reduce of peak period traffic congestion.
- Improve road safety of all road users.

Based on overall project objectives urban design objectives and principles have been developed so that the lead team designers may have urban design criteria established to assist with the engineering design of the road, earthworks and structures. These have been developed specifically to suit the existing area to promote a positive outcome.

2.1 Urban Design Principles and Objectives

2.1.1 Objective 1

Maintain the elements that define the character of the area. Principles employed to achieve this objective include:

- Work with the existing topography where possible to minimise cut / fill and retaining walls where possible.
- Maintain the vertical geometry established with the existing mature trees lining the road.

2.1.2 Objective 2

Ensure the proposal integrates into the landscape. Principles employed to achieve this objective include:

- Design project structures to blend into the natural environment.
- Minimise vertical structures within the proposal.
- Minimise visual impact during the construction period.

2.2 Urban design strategy

This section summarises the considerations to be adopted during the design process in order to meet the project objectives.

- Minimise any tree losses and where clearing is required ensure that sufficient stands of vegetation remain to maintain the existing natural environment character.
- Source native plant species to be used in revegetation works to batters as well as any areas of disturbance during construction.
- Integrate natural patterns into the design of the retaining walls.
- Appropriate treatments may include oxide colours in concrete structures to soften their impact.
- Take practical measures to to locate stockpiles and construction materials away from highly visible areas.

3. METHODOLOGY

3.1 Landscape Character and Visual Impact Assessment

The following terms are defined in the *Guidelines For Landscape Character And Visual Impact Assessment*, (RMS, 2018) and have been used when completing the landscape character and visual impact assessment. Measuring the impact of the proposal is based on the assessment of the sensitivity of the existing area and the and the magnitude of the proposal on that area (RMS, 2018).

3.1.1 Sensitivity

Sensitivity of an area takes into consideration the qualities of an area and the number and types of receivers within the setting. It establishes how sensitive the existing character is in relation to the proposed changes.

3.1.2 Magnitude

Magnitude addresses the physical scale of the work, distance it is perceived and the overall contrast with the existing environment. In order to accurately assess the magnitude of the work, all elements need to be considered with specific note taken to location.

3.1.3 Evaluating the impact

Assessing the impact of the proposal involves a combination of the sensitivity and magnitude appraisal in order to provide a rating for the individual character zone or visual impact. In addition to rating the landscape character zones and individual viewpoints, a summary of the assessment is to be provided in order to justify the result and provide an indication of the overall impact of the proposal. See Table 1 below for landscape character and visual impact rating matrix.

		MAGNITUDE				
			HIGH	MODERATE	LOW	NEGLIGIBLE
SENSITIVITY	HIGH	HIGH	HIGH - MODERATE	MODERATE	NEGLIGIBLE	
	MODERATE	HIGH - MODERATE	MODERATE	MODERATE- LOW	NEGLIGIBLE	
	LOW	MODERATE	MODERATE- LOW	LOW	NEGLIGIBLE	
	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	
	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	

Table 1: Landscape character and visual impact rating matrix

SOURCE: *Guideline For Landscape Character and Visual Impact Assessment* (RMS, 2018)

3.2 Landscape Character Impact Assessment Tasks

The following landscape character assessment will assist in establishing how the overall impact of the proposal will impact on the local areas landscape character and the community’s sense of place. Landscape character zones can be defined as an area with similar properties or strongly defined spatial qualities, distinct from areas immediately nearby. Character zones for this proposal have been established from visiting the site and using information gathered from other consultants through design plans. Generally the existing landscape character is consistent along the road. Three separate character zones have been identified which have been based on the proposals impact on the landscape character. These have been identified based on both the site characteristics and the requirement of either a cut retaining wall, a fill retaining wall or for earthworks such as batters or landscape mounds. These zones have been identified in Figure 2 and will be analysed in section 3 of this report with reference the following aspects of the site:

- Geology
- Topography
- Hydrology
- Vegetation
- Land use
- Indigenous and European cultural heritage
- Built form
- Infrastructure environment
- Spatial qualities

