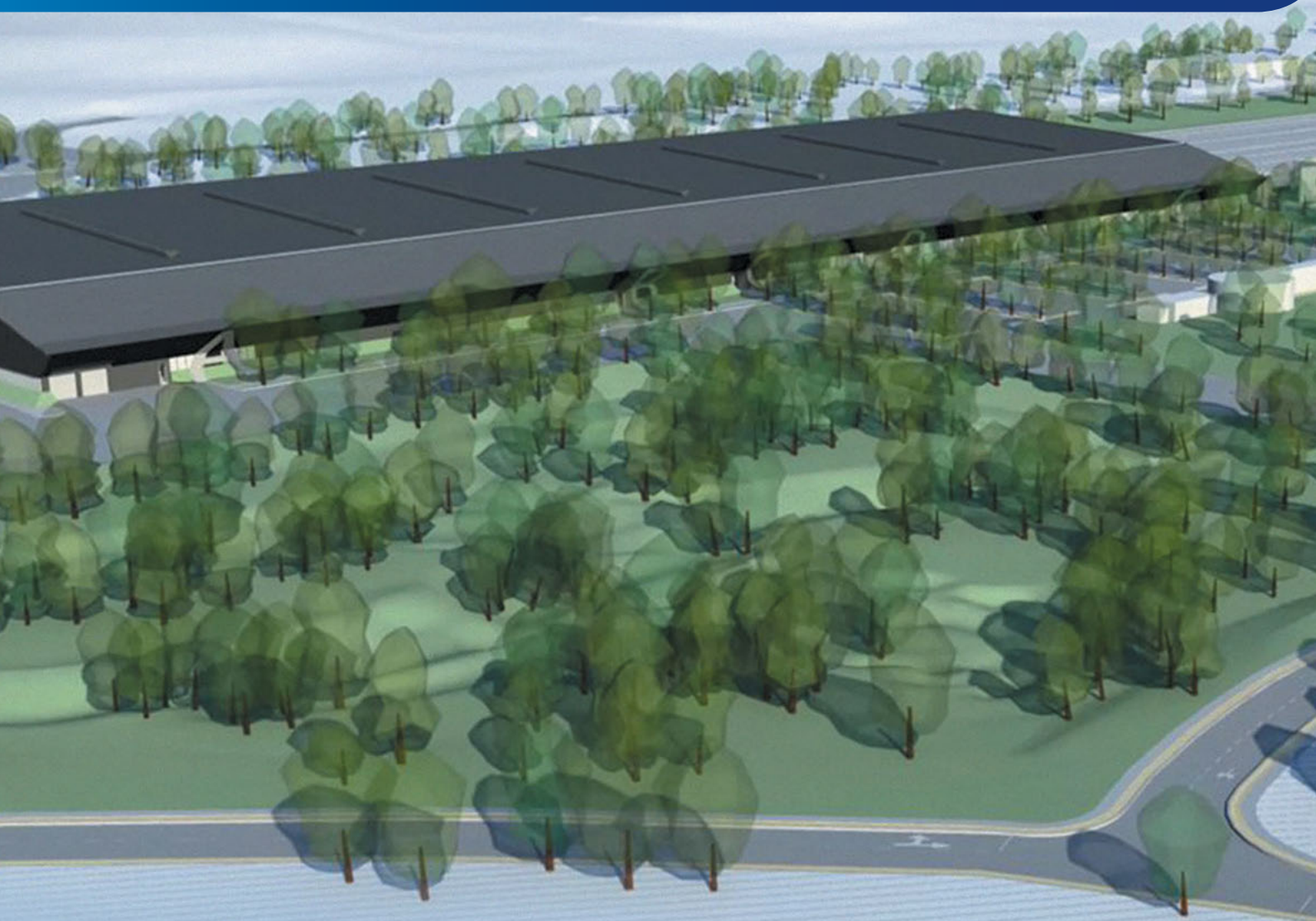


New Intercity Fleet Maintenance Facility

Addendum Review of Environmental Factors –
Alternative Construction Access Routes



*Artist's impression of the New Intercity Fleet Maintenance Facility.
Indicative image only, subject to detailed design*




New Intercity Fleet Maintenance Facility
Addendum Review of Environmental Factors -
Alternative Construction Traffic Access Routes

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ABBREVIATIONS AND GLOSSARY

ACHAR	Aboriginal Cultural Heritage Assessment Report
Addendum REF	This Review of Environmental Factors (REF), which supplements the environmental impact assessment as defined in Condition of Approval number 1 for the approved project
AEP	Annual exceedance probability – the probability of a particular rainfall amount for a specified duration being equalled or exceeded in any one year period expressed as a percentage.
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Ambient noise	The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far.
approved project (the)	Construction and operation of the New Intercity Fleet Maintenance Facility in Kangy Angy (refer to section 1.1). It is as described in the project REF, the project submissions report and the project determination report.
Audible	Audible refers to a sound that can be heard. There are a range of audibility grades, varying from ‘barely audible’ and ‘just audible’ to ‘clearly audible’ and ‘prominent’.
BAM	BioBanking Assessment Methodology
BC Act	<i>Biodiversity Conservation Act 2016</i>
CCTV	closed circuit television
Central Coast Council	Central Coast Council refers to the newly created Council consisting of the former Gosford and Wyong Shire Councils following commencement of the NSW council amalgamations on 12 May 2016. Any reference to the Wyong Shire LGA or Wyong Shire Council within this document should be considered to be a reference to the current Central Coast LGA or Central Coast Council.
Coastal Management SEPP	<i>State Environmental Planning Policy (Coastal Management) 2018</i>
Combined submissions report (the)	<i>The New Intercity Fleet Maintenance Facility Combined Submissions Report</i>
Contaminated Land Act	<i>Contaminated Land Management Act 1997</i>
CTMP	Construction Traffic Management Plan
Down Main	The western most track on the Main North Line, allows movements away from Central Station in a northerly direction heading towards Newcastle
DoEE	(Commonwealth) Department of Environment and Energy
EEC	endangered ecological community
EPA	NSW Environment Protection Authority

EP&A Act	(NSW) <i>Environmental Planning and Assessment 1979</i>
EP&A Regulation	(NSW) <i>Environmental Planning and Regulation 2000</i>
EPBC Act	(Commonwealth) <i>Environment Protection and Biodiversity Conservation 1999</i>
EPL	Environment Protection Licence
ESCP	Erosion and Sediment Control Plan
FM Act	(NSW) <i>Fisheries Management Act 1994</i>
GHG	Greenhouse gas
Heavy vehicle	A motor vehicle that has a loaded mass of more than 4.5 tonnes
Heritage Act	(NSW) <i>Heritage Act 1977</i>
H-Sets	Otherwise known as OSCars (Outer Suburban Cars (a type of train)), H-sets run on the South Coast, Blue Mountains (to Springwood) and Central Coast/Newcastle Lines. These trains were first introduced in 2006.
Infrastructure SEPP	(NSW) <i>State Environmental Planning Policy (Infrastructure) 2007</i>
kV	kilovolt
L _{Aeq}	equivalent continuous sound level
LALC	Local Aboriginal Land Council
LEP	local environmental plan
LGA	local government area
Light vehicle	A motor vehicle that has a loaded mass of less than 4.5 tonnes
LoS	level of service
Mahony's Toadlet	<i>Uperoleia mahonyi sp. nov.</i> Mahony's Toadlet, as described in the <i>New Intercity Fleet Maintenance Facility Project - Additional Species Impact Statement (WSP Parsons Brinckerhoff 2016c)</i> , which was previously described as an undescribed frog species, recorded as Undescribed Red-groined Toadlet (<i>Uperoleia sp</i>) in the <i>New Intercity Fleet Maintenance Facility Project –Species Impact Statement (WSP Parsons Brinckerhoff 2017b)</i>
modified project (the)	Refers to the approved project as modified by the proposed modification associated with the New Intercity Fleet Maintenance Facility
MNES	Matters of National Environmental Significance
Native Vegetation Act	(NSW) <i>Native Vegetation Act 2003</i>
New Intercity Fleet	The New Intercity Fleet is a new fleet of modern trains set to replace the existing intercity fleet and is intended to service the Central Coast and Newcastle, the Blue Mountains Line and the South Coast Line
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NVIA	Noise and Vibration Impact Assessment

NW Act	<i>Noxious Weeds Act 1993</i>
OEH	(NSW) Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
OOH	Out of hours
OSCars	Outer Suburban Cars (refer to H-sets above)
PAD	potential archaeological deposit
PCT	plant community type
PCT 1568	PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest High
POEO Act	(NSW) <i>Protection of the Environment Operations Act 1997</i>
proposed modification (the)	Construction and operation of the temporary construction traffic access routes (refer to Chapter 3)
project determination report (the)	<i>The New Intercity Fleet Maintenance Facility Determination Report (Transport for NSW, 2017a)</i>
Project REF (the)	<i>New Intercity Fleet Maintenance Facility Review of Environmental Factors (WSP / Parsons Brinckerhoff, 2016a)</i>
project submissions report (the)	<i>The New Intercity Fleet Maintenance Facility Combined Submissions Report (WSP / Parsons Brinckerhoff, 2017a)</i>
REF	Review of Environmental Factors
Roads Act	(NSW) <i>Roads Act 1993</i>
Roads and Maritime	<i>Roads and Maritime Services</i>
SHR	State Heritage Register
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TSC Act	(NSW) <i>Threatened Species Conservation 1995</i>
Up Main	The eastern most track on the Main North Line, allows movements to Central Station in a southerly direction heading away from Newcastle
VMP	Vegetation Management Plan
Water Management Act	(NSW) <i>Water Management Act 2000</i>
Wyang LEP	<i>Wyang Local Environmental Plan 2013</i>

EXECUTIVE SUMMARY

Transport for NSW is proposing to modify the approval for the New Intercity Fleet Maintenance Facility (the approved project) to include a temporary alternative access road for use during construction (the proposed modification). A summary of the proposed modification and potential impacts associated with the proposed modification is provided below.

NEED FOR THE PROPOSED MODIFICATION

Access to the approved project is via Enterprise Drive, on the eastern side of the rail corridor associated with the Main North Line. This access arrangement provides limited access for larger construction vehicles due to the current standard of surrounding roads and the low clearance of existing bridges beneath the rail corridor. To provide access to the approved project, the project Review of Environmental Factors (project REF) (WSP | Parsons Brinckerhoff, 2016a) included a new access roadway from Enterprise Drive, and a permanent road bridge crossing the railway line (Main North Line).

In the project REF, it was proposed that access for construction vehicles during the main works for the approved project (project construction traffic) would occur via the new access road, and a road bridge over the Main North Line. The road bridge was proposed to be built first, as part of the enabling works for the approved project.

Transport for NSW has since appointed a construction contractor (John Holland Group) that has undertaken further design and construction planning. As a result, the construction methodology has been refined and the new access roadway, bridge and maintenance facility will be constructed concurrently. This will mean the maintenance facility will be delivered as efficiently as possible and ensure that operations can commence in 2020 to support the introduction of the New Intercity Fleet.

Temporary, alternative construction traffic access routes (the proposed modification) are therefore required to provide access for construction vehicles until construction of the new access road bridge is completed. This is expected to be in mid-2019.

ALTERNATIVES AND OPTIONS CONSIDERED FOR THE PROPOSED MODIFICATION

Three options, including a 'do nothing option' were considered for the proposed modification:

- Option 1 – Do nothing
- Option 2 – Access via Turpentine Road and Ourimbah Road
- Option 3 – Access via Hereford Street, Chittaway Road and down-side service corridor.

An option for a level crossing of the Main North Line was not considered as possession of the rail corridor would be required and train scheduling would pose a constraint to vehicles crossing the corridor due to safety.

The identified options were assessed against the objectives for the proposed modification. Overall, Option 2 was selected as the preferred option for light vehicles and Option 3 was selected as the preferred option for heavy vehicles, as it would allow for temporary access for the type and number of construction vehicles identified for construction of the approved project. These options were also considered to have the least environmental and social impacts, including impacts to road users, as the construction phase would not be extended (as per the 'do nothing' option).

Further detail regarding the alternative and options assessment for the proposed modification is provided in Chapter 2 of this Addendum REF.

DESCRIPTION OF THE PROPOSED MODIFICATION

The proposed modification would include localised upgrade of existing roads surrounding the approved project, including an access road within the rail corridor (existing rail service road), to provide separate temporary access routes for light and heavy vehicles associated with the project construction traffic.

Access for heavy vehicles would occur via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road).

The proposed modification would include the following key elements to enable access for heavy vehicles:

- Widening of Chittaway Road around the existing rail underpass to provide sufficient turning room for longer vehicles, including a turning area on the western side
- Upgrade of the existing rail service access road
- Construction of a temporary heavy vehicle access road connection between the maintenance facility site and the rail service access road.

As discussed in the project REF, access for light vehicles would occur via Turpentine, Ourimbah and Orchard Roads, during the construction of the new access road bridge. As the new access roadway, bridge and maintenance facility will be constructed concurrently, the light vehicle access would be used for both enabling and main works until mid-2019 when the new access bridge for the approved project is anticipated to be completed. No upgrades to the existing roads are required for access. Further consideration of the potential impacts from light vehicles accessing the road has been provided in this addendum REF.

Construction for the proposed modification is anticipated to take six weeks to complete and would be used temporarily until mid-2019 when the new access bridge is anticipated to be completed.

Further details regarding the proposed scope of works associated with the proposed modification are provided in Chapter 3 of this Addendum REF.

STATUTORY CONSIDERATIONS

The approved project was determined by Transport for NSW under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (now Division 5.1) in August 2017. The permissibility of the approved project was determined by virtue of clause 79 of *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP) which outlines that ‘railway infrastructure facilities’ are permissible without the need for development consent. Rail infrastructure facilities are defined in Clause 78 of the Infrastructure SEPP, which includes ‘maintenance, repair and stabling facilities for rolling stock’ (part (g) of the definition of ‘rail infrastructure facilities’).

As the proposed modification is for work associated with the construction of the New Intercity Maintenance Facility and is to be carried out on behalf of Transport for NSW, it can continue to be assessed under Division 5.1 of the EP&A Act. Development consent from Central Coast Council (formerly Wyong Shire Council) is therefore not required.

Additionally, the proposed modification is unlikely to have a significant impact on relevant matters of national environmental significance or on Commonwealth land, and therefore further referral to the Commonwealth Department of the Environment and Energy under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is not required.

Further detail regarding the statutory and other legislative considerations for the proposed modification is provided in Chapter 4 of this Addendum REF.

ENVIRONMENTAL IMPACT ASSESSMENT

The potential impacts of the proposed modification have been considered in accordance with the requirements of the EP&A Act (section 5.5), the EP&A Regulation (clause 228) and the EPBC Act.

The key potential impacts associated with the proposed modification have been identified as comprising:

- Biodiversity – including the loss of 0.1 hectares of native vegetation
- Noise and vibration – including impacts during both construction and use of the proposed modification
- Aboriginal heritage – including the potential to identify currently undiscovered Aboriginal artefacts within the site
- Traffic and transport – which would primarily occur during use of the proposed modification
- Hydrology, flooding and groundwater – including the potential to be impacted by a 1:100-year flooding event.

Chapter 6 of this Addendum REF provides a detailed assessment of the likely effect of the proposed modification including the key impacts listed above.

This Addendum REF has considered the potential impacts associated with the proposed modification and cumulative impacts of the modified project for a range of environmental factors. Provided that the proposed safeguards and mitigation measures are implemented, the overall impacts associated with the proposed modification and the cumulative impacts of the modified project are not likely to significantly affect the environment, and therefore an EIS is not considered to be required.

NEXT STEPS

CONSULTATION DURING REF PUBLIC DISPLAY

This Addendum REF is being placed on public display from Monday 25 June to Monday 16 July 2018, and during this time written submissions are invited from the community. Further information on stakeholder and community consultation is provided in Chapter 5 of this Addendum REF.

The Addendum REF will be available to be viewed at the following locations:

- Central Coast Council, 49 Mann Street Gosford NSW from 8:30 am to 5.00 pm, Monday to Friday
- Central Coast Council, 2 Hely Street Wyong NSW from 8:30 am to 5.00 pm, Monday to Friday
- Tuggerah Library and Council Services, 50 Wyong Road Tuggerah from 9.00 am to 5:30 pm, Monday to Friday and 9.00 am to 3.00 pm Saturday
- Transport for NSW Level 5, Tower A, Zenith Centre 821 Pacific Highway, Chatswood from 8.30 am to 5.00 pm, Monday to Friday.

Written submissions on the Addendum REF are encouraged throughout the public display period. All submissions should be emailed to projects@transport.nsw.gov.au or sent to:

Reference: New Intercity Fleet Maintenance Facility Project – Alternative access
Associate Director, Environmental Impact Assessment
Transport for New South Wales
Locked Bag 6501
St Leonards NSW 2065

At the close of the display period, Transport for NSW will consider the submissions received regarding the proposed modification. A Determination Report for the modified project will be prepared to address and respond to any issues raised. The report, along with the Addendum REF and any other relevant information, will be used by Transport for NSW to assess and determine whether to approve the proposed modification.

Should the New Intercity Fleet Maintenance Facility Alternative Construction Traffic Access Routes be determined to be approved, the local community would be notified of the determination via the project website. Correspondence would also be sent to those who make a submission. This information would include contact details for further information and an indication of the anticipated timing of construction work. Further detail regarding the stakeholder and community consultation which has been undertaken and which is proposed is provided in Chapter 5 of this Addendum REF.

1 INTRODUCTION

Transport for NSW proposes to modify the New Intercity Fleet Maintenance Facility (the approved project) to include alternative construction traffic access routes for temporary use during construction (the proposed modification). The regional location of the proposed modification is shown in Figure 1.1.

This chapter outlines the project background for the proposed modification. This chapter also outlines the purpose and structure of this Addendum REF.

1.1 THE APPROVED PROJECT

In May 2014, the NSW Government announced its intention to invest in the procurement of the New Intercity Fleet, a fleet of trains that will carry Central Coast, Newcastle, the Blue Mountains and South Coast customers to and from Sydney. The introduction of the New Intercity Fleet will allow for the replacement of the older train fleets currently used to provide intercity services, improving the level of customer service, reducing operational costs and increasing capacity for intercity passengers. The primary need for the proposed New Intercity Fleet Maintenance Facility is a direct result of the procurement of the New Intercity Fleet trains and the need to adequately maintain them, as well as to improve current train operations across the Sydney metropolitan network.