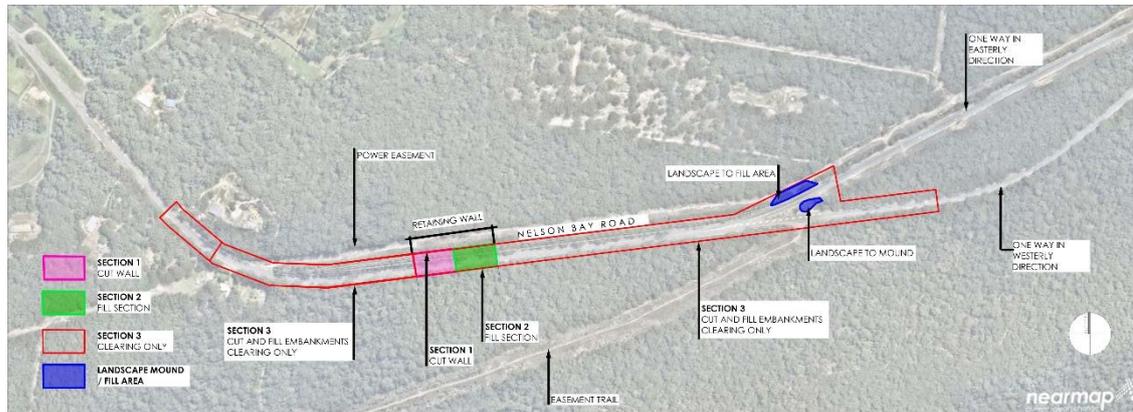


Figure 2: Landscape Character Zones

Source: SMEC, General Arrangement Plan

3.3 Visual Impact Assessment Tasks

The methodology applied to this study involves systematically evaluating the visual environment pertaining to the site and using value judgements based on community responses to scenery. This identifies aspects that are more objective (such as the physical setting, character and visibility of a proposal), from more subjective aspects, such as the compatibility of the proposal within the setting.

Visual data collection involves systematically evaluating the visual environment from relevant viewpoints through fieldwork to determine the actual potential for views to the site. Once a viewpoint has been identified, data is recorded both photographically and as detailed notes.

The selection of viewpoints has generally been based on locations where potential for views of the PL proposed development would occur. Viewpoint selection criteria include: consideration of where views can be obtained from publicly frequented locations, such as major traffic corridors; prominent look-outs or locations of high scenic value; or, where members of the local community may be affected. This assessment has been undertaken in accordance of the requirements of Guidelines for Landscape Character and Visual Impact Assessment (RMS, 2013) and as such, the work has been carried out following the below steps:

- Assess the visibility of the Proposal. This includes a review of the existing visual environment/landscape setting of the locality.
- Identify existing viewpoints and their sensitivity. This requires the preparation of a viewpoint analysis using a representative number of viewpoints located within a reasonable distance of the site located within its visual catchment.
- Assess visual impacts. A brief description of the proposal is included within this section followed by an assessment of the likely impacts based on a composite of the sensitivity of the view and the magnitude of the proposal being a combination of scale, size and character having regard to the proximity of the viewer.

4. LANDSCAPE CHARACTER ASSESSMENT

4.1 Section 1 – Elevated topography

This section has been identified due to the elevated topography adjacent to the road which results in the requirement of a cut retaining wall. Refer to Table 2 for landscape character attributes:

Landscape Character Attribute	Description
Geology	The soil is Hawks Nest (hn) described as being deep Podzols and Siliceous Sands/Podzols on deep poorly drained Humus Podzols on sand-sheets. Fine-medium grained sand is present throughout the site. (L.E Matthei, 1995).
Topography	Significant upslope batters located on the northern side of the road
Hydrology	There are no existing drainage structures or natural drainage lines within the proposal extents. All surface flows infiltrate the subgrade through the permeable ground materials and then is conveyed through the site through the sandy subgrade. It is not proposed to provide any drainage structures.
Land use	Road corridor through existing Worimi National Park lies immediately south of the road corridor. An easement trail lies to the south and an electrical easement approximately 40m to the north.
Indigenous / European heritage	An Aboriginal cultural heritage working paper is being prepared by others. The findings from this assessment are summarised within the REF.
Spatial qualities	Generally enclosed by vegetation to both sides of the road. Mid distance views along the road corridor in an easterly direction. Views to the west along the road corridor are somewhat reduced due to existing vegetation obstructing views along the sweeping corner.
Vegetation	Dense vegetation exists on both sides of the road with. Refer to Figure 3. Predominantly uncleared woodland and tall open forest. Common species include <i>Angophora costata</i> , <i>Eucalyptus pilularis</i> , <i>Eucalyptus gummifera</i> , <i>Banksia serrata</i> . <i>Acacia longifolia</i> is a common understorey species. <i>Melaleuca quinquenervia</i> , <i>Eucalyptus robusta</i> , <i>Casurina glauca</i> and <i>Ghania spp</i> swamp forest of the Central Coast and Lower North Coast, is habitat for Green-thighed Frog (listed as endangered under <i>Biodiversity Conservation Act 2016</i>) is within the road corridor and would be impacted by main construction works.
Built form	None visible.
Road Environment	Located on a crest in the road.