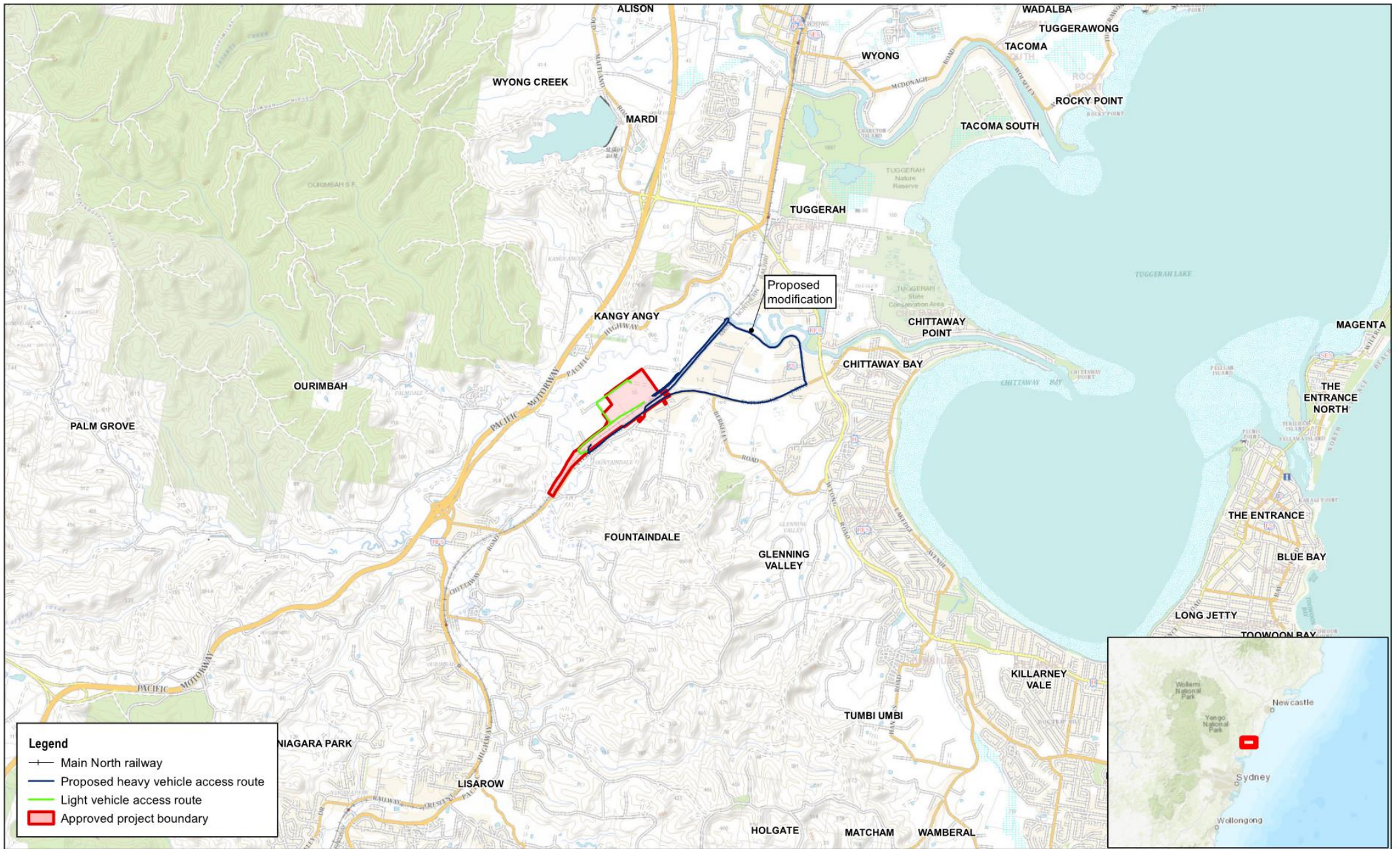
The New Intercity Maintenance Facility project was determined by Transport for NSW in August 2017 and is described in greater detail the *New Intercity Fleet Maintenance Facility Review of Environmental Factors* (WSP | Parsons Brinckerhoff, 2016a) (the 'project REF'), *New Intercity Fleet Maintenance Facility Combined Submissions Report* (WSP | Parsons Brinckerhoff, 2017a) (the 'project submissions report') and *New Intercity Fleet Maintenance Facility Determination Report* (Transport for NSW, 2017a) (the 'project determination report'). The New Intercity Maintenance Facility (as collectively described through these documents) is referred to in this Addendum REF as the 'approved project'.

The key features of the approved project include construction and operation of:

- The fleet maintenance building, and associated infrastructure
- Administration buildings and other facilities
- New railway track infrastructure, including a new rail bridge (consisting of two separate structures) over Chittaway Creek and Turpentine Road
- A new access roadway and bridge to the maintenance facility site off Enterprise Drive
- Relocation of the existing high voltage power transmission line and Combined Services Route.

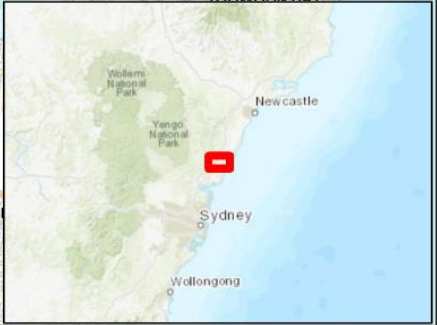
Access for larger construction vehicles was identified in the project REF to occur via the new access roadway and bridge to the maintenance facility site off Enterprise Drive, which was proposed to be constructed during the enabling works. Delays to project commencement and refinement of the construction methodology have resulted in the requirement for the new access roadway, bridge and maintenance facility to be constructed concurrently to allow the introduction of the New Intercity Fleet trains in 2020.

The project REF also detailed access for light vehicles during enabling works for the approved project would be via Turpentine, Ourimbah and Orchard Roads.





Legend

- Main North railway
- Proposed heavy vehicle access route
- Light vehicle access route
- ▭ Approved project boundary



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 Date: 21/06/2018 Approved by: -

 
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Transport for NSW

New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 1.1
 Regional context

1.2 PROPOSED MODIFICATION

The proposed modification includes localised upgrade of existing roads surrounding the approved project, including an access road within the rail corridor (existing rail service road), to provide separate temporary access routes for light and heavy vehicles accessing the site.

Access for light vehicles would be via Turpentine Road and Ourimbah Road, with no upgrades to the existing roads required for access.

Access for heavy vehicles would be via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road).

The proposed modification would include:

- Widening of Chittaway Road around the existing rail underpass to provide sufficient turning room for longer vehicles, including a turning area on the western side
- Upgrade of the existing rail service access road
- Construction of a temporary heavy vehicle access road connection between the maintenance facility site and the rail service access road.

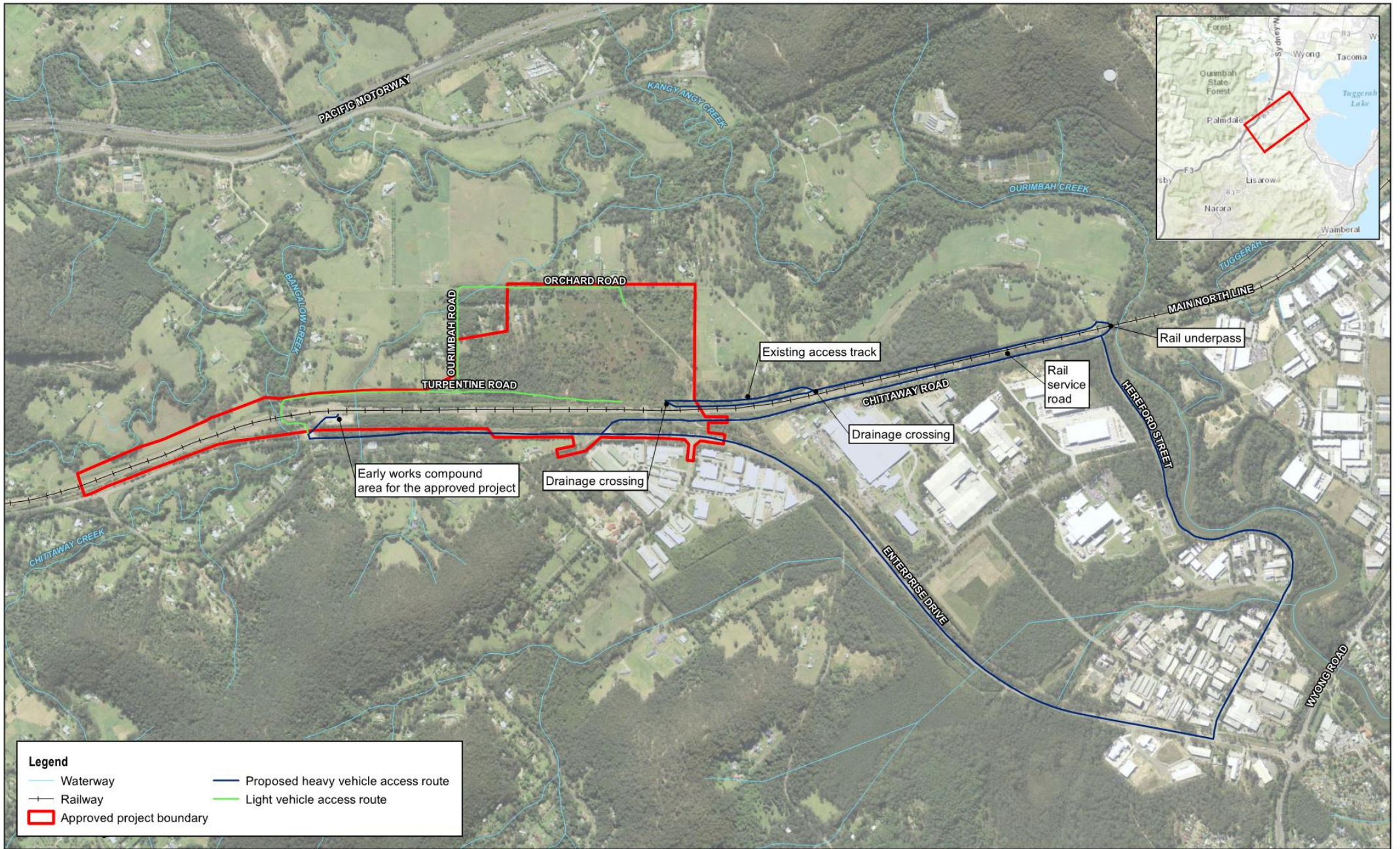
Further detail regarding the proposed scope of works associated with the proposed modification is provided in Chapter 3 of this Addendum REF.

The location of the proposed modification and proposed access routes are shown in Figure 1.2.

1.3 THE MODIFIED PROJECT

The approved project will allow for the maintenance of New Intercity Fleet trains at a dedicated maintenance facility at Kangy Angy. The approved project included the construction and operation of the maintenance facility as well as a road bridge to access the project site. The proposed modification would allow for temporary construction traffic access to the maintenance facility site at Kangy Angy until construction of the road bridge is completed.

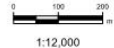
As the proposed modification was not considered in the project REF (WSP | Parsons Brinckerhoff, 2016a) and Combined Submissions Report (WSP | Parsons Brinckerhoff 2017a), further assessment of the proposed modification is required in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act).



Legend

- Waterway
- Proposed heavy vehicle access route
- Light vehicle access route
- Railway
- Approved project boundary

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New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 1.2
 Location of the proposed modification

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1.4 APPROVED PROJECT OBJECTIVES

The original objectives of the approved project were identified in section 1.4 of the project REF being to:

- Cater for future intercity fleet capacity requirements
- Provide more cost effective maintenance operations than current NSW intercity facilities
- Supports commissioning of trains
- Support efficient operation of trains
- Support train condition monitoring and maintenance requirements.

As detailed above, the proposed modification is required to provide temporary construction traffic access to the project site to facilitate construction of the maintenance facility.

The proposed modification will both complement and support the objectives of the approved project as detailed in the project REF. Accordingly, it is considered that the proposed modification is consistent with the objectives of the approved project.

Additional objectives for the proposed modification are provided in section 2.2.

1.5 PURPOSE AND STRUCTURE OF THE ADDENDUM REF

This Addendum REF has been prepared by WSP on behalf of Transport for NSW to assess a proposed modification to the construction methodology associated with the approved project. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the EP&A Act. This Addendum REF should be read in conjunction with the project REF. The purpose of this Addendum REF is to describe the proposed access modification, document and assess the likely impacts of the proposed modification on the environment, and to detail protective measures to be implemented.

1.5.1 STRUCTURE OF THE ADDENDUM REF

The structure and content of the Addendum REF is outlined in Table 1.1.

Table 1.1 Structure and content of the Addendum Review of Environmental Factors

CHAPTER	DESCRIPTION
Chapter 1 – <i>Introduction</i>	Outlines the background of the Project and overview of the proposed modification.
Chapter 2 – <i>Need and options considered</i>	Outlines the overall need for the proposed modification and alternatives considered.
Chapter 3 – <i>Description of the proposed modification</i>	Provides a detailed description of the proposed modification, including the elements of the proposed modification, and proposed construction methodology.
Chapter 4 – <i>Statutory and planning considerations</i>	Outlines the relevant environmental planning instruments and policies and provides an assessment of their relevance to the proposed modification.
Chapter 5 – <i>Stakeholder and community consultation</i>	Outlines how the community and stakeholders have been, and will continue to be, involved as part of the proposed modification development.
Chapter 6 – <i>Environmental impact assessment</i>	Provides an assessment of the potential change in impact from the proposed modification in relation to the approved project. Key issues considered include: biodiversity, noise and vibration, Aboriginal heritage, traffic and transport, non-Aboriginal heritage and hydrology, drainage and flooding.

CHAPTER	DESCRIPTION
Chapter 7 – <i>Environmental management</i>	Outlines the proposed environmental management systems to be implemented and provides the revised management and mitigation measures.
Chapter 8 – <i>Justification and conclusion</i>	Provides the justification for the proposed modification and an outline of the key conclusions of this report.
Chapter 9 – <i>References</i>	Provides a list of key references used in preparing this Addendum REF.

This Addendum REF is supported by five specialist studies which provide detailed assessment of specific environmental issues associated with the amended Project. These specialist studies form appendices to the main Addendum REF and have been used to inform the REF as follows:

- Appendix A – *New Intercity Fleet Maintenance Facility, Temporary Alternative Access - Ecological Constraints Report* (WSP, 2018a)
- Appendix B – *Addendum assessment of additional construction activities and access routes* (WSP, 2018b)
- Appendix C – *New Intercity Fleet Maintenance Facility – Alternative Access - Aboriginal Due Diligence Assessment and Non- Aboriginal Heritage Assessment* (Artefact Heritage, 2018)
- Appendix D – *New Intercity Fleet Maintenance Facility Review of Environmental Factors - Addendum Traffic Impact Assessment* (WSP, 2018c)
- Appendix E – *New Intercity Fleet Maintenance Facility – Addendum Flooding, drainage and water quality technical assessment* (WSP, 2018d).

2 NEED AND OPTIONS CONSIDERED

2.1 NEED FOR THE PROPOSED MODIFICATION

Chapter 2 of the project REF detailed the strategic need for the approved project, the project objectives and the options that were considered for the development of the overall maintenance facility.

Access to the maintenance facility is currently via Enterprise Drive, on the eastern side of the rail corridor, with limited access for larger construction vehicles due to the current standard of surrounding roads and the low clearance of existing bridges beneath the rail corridor. To provide access to the approved project, the project REF identified the proposed construction of a new access roadway from Enterprise Drive, and a permanent road bridge crossing the Main North Line.

In the project REF, it was proposed that access for construction vehicles for the approved project would also occur via the new access road, and associated road bridge, which would be constructed as part of the enabling works. Transport for NSW has since appointed a construction contractor (John Holland Group) that has undertaken further design and construction planning. As a result, the construction methodology has been refined and the new access roadway, bridge and maintenance facility will be constructed concurrently. This will mean the maintenance facility will be delivered as efficiently as possible and ensure that operations can commence in 2020 to support the introduction of the New Intercity Fleet.

Alternative construction traffic access routes are therefore required to provide temporary access for construction vehicles until construction of the new access road bridge is completed, which is expected to occur in mid-2019.

2.2 OBJECTIVES OF THE PROPOSED MODIFICATION

The objectives of the proposed modification are to:

- Provide a temporary access road for construction vehicles associated with the approved project
 - Allow for the peak vehicle movements detailed in the project REF (summarised in section 1.1.1)
 - Minimise potential environmental and social impacts associated with the temporary access road.
-

2.3 ALTERNATIVES AND OPTIONS CONSIDERED

2.3.1 IDENTIFIED OPTIONS

Two options for the proposed modification were identified and compared to the option of ‘do nothing’:

- Option 1 – Do nothing
- Option 2 – Access via Turpentine Road and Ourimbah Road
- Option 3 – Access via Hereford Street, Chittaway Road and down-side service corridor.

A level crossing option was not considered as possession of the rail corridor would be required and train scheduling would pose a constraint to vehicles safely crossing the corridor.

2.3.2 ANALYSIS OF OPTIONS

Identified options were assessed against the project objectives outlined in section 2.2 above. An analysis of each option is provided in the following sections.

2.3.2.1 OPTION 1 – DO NOTHING

Transport for NSW considered a ‘do nothing’ option, which would include delaying the schedule of the approved project until the new access road is constructed. The first train delivery as part of the New Intercity Fleet is anticipated by 2019, and the ‘do nothing’ option would require the use of existing train stabling and maintenance facilities (such as Eveleigh), which are currently used for other fleet types, to maintain the New Intercity Fleet until the new facility is constructed. The first New Intercity Fleet trains will be tested and commissioned at Eveleigh, however due to limited capacity the New Intercity Fleet requires a dedicated maintenance facility. A ‘do nothing’ option would also extend the duration of the construction phase impacts in the vicinity of the facility.

As identified in the project REF, the utilisation of other stabling and maintenance facilities was not feasible due to existing stabling needs, functional constraints, and the extensive works that would be required to adapt existing infrastructure to stable the New Intercity Fleet trains. As such, the ‘do nothing’ option is not feasible and therefore was not considered further as part of the options assessment.

2.3.2.2 OPTION 2 – ACCESS VIA TURPENTINE, OURIMBAH AND ORCHARD ROADS

This option would require vehicles to use the intersection of Turpentine Road and Enterprise Drive and travel beneath an existing rail bridge, via a road underpass on Turpentine Road to Ourimbah and Orchard Roads, prior to accessing the approved project site.