Table 2: Section 1 – Landscape Character Attributes



Figure 3: Section 1 - Typical Roadside Vegetation

4.1.1 Proposal

- Road widening.
- Cut retaining walls on the northern side. Refer to Figure 4 below.
- Vegetation clearing to accommodate clear zone requirements.
- Fauna fence.
- Access track behind fauna fence.
- Urban design – Sand dune patterning is proposed to be applied to the wall in the formwork process to tie into the character of the area. Appropriate treatments may also incorporate oxide colours into the concrete mix to soften the appearance of the wall.

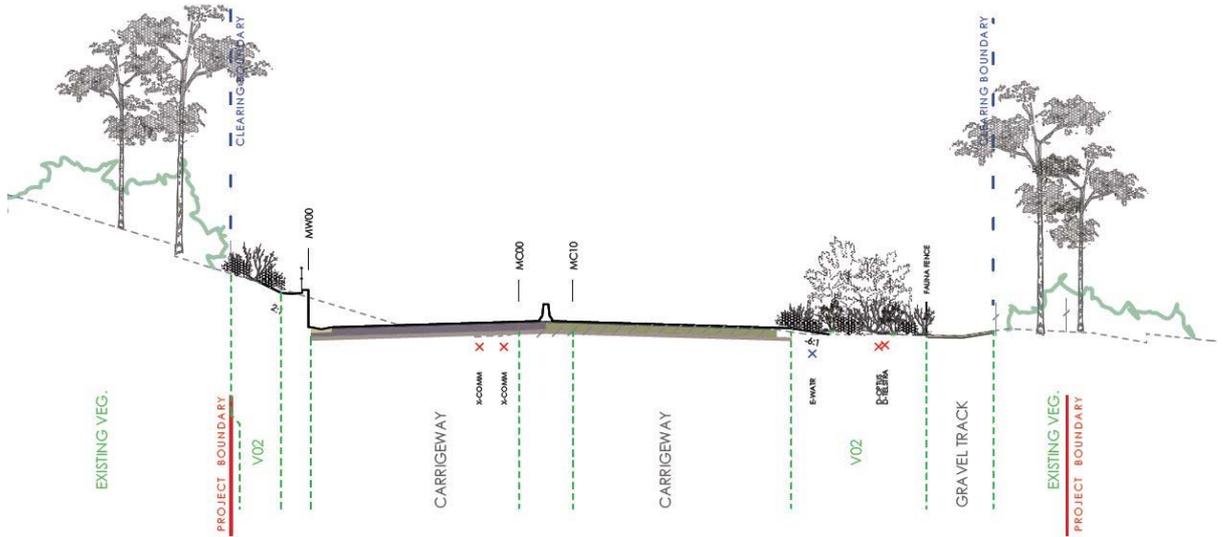


Figure 4: Section 1 Typical Section

Source: Terras, Typical section

4.1.2 Landscape Character Assessment

Sensitivity

Low to moderate given the existing vegetation located outside the proposal boundaries

Magnitude

Moderate to high due to the size of the retaining wall

Impact

Due to the requirement to cut into the existing batter a retaining wall is required in this location. In some points it can be up to 5m. This would have an impact due to its visibility on road users however visual access to the wall would be minimal due to the limited extent of the proposed wall. Refer to Table 3 Landscape character impact matrix below.

Sensitivity	Low - Moderate
Magnitude	Moderate - High
Impact	Moderate

Table 3: Landscape character impact matrix

4.2 Section 2 – Low lying topography

This section has been identified due to the low lying topography adjacent to the road which results in the requirement of a fill retaining wall. Refer to Table 4 for landscape character attributes:

Landscape Attribute	Character	Description
Geology		The soil is Hawks Nest (hn) described as being deep Podzols and Siliceous Sands/Podzols on deep poorly drained Humus Podzols on sandsheets. Fine-medium grained sand is present throughout the site (L.E Matthei,1995).
Topography		Existing slope down on the northern side of the road
Hydrology		Depression adjacent to the road which appears to collect water. There are no existing drainage structures or natural drainage lines within the proposal extents. All surface flows infiltrate the subgrade through the permeable ground materials and then is conveyed through the site through the sandy subgrade. It is not proposed to provide any drainage structures.
Land use		Worimi National Park lies immediately south of the road corridor. An easement trail lies to the south and a trail approximately 40m to the north.
Indigenous / European heritage		An Aboriginal cultural heritage working paper working paper is being prepared by others. The findings from this assessment will be summarised within the REF.
Spatial qualities		Generally enclosed by vegetation to both sides of the road. Mid distance views along the road corridor in an easterly direction. Views to the west along road corridor somewhat reduced due to sweeping corner.
Vegetation		Dense vegetation exists on both sides of the road. Refer to Figure 5. Predominantly uncleared woodland and tall open forest. Common species include <i>Angophora costata</i> , <i>Eucalyptus pilularis</i> , <i>Eucalyptus gummifera</i> , <i>Banksia serrata</i> . <i>Acacia longifolia</i> is a common understorey species. <i>Melaleuca quinquenervia</i> , <i>Eucalyptus robusta</i> , <i>Casurina glauca</i> and <i>Ghania</i> spp swamp forest of the Central Coast and Lower North Coast, is habitat for Green-thighed Frog (listed as endangered under <i>Biodiversity Conservation Act 2016</i>) is within the road corridor and would be impacted by main construction works.
Built form		None visible
Road Environment		Located on a crest in the road.