While this option would provide the most direct route to the site, Option 2 would require vehicles to cross the rail corridor via a road underpass, which has a restricted height of approximately 3.3 metres. This would restrict the size of construction vehicles able to access the site at this location due to the road geometry, reducing the ability to transport heavy equipment and machinery to the approved project site, and increasing the number of smaller vehicles accessing the site. This would slow down construction works and extend the duration of the construction phase.

2.3.2.3 OPTION 3 – ACCESS VIA HEREFORD STREET, CHITTAWAY ROAD AND DOWN-SIDE SERVICE CORRIDOR

Option 3 would require vehicles to access the approved project site by travelling along Enterprise Drive to Hereford Street, crossing the rail corridor using a road underpass to Chittaway Road, then travelling along the existing rail service road. Using the existing access track would allow trucks to travel directly from the Chittaway Road underpass to the project site.

This option would require construction vehicles to travel a greater distance to the project area compared to Option 2, however Enterprise Drive and much of Hereford Street and Chittaway Road are suitable for heavy vehicles without any requirement to upgrade these roads. This option would also travel near light industrial and commercial development for the majority of the route, avoiding residential and other sensitive receivers (as would occur for Option 2).

The existing Chittaway Road underpass has a clearance of approximately 4.0 metres, which would be suitable for larger construction vehicles. However, minor works to Hereford Street and Chittaway Road around the existing rail underpass would likely be required to improve access for heavy vehicles.

2.3.3 SUMMARY

Option 2 was selected as the preferred option for light vehicles as it would use existing roadways assessed in the project REF. Option 3 was the only feasible option for heavy vehicles due to height clearance limitations, allowing for temporary access for the type and number of construction vehicles identified for construction of the approved project. These options were also considered to have the least environmental and social impacts (compared to Option 2 alone), including impacts to road users, as the construction phase would not be extended (as per the ‘do nothing’ option).

3 DESCRIPTION OF THE PROPOSED MODIFICATION

3.1 DESCRIPTION OF THE PROPOSED MODIFICATION

3.1.1 OVERVIEW OF KEY COMPONENTS

The key components of the proposed modification include access for project construction vehicles, including separate access for light and heavy vehicles.

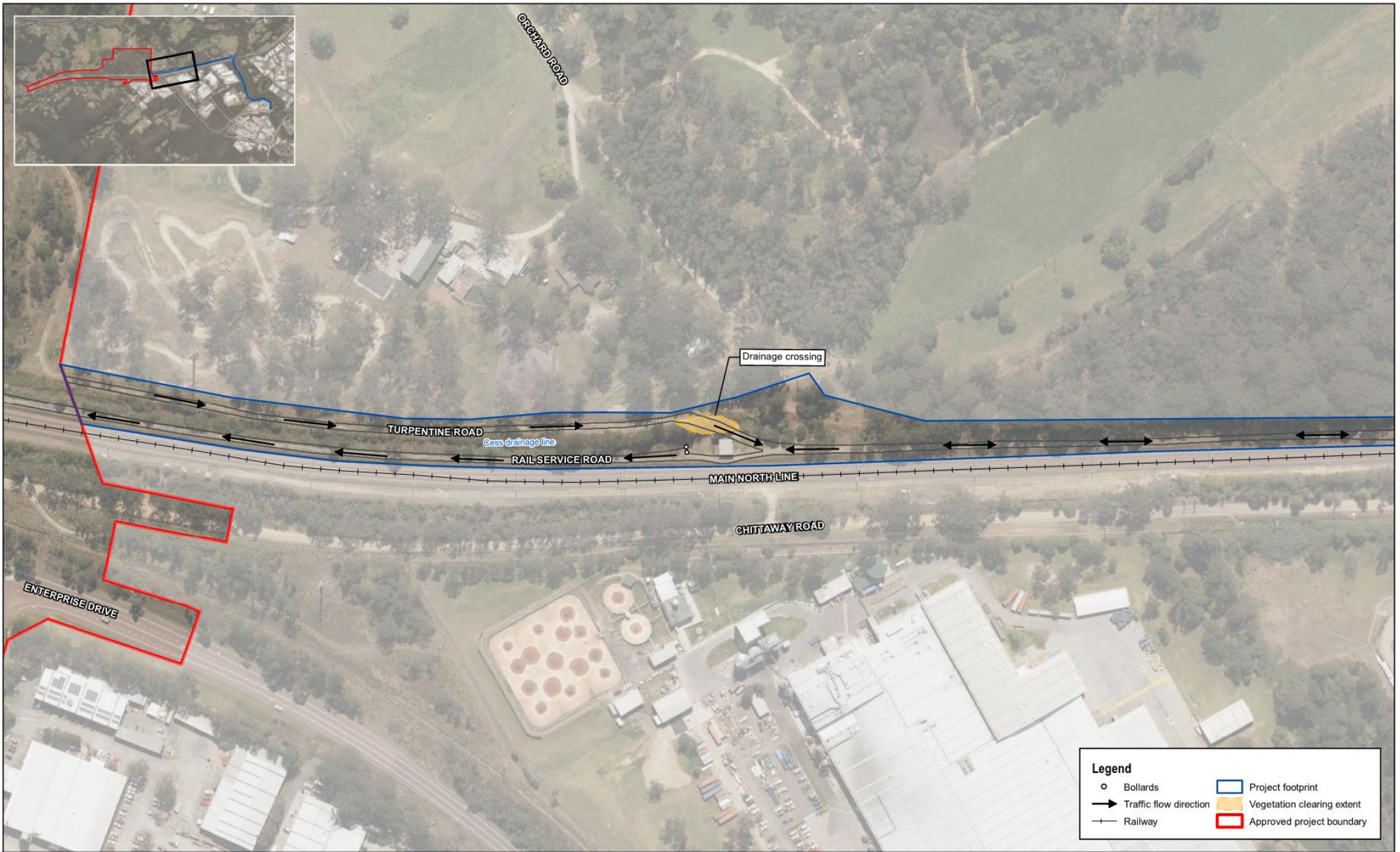
Access for heavy vehicles would be via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor.

Key components of the revised heavy vehicle access route would include:

- Widening of Chittaway Road around the existing rail underpass to provide sufficient turning room for longer vehicles, including a turning area on the western side.
- Modifications to the existing rail service road, including:
 - Regrading of the existing surface to create access ramps into the service road
 - Widening to create a queuing area for up to two heavy vehicles near the entrance to the rail service road
 - Uni-directional road sections for the majority of the rail service road (approximately 1.8 kilometres)
 - Establishing a passing bay that would be approximately 100-metres long, and located 400 metres east of Chittaway Road, to allow passing of vehicles
 - Establishing a crossing of an existing drainage line, near an existing sectioning hut
 - Installation of a suitable barriers/fencing for the length of the upgrade to delineate the access road from the railway (with suitable access provided for Sydney Trains personnel) and protect existing services
 - Use of traffic controllers along Hereford Street and Chittaway Road as required to guide public and construction vehicles
 - Treatment of Chittaway Road and the rail service road for stability and to reduce dust.
- Upgrade of an existing vehicular access track (identified as an extension of Turpentine Road) on the western side of the rail corridor from the approved project, with a drainage line crossing for access to the rail service road.
- Traffic management would be implemented along the alternative construction traffic access route as required.

As discussed in the project REF, access for light vehicles would occur via Turpentine, Ourimbah and Orchard Roads during the construction of the new access road bridge. As the new access roadway, bridge and maintenance facility will be constructed concurrently, the light vehicle access would be used for both enabling and main works until mid-2019 when the new access bridge for the approved project is anticipated to be completed. No upgrades to the existing roads are required for access.

An overview of vehicle access routes is shown in Figure 1.2. Existing roads would be utilised for the majority of the route, with no works proposed. Areas where disturbance is proposed to accommodate upgrades to the existing roads are shown in Figure 3.1 below.



Legend

- Bollards
- ➔ Traffic flow direction
- +— Railway
- ▭ Project footprint
- ▭ Vegetation clearing extent
- ▭ Approved project boundary

Map: 2202522A_GIS_F140_A3	Author: MitchellEm
Date: 14/06/2018	Approved by: -




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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 3.1
 Proposed modification
 Page 1 of 2

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Legend

- Bollards
- ➔ Traffic flow direction
- +— Railway
- ▭ Project footprint
- Vegetation clearing extent
- Vegetation trimming extent

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 Author: MitchellEm
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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 3.2
 Proposed modification
 Page 2 of 2

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3.1.2 HEAVY VEHICLE ACCESS

The proposed heavy vehicle access route is shown in Figure 1.2, and is summarised in the following sections.

3.1.2.1 CHITTAWAY ROAD

Heavy vehicles would use the full length of Chittaway Road to access the approved project site. To prevent traffic conflicts, the current Chittaway Road – Enterprise Drive junction would be permanently closed to the public for the construction of the road access bridge from Enterprise Drive. A new slip road would be constructed to provide access to Chittaway Road (the bridge, new slip road and road closure was assessed as part of the approved project). Signage would be implemented to inform public vehicles that it is a no-through road, and to redirect them.

Heavy vehicles would also access Chittaway Road from Hereford Street for construction of the road bridge.

3.1.2.2 ENTERPRISE DRIVE AND HEREFORD STREET

Heavy vehicles would travel via Enterprise Drive to Hereford Street. Enterprise Drive is suitable for heavy vehicle access, with no upgrades to the existing road required for access. The majority of Hereford Street is also suitable for heavy vehicle access, however some minor use of the road verge is anticipated to be required for passing vehicles. Minor works to widen the road pavement at the intersection of Hereford Street and Chittaway Road would be required to allow sufficient turning room for long vehicles.

3.1.2.3 CHITTAWAY ROAD RAIL UNDERPASS

Chittaway Road passes beneath a rail bridge on the southern side of Ourimbah Creek. The existing geometry of the road is not suitable to allow turning of long vehicles. Widening of Chittaway Road on the eastern and western sides of the existing rail underpass would be required to allow access for project construction vehicles (refer to Figure 3.2).

On the eastern side of the rail underpass, Chittaway Road would be widened within the existing road reserve, including vegetation clearing and trimming of overhanging branches. Minor earthworks would be required to level part of the rail embankment. Figure 3.2 shows the eastern side of the existing rail underpass.



Figure 3.2 Chittaway Road underpass (eastern side, facing south-east)

On the western side of the rail underpass, the existing road would be widened to create a turning circle for long load construction vehicles. The turning circle would be cut into the surrounding topography to meet the existing road grade. The turning circle would be utilised by construction vehicles only under controlled traffic management, with no alteration to public vehicle movements required. Figure 3.3 shows the western side of the existing rail underpass.



Figure 3.3 Existing Chittaway Road underpass (western side)

Traffic control would be established at either end of the turning circle to control the movement of long vehicles.

3.1.2.4 RAIL SERVICE ROAD

The existing rail service road provides access for personnel from Sydney Trains to the rail corridor for maintenance and repairs to the rail line and associated infrastructure, including a sectioning hut near the boundary of the approved project. Access to the rail corridor is via an existing access gate from Chittaway Road on the western side of the rail underpass. Figure 3.4 shows part of the existing rail service road.

Project construction vehicles, including long vehicles, would access the existing rail service road via the access gate from Chittaway Road. Traffic controllers would direct vehicle movements to and from the rail service road to prevent conflict between construction and public vehicles accessing Chittaway Road.

Where required, works to the rail service road would be carried out to increase the stability of the road to support heavy vehicles and reduce dust.

The majority of access along the rail service road would be uni-directional (i.e. only suitable for one vehicle to travel on at a time).

A vehicle queuing area would be constructed adjacent to Chittaway Road within the rail service corridor for project construction vehicles. A bi-directional (i.e. suitable for two passing vehicles to travel on at a time) road section would also be constructed about 400 metres east of Chittaway Road to allow passing of vehicles within the mid-section of the rail service road. The bi-directional road section would be about 100-metres long, and 5.9-metres wide.



Figure 3.4 Existing rail service road (facing south)

A temporary pedestrian gate providing access for rail personnel would be maintained during construction for Sydney Trains use only.

On the eastern side of the rail service road, a barrier would be installed at the boundary of the rail danger zone (around three metres from the outside rail) to segregate project construction vehicles from the live railway. Security fencing with back props would also be installed along the western side of the rail service road to prevent unauthorised access.

3.1.2.5 DRAINAGE CROSSING

The drainage crossing would be required for project construction vehicles to cross the existing drainage line into the rail service road. The drainage crossing would be constructed near the existing sectioning hut.

The drainage crossing would be about 10-metres long and include:

- Geofabric to segregate the existing vegetated batter and regenerate it after removal
- Placement of steel culverts for drainage with imported fill to raise the level between the access track and rail service road
- Overlaying of pavement primer for dust and erosion control
- Installation of security or chain-wire fencing parallel
- A temporary gate south of the sectioning hut to provide safe access for Sydney Trains' personnel to the area, and prevent unauthorised access to the rail corridor.

Figure 3.5 shows the location of the existing sectioning hut and proposed drainage crossing.



Figure 3.5 Location of the drainage crossing (facing north)

3.1.2.6 EXISTING ACCESS TRACK

Project construction vehicles would enter the approved project site via the down-side rail service road, where they would cross the drainage line within the boundary of the approved project (not included in the scope of the proposed modification).

The project construction vehicles would exit the approved project on the western side of the drainage line via an existing access track (identified as an extension to Turpentine Road) which runs parallel to the rail corridor. Vehicles would cross the drainage line via a drainage crossing near the sectioning hut.

Minor upgrade of the track would be required, including resurfacing with roadbase to allow access for heavy vehicles. The construction vehicles would utilise the existing track width, with only minor vegetation trimming required to remove overhanging branches.

Temporary fencing would be installed to prevent unauthorised access. Hoarding would also be installed where practical, to reduce visual impacts to surrounding receivers.



Figure 3.6 Existing access track (facing south-east)

3.1.3 REMOVAL AND REMEDIATION OF TEMPORARY AREAS

The proposed modification would only be temporary, and used until the road bridge (described in the project REF) is constructed to provide permanent access. When it is no longer required, the barriers and drainage crossing would be removed. There would also be remediation of areas to their original state including revegetation and stabilisation to ensure minimal residual environmental impact and provide ongoing benefits for future access.

3.2 CONSTRUCTION ACTIVITIES (ROAD UPGRADES)

3.2.1 WORK METHODOLOGY

The proposed modification would be built under Australian standards and in accordance with temporary works procedures, as managed by the currently appointed contractor for the approved project (project contractor), under the project construction environmental management plan (CEMP).

3.2.2 CONSTRUCTION PROGRAM AND STAGING

Construction of the proposed modification is anticipated to take six weeks to complete, and would indicatively comprise the following stages of work (subject to further consideration):

- Stage 1 – Site establishment, install fencing and clear vegetation
- Stage 3 – Upgrade to the existing rail service road and existing access track to the approved project
- Stage 2 – Install temporary drainage crossing over drainage line near section hut, adjacent to the Main North Line
- Stage 4 – Roadworks to Chittaway Road rail underpass
- Stage 5 – Removal of temporary measures, revegetation and reinstatement to existing conditions
- Stage 6 – Site demobilisation and handback.

3.2.3 CONSTRUCTION WORKFORCE

It is anticipated that up to around 33 people would be onsite (to carry out the works associated with the proposed modification) at any one time, including:

- Site management: Four persons
- Environmental Coordinator: One person
- OHS Coordinator: One person
- Traffic controllers: Four persons
- Protection officers: Four persons
- Civil construction crew: 12 persons
- Haulage/materials: Two to six persons.

3.2.4 CONSTRUCTION DURATION AND WORK HOURS

Construction of the proposed modification would take about six weeks.

The majority of the proposed modification would be constructed during standard hours:

- 7.00 am to 6.00 pm – Monday to Friday
- 8.00 am to 1.00 pm – Saturdays
- No work on Sundays or public holidays, except for works undertaken during rail possessions (refer to section 3.2.5).

Some of the downside service road access works may require rail possessions during out of hours (OOH) periods when trains are not operating. Rail possessions are normally conducted at weekends or holiday periods as scheduled by the rail operator.

Potential work during OOH periods would be undertaken in accordance with the Transport for NSW *Construction Noise Strategy* (Transport for NSW, 2017b). These activities will be assessed with regards to their potential noise and vibration impacts and subsequent mitigation measures implemented.

3.2.5 RAIL POSSESSIONS

The upgrade of the rail service road may require possession of the Main North Line during certain construction activities, such as the installation of protection barriers.

If required, any rail possessions would be undertaken in accordance with the methodology detailed in the project REF.

Once constructed, the use of the alternative access routes (discussed in section 3.3) is not anticipated to require rail possessions.

3.2.6 CONSTRUCTION PLANT AND EQUIPMENT

The indicative plant and equipment required for construction of the proposed modification would include the following:

- Excavator (5–12 tonne)
- Skidsteer/Pozitrack
- Tipper Trucks
- Semi-trailers
- Roller (12 tonne)
- Grader
- Watercart (10 kilolitre)
- Franna Crane (if required for barrier system)
- Cherry Picker
- Powered hand tools i.e. Chainsaws/pruners.

3.2.7 EARTHWORKS

It is not anticipated that substantial earthworks would be required for construction of the proposed modification. The area of earthworks would be limited to the Chittaway Road rail underpass, drainage line crossing and rail service road.

An outline of the estimated cut and fill requirements for the proposed modification, in cubic metres (m³), are provided in Table 3.1.

Table 3.1 Estimated cut and fill requirements

ACTIVITY	APPROXIMATE VOLUME (cubic metres)
Chittaway Road turning area	
Imported fill	200
Cut for turning circle	900
Rail service road	
Imported fill	60
Drainage crossing	
Fill	400

3.2.8 CONSTRUCTION WORKSITE, POTENTIAL COMPOUNDS AND STORAGE

The works would utilise the enabling works compound area for the approved project for management and site coordination.

Any laydown/storage would be located within the approved project site boundary.

No additional areas would be required to be cleared or established for works for the proposed modification.

3.2.9 CONSTRUCTION TRAFFIC AND ACCESS

Traffic movements for construction of the proposed modification would require at peak:

- 20 light vehicles per day
- 10 heavy vehicles per day.

Traffic control would be implemented, in accordance with the traffic management plan, for construction impacting vehicle movements on public roads. This may include temporary traffic control for the Chittaway Road underpass during the works.

Works within the rail corridor would be completed under supervision of a protection officer to Transport for NSW and Sydney Trains requirements (discussed in section 3.2.5).

3.3 USE OF THE ALTERNATIVE CONSTRUCTION TRAFFIC ACCESS ROUTES

The proposed modification would be used temporarily until the new access bridge for the approved project is completed. Traffic management would occur as part of a traffic management plan prepared for the proposed modification and would be coordinated between the project team, traffic controllers and Central Coast Council.

Details of project construction vehicles are discussed in the project REF and summarised in the following section.

3.3.1 PROJECT CONSTRUCTION VEHICLE MOVEMENTS

Project construction vehicle routes are shown in Figure 1.2.

The volume of project construction vehicles are detailed in the project REF and summarised in Table 3.2 below.

Table 3.2 New Intercity Fleet Maintenance Facility construction traffic

STAGE	DAILY (ONE-WAY)		MAXIMUM PER HOUR (ONE-WAY)	
	Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle
Project construction – standard	200	84	300	11
Project construction – during rail possessions	300	84		

Existing posted speed limits would be maintained during operation of the proposed modification as required. Vehicle speeds would be restricted to 10 kilometres per hour within the existing rail service road.

3.3.2 DEMOBILISATION AND HANDBACK

Use of the alternative construction traffic access route would be required until construction of the new access roadway and bridge to the maintenance facility is completed. At this time the temporary infrastructure would be removed and the areas returned to existing conditions as far as practical.

Temporary barriers within the rail service road and existing track would be removed, and existing access arrangements reinstated for rail personnel. The temporary drainage crossing would be removed and vegetation allowed to re-establish.

The turning area adjacent to the Chittaway Road rail underpass would be returned to the landowner.

There would also be remediation of areas to their original state including revegetation and stabilisation to ensure minimal residual environmental impact and provide ongoing benefits for future access.

3.4 PROPERTY ACQUISITION

It is not anticipated that property acquisition would be required to complete the proposed scope of work for the proposed modification.

4 STATUTORY AND PLANNING FRAMEWORK

This chapter outlines the statutory requirements and approvals process for the proposed modification. The environmental planning instruments relevant to the construction and use of the alternative access routes are also outlined.

4.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

4.1.1 STATE ENVIRONMENTAL PLANNING POLICIES

4.1.1.1 STATE ENVIRONMENTAL PLANNING POLICY (INFRASTRUCTURE) 2007

The approved project was determined by Transport for NSW under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (now Division 5.1) in August 2017. The permissibility of the approved project was determined by virtue of clause 79 of *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP) which outlines that ‘railway infrastructure facilities’ are permissible without the need for development consent. Rail infrastructure facilities are defined in Clause 78 of the Infrastructure SEPP, which includes ‘maintenance, repair and stabling facilities for rolling stock’ (part (g) of the definition of ‘rail infrastructure facilities’).

As the proposed modification is for work associated with the construction of the New Intercity Maintenance Facility and is to be carried out on behalf of Transport for NSW, it can continue to be assessed under Division 5.1 of the EP&A Act. Development consent from Central Coast Council (formerly Wyong Shire Council) is therefore not required.

Part 2 of the Infrastructure SEPP also 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 Infrastructure SEPP (where applicable), is discussed in Chapter 5 of this Addendum REF.

4.1.1.2 STATE ENVIRONMENTAL PLANNING POLICY NO.44 — KOALA HABITAT PROTECTION

A discussion on the *State Environmental Planning Policy No 44 (Koala Habitat Protection)* is included in section 5.3.3 of the project REF. No koala habitat or evidence of koala habitation was identified within the study area for the proposed modification (refer to section 6.2).

4.1.1.3 STATE ENVIRONMENTAL PLANNING POLICY NO. 55 — REMEDIATION OF LAND

A discussion on the *State Environmental Planning Policy No. 55 (Remediation of Land)* is included in section 5.3.4 of the project REF. The works associated with the proposed modification are consistent with the assessment presented in the project REF.

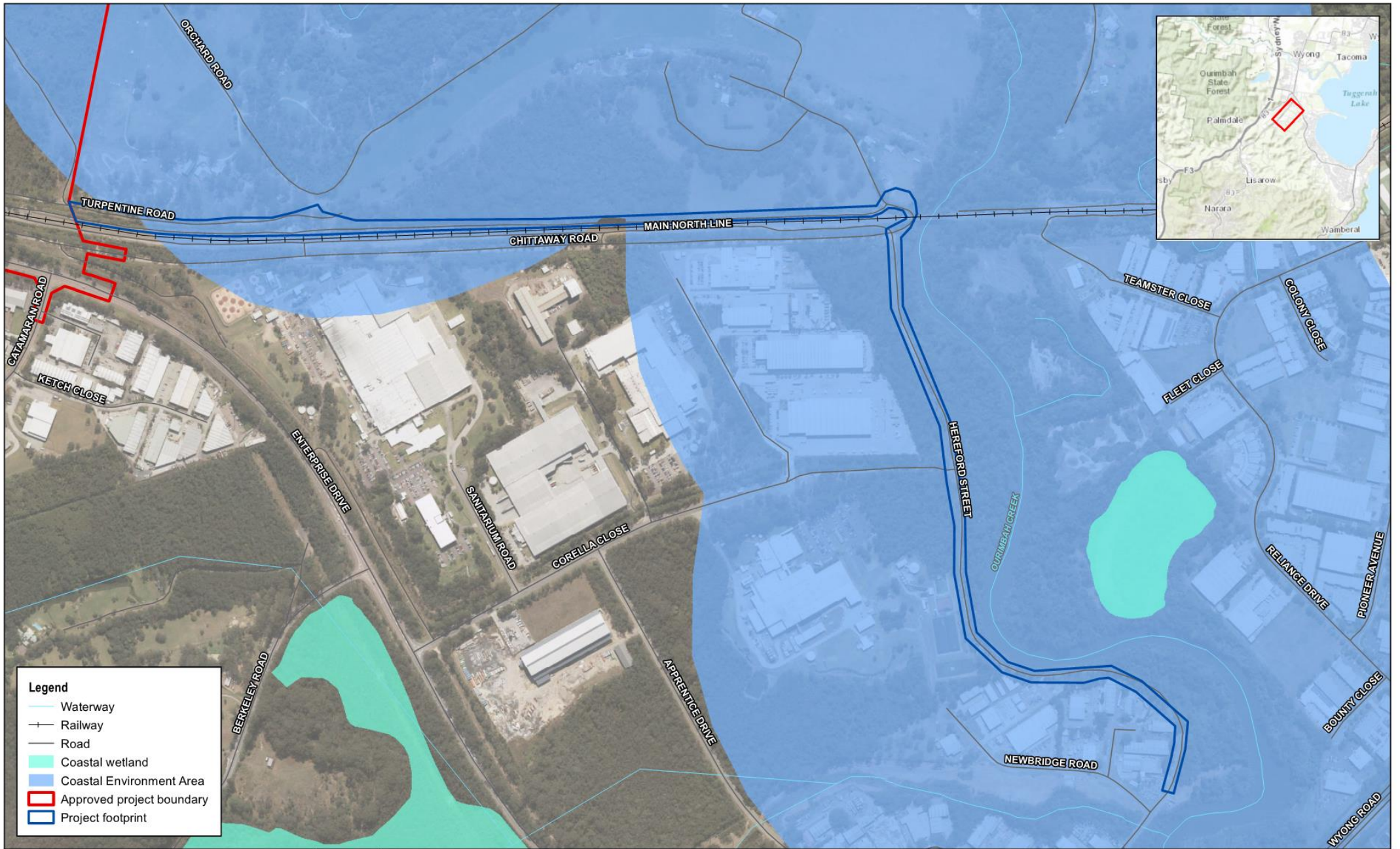
4.1.1.4 STATE ENVIRONMENTAL PLANNING POLICY (COASTAL MANAGEMENT) 2018

The *State Environmental Planning Policy No. 71 (Coastal Protection)* has recently been repealed by *State Environmental Planning Policy (Coastal Management) 2018* (Coastal Management SEPP), which commenced on 3 April 2018. As discussed in section 5.3.5 of the project REF, a part of the site was identified as being partly within the SEPP 71 ‘coastal zone’ (refer to Figure 5.2 of the Project REF) and as such, the Coastal Management SEPP was considered as part of the Project.

The Coastal Management SEPP aims to update and consolidate into one integrated policy, a series of previous SEPPs including *State Environmental Planning Policy 14 (Coastal Wetlands)*, *State Environmental Planning Policy 26 (Littoral Rainforests)* and *State Environmental Planning Policy 71 (Coastal Protection)*. The Coastal Management SEPP gives effect to the objectives of the new *Coastal Management Act 2016* from a land use planning perspective, specifying how development proposals are to be assessed if they fall within the coastal zone.

Similar to the approved project, the proposed modification would be located in an area that is partly identified as being within the 'Coastal Environment Area' (previously referred to as the 'coastal zone') under the new Coastal Management SEPP (refer to Figure 4.1). The Coastal environment area includes areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands.

As the proposed modification is located some distance from the coastal foreshore, the proposed modification is not expected to have a detrimental impact on the amenity, environmental qualities or water quality of the coastal foreshore or coastal waterbodies as identified in the project REF. The proposed modification is therefore considered to be consistent with the discussion regarding coastal management provided in the project REF.



Legend

- Waterway
- + Railway
- Road
- Coastal wetland
- Coastal Environment Area
- Approved project boundary
- Project footprint

Map: 2202522A_GIS_F145_A2 Author: MitchellEm
 Date: 14/06/2018 Approved by: -



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



New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 4.1
 State Environmental Planning Policy (Coastal Management) 2018
 - Coastal Environment Area

Data source: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBasis, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Mapbox India, OpenStreetMap contributors, and the GIS User Community
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4.1.2 LOCAL ENVIRONMENTAL PLANS

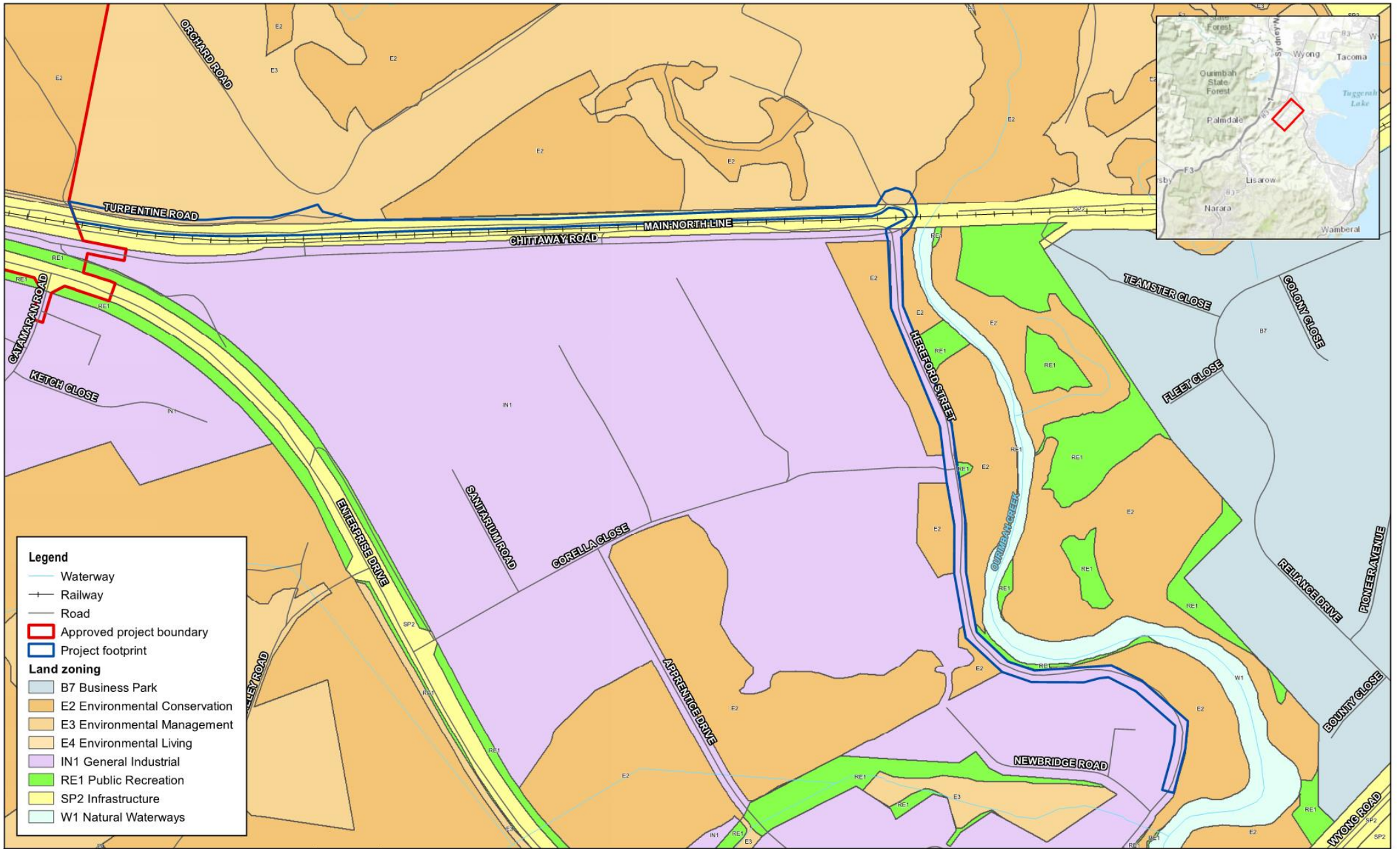
The proposed modification is located within the Central Coast LGA. The provisions of the *Wyang Local Environmental Plan 2013* (Wyang LEP) apply to the Central Coast LGA. As discussed in section 5.3.6 of the project REF, subject to the provisions of the Infrastructure SEPP, the Wyong LEP would not apply to the proposed modification to the extent that it imposes controls which are inconsistent with the Infrastructure SEPP. Notwithstanding, the aims and objectives of the Wyong LEP have been considered. The proposed modification would be located across a range of zones as described in Table 4.1 and shown on Figure 4.2.

Table 4.1 Relevant land use zones and objectives (Wyang LEP)

ZONE	ZONE OBJECTIVES
E2 Environmental Conservation	<ul style="list-style-type: none"> — To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values. — To prevent development that could destroy, damage or otherwise have an adverse effect on those values. — To protect endangered ecological communities, coastal wetlands and littoral rainforests. — To enable development of public works and environmental facilities if such development would not have a detrimental impact on ecological, scientific, cultural or aesthetic values.
E3 Environmental Management	<ul style="list-style-type: none"> — To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values. — To provide for a limited range of development that does not have an adverse effect on those values.
E4 Environmental Living	<ul style="list-style-type: none"> — To provide for low-impact residential development in areas with special ecological, scientific or aesthetic values. — To ensure that residential development does not have an adverse effect on those values. — To allow additional land uses that will not have an adverse impact on those values.
IN1 General Industrial	<ul style="list-style-type: none"> — To provide a wide range of industrial and warehouse land uses. — To encourage employment opportunities. — To minimise any adverse effect of industry on other land uses. — To support and protect industrial land for industrial uses. — To enable other land uses that provide facilities or services to meet the day-to-day needs of workers in the area.
SP2 Infrastructure	<ul style="list-style-type: none"> — To provide for infrastructure and related uses. — To prevent development that is not compatible with or that may detract from the provision of infrastructure. — To recognise existing railway land and to enable future development for railway and associated purposes. — To recognise major roads and to enable future development and expansion of major road networks and associated purposes. — To recognise existing land and to enable future development for utility undertakings and associated purposes.

The proposed modification includes use of existing roads, and a rail service road, and is consistent with the objectives of the zones identified in Table 4.1.

A review of the proposed modification identified that the additional works would similarly impact the same zones as considered in the approved project. The modified project is considered to be consistent with the assessment provided in the project REF with respect to the Wyong LEP.



Legend

- Waterway
- Railway
- Road
- Approved project boundary
- Project footprint

Land zoning

- B7 Business Park
- E2 Environmental Conservation
- E3 Environmental Management
- E4 Environmental Living
- IN1 General Industrial
- RE1 Public Recreation
- SP2 Infrastructure
- W1 Natural Waterways

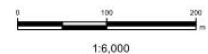
Map: 2202522A_GIS_F141_A2

Author: MitchellEm



Date: 14/06/2018

Approved by: -



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Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3



New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 4.2

Wyong Local Environmental Plan (2013) zones

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4.2 OTHER RELEVANT NSW LEGISLATION

4.2.1 THREATENED SPECIES CONSERVATION ACT 1995 (REPEALED)

The *Threatened Species Conservation Act 1995* (TSC Act) was repealed by the *Biodiversity Conservation Act 2016* (BC Act) on 25 August 2017. However, assessment of the approved project was completed under the TSC Act prior to its repeal, and transitional provisions apply to the proposed modification (discussed further in section 4.2.2 below).

The TSC Act lists threatened species, populations or ecological communities to be considered in deciding whether there are likely significant impacts on threatened biota or their habitats. If a significant impact is likely, an assessment of significance that addresses the requirements of the EP&A Act must be completed.

For this Addendum REF, an assessment of significance in accordance with the TSC Act was undertaken for potential impacts to biodiversity associated with the proposed modification. It was determined that no threatened ecological communities, threatened fauna species or threatened flora species would likely be significantly affected by the proposed modification. Moreover, the loss of 0.1 hectares of native vegetation (PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest High) associated with the proposed modification would not alter the conclusions drawn in the project REF.

Further detail on the potential impacts to threatened species, populations and ecological communities associated with the proposed modification is provided in section 6.2 of this Addendum REF.

4.2.2 BIODIVERSITY CONSERVATION ACT 2016

The BC Act and its supporting regulations commenced on 25 August 2017. The BC Act repeals the TSC Act along with the *Native Vegetation Act 2003* and part of the *National Parks and Wildlife Act 1974*. The BC Act sets out the environmental impact assessment framework for threatened species, threatened ecological communities and areas of outstanding biodiversity value (formerly critical habitat) for activities under Division 5.1 of the EP&A Act (amongst other types of development).

However, the environmental impact assessment of the activity began under Part 5 (now Division 5.1) of the EP&A Act before the commencement of the BC Act. Therefore, the transitional provisions of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* apply to the proposed modification and it has been assessed in accordance with the TSC Act.

Impacts to biodiversity associated with the proposed modification are assessed in section 6.2 of this Addendum REF.

4.2.3 NATIONAL PARKS AND WILDLIFE ACT 1974

As discussed in section 4.2.2 above, the *National Parks and Wildlife Act 1974* (NPW Act) was partially repealed by the BC Act on 25 August 2017. However, the NPW Act remains as the principal legislative instrument which regulates Aboriginal cultural heritage in New South Wales.