Table 4: Section 2 – Landscape Character Attributes



Figure 5: Section 2 - Typical Roadside Vegetation

4.2.1 Proposal – Fill retaining wall

- Road widening
- Fill retaining walls on the northern side. Refer to Figure 6 below.
- Vehicle barriers
- Vegetation clearing to accommodate clear zone requirements.
- Fauna fence.
- Access track behind fauna fence.
- Urban design – As this wall would not be visible from the road urban design will not be prioritised.

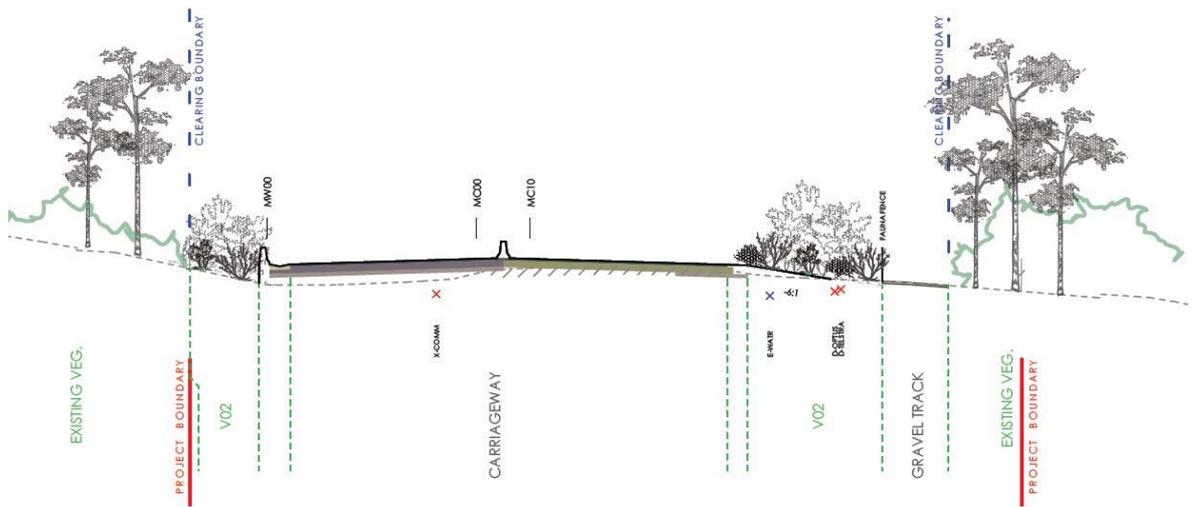


Figure 6: Section 2 typical section

Source: Terras, Typical section

4.2.2 Landscape character assessment

Sensitivity

Low to moderate given the existing vegetation located outside the proposal boundaries.

Magnitude

Low to moderate as the main impact would be the inclusion of a low vehicle barrier.

Impact

Due to the road widening and requirement to build a fill retaining wall, a concrete vehicle barrier would also be required on top of the wall for road user safety. While the vehicle barrier would be seen, the retaining wall will not be visible by road users. In addition this wall would rarely be seen on the lower side of the wall due to the existing land use. Refer to Table 5 Landscape character impact matrix below.