Under Section 90(1) of the Act, an Aboriginal heritage impact permit (AHIP) may be issued for an activity which will harm an Aboriginal object. The regulation of AHIPs is provided in Part 6 Division 2 of the Act.

The project REF identified that no registered Aboriginal sites were within or in close proximity to the study area. However, outside of the existing railway corridor, the maintenance facility site was considered to have moderate or high archaeological potential (refer section 7.5 of the project REF). Subsequent to the preparation of the project REF, Aboriginal archaeological test excavations were undertaken, and one Aboriginal site within the approved project site boundary was identified. It was determined that construction of the approved project would have a direct partial impact on the site, and therefore an AHIP application was prepared and lodged with Office of Environment and Heritage in December 2017, which was subsequently approved in February 2018 (refer to section 6.4.2.1).

An Aboriginal Due Diligence Assessment has been completed as part of this Addendum REF (refer to Appendix C) to assess the potential Aboriginal heritage impacts associated with the proposed modification. The proposed modification was identified to contain an area of moderate archaeological potential adjacent to Chittaway Road and the existing rail underpass (refer to section 6.4.2.2 for further detail). Further investigation of Aboriginal heritage in this area would be undertaken to determine if an AHIP is required for the proposed modification (refer to section 6.4.3 for further detail).

4.2.4 NATIVE VEGETATION ACT 2003

The *Native Vegetation Act 2003* (Native Vegetation Act) was repealed by the BC Act on 25 August 2017 (refer to section 4.2.2 below). However, assessment of the approved project was completed under the Native Vegetation Act prior to its repeal, and transitional provisions apply to the proposed modification (discussed further in section 4.2.2 above).

A summary of the Native Vegetation Act was provided in section 5.4.3 of the project REF and remains consistent with the proposed modification.

Clearing of native vegetation was considered for the approved project (refer to section 7.1 of the project REF). The proposed modification would require some additional native vegetation clearance to allow for vehicle access. While an approval to clear this vegetation is not required under Section 25(g) of the Native Vegetation Act, a comprehensive assessment of the extent and potential impact of the clearing associated with the proposed modification has been completed as part of this Addendum REF (refer to section 6.2 and Appendix A).

4.2.5 HERITAGE ACT 1997

A summary of the *Heritage Act 1997* (Heritage Act) was provided in section 5.4.5 of the project REF. The proposed modification is not anticipated to impact on any item protected under the Heritage Act, and is consistent with the assessment presented in the project REF.

4.2.6 FISHERIES MANAGEMENT ACT 1994

A summary of the *Fisheries Management Act 1994* (FM Act) is included in section 5.4.10 of the project REF and remains consistent with the proposed modification.

The proposed modification includes crossing of an existing drainage line adjacent to the rail service corridor. As discussed in section 6.7, this feature is a cess drain for the Main North Line and associated rail service road. The cess drains northwest to Ourimbah Creek. As discussed in section 6.2, the cess drain is not considered as fish habitat, however the crossing would be designed and constructed with consideration to the NSW Department of Primary Industry's fish passage requirements (Fairfull et al. 2003).

4.2.7 CONTAMINATED LAND MANAGEMENT ACT 1997

A summary of the *Contaminated Land Management Act 1997* (Contaminated Land Act) was provided in section 5.4.6 of the project REF.

The works associated with the proposed modification are consistent with the assessment presented in the project REF.

4.2.8 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

A summary of the *Protection of the Environment Operations Act 1997* (POEO Act) was provided in section 5.4.7 of the project REF. The works associated with the proposed modification would not result in a development activity that would require an Environment Protection Licence under the POEO Act and is therefore considered to be consistent with the assessment presented in the project REF.

4.2.9 ROADS ACT 1993

A summary of the *Roads Act 1993* (Roads Act) was provided in section 5.4.8 of the project REF.

The proposed works would require widening of Chittaway Road around the existing rail underpass to accommodate turning of heavy vehicles. Section 138 of the Roads Act requires consent from the relevant roads authority for the erection of a structure, or the carrying out of a work in, on or over a public road, or the digging up or disturbance of the surface of a public road. Clause 5(1) of Schedule 2 of the Roads Act states that a public authority (such as Transport for NSW) is not required to obtain a road authority's consent in accordance with Section 138 of the Act for works in, on or over an unclassified road. However, consent from Roads and Maritime Services is still required for works in, on or over a classified road.

The proposed modification does not include any work to classified roads, including Enterprise Drive, and consent from the relevant road authority (Central Coast Council) with respect to the proposed works to Chittaway Road is not required. Consultation with Central Coast Council has been undertaken as part of the Infrastructure SEPP consultation for the proposed modification with respect to impacts on the identified roads.

4.2.10 WATER MANAGEMENT ACT 2000

A summary of the *Water Management Act 2000* (Water Management Act) was provided in section 5.4.9 of the project REF. The works associated with the proposed modification are consistent with the assessment presented in the project 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 Commonwealth Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land.

The approved project was identified by the Commonwealth Department of the Environment and Energy to be a 'controlled action' under the provisions of the EPBC Act due to the potential for impacts to two species listed under the EPBC Act, being the Critically Endangered Regent Honeyeater and Swift Parrot. As such, approval was obtained from the Federal Minister for the Environment and Energy under the EPBC Act on 15 May 2017, in addition to the project approval under Division 5.1 (formerly Part 5) of the EP&A Act. Following this, a decision was made on 7 November 2017 by the Department of Environment and Energy to vary conditions of approval 1 and 2 from the existing project approval under the EPBC Act.

An assessment of the impacts of the proposed modification impact on matters of national environmental significance and the environment of Commonwealth land concluded that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land (refer to Section 8.4 for further detail). Accordingly, the proposed modification is not considered to trigger a referral under the EPBC Act, and additionally is consistent with the existing EPBC approval (EPBC 2016/7681) issued for the approved project on 15 May 2017.

4.4 CONFIRMATION OF STATUTORY POSITION

All relevant statutory planning instruments have been examined for the revised proposal. It is concluded that the Infrastructure SEPP overrides the development consent requirements, thereby permitting assessment of the revised proposal under Division 5.1 of the EP&A Act.

The proposed modification is unlikely to have a significant impact on relevant matters of national environmental significance or on Commonwealth land, and a further referral to the Commonwealth Department of the Environment and Energy under the EPBC Act is not required.

5 STAKEHOLDER AND COMMUNITY CONSULTATION

5.1 CONSULTATION OBJECTIVES

The community objectives for the Project were outlined in section 6.1 of the Project REF and remain consistent for the proposed modification.

5.2 CONSULTATION UNDERTAKEN TO DATE

Transport for NSW has undertaken a range of consultation with the community, state and local government agencies and key stakeholders throughout the development of the Project. Consultation undertaken to date has included:

- Consultation undertaken prior to project REF display including:
 - Door knocking
 - Meetings with local residents and businesses
 - Establishing a 1800 project information line
 - Updates to the project website
 - Meetings and briefings with a range of stakeholders and Government agencies
 - Regular community notifications delivered via letter box drop and available on the project website
- Consultation during public display of the REF
- Project information newsletters
 - Public displays of the project REF and supporting information
 - Advertisements noting display and community information session times and locations
 - Two community information sessions
 - Ongoing meetings with residents
 - Continued use of the project information line, website and email address
 - Ongoing Government and stakeholder consultation
 - Acceptance of and response to written submissions as part of the combined submissions report.

Further details of these consultation activities have previously been described in the project REF and project submissions report.

5.3 CONSULTATION UNDERTAKEN FOR THE PROPOSED MODIFICATION

5.3.1 CONSULTATION WITH GOVERNMENT AGENCIES

Consultation with government authorities and agencies including Central Coast Council is ongoing throughout the construction of the maintenance facility. The Office of Environment and Heritage would need to be consulted with regard to the area of Aboriginal archaeological sensitivity near the Chittaway Road underpass, discussed further in section 6.4.

5.3.2 ABORIGINAL COMMUNITY INVOLVEMENT

The approved project and project modification are within the boundary of the Darkinjung Local Aboriginal Land Council (LALC). Darkinjung LALC has been consulted during the Aboriginal heritage impact assessment process and participated in test excavations for the approved project. Aboriginal stakeholders would be consulted as part of further investigations for the proposed modification.

Further discussion regarding the potential Aboriginal impacts associated with the modification is provided in section 6.4 of this REF.

5.3.3 INFRASTRUCTURE SEPP CONSULTATION

Part 2, Division 1 of the Infrastructure SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Clauses 13, 14, 15 and 16 of the Infrastructure SEPP require that public authorities consult with councils and other agencies, when proposing to carry out development without consent.

Table 5.1 lists the clauses to be considered, a summary of whether these are relevant to the Project and identification of any requirements for the Infrastructure SEPP consultation.

Table 5.1 Summary of consultation under the Infrastructure SEPP

CLAUSE	RESPONSE
<i>Clause 13</i>	
1(a) Substantial impact on stormwater management services provided by a council.	No formal stormwater system is currently available within the immediate vicinity of the proposed modification, and therefore this would not be impacted by the proposed modification. Formal consultation with Central Coast Council is therefore not considered to be required to be undertaken in accordance with this clause.
1(b) Likely to generate traffic to an extent that would strain the capacity of the road system in a local government area.	The proposed modification would temporarily result in increased traffic beyond the traffic increases identified in the project REF. This impact would have the potential to temporarily impact the existing operation of local roads. However, in the long-term, the proposed is not expected to result in a substantial impact to current and future traffic volumes, therefore not resulting in a strain to the existing capacity of the road system in the LGA. Formal consultation with Central Coast Council is not considered to be required under this clause.
1(c) Involves connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council.	The proposed modification is not anticipated to substantially impact on the capacity of a sewerage system provided by Central Coast Council or the connection into such a system. Formal consultation with Central Coast Council is not considered to be required under this clause.
1(d) Involves connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council.	Water would be required during construction for the management of dust. The source of this water would be determined during the detailed design phase of the proposed modification. Formal consultation with Central Coast Council is not considered to be required for this clause at this stage.

CLAUSE	RESPONSE
1(e) Involves the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential.	<p>The proposed modification would not involve the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic.</p> <p>Formal consultation with Central Coast Council is not considered to be required under this clause.</p>
1(f) Involves excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the <i>Roads Act 1993</i> (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath).	<p>The proposed modification would involve impacts to an existing road managed by Central Coast Council.</p> <p>Formal consultation with Central Coast Council would be undertaken in accordance with this clause.</p>
Clause 14	
Is likely to have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item) or a heritage conservation area.	<p>The proposed modification would not involve any substantial impact to a local heritage item or heritage conservation area.</p> <p>Formal consultation with Central Coast Council is not considered to be required under this clause.</p>
Clause 15	
Development that is to be carried out on flood liable land that may be carried out without consent and that would change flood patterns other than to a minor extent.	<p>The proposed modification would involve development in an area that is considered to constitute flood liable land. However, an assessment of potential flooding impacts from the proposed modification (refer to section 6.7) concluded that with the implementation of safeguards and management measures, the proposed modification would not significantly change flood patterns in the area.</p> <p>Formal consultation with Central Coast Council is not considered to be required for this clause at this stage.</p>
Clause 16	
Clause 16 of the Infrastructure SEPP states that a consent authority must not carry out any of the following development without giving written notice to the specified authority and taken their responses into consideration:	
<i>(a) development adjacent to land reserved under the National Parks and Wildlife Act 1974</i> (Office of Environment and Heritage)	The proposed modification is not located adjacent to land reserved under the <i>National Parks and Wildlife Act 1974</i> .

CLAUSE	RESPONSE
<i>(b) development adjacent to a marine park declared under the Marine Parks Act 1997</i> (Marine Parks Authority)	The proposed modification is not located adjacent to a marine park declared under the <i>Marine Parks Act 1997</i> .
<i>(c) development adjacent to an aquatic reserve declared under the Fisheries Management Act 1994</i> (Office of Environment and Heritage)	The proposed modification is not located adjacent to an aquatic reserve declared under the <i>Fisheries Management Act 1994</i> .
<i>(d) development in the foreshore area within the meaning of the Sydney Harbour Foreshore Authority Act 1998</i> (Sydney Harbour Foreshore Authority)	The proposed modification is not located foreshore area within the meaning of the <i>Sydney Harbour Foreshore Authority Act 1998</i> .
<i>(e) development comprising a fixed or floating structure in or over navigable waters</i> (Maritime Authority of NSW)	The proposed modification is not development that would comprise a fixed or floating structure in or over navigable waters.
<i>(f) development for the purposes of an educational establishment, health services facility, correctional centre or group home, or for residential purposes, in an area that is bush fire prone land (as defined by the Act)</i> (NSW Rural Fire Service)	The proposed modification is not development for the purposes of an educational establishment, health services facility, correctional centre or group home, or for residential purposes, in an area that is bush fire prone land.

5.4 ONGOING AND FUTURE CONSULTATION

5.4.1 CONSULTATION DURING DISPLAY EXHIBITION OF THE PROPOSED MODIFICATION

The Addendum REF is proposed to be on public display from Monday 25 June to Monday 16 July 2018.

Feedback received during the public display period will assist Transport for NSW in assessing the impacts of the alternative construction traffic access routes.

Community consultation is proposed to be undertaken in two forms:

- 1 Targeted consultation with directly affected property owners, involving:
 - Letters sent to property owners located along the proposed site access route providing information about the Addendum REF and an invitation to provide feedback
 - Distribution of an Addendum REF summary which includes additional detail about the proposal, maps and other supplementary information
 - Offers of one-on-one briefings and/or meetings with directly affected property owners.

Letters will also be sent to other key stakeholders such as Central Coast Council and businesses located in the industrial area near the proposed heavy vehicle access route.

- 2 General notification and engagement with the community and stakeholders, involving distribution of the Addendum REF summary to approximately 800 nearby community members and stakeholders.

In addition to the activities above the Addendum REF and other associated materials will be placed on the Transport for NSW website (transport.nsw.gov.au/projects).

Community members and stakeholders will also be able to view the New Intercity Fleet Maintenance Facility Project Addendum REF at:

**Transport for NSW
Level 5, Tower A, Zenith Centre
821 Pacific Highway
Chatswood NSW**

**Central Coast Council
49 Mann Street
Gosford NSW**

**Tuggerah Library and Council Services
50 Wyong Road
Tuggerah NSW**

**Central Coast Council
2 Hely Street
Wyong NSW**

Community feedback can be sent to:

projects@transport.nsw.gov.au

or

*New Intercity Fleet Maintenance Facility Project
Associate Director, Environmental Impact Assessment
Locked Bag 6501
St Leonards NSW 2065*

Information regarding the proposed modification, including ongoing updates, will also be made available through the Transport for NSW website www.transport.nsw.gov.au/Projects.

5.4.2 POST-DETERMINATION CONSULTATION ACTIVITIES

Post-determination consultation activities for the proposed modification would be consistent with the activities identified in section 2.7 of the combined submission report.

6 ENVIRONMENTAL ASSESSMENT

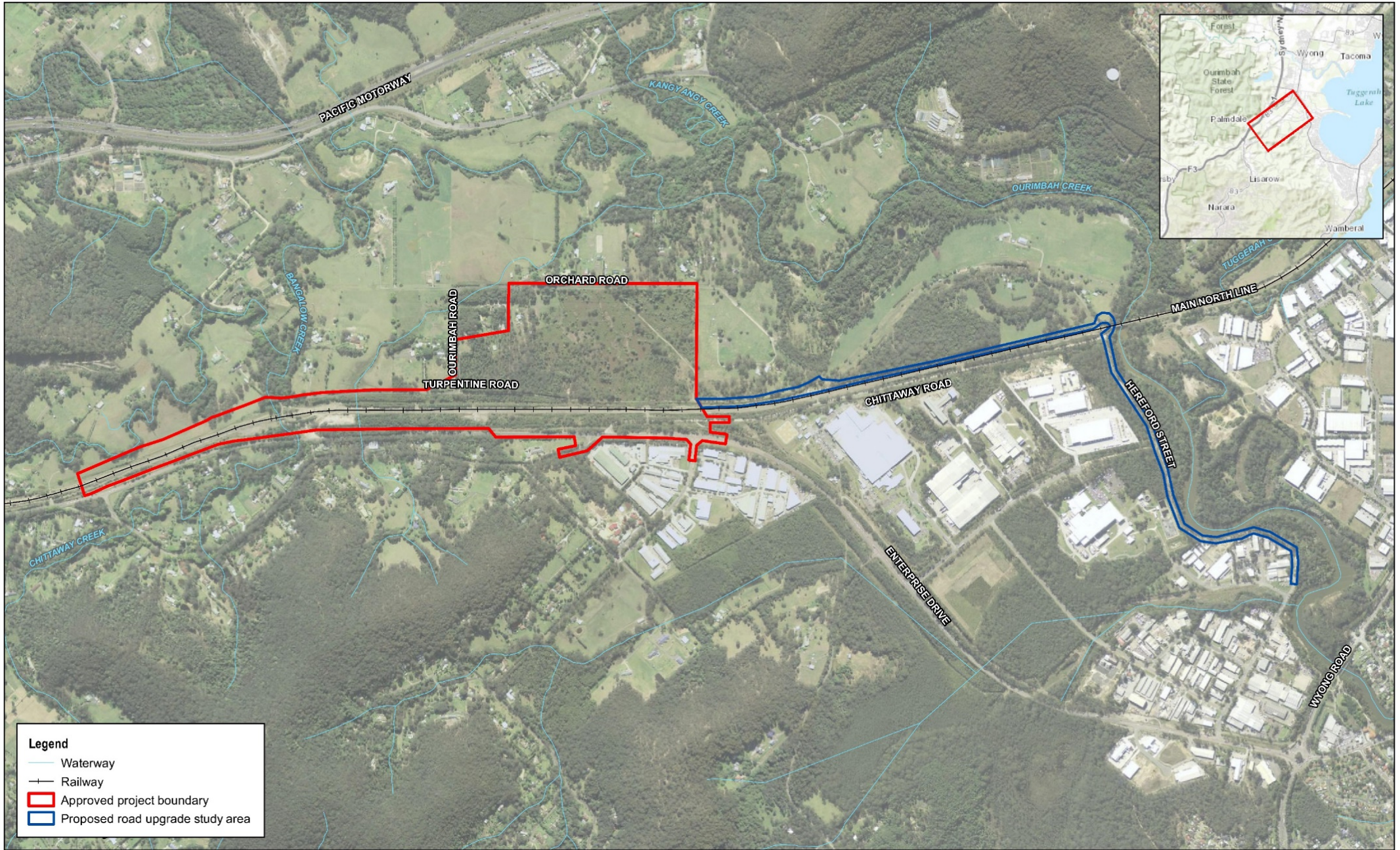
6.1 ASSESSMENT METHODOLOGY

This chapter summarises the key and non-key environmental impacts which have been considered for construction and use of the alternative construction traffic access routes (the proposed modification). The assessment of key environmental impacts is supported by specialist studies, which provide detailed information on background data, assessment methodologies and results.

The environmental impacts of the approved project were assessed in the environmental impact assessment as defined in Condition of Approval 1 for the approved project. The sections below include a summary of the previously assessed impacts and consideration of the potential additional impacts which may occur from the proposed modification. Additional impacts are considered for construction of the proposed modification (road upgrades) and use of the roads for project construction vehicles. An assessment of the cumulative impacts of the modified project is provided in section 6.8.

The proposed modification does not include any changes to project elements for the scope of works defined for the approved project. The proposed modification would be undertaken in accordance with the existing Conditions of Approval for the approved project, where relevant. Accordingly, this chapter only proposes additional mitigation measures in respect of the modified project that are not already in place for the approved project.

The boundary of the approved project and proposed modification is shown in Figure 1.2. The study area for the proposed modification can vary in size depending on the environmental issue being discussed, and the specific area for each issue is described in the relevant specialist studies and corresponding sections below. A study area encompassing areas of potential disturbance was adopted for environmental issues considering direct impacts (biodiversity, heritage and hydrology). This study area is referred to as the proposed road upgrade study area and is shown in Figure 6.1 below. Assessment of the remaining environmental issues considered the entire alternative construction traffic access route, as shown in Figure 1.2.



Legend

- Waterway
- Railway
- Approved project boundary
- Proposed road upgrade study area

Map: 2202522A_GIS_F142_A1 Author: MitchellEm
 Date: 4/06/2018 Approved by: -



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Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3



New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 6.1
 Proposed road upgrade study area

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6.2 BIODIVERSITY

This section summarises the findings of the *Ecological Constraints Report* prepared by WSP in June 2018 for the proposed modification. The report is provided in Appendix A.

6.2.1 METHODOLOGY

The study area for biodiversity included the proposed road upgrade study area shown in Figure 6.1.

6.2.1.1 DATABASE SEARCH AND LITERATURE REVIEW

A desktop review of relevant government databases (refer to section 7.1.2 of the project REF) was undertaken comprising a 10-kilometre radius surrounding the study area.

Previous vegetation mapping, ecological studies and other relevant studies of the study area and locality were also reviewed, including:

- *New Intercity Fleet Maintenance Facility Project – Biodiversity Assessment Report* (WSP | Parsons Brinckerhoff, 2016b)
- *New Intercity Fleet Maintenance Facility Project – Species Impact Statement* (WSP | Parsons Brinckerhoff, 2016c)
- *New Intercity Fleet Maintenance Facility Project – Additional Species Impact Statement* (WSP | Parsons Brinckerhoff, 2017b)

6.2.1.2 FIELD SURVEYS

Field surveys of the study area were undertaken by ecologists from WSP on 26 and 28 March 2018 to validate existing vegetation mapping for the area.

FLORA SURVEY

Flora surveys included:

- Random meander surveys – of the study area, whereby the recorder walks in a random manner throughout the site recording species observed, boundaries between various vegetation communities and condition of vegetation.
- Quantitative (quadrat/transect) – Eight quadrat/transect surveys were completed as outlined in the procedure contained in the BioBanking Assessment Methodology (BAM) (Office of Environment and Heritage 2014).

VEGETATION CONDITION

The vegetation within the study area was firstly assessed to a plant community type (PCT) and then aligned to a vegetation zone, i.e. similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition. The vegetation condition states include high, moderate and low (discussed further in Appendix A).

TARGETED MELALEUCA BICONVEXA SURVEYS

Targeted *Melaleuca biconvexa* surveys were completed in accordance with the *Guide to Surveying Threatened Plants* (Office of Environment & Heritage, 2016), and methodology adopted during surveys completed for the approved project. The methodology utilised for targeted *Melaleuca biconvexa* surveys is discussed further in Appendix A.

FAUNA SURVEYS AND HABITAT ASSESSMENT

Fauna surveys were limited to fauna habitat assessments to determine the likelihood of a threatened species identified in the database searches or previous assessments, occurring within the study area. Fauna habitats were assessed as good, moderate or poor, based on indicators including:

- Structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources (including koala feed trees)

- 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.

Species subject to likelihood of occurrence assessments were those identified during the desktop and field based investigations and any additional species considered having the potential to occur. Likelihood of occurrence includes the categories of recorded (identified within the study area), high, moderate and low. Further detail is provided in Appendix A.

CONSERVATION SIGNIFICANCE ASSESSMENT AND ECOLOGICAL CONSTRAINTS WORKSHOP

A conservation significance assessment was undertaken to identify biodiversity values within the study area and assign each value a conservational ranking (high, moderate or low) based on a set conservational significance categories and principals.

Following this assessment, an ecological constraints workshop was undertaken on 17 April 2018 with the project team and a WSP ecologist to identify and avoid key ecological constraints in the concept design, where practicable.

6.2.2 EXISTING ENVIRONMENT

6.2.2.1 LANDSCAPE

The proposed modification area is partially located within the existing rail corridor which runs in a north-east direction. Within the rail corridor, vegetation has been heavily modified by rail construction, modifications and maintenance activities. Vegetation along both sides of Hereford Street has been modified however, unlike the rail corridor, there were areas which had retained a mature canopy as well as native midstorey and understorey components.

6.2.2.2 VEGETATION COMMUNITIES

Vegetation communities identified within the proposed road upgrade study area are summarised in Table 6.1 the locations of which are shown on Figure 3.1 in Appendix A:

Table 6.1 Vegetation communities identified within the study area

PLANT COMMUNITY TYPE (PCT)	CONDITION	BC ACT STATUS	EPBC ACT STATUS	EXTENT WITHIN STUDY AREA (ha)
PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Low condition	Endangered – Swamp Sclerophyll Forest on Coastal Floodplains	Not listed	0.6
PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	Low condition	Not listed	Not listed	1.3
PCT 1564 Blackbutt – Rough-barked Apple – Turpentine – ferny tall open forest of the Central Coast	Moderate condition	Not listed	Not listed	0.3
PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter	Low condition	Endangered – River-flat Eucalypt Forest	Not listed	0.2
Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation	Poor condition	Not listed	Not listed	3.5

6.2.2.3 FLORA SPECIES

A high diversity of native and exotic plant species was recorded within the study area.

One threatened plant species, *Melaleuca biconvexa* (Biconvex Paperbark) listed as Vulnerable under the BC Act and EPBC Act, was recorded within the study area along the rail corridor and two locations along Hereford Street. The locations of *Melaleuca biconvexa* (Biconvex Paperbark) within the study area are shown on Figure 3.1 in Appendix A.

Six species of plant identified within the study area were listed as priority weeds under the NSW *Biosecurity Act 2015*. Fifteen additional exotic species identified as 'High Threat Weeds' were recorded within the study area. These weed species are outlined in section 3.3.1 of the *Ecological Constraints Report*.

6.2.2.4 FAUNA HABITAT

Fauna habitat identified within the study area includes:

- Forested wetlands – observed to comprise limited habitat features with little to no fallen timber, hollows or leaf litter recorded. This habitat type does however provide foraging habitat for seasonal blossom nomads and sheltering and foraging habitat for other small animals.
- Wet sclerophyll forest – including tree hollows in mature trees, canopy stratum providing seasonal nectar foraging resources for nectarivorous birds, bats and arboreal mammals, and understorey and groundcover habitat including fallen timber, leaf litter and other structural habitats likely to provide habitat for a range of bird, mammal, amphibian and bat species.
- Cleared land and scattered trees – providing limited habitat for habitat for native and introduced fauna species that are adapted to open environments and tolerant of human disturbance.

Potential habitat for Mahony's Toadlet was determined to occur in an area adjacent to the rail service road (refer to Figure 3.1, Appendix A).

6.2.2.5 THREATENED BIODIVERSITY

THREATENED ECOLOGICAL COMMUNITIES

Two endangered ecological communities listed under the BC Act were identified within the study area:

- Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- River-flat Eucalypt Forest on coastal floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

No threatened ecological communities listed under the FM Act or the EPBC Act were recorded from within the study area.

ENDANGERED POPULATIONS

No endangered populations are considered likely to occur within the study area based on the lack of available habitat, known distributions and as they were not recorded during previous or current surveys.

ENDANGERED PLANT SPECIES

One threatened plant species, *Melaleuca biconvexa* (Biconvex Paperbark), was recorded within the study area. It is estimated that about 694 *Melaleuca biconvexa* (Biconvex Paperbark) stems occur within the study area. The majority of stems recorded were within the intermediate age class with few mature individuals observed.

Two other species, *Maundia triglochoides* and *Persicaria elatior* (Tall Knotweed), were not recorded but considered to have a moderate likelihood of occurrence within the study area.

THREATENED ANIMAL SPECIES

No threatened animal species were recorded within the study area.

Species recorded in habitat similar to that occurring within the study area during surveys completed for the approved project (WSP, 2016) included Varied Sittella, Little Lorikeet, Little Bentwing-bat, Eastern Bent-wing Bat, Southern Myotis, Greyheaded Flying-fox, Wallum Froglet and Mahony's Toadlet.

A further 28 species are considered to have a moderate or higher likelihood of occurring within the study area.

MIGRATORY SPECIES

No migratory species were recorded within the study area during the field survey.

Migratory species considered to have a moderate or higher likelihood of occurrence within the study area include *Monarcha melanopsis* (Black-faced Monarch), *Ardea ibis* (Cattle Egret), *Merops ornatus* (Rainbow Bee-eater), *Rhipidura rufifrons* (Rufous Fantail), *Myiagra cyanoleuca* (Satin Flycatcher), *Monarcha trivirgatus* (Spectacled Monarch).

PELAGIC, ESTUARINE OR WETLAND FAUNA

There is no suitable habitat within the study area for threatened species dependent upon pelagic, estuarine and/or wetland species, and as such they have not been considered further.

6.2.3 POTENTIAL IMPACTS

6.2.3.1 SUMMARY OF PREVIOUSLY ASSESSED IMPACTS

Section 7.1 of the project REF (WSP | Parsons Brinckerhoff, 2016a) assessed the potential impacts on threatened flora and fauna of the approved project. The Combined Submissions Report for the approved project (WSP | Parsons Brinckerhoff, 2017a) also included design changes that reduced the overall impact of the project on biodiversity.

A Species Impact Assessment (SIS) (WSP | Parsons Brinckerhoff, 2016c) was prepared under Part 5 of the EP&A Act (now Division 5.1) for the approved project. An additional SIS (WSP | Parsons Brinckerhoff, 2017b) was prepared for the Mahony's Toadlet, which was previously assessed as an undescribed Red-groined Toadlet (*Uperoleia sp*), however was given a provisional listing as an endangered species under the TSC Act in March 2017. The additional SIS also assessed impacts to the Wallum Froglet, which was identified within the study area during subsequent surveys.

The approved project was also referred to the Australian Department of Environment and Energy (DoEE) under the EPBC Act for the potential significant impacts to matters of national environmental significance (MNES). Based on this referral, the DoEE determined that the project would be a 'controlled action' due to potential impacts to two species listed under the EPBC Act, being the Critically Endangered Regent Honeyeater and Swift Parrot. A controlled action assessment was subsequently prepared and placed on public display from 21 October 2016 to 21 November 2016. The project gained EPBC Act approval (EPBC 2016/7681) on the 15 May 2017.

The approved native vegetation removal for the approved project is summarised in Table 6.2.

Table 6.2 Approved native vegetation removal

PLANT COMMUNITY TYPE (PCT)	EXTENT WITHIN STUDY AREA (ha)
PCT 1723 – Melaleuca biconvexa – Swamp Mahogany – Cabbage Palm swamp forest of the Central Coast	22.6
PCT 1528 – Jackwood – Lilly Pilly – Sassafras riparian warm temperate rainforest of the Central Coast	1.2
PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	3.3
Total	27.1

6.2.3.2 ADDITIONAL IMPACTS

CONSTRUCTION

REMOVAL OF NATIVE VEGETATION AND FAUNA HABITAT

The proposed modification has been designed to minimise impacts to biodiversity as far as practical. This included completion of an ecological constraints workshop on 17 April 2018 to avoid key ecological constraints in the concept design. As a result, the proposed modification was designed to avoid direct impact to all threatened ecological communities, *Melaleuca biconvexa* populations and Mahony's Toadlet habitat (based on the known habitat preference for this species). The proposed modification would result in direct impact to an additional 0.1 hectares of PCT 1568 – Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast, which was unable to be avoided through design. Overall, the total area of native vegetation impact required for the approved project and the proposed modification would be increased to 27.2 hectares. The impacted areas of vegetation are shown in Appendix A.

The removal of an additional 0.1 hectares of potential habitat is less than 0.01 per cent that is considered to be currently available within the locality (five-kilometre radius) (see Appendix A). This incremental loss is considered unlikely to significantly affect potential fauna species in the locality.

With the implementation of safeguards and management measures detailed in section 6.2.4, no further impacts to native vegetation and fauna habitat are anticipated.

USE OF THE ALTERNATIVE CONSTRUCTION TRAFFIC ACCESS ROUTES

Other than minor impacts to grassed verges, impacts to vegetation from use of the proposed modification are not anticipated.

There may be the potential for fauna to be injured by moving vehicles. This includes potential Mahony's Toadlet in an area of habitat identified adjacent to the rail service road (refer to Figure 3.1, Appendix A). To prevent potential injury to Mahony's Toadlet, a frog exclusion fence would be installed around the identified potential habitat in addition to the safeguards and management measures identified in section 6.2.4.

With the implementation of safeguards and management measures identified in section 6.2.4, no further impacts to biodiversity are anticipated.

CONSISTENCY IMPACT ASSESSMENT

A consistency assessment of impacts originally assessed as part of the SIS (WSP | Parsons Brinckerhoff, 2016c) and additional SIS (WSP | Parsons Brinckerhoff, 2017b) is included in Appendix A. The removal of an additional 0.1 hectares of native vegetation as a result of the proposed modification is considered to be consistent with impacts assessed as part of the approved project.

It is recommended that the Biodiversity Offset Strategy to include an additional 0.1 hectares of PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest.

6.2.4 ADDITIONAL SAFEGUARDS AND MANAGEMENT MEASURES

Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant. The following additional safeguards and management measures to those identified for the approved project are proposed:

- The project CEMP, Flora and Fauna Management Plan and threatened species management plans (including for Swamp Sclerophyll Forest, Biconvex Paperbark and Mahony's Toadlet) would be updated to include the proposed modification.
- The Biodiversity Offset Strategy for the project would be updated to include an additional 0.1 hectares of PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest High.
- The potential for vehicular impacts to moving frogs would be mitigated by the separation of the proposed alternative access (on the rail service road) from potential Mahony's Toadlet habitat by a frog exclusion fence to prevent potential injury or mortality.

6.3 NOISE AND VIBRATION

This section summarises the findings of the *Noise and Vibration Impact Assessment* (NVIA) prepared by WSP in June 2018 for the proposed modification. The report is provided in Appendix B.

6.3.1 ASSESSMENT CRITERIA

The assessment has been prepared with reference to the following guidelines, policies and standards:

- Industrial Noise Policy (NSW EPA, 2000) (under transitional arrangements)
- Noise Policy for Industry (NSW EPA, 2017)
- Interim Construction Noise Guideline (DECC, 2009)
- Construction Noise Strategy (Transport for NSW, 2013)
- Road Noise Policy (EPA, 2011)
- Assessing Vibration: A Technical Guideline (Vibration Guideline) (DEC, 2006)
- DIN Standard 4150-2 Part 3: Structural Vibration in Buildings: Effects on Structures (DIN, 1999).

A summary of the noise and vibration assessment criteria is provided below, with additional detail provided in Chapter 5 of the *Noise and Vibration Impact Assessment* attached as Appendix B.

6.3.1.1 NOISE

CONSTRUCTION

Noise impacts from construction noise are assessed using the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) and the TfNSW *Construction Noise Strategy* (CNS) (Transport for NSW, 2013). The ICNG defines a noise management level for residential and other sensitive land uses. Above this level, feasible and reasonable mitigation should be considered to reduce noise levels.

Section 7.2.1 of the project REF defines noise management levels (NML) as specified in the ICNG and how they are applied for residential receivers, which are based on the measured rated background level (RBL) as defined in the INP, plus an additional allowance of 10 dB during standard hours and 5 dB outside of standard hours. Where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered ‘highly noise affected’ and require additional considerations to mitigate potential impacts.

Additional background monitoring was completed at one noise monitoring location (BG5) for the proposed modification (refer to section 6.3.2). Table 6.3 provides a summary of the existing and additional applicable NMLs for residential receivers based on the background noise monitoring conducted.

Table 6.3 Construction noise management levels for residential receivers

NOISE MONITORING LOCATION	NML L _{EQ,15MIN}			
	DAY (STANDARD HOURS) ¹	DAY (OUT-OF-HOURS) ²	EVENING (OUT-OF-HOURS) ³	NIGHT (OUT-OF-HOURS) ⁴
Background noise monitoring and NML for the approved project				
BG1	55	50	50	48
BG2	54	49	45	40
BG3	59	54	49	40
BG4	50	45	45	44

NOISE MONITORING LOCATION	NML $L_{EQ,15MIN}$			
	DAY (STANDARD HOURS) ¹	DAY (OUT-OF-HOURS) ²	EVENING (OUT-OF-HOURS) ³	NIGHT (OUT-OF-HOURS) ⁴
Additional background noise monitoring and NML for the proposed modification				
BG5	57	52	53	50

¹ Day (standard hours) - Monday–Friday 7am–6pm, Saturday 8am– 1pm, No work on Sundays or public holidays

² Day (out of hours) – Saturday 1pm – 6pm and Sundays or public holidays

³ Evening: 6pm to 10pm;

⁴ Night: 10pm to 7am Monday to Saturday, 10pm to 8am Sunday.

NMLs that have been adopted for non-residential sensitive receivers as required by the ICNG are consistent with the approved project, and are summarised in Table 6.4.

Table 6.4 Construction noise management levels for residential receivers

LAND USE	NML $L_{EQ,15 MIN}$ DBA (Applies when properties are being used)
Industrial	75 (external)
Commercial	70 (external)
Child care centre ¹	55 (external)
School	55 (external)

¹Based on the maximum recommended internal noise level as specified in *AS 2107 Recommended design sound levels and reverberation times for building interiors*. An external noise level has been specified based on an outside to inside correction of 10 dB, assuming windows are partially open for ventilation.