Sensitivity	Low - Moderate
Magnitude	Low - Moderate
Impact	Low

Table 5: Landscape character impact matrix

4.3 Section 3 – Mild topography

This section has been identified due to level changes in the topography being relatively minor and as such, does not require retaining. Refer to Table 6 for landscape character attributes:

Landscape Attribute	Character	Description
Geology		The soil is Hawks Nest (hn) described as being deep Podzols and Siliceous Sands/Podzols on deep poorly drained Humus Podzols on sand-sheets. Fine-medium grained sand is present throughout the site (L.E. Matthei).
Topography		Slightly undulating on either side of the road
Hydrology		There are no existing drainage structures within the proposal extents. All surface flows infiltrate the subgrade through the permeable ground materials and then is conveyed through the site through the sandy subgrade. It is not proposed to provide any drainage structures.
Land use		Worimi National Park lies immediately south of the road corridor. An easement trail lies to the south and a trail approximately 40m to the north.
Indigenous / European heritage		An Aboriginal cultural heritage working paper working paper is being prepared by others. The findings from this assessment will be summarised within the REF.
Spatial qualities		Generally enclosed by vegetation to both sides of the road with views restricted along the road corridor.
Vegetation		Dense vegetation on both sides of the road. Refer to Figure 7. Predominantly uncleared woodland and tall open forest. Common species include <i>Angophora costata</i> , <i>Eucalyptus pilularis</i> , <i>Eucalyptus gummifera</i> , <i>Banksia serrata</i> . <i>Acacia longifolia</i> is a common understorey species. <i>Melaleuca quinquenervia</i> , <i>Eucalyptus robusta</i> , <i>Casurina glauca</i> and <i>Ghania</i> spp swamp forest of the Central Coast and Lower North Coast, is habitat for Green-thighed Frog (listed as endangered under <i>Biodiversity Conservation Act 2016</i>) is within the road corridor and would be impacted by main construction works.
Built form		None visible.
Road Environment		Generally flat two lane road separating east bound.

Table 6: Section 3 – Landscape Character Attributes



Figure 7: Section 3 - Typical Roadside Vegetation

4.3.1 Proposal – Landscape batters / landscape mounds

- Batters on the northern side of the road to accommodate small changes in elevation.
- Vegetation clearing to accommodate clear zone requirements.
- Landscape mounds will be created to lose fill from the road work. Refer to Figure 8 below.
- Fauna fence.
- Access track behind fauna fence.
- Urban design – Due to the requirements of batters to accommodate level changes clearing would be required on either side of the road. In order to minimise the impact of this batters will be revegetated outside of clear zones.

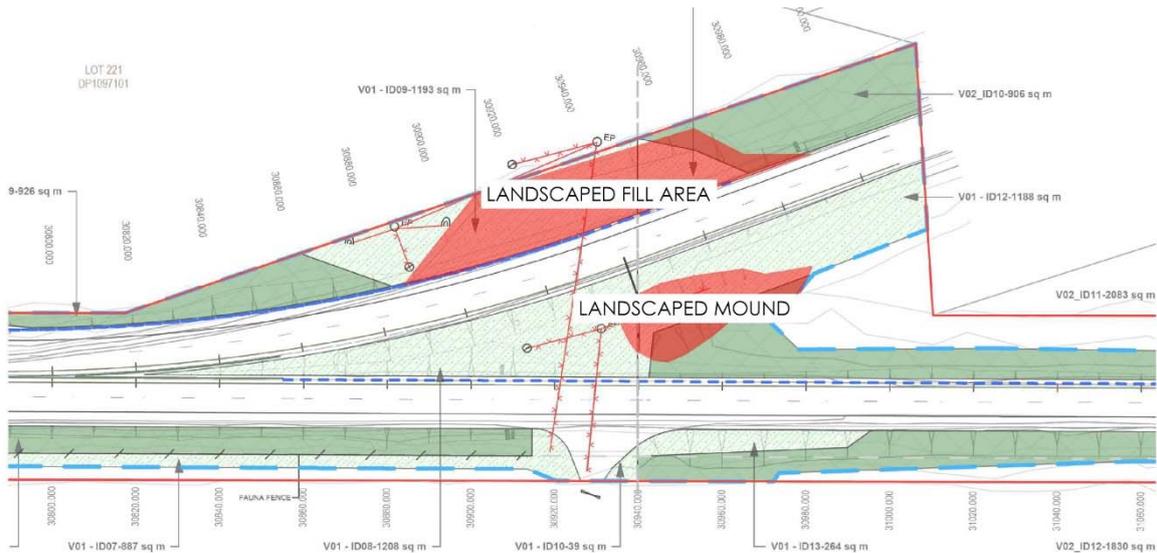


Figure 8: Landscape mounds

4.3.2 Landscape character assessment

Sensitivity

Low to moderate given the existing vegetation located outside the proposal boundaries

Magnitude

Low as there are no built structures proposed in this zone

Impact

Due minimal changes in road levels no built structures are required and any batters formed to accommodate the level change would be revegetated with species suitable to the local environment. Refer to Table 7 Landscape character impact matrix below.