A summary of common noise sources and their typical noise levels for comparative analysis was provided in section 7.2.1 of the project REF.

OPERATIONAL

Consideration of operational noise impacts for the approved project was included in section 7.2 of the project REF.

The proposed modification includes use of temporary alternative construction traffic access routes for project construction vehicles until the new access roadway and bridge to the maintenance facility is completed, and further consideration of operational noise impacts is not required.

SLEEP DISTURBANCE

As per the project REF, sleep disturbance screening criteria of $RBL+15$ dB and L_{max} 65 dBA have been adopted for the additional receivers.

OFF-SITE ROAD TRAFFIC

The proposed modification includes alternative access for construction vehicles. Heavy vehicles would utilise Enterprise Drive, Hereford Street, Chittaway Road and the rail service road. Light vehicles would utilise Turpentine, Ourimbah and Orchard Roads. As summarised in the project REF, the *Road Noise Policy* (RNP) (EPA, 2011) has been used to assess both the noise from traffic generated by the project and the impact of the new access road. Table 6.5 presents the road traffic noise criteria from the RNP for land use developments with a potential to create additional traffic on an existing road.

Table 6.5 Off-site road traffic noise assessment criteria

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	DAY (7.00 am to 10.00 pm)	NIGHT (10.00 pm to 7.00 am)
Collector/sub-arterial/arterial/freeway	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	L _{eq,15hr} 60 dBA	L _{eq,9hr} 55 dBA
	New road	L _{eq,15hr} 55 dBA	L _{eq,9hr} 50 dBA
Local road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	L _{eq,1hr} 55 dBA	L _{eq,1hr} 50 dBA

VIBRATION

Table 6.6 presents indicative safe working distances from structures for the most significant vibration generating plant. The following list the typical separation distances between the nearest receivers and the project site.

Table 6.6 Indicative vibration levels

ITEM	INDICATIVE SAFE WORKING DISTANCE, COSMETIC DAMAGE (m)	INDICATIVE SAFE WORKING DISTANCE, HUMAN COMFORT (m)
Vibratory roller < 300 kN (typically 7-13 t)	15	100
Excavator	2	N/A

Vibration levels are indicative only and may vary on site and are dependent on individual equipment, mode of operation and ground conditions.

No sensitive receivers were identified within 15 metres of equipment likely to produce significant vibration levels. As a result, cosmetic damage limits are expected to be satisfied for off-site receivers.

6.3.2 EXISTING ENVIRONMENT

6.3.2.1 SENSITIVE RECEIVERS

Sensitive receivers were identified in section 7.2.3 of the project REF.

Additional sensitive receivers identified for the proposed modification which were not included for the approved project include commercial receivers adjacent to the east, rural residences to the west and suburban residential receivers located to the east and north of the proposed modification. Closest to the proposed modification are residential receivers at:

- 17 Chittaway Road, Kangy Angy
- 139 Orchard Road, Kangy Angy.

A full list of sensitive receivers is provided in Appendix B.

6.3.2.2 NOISE MONITORING RESULTS

Noise monitoring completed for the approved project is summarised in section 7.2.3 of the project REF.

Additional short term attended and long term unattended noise measurements were undertaken at one monitoring location (BG5) between 26 March 2018 and 13 April 2018 at 17 Chittaway Road, Kangy Angy.

Table 6.7 summaries the long term unattended noise monitoring results which were received. The data is reported as the average equivalent continuous average sound levels ($L_{eq,15min}$) and RBLs as defined in the NSW *Industrial Noise Policy* (INP) (EPA, 2000).

Table 6.7 Additional unattended and attended noise measurement results (dBA)

ID	ADDRESS	DAY $L_{eq,15min}$	DAY RBL	EVENING $L_{eq,15min}$	EVENING RBL	NIGHT $L_{eq,15min}$	NIGHT RBL
BG5	17 Chittaway Road, Kangy Angy	64	40	64	40	62	39

Short term attended noise monitoring and train pass-by noise measurements were also recorded during the monitoring period. The results for this monitoring are presented in Table 3.3 of Appendix B.

6.3.3 POTENTIAL IMPACTS

6.3.3.1 SUMMARY OF ASSESSED IMPACTS

A *Noise and Vibration Impact Assessment* was undertaken for construction and operation of the approved project (WSP | Parsons Brinckerhoff, 2016d). No change in the operation of the approved project is proposed and no further consideration of operational impacts are included in this Addendum REF. A summary of the assessed impacts for construction of the approved project is provided in the following section.

PROJECT CONSTRUCTION ACTIVITIES

The assessment predicted that noise management levels exceedances would occur, during construction in standard hours, at several residential properties on Orchard Road, Schubolt Lane, Turpentine Road and Old Chittaway Road, other individual residential properties and the child care centre. The noisiest stage of construction was predicted to be the enabling works, during which most residential receivers would be impacted by any out-of-hours construction works. Vibration was unlikely to be a substantial risk for most receivers, however it may be perceptible at the nearest houses to the project during use of sheet piling rigs, vibratory rollers and rock breakers.

Following display of the project REF, the geological conditions and constructability of the bridge were reviewed, which resulted in the choice of driven (impact) piles instead of bored piles as the construction methodology for the road access bridge piers. As a result, an *Additional Impact Piling Construction Assessment* (WSP | Parsons Brinckerhoff, 2016e) was prepared to consider additional noise and vibration impacts from the alternative piling method. This assessment was included in the *Combined Submissions Report* (WSP | Parsons Brinckerhoff, 2017a).

PROJECT CONSTRUCTION TRAFFIC

The *Noise and Vibration Impact Assessment* for the approved project (WSP | Parsons Brinckerhoff, 2016d) considered noise impacts from additional road traffic during construction and operation of the approved project.

Project construction traffic was assessed for up to 600 light vehicles (300 in / out) and 168 (84 in / out) heavy vehicle movements in total from the project accessing construction sites on Enterprise Drive and the new access road during peak construction. For the purposes of the assessment, it was assumed that 75 percent of the estimated daily project construction traffic (84 heavy vehicles) would occur within a worst case one-hour period.

During construction, noise levels of up to 3 dBA above the night criteria may be expected where 75 percent of the construction traffic occurs in one hour before 7.00 am for the new access road.

The project was not predicted to significantly change the road traffic noise levels during standard hours.

6.3.3.2 ADDITIONAL IMPACTS

CONSTRUCTION

NOISE MODELLING METHODOLOGY AND ASSESSMENT SCENARIOS

In order to assess the potential noise impacts associated with the construction of the proposed modification, noise modelling was used to assess the construction scenarios outlined in Table 6.8, with further detail provided in Appendix B.

Table 6.8 Noise modelling scenarios

SCENARIO	ACTIVITY	TIME PERIOD ¹	EQUIPMENT
1	Adjustment to the existing Chittaway Road rail underpass	SH	Excavator, skidsteer (bobcat), tipper truck, semi-trailer, smooth drum roller, grader, watercart, mobile crane, cherry picker, powered hand tools (chainsaws/pruners).
2	Installation of a temporary drainage crossing next to the rail service road	SH	
3	Upgrade of the rail service road	SH, OOHW	
4	Use of the rail service road	SH, OOHW	Heavy vehicles (refer to section 6.3.3.1 above).

Notes

1 – SH (standard hours), OOHW (out of hours work)

PREDICTED NOISE LEVELS

Construction noise levels for the additional construction scenarios included:

- Scenario 1:
 - Exceedance of the NML (standard hours) by 10 dB at 17 Chittaway Road, Kangy Angy
- Scenario 2:
 - Exceedance of the NML (standard hours) by 9 dB at 139 Orchard Road.
- Scenario 3:
 - Exceedance of the NML (standard hours) at 5 receivers, with an exceedance of 13 dB at the worst affected receiver (17 Chittaway Road)
 - Exceedance of the NML (night time) at 26 receivers, including 10 additional receivers not identified in the project REF
 - Exceedance of the sleep disturbance criteria at four receivers.
- Scenario 4:
 - Exceedance of the NML (standard hours) at 4 receivers, with an exceedance of 7 dB at the worst affected receiver (17 Chittaway Road).
 - Exceedance of the NML (night time) at 29 receivers, including 10 additional receivers not identified in the project REF.
 - Exceedance of the sleep disturbance criteria at four receivers.

No further exceedances were predicted for construction of the proposed modification. Further detail is provided in Appendix B.

CONSTRUCTION VIBRATION ASSESSMENT

No sensitive receivers were identified within 100 metres of equipment likely to produce significant vibration levels. As a result, no impact to cosmetic damage or human comfort for off-site receivers from construction vibration are anticipated.

USE OF THE ALTERNATIVE CONSTRUCTION TRAFFIC ACCESS ROUTES (OFF-SITE ROAD TRAFFIC)

As discussed above, use of the rail service road has been considered as construction noise under the ICNG as it is a private road.

The approved project identified vehicle movements on the surrounding roads in addition to the construction of a new access road from Chittaway Road which would also provide an additional link between Enterprise Drive and Orchard Road for potential future use by local residents (subject to agreement with Central Coast Council).

The proposed modification has the potential to cause additional impacts at receivers nearest to the alternative route. Assessment of noise generated by project construction vehicles has been undertaken in accordance with the *Road Noise Policy* (RNP). For the purpose of the noise assessment, it was conservatively assumed that the total daily project construction traffic would occur within a worst-case one hour period.

Traffic along the proposed alternative routes have been assessed under the RNP. The roads have been assessed as a local road category.

Table 6.9 provides a summary of the predicted traffic road noise levels for the proposed modification.

Table 6.9 Predicted traffic road noise levels for the alternative construction traffic access routes (dBA).

ROUTE	RECEIVER	CRITERIA $L_{EQ,1HR}$		PREDICTED TRAFFIC NOISE LEVEL $L_{EQ,1HR}$
		Day criteria	Night criteria	
Turpentine Road	26 Turpentine Road	55	50	46
Ourimbah Road	12 Ourimbah Road	55	50	50
Hereford Street	4 Geoffrey Road	55	50	48
Chittaway Road	139 Orchard Road	55	50	53

During the day, the RNP criteria are expected to be complied with the total daily project construction traffic occurring within a one hour period.

Assessment of construction road traffic noise of all other roads have been covered under the NVIA as the assessment was conservative assuming all vehicles travelling down each potentially affected road.

Where no more than 42 project heavy vehicles per hour travel on Chittaway Road, the night time noise criteria are expected to be complied with at the nearest receivers. Mitigation for heavy vehicle movements has been identified as part of the assessment of construction scenarios assessed in section 6.3.2 and is incorporated into the additional safeguards and management measures in section 6.3.4 below.

6.3.4 ADDITIONAL SAFEGUARDS AND MANAGEMENT MEASURES

Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant. The following additional safeguards and management measures to those identified for the approved project are proposed:

- The proposed modification would be incorporated into the construction noise and vibration management plan (CNVMP) for the approved project, prior to commencement of works.
- Access to site be managed to minimise out of hours construction traffic as part of the CNVMP.

- During the upgrade of the Chittaway Road rail underpass and drainage crossing, out of hours works should minimise use of noise intensive equipment (e.g. the smooth drum roller and powered hand tools). Minimising use of noisy equipment would result in all receivers complying with night time NMLs with the exception of 17 Chittaway Road. If the use of noisy equipment cannot be limited, monitoring at 17 Chittaway Road would be considered in accordance with the CNS.
- Use of noise intensive equipment should also be minimised during rail service road widening works. With elimination of the use of noise intensive equipment, all receivers will comply with night time NMLs except for 17 Chittaway Road and 139 Orchard Road. If the use of noisy equipment cannot be limited, monitoring at 17 Chittaway Road and 139 Orchard Road would be considered in accordance with the CNS.
- Where not feasible to and reasonable to limit the number of vehicle movements to those listed above, written approval is to be requested from TfNSW prior to an increase in vehicle movements. Any increase in vehicle movements (to a maximum of those listed below) would require a letterbox drop in accordance with the CNS:
 - Day time OOHW – 84 truck movements per hour
 - Evening OOHW – 84 truck movements per hour
 - Night time OOHW – 12 truck movements per hour.
- Where not feasible to and reasonable to limit the number of vehicle movements to those listed above, the following movements would trigger letter box drops as an additional mitigation measure under the CNS:
 - Day time OOHW – 84 truck movements per hour
 - Evening OOHW – 84 truck movements per hour
 - Night time OOHW – 12 truck movements per hour.
- Noisy and OOH activities for construction of the proposed modification would be coordinated with the approved project to avoid similar activities occurring concurrently.

6.4 ABORIGINAL HERITAGE

This section summarises the findings of the *Aboriginal Due Diligence Assessment and Non-Aboriginal Heritage Assessment* prepared by Artefact Heritage in June 2018 for the proposed modification. The report is provided in Appendix C.

6.4.1 METHODOLOGY

The *Aboriginal Due Diligence Assessment* was completed in accordance with the OEH *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (OEH due diligence guidelines) (DECCW, 2010).

The proposed road upgrade study area (refer to Figure 6.1) was adopted for the *Aboriginal Due Diligence Assessment and Non-Aboriginal Heritage Assessment* prepared for the proposed modification.

A site inspection of the study area was conducted on 26 March 2018. The survey was conducted on foot to gain an overall impression of the intactness of the study area and identify whether Aboriginal objects or historical archaeological remains are likely to occur beneath the ground surface. Photographs were taken to record different aspects of the landform units within the study area, vegetation, levels of disturbance and potential for Aboriginal sites.

An extensive search of the Aboriginal Heritage Information System (AHIMS) database was conducted on 20 February 2018. The AHIMS search area was carried out for the land between coordinates 345800 to 355800 East and 6305700 to 6315700 North.

6.4.1.1 GEOLOGY, SOILS AND HYDROLOGY

Soil landscapes have distinct morphological and topological characteristics that result in specific archaeological potential. The study area is comprised of Quaternary alluvium with the underlying bedrock consisting of the laminate, shale and sandstone of the Terrigal formation. The underlying bedrock is likely found close to the surface in the central portion of the study area. The study area predominantly consists of the Wyong Soil Landscape. Soils are largely comprised of 10 to 40 centimetres of brownish black loam overlaying over two metres of mottled brownish grey clay. In some areas adjacent to waterways, deep deposits of quartz sands also have the potential to be present.

Portions of the landscape within the study area have been heavily modified. Modifications are particularly evident within the Old Chittaway Road rail underpass which has been cut into the surrounding landscape. No natural ground surface was observed within the portion of the study area near the current rail corridor.

At its closest point, the study area is located approximately five metres from Ourimbah Creek. Much of the Ourimbah Creek catchment is prone to flooding, including prior to land-clearing, and severe stream bank erosion.

6.4.1.2 ABORIGINAL ARCHAEOLOGICAL CONTEXT

The proposed modification is located within the boundary of the Darkinjung LALC and in the parish of Tuggerah County of Northumberland. A number of previous archaeological investigations have been undertaken in the region, and across the study area specifically. A comprehensive summary of previous studies within the region is summarised in the *Aboriginal Archaeological Survey Report (ASR)* for the project REF (Artefact, 2016) (refer to section 6.4.2.1).

No Aboriginal objects, potential heritage items or areas of archaeological potential were identified during the site inspection near the rail corridor or Hereford Street. The site inspection found that the exposures within the rail corridor were limited to vehicle tracks, and the landform was heavily modified. It is considered likely the modifications, associated with construction, upgrade and maintenance of the railway line and roads, removed any earlier archaeological evidence that was present in this part of the study area.

The majority of the northern side of Hereford Street is comprised of a heavily vegetated steep riverbank, which includes several old growth trees, but no cultural scarring was identified. While several portions are within 200 metres of Ourimbah Creek, which may indicate prior archaeological potential, it is considered that the earthworks associated with

levelling of the road surface, construction of the rail underpass and the development of road side drainage would have resulted in extensive disturbance to the soil profile. These portions of the study area are not considered to be archaeologically sensitive.

One area of potential archaeological sensitivity was identified in an open paddock area to the west of Chittaway Road near the rail underpass, where the road is cut into the surrounding topography. Historical disturbance within this area appears to be limited to shallow disturbance associated with agricultural use of the land. The open paddock area was identified as an area containing moderate Aboriginal archaeological sensitivity. This assessment of sensitivity is based on:

- Location on a raised terrace landform with the likelihood of intact, well stratified deposits
- Low levels of disturbance
- Proximity to Ourimbah Creek (approximately 25 metres) as landscapes within 200 metres of water are considered sensitive under the OEH due diligence guidelines.

The potential area of sensitivity is identified in Figure 6.2.

6.4.1.3 REGISTERED ABORIGINAL HERITAGE SITES IN THE STUDY AREA

A search of the AHIMS database identified 32 sites within the search area. No registered sites were located within the study area. The most frequently recorded sites within the AHIMS search area were artefacts (16 sites), grinding grooves (five sites) and art sites (four sites). Most of the sites within the search area were associated with sandstone and recorded in the hills of the Narrabeen Sandstone country, to the north and south of the valley containing the study area. However, a number of sites, all artefacts, were also recorded on the alluvial land alongside Wyong and Ourimbah Creeks.

One Aboriginal Place, Tuggerah Lakes Resting Place, was identified approximately 4.5 kilometres north east of the study area. This area is recognised as a resource and gathering place.

The closest of these sites to the study area is AHIMS No. 45-3-1143 (Ourimbah), located approximately 60 metres to the south-east of the study area near the Chittaway Road turning area. This site consisted of two chert flakes within a dispersed sand deposit and was likely to have originated from Ourimbah Creek.

Two other sites within the vicinity of the study area were identified:

- Tangy Dangy (AHIMS ID 45-3-1146), which is located approximately 200 metres to the north-west and consists of 24 flaked stone artefacts
- Kangy Angy AS 01 (AHIMS ID 45-3-4017), which is located within the approved project site boundary.

6.4.2 POTENTIAL IMPACTS

6.4.2.1 SUMMARY OF ASSESSED IMPACTS

An *Aboriginal Archaeological Survey Report* was prepared for the project REF (Artefact, 2016). It assessed the archaeological potential of the approved project site boundary as high for most of the area, due to the site's low level of historical ground disturbance and location in proximity to a permanent water source. There was also a moderate potential for scarred trees in uncleared areas of the approved project site boundary.