Sensitivity	Low - Moderate
Magnitude	Low
Impact	Low

Table 7: Landscape character impact matrix

5. VISUAL IMPACT ASSESSMENT

5.1 Viewpoint Analysis

This section of the VIA considers the viewpoints from a number of locations within and in close proximity to the site where the proposed works can be viewed. This is done by conducting inspections and determining how the development would appear from these locations. The purpose of this investigation is to establish the likely impact that the proposal may have on the local visual environment.

Where accessible, areas within the study locality were visited to gain an appreciation of views and sight lines back to the subject site. This VIA assesses the existing visual amenity of the site and resultant visual impact of the proposed development.

Visual impact assessment is concerned with changes to the physical landscape in terms of features/elements that may give rise to changes in character. Visual appraisal is concerned with the changes that arise in the composition of available views as a result of changes to the landscape, people's responses to the changes and to the overall effects on visual amenity. Changes may result in adverse (negative) or beneficial (positive) effects.

The nature of landscape and visual assessment requires both objective analysis and subjective professional judgement. Accordingly, the following assessment is based on the best practice guidance listed above, information and data analysis techniques, uses subjective professional judgement.

A number of potential viewpoints were assessed for inclusion in this report, refer to Figure 9 below. Due to local topography, existing vegetation, existing road alignment and the proposed works such as retaining walls, clearing works and landscape mounds. The proposal would only have visual effect upon those areas within or immediately adjacent to the site, and generally only experienced by road users for a very short period of time as they pass through the site.



Figure 9: Attempted viewpoints

Source: SMEC, General Arrangement Plan

5.2 Viewpoint 1

This viewpoint has been taken from the western extents of the site. It looks east towards the retaining wall locations, which would be visible by road users as they pass between this photo location until they pass the walls themselves.

Additional works visible from this location include vegetation clearing for the road widening and clear zones as well as the median barrier. The fauna fence and the access track will also be visible until the new planting works establish. Refer to Figure 10 below.



Figure 10: Viewpoint 1

5.2.1 Visual impact assessment

Sensitivity

Low to moderate. The time in which the retaining wall would be seen by road users limits the sensitivity on this occasion due to the short period of exposure as traffic moves past.

Magnitude

Moderate to high due to the size of the retaining wall

Impact

Moderate - Due to the requirement to cut into the existing batter a retaining wall will be required in this location. In some points the retaining wall is up to 5m in height, however usual access to the wall would be minimal due to the limited extent and short exposure of the proposed wall. The impact on westward traffic again be reduced due to traffic moving in the opposite direction. In addition to this vegetation will be required to be cleared to accommodate clear zone requirements batters and safety and median barriers. Given the existing vegetation located outside the proposal boundaries would still provide a vegetative screen after the required clearing is completed. Refer to Table 8 Visual impact matrix.

Sensitivity	Low - Moderate
Magnitude	Moderate - High
Impact	Moderate

Table 8: Viewpoint 1 - Visual impact matrix

5.3 Viewpoint 2

This viewpoint has been taken from the point where the carriageways splits. It looks west towards the retaining wall locations, however due to the existing vegetation and crest in the road the retaining walls would not be visible. There are areas either side of the road that would require clearing.

Works in this location would be limited to vegetation clearing for the road widening and clear zones as well as the median barrier. The fauna fence and the access track will also be visible until the new planting works establish. Refer to Figure 11 below.



Figure 11: Viewpoint 2

5.3.1 Visual impact assessment

Sensitivity

Low – moderate given the minimal construction outside of the road widening and existing vegetation located outside the proposal boundaries

Magnitude

Low as there are no built structures proposed in this zone, other than median barriers, batters will be revegetated and existing established vegetation beyond the extent of works would remain.

Impact

Low - Due to the extent of existing vegetation and the fact that no built structures are required, batters formed to accommodate the level change would be revegetated with species suitable to the local environment. This in conjunction with the presence of established vegetation, would ensure the impact is minimal. Refer to Table 9 Visual impact matrix.

Sensitivity	Low
Magnitude	Low - Moderate
Impact	Low

Table 9: Viewpoint 2 - Visual impact matrix

5.4 Viewpoint 3

This viewpoint has been taken from western end of the site. It looks south east towards the site, however due to the existing vegetation and curve in the road the retaining walls would not be visible. There are areas on the southern side of the road that will require clearing.

Works in this location would be limited to vegetation clearing for the road widening and clear zones. Refer to Figure 12 below.



Figure 12: Viewpoint 3

5.4.1 Visual impact assessment

Sensitivity

Moderate - high given the areas to be cleared are located outside of existing residences.

Magnitude

Low as there are no built structures proposed in this zone, batters will be revegetated and existing established vegetation beyond the extent of works would remain.

Impact

Moderate - Due to the location of existing residences and the requirement for batters to be formed to accommodate the level change. This area will be revegetated with species suitable to the local environment in order to assist in minimising impact. Refer to Table 10 Visual impact matrix.

Sensitivity	Low
Magnitude	Low - Moderate
Impact	Low

Table 10: Viewpoint 3 - Visual impact matrix

5.5 Viewpoint 4

This viewpoint has been taken from eastern end of the site. It looks south west towards the site, however due to the crest in the road the retaining walls would not be visible. There are areas on the either side of the road that will require clearing.

Works in this location would be limited to a landscape mound located where the road splits, vegetation clearing for the road widening / clear zones and the fauna fence and the access track until the new planting works establish. Refer to Figure 13 below.

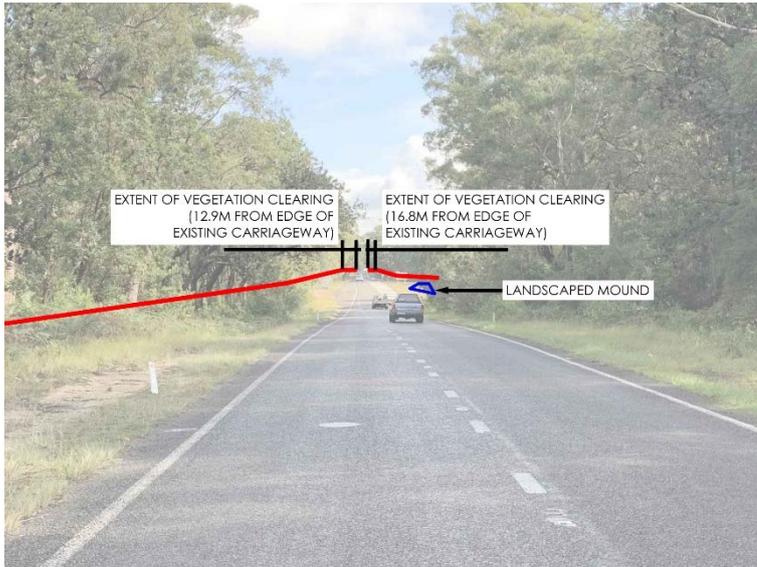


Figure 13: Viewpoint 4

5.5.1 Visual impact assessment

Sensitivity

Low – moderate given the minimal construction outside of the road widening and existing vegetation located outside the proposal boundaries. The landscape mound will be located in an existing cleared area and

Magnitude

Low as there are no built structures proposed in this zone, other than median barriers, batters will be revegetated and existing established vegetation beyond the extent of works would remain.

Impact

Due to the extent of existing vegetation and the fact that no built structures are required, batters formed to accommodate the level change and landscape mounds will be revegetated with species suitable to the local environment. This in conjunction with the presence of established vegetation, will ensure the impact is minimal. Refer to Table 11 Visual impact matrix.

Sensitivity	Low - Moderate
Magnitude	Low
Impact	Low

Table 11: Viewpoint 4 - Visual impact matrix

6. IMPACT ASSESSMENT

6.1 Summary

The landscape character and visual impact assessment described below is based on the individual viewpoint analysis in conjunction with the three Landscape Character Zones described in section 4, elevated topography, low lying topography and mild topography. The results of these assessments range from Low to Moderate and are shown in Figure 14 below summarised below with regard to their overall impact.

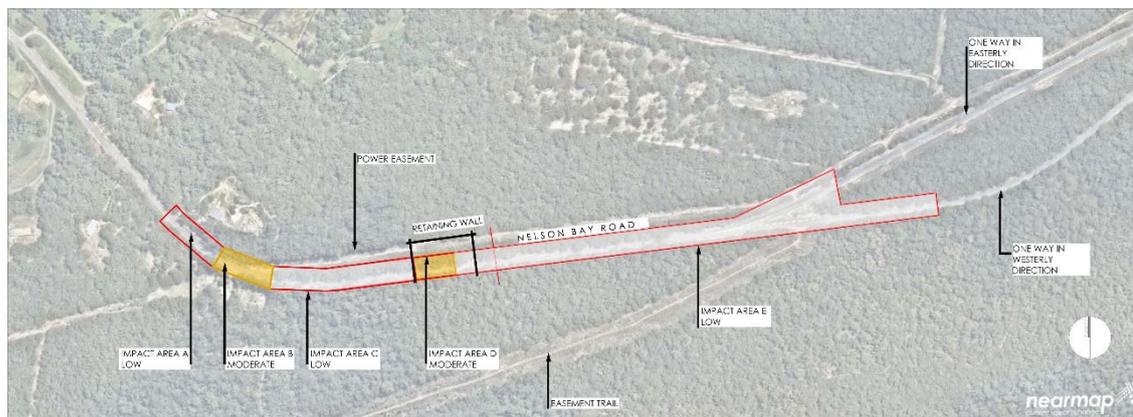


Figure 14: Landscape character impacts summary plan

Source: SMEC, General Arrangement

General

- Landscape impact would be affected by the type of retaining wall required due to the changes in topography of the site, vegetation clearing required for clear zones and the fauna fence / access track. Landscape mounds will also be required to lose fill from the proposed road work.
- Generally the resulting character would still maintain a sense of enclosed vegetation due to the existing dense vegetation on either side of the road. There is an existing cleared electrical easement to the north, however, it is expected that tree clearing would not result in a break in the vegetation.
- Landscape impact ranges from moderate to low.
- Areas of moderate impact are only located along a short stretch of the proposal.
- The extent of the area that the proposal would be visible from is limited to mobile receptors who travel along the new stretch of road.
- Due to the nature of the existing dense vegetation along either side of the road and sweeping bends located at either end of the proposed alignment exposure would be for a relatively short period.

Impact area A – Low

- The main impact would be on the road users travelling along Nelson Bay Road. The impact will be the visual presence of the vehicle barriers and until the new vegetation establishes, batters, fauna fence and access track will be visible.

Impact area B – Moderate

- Some residents will be moderately impacted by the clearing required to accommodate clear zones and level changes.

Impact area C – Low

- The main impact would be on the road users travelling along Nelson Bay Road. The impact will be the visual presence of the vehicle barriers and until the new vegetation establishes, batters, fauna fence and access track will be visible.
- There will be moderate views of the cut retaining wall as motorists' approach.

Impact area D – Moderate

- The main impact would be on the road users travelling along Nelson Bay Road. The impact will be the visual presence of the vehicle barriers and until the revegetation establishes, batters fauna fence and access track will be visible.
- The impact is proposed to be ameliorated by incorporating patterning and oxide mixed in the concrete in order to soften the look of the walls.

Impact area E - Low

- The main impact would be on the road users travelling along Nelson Bay Road. The impact will be the visual presence of the vehicle barriers and until the new vegetation establishes, batters, fauna fence and access track will be visible.
- The location of the landscape mounds are limited to the area where the road splits and will be revegetated to integrate with existing stands of vegetation.

6.1.2 Recommendations

The following recommendations are proposed:

- Revegetation of roadside batters, landscape mounds, in front of the fauna fence and other areas disturbed by proposed works using species suitable to the local environment.
- To improve the urban design of the proposal the implementation of an appropriate treatment to retaining walls to create interest and to be complementary to the landscape character through which the road works is proposed.

6.2.3 Conclusion

Overall the proposal would have a low impact on the site's landscape character and visual amenity.

The proposal is to occur within an established road corridor. All zones and view points have a similar landscape character comprised of vegetated forest aligning the existing road corridor. With the exception of a short stretch impacted by the construction of the cut retaining wall, impact is limited to removal of trees, landscape batters, inclusion of a median barrier and road widening.

Although there is an electrical easement within close proximity to the north of the proposed works, it is anticipated that a vegetation screen would be retained on the adjoining land between the corridor and the electrical easement. Landscape mounds and other batters will be revegetated and will, in time, integrate with the retained vegetation. The greatest impact would be where the retaining wall is proposed within Section Two. The implementation of appropriate treatments to retaining walls will create interest and complement the landscape character through which the road works are proposed. The landscape character and visual impact would be effected, however, it would be reduced with the implementation of the mitigation measures, refer to Section 6.1.2 above.

7. References

- L.E. Matthei *Soil Landscapes of the Newcastle 1:100 000 Sheet*, Report, Department of Land & Water Conservation, Sydney, 1995
- Roads and Maritime Services (RMS) *Guideline For Landscape Character And Visual Impact Assessment*, Environmental Impact Assessment Practice Note EIA-N04, Centre for Urban Design, 2018
- SMEC *Concept Design Report – Nelson Bay Road Section 1*, 2020
- SMEC 100% detailed design drawings for Main Road MR108 – Nelson Bay Road Upgrade Section 1, *General, Pavement, Road Cross sections, Road Alignment and detail, Utilities*, 2020



[Transport.nsw.gov.au](https://transport.nsw.gov.au)



13 22 13



Customer feedback
Transport for NSW
Locked Bag 928,
North Sydney NSW 2059

May 2021
TfNSW 20.432
ISBN: 978-1-922463-49-4