Following the Project REF, Aboriginal archaeological test excavations within the approved project site boundary were undertaken by Artefact Heritage and the results were summarised in an *Aboriginal Cultural Heritage Assessment Report* (ACHAR) (Artefact, 2017). The archaeological test excavations identified one Aboriginal site located within the approved project site boundary, site KA AS 01 (AHIMS ID 45-3-4017). The site was described as a low density subsurface artefact scatter with intact stratigraphic contexts and moderate archaeological and cultural significance. It was determined that construction of the Project would have a direct partial impact on the site. An Aboriginal Heritage Impact Permit (AHIP) was issued by OEH for the approved project in February 2018 (C0003251).



Figure 6.2 Potential area of archaeological sensitivity

6.4.2.2 ADDITIONAL IMPACTS

CONSTRUCTION

No previously identified Aboriginal sites or Aboriginal objects were identified within the study area. However, one area of potential archaeological sensitivity was identified within the study area near the proposed Chittaway Road turning area. The construction works would involve widening of Chittaway Road through excavating the soil to approximately one metre below the existing ground level. Further investigation and Aboriginal stakeholder consultation is required in this area to determine if Aboriginal objects are present.

The remainder of the study area has been previously significantly disturbed due to earthworks associated with the development of the existing rail embankment and road corridors. Therefore, the potential for intact archaeological deposits is considered low in these areas, and there is not likely to be a loss of Aboriginal heritage value. No further investigation of these areas was considered to be required.

USE OF THE ALTERNATIVE CONSTRUCTION TRAFFIC ACCESS ROUTES

No disturbance of areas outside those disturbed during construction is proposed as part of the use of the alternative access routes, as such no impacts to Aboriginal heritage are anticipated.

6.4.3 ADDITIONAL SAFEGUARDS AND MANAGEMENT MEASURES

Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant. The following additional safeguards and management measures are proposed to minimise and manage potential impacts to Aboriginal heritage:

- In accordance with the OEH due diligence guidelines, further archaeological investigation and Aboriginal stakeholder consultation is required for the area of potential archaeological sensitivity adjacent to Chittaway Road. This should include:
 - Archaeological survey and test excavation conducted in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH, 2010a)
 - Comprehensive Aboriginal stakeholder consultation throughout the archaeological test excavation process, as outlined in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH, 2010b). This would include 28 days for stakeholders to review the draft test excavation methodology.
- An AHIP would be required for the proposed modification prior to any work potentially impacting on Aboriginal objects.

If any unexpected Aboriginal objects, or potential objects, are uncovered during construction, work in the vicinity should cease, and OEH and Darkinjung LALC should be contacted in accordance with the unexpected finds protocol outlined in the project construction environmental management plan.

6.5 NON-ABORIGINAL HERITAGE

This section summarises the findings of the *New Intercity Fleet Maintenance Facility – Alternative Access - Aboriginal Due Diligence Assessment and Non-Aboriginal Heritage Assessment* prepared by Artefact Heritage in June 2018 for the proposed modification. The report is provided in Appendix C.

6.5.1 METHODOLOGY

The proposed road upgrade study area (refer to Figure 6.1) was adopted for the non-Aboriginal heritage assessment. A search of existing heritage items within the study area was undertaken through a search of the following heritage lists and registers:

- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- State Heritage Register
- Wyong LEP 2013
- Section 170 Heritage and Conservation Registers for RMS and Sydney Trains.

The following non-statutory heritage lists were also searched:

- Register of the National Estate
- National Trust Register.

An inspection of the site was also conducted on the 26 March 2018. The aim of the site inspection was to identify whether any built heritage items are located within or in the vicinity of the study area.

6.5.2 EXISTING ENVIRONMENT

6.5.2.1 HISTORICAL ARCHAEOLOGICAL POTENTIAL

European development of the study area was identified to have occurred as follows:

- 1830s – Grant of the land, as part of a series of properties, in the 1830s and subsequent agricultural development.
- 1880 – Construction of the original Main North Line alignment, and reorientation of surrounding roads including Old Chittaway Road (renamed to Hereford Street in 1993). The original rail alignment included long curving section of track, to the north-west of the current alignment, including a small sandstone cutting.
- 1889 – Subdivision and development of Fountaindale Estate, including a small orchard in the eastern portion of the study area.
- 1950 – Construction of the current Main North Line alignment, including the rail bridge over Chittaway Road.

The majority of the study area is located within existing road and rail corridors, and the ongoing development of this infrastructure suggests that there is nil to low potential for the study area to contain any intact archaeological resources due to prior agricultural use.

A portion of the study area crosses the original railway alignment where it diverges from the alignment of the current line. The majority of the abandoned section of the original alignment, including potential heritage elements such as the brick lined overbridge and sandstone cutting, are located outside the study area. Most of the fabric associated with the portion of original alignment still in use is expected to have been replaced over the course of time. There is low potential that evidence of former railway infrastructure, including earlier drainage structures and associated goods sheds/sidings, survives within the study area.

There is low potential that evidence of former structures associated with the later 19th and mid-20th century agricultural and residential development of the Fountaindale Estate may remain within the study area. These remains are likely to

consist of the footings or former structures, water reservoir structures, privies, rubbish pits and postholes associated with fence lines and outbuildings.

6.5.2.2 POTENTIAL HERITAGE ITEMS

There are no listed heritage items within or in proximity to the study area. However, the investigation resulted in the identification of several items which may be of some heritage significance.

MAIN NORTH LINE

The central portion of the study area includes a section of the current Main North Line. Most of the line within the study area was developed as part of upgrades completed in the 1950s, however a portion of the study area crosses the original railway alignment. The original alignment of the 1880s Main North Line intersects the study area at the location of the proposed drainage crossing. It appears that construction of the 1950s deviation and associated drainage channel has removed any remaining evidence of the original alignment in this area.

The majority of the abandoned section of the original alignment, including potential heritage elements such as the brick lined overbridge and sandstone cutting, are located outside the study area.

OLD CHITTAWAY ROAD

Old Chittaway Road was in existence prior to the 1880s, when it was realigned to accommodate the construction of the Main North Line. The study area includes part of the original alignment of Old Chittaway Road, which follows the current alignment of Hereford Street. This area was laid out in the late 1880s and remained unsurfaced through to at least the mid-twentieth century. Currently Hereford Street is comprised of a bituminised surface. There is moderate potential that remains of the earlier Old Chittaway Road are extant below the surface. Upgrades to the rail line in the 1950s is likely to have removed the portions of Old Chittaway Road within the vicinity of the rail underpass, fabric within this portion of the study area is unlikely to remain.

6.5.3 POTENTIAL IMPACTS

6.5.3.1 SUMMARY OF ASSESSED IMPACTS

The Non-Aboriginal Heritage Impact Assessment prepared for the approved Project (Artefact, 2016a) identified two potential heritage items within the approved Project site boundary:

- The Main North railway and Turpentine Road/Chittaway Creek underpass, assessed to be of state heritage significance.
- Old Chittaway Road, assessed to be of local heritage significance.

The assessment determined that the approved project would have a minor impact on the Turpentine Road/Chittaway Creek underpass due to obscuring the view of the item from the north. The c.1890 alignment of Old Chittaway Road would also be slightly altered, which would also be considered a minor impact.

6.5.3.2 ADDITIONAL IMPACTS

CONSTRUCTION

The proposed modification would not result in alterations to the current railway alignment or fabric. It would involve the construction of a temporary drainage crossing on the northern side of the current Main North Line. Remains associated with the former Main North Line within this portion of the alignment are likely limited to structural elements associated with the 1950s alterations to the line. No excavations are proposed in the vicinity of the former Main North Line alignment as part of the proposed modification, and therefore there no impacts are anticipated.

The Old Chittaway Road overbridge would not be modified as part of the proposed works so there will be nil impacts to fabric or archaeological remains. The item will be subject to negligible temporary visual impacts. The proposed widening of Old Chittaway Road would be undertaken in the vicinity of the current iteration of Old Chittaway Road, which dates

to c1950. While these works are near the original alignment, no archaeological remains are considered likely to be present and therefore no potential impacts are anticipated.

The proposed modification would involve use of the current Hereford Street, which is consistent with the original alignment of Old Chittaway Road. There is low-moderate potential for remains associated with the original construction of the road to be present below the current bitumen surface. Proposed works along Hereford Street would be limited to the use of the existing road surface and inadvertent damage to the existing ground vegetation from increased traffic, which would have no impacts to potential remains of Old Chittaway Road.

USE OF THE ALTERNATIVE CONSTRUCTION TRAFFIC ACCESS ROUTES

No disturbance of areas outside those disturbed during construction is proposed as part of use of the alternative access, as such no impacts to non-Aboriginal heritage are anticipated.

6.5.4 ADDITIONAL SAFEGUARDS AND MANAGEMENT MEASURES

Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, including implementation of an unexpected finds procedure to manage by an unexpected finds procedure as described in Section 7.4.5 of the project REF.

No additional safeguards and management measures are considered to be required with respect to the proposed modification.

6.6 TRAFFIC, TRANSPORT AND ACCESS

This section summarises the findings of the *New Intercity Fleet Maintenance Facility Review of Environmental Factors - Addendum Traffic Impact Assessment* prepared by WSP in June 2018 for the proposed modification. The report is provided in Appendix D.

6.6.1 METHODOLOGY

The *Addendum Traffic Impact Assessment* considered the entire proposed alternative access shown in Figure 1.2.

Traffic surveys were undertaken for a weekday AM and PM peak period on Tuesday 27 March 2018 at the following three key intersections:

- Enterprise Drive and Turpentine Road
- Enterprise Drive, Old Chittaway Road and Chittaway Road
- Enterprise Drive and Hereford Street.

Modelling of current and predicted future intersection performance was undertaken using SIDRA software for weekday AM and PM peak hour periods. This software provides several useful indicators to determine the level of intersection performance. These are known as Level of Service (LoS), Degree of Saturation, Average Delay (seconds), and queue length (metres). LoS is a qualitative measure used to describe the potential for delay during traffic operation, usually in peak demand situations. LoS is designated by assigning ratings from A to F, with A the best and F the worst. A LoS of D or better is considered acceptable. The traffic modelling assumptions are summarised in section 2.4 in Appendix D.

A site inspection was undertaken on Wednesday 28 March 2018 to understand the road network and traffic, and identify potential traffic or road safety issues related to proposed construction traffic haulage routes and access locations.

6.6.2 EXISTING ENVIRONMENT

6.6.2.1 ROAD NETWORK

The key roads within and surrounding the proposed modification include:

- *Enterprise Drive* – a regional road that runs east-west between Wyong and the Pacific Highway. It is a two-lane, two-way undivided road with a posted speed limit of 90 kilometres per hour.
- *Chittaway Road* – which runs along the western side of the railway track, linking Enterprise Drive to the south and Hereford Street to the north. This road has a sealed width between four to five metres, which offers minimal clearance between passing vehicles.
- *Old Chittaway Road* – which provides local access to residential properties, and forms a priority controlled T-intersection with Enterprise Drive. It is a two-lane, two-way undivided road, approximately 5.5 metres wide with a posted speed limit of 60 kilometres per hour.
- *Turpentine Road, Ourimbah Road and Orchard Road* – which are two-lane, two-way undivided no-though local access roads that connect approximately 25 properties with the Enterprise Drive. The speed limit is 20 kilometres per hour next to the railway overpass. Turpentine Road forms a priority controlled intersection with Enterprise Drive at the south-east section of the proposed modification.
- *Hereford Street* – a two-lane, two-way undivided road and forms a T-junction with Enterprise Drive in the south. It provides access to the industrial precinct. It has a 12-metre-wide corridor with unrestricted on-street parking on both sides to its intersection with Newbridge Road. The road has a sealed width which varies between four to five metres north of Newbridge Road to Chittaway Road.

6.6.2.2 INTERSECTIONS

The existing intersections within the vicinity of the proposed modification are:

- *Enterprise Drive and Turpentine Road* — a basic T-intersection which is two lane, two-way undivided on Enterprise Drive with no turning or passing facilities and two lane, two-way undivided and unmarked on Turpentine Road. Turpentine Road at Enterprise Drive has a widened pavement area which narrows further west of the intersection.
- *Enterprise Drive and Chittaway Road* — a staggered T-intersection with an acceleration lane also provided on Enterprise Drive in the westbound direction from Old Chittaway Road (south-east) to facilitate left-turn merging traffic from Old Chittaway Road.
- *Enterprise Drive and Hereford Street* — a priority controlled, channelised T-intersection, with an auxillary left-turn lane to facilitate left-turn traffic from Enterprise Drive in the east bound direction, and an acceleration lane on Enterprise Drive to facilitate left-turn merging traffic from Hereford Street. A channelised right-turn treatment is provided on Enterprise Drive in the westbound direction.

INTERSECTION PERFORMANCE

Additional traffic surveys were undertaken at the existing intersections for weekday AM and PM periods (refer to Appendix D).

The weekday peak hour was identified to occur between 6.45 am and 7.45 am and the PM peak hour between 4.15 pm and 5.15 pm.

The LoS was generally rated as C for all intersections during AM and PM periods, and is outlined in Table 6.12 below.

6.6.2.3 OTHER TRANSPORT INFRASTRUCTURE

The rail services, bus services and pedestrian and cyclist infrastructure surrounding the proposed modification are the same as described in section 7.6.1 of the project REF.

6.6.3 POTENTIAL IMPACTS

6.6.3.1 SUMMARY OF ASSESSED IMPACTS

The approved project includes use of Enterprise Drive for light and heavy vehicles which would access the approved project via the new road bridge during construction. The volume of project construction vehicles considered for the approved project is summarised in Table 6.10.

Table 6.10 New Intercity Fleet Maintenance Facility construction traffic

STAGE	DAILY (ONE-WAY)		AM PEAK (ONE-WAY)		PM PEAK (ONE-WAY)	
	Light vehicle	Heavy vehicle	Light vehicle ¹	Heavy vehicle ³	Light vehicle ²	Heavy vehicle ³
Project construction – standard	200	84	50	11	50	11
Project construction – during rail possessions	300	84	75	11	75	11

Notes:

1 – The assessment assumed that 25 per cent of the approved projects construction traffic (light vehicles) would coincide with the background traffic AM peak

2 – The assessment assumed that 25 per cent of the approved projects construction traffic (light vehicles) would coincide with the background traffic PM peak

3 – The approved projects construction traffic (heavy vehicles) were averaged over an eight-hour period.

Further breakdown of project construction traffic was provided in the project REF.

Revised estimates of heavy vehicle movements were considered in the *Combined Submissions Report* (WSP | Parsons Brinckerhoff, 2017a). However, the overall external truck movements required over the duration of the construction program was reduced.

As part of the *Traffic and Transport Impact Assessment* undertaken for the project REF (WSP | Parsons Brinckerhoff, 20116e), intersection traffic modelling was undertaken at Enterprise Drive. As described in section 7.6 of the project REF, the modelling indicated that the proposed layout of Enterprise Drive, Old Chittaway Road and the new access road intersection would operate at a level of service (LoS) of 'F' for both construction traffic (peak period in 2017) and operational traffic during both the morning and afternoon peak hours (representing a low performance for this intersection).

Due to the low LoS, the intersection layout was revised to a roundabout. This change was described and assessed as part of the project *Combined Submissions Report* (WSP | Parsons Brinckerhoff, 2017). Additional traffic modelling was undertaken to assess the operation of the revised intersection layout. The modelling showed that the roundabout would operate at a substantially improved LoS compared to the previous intersection layout, with the LoS predicted to be between A and B during both the construction and operational phases of the project.

6.6.3.2 ADDITIONAL IMPACTS

CONSTRUCTION

Traffic movements for construction of the proposed modification (road upgrade) would require at peak:

- 20 light vehicles per day
- 10 heavy vehicles per day.

During construction of the proposed modification, the following changes to vehicle access would be implemented:

- At the Enterprise Drive and Turpentine Road intersection:
 - No heavy construction vehicle access through this intersection
 - Right turn movements would not be allowed between Enterprise Drive and Turpentine Road for construction traffic.
- At the Enterprise Drive and Chittaway Road intersection:
 - No heavy vehicle access through this intersection
- Due to the proposed right turn restrictions at the intersection of Enterprise Drive and Turpentine Road, construction light traffic will be detoured via Old Chittaway Road.
- No changes to access at the Enterprise Drive and Hereford Street is proposed.

These access changes would be maintained during use of the alternative access routes.

In the context of the project construction traffic, traffic associated with construction of the proposed modification is minor, and no impact to intersection performance is anticipated. Modelling of construction traffic for the proposed modification has not been completed.

Access for road users using local roads would be maintained during construction of the proposed modification, however some delays under traffic management conditions are anticipated to occur.

USE OF THE ALTERNATIVE CONSTRUCTION TRAFFIC ACCESS ROUTES

Project traffic volumes considered for use of the alternative access routes are consistent with those considered in the project REF. It is expected that higher light vehicle volumes (300 in/300 out) would be generated during rail possessions. However, rail possessions are normally conducted at weekends or holiday periods when background traffic is much lower than a typical weekday period. Therefore, anticipated daily construction volumes of four hundred light vehicles

(200 in/200 out) during the standard construction period were adopted for the traffic assessment which is consistent traffic volumes described in the project REF.

Construction of the proposed modification would generate 20 light vehicles and 10 heavy vehicles.

Additional consideration of AM and PM peak periods for intersections impacted by the proposed modification identified that weekday AM background peak periods occur between 6.45 am and 7.45 am. This partially overlaps the peak for project construction traffic, which would occur prior to 7:00 am. It was assumed that 50 per cent of the project construction traffic would coincide with the weekday AM background traffic peak. Weekday PM background traffic peaks were identified to occur between 4:15 pm and 5:15 pm, with 25 per cent of the project construction traffic assumed to coincide with this period. The anticipated traffic volumes for the proposed modification are summarised in Table 6.11.

Table 6.11 Anticipated traffic volumes during construction and use of the alternative construction traffic access routes

STAGE	DAILY (ONE-WAY)		AM PEAK (ONE-WAY)		PM PEAK (ONE-WAY)	
	Light vehicle	Heavy vehicle	Light vehicle ¹	Heavy vehicle ³	Light vehicle ²	Heavy vehicle ³
Construction of the proposed modification	20	10	10	2	5	2
Use of the alternative construction traffic access routes	200	84	100	11	50	11

Notes:

- 1 – The assessment assumed that 50 per cent of the approved projects construction traffic (light vehicles) would coincide with the background traffic AM peak
- 2 – The assessment assumed that 25 per cent of the approved projects construction traffic (light vehicles) would coincide with the background traffic PM peak
- 3 – The approved projects construction traffic (heavy vehicles) were averaged over an eight-hour period.

The proposed modification includes use of an alternative access road for project construction vehicles. Intersection traffic modelling was undertaken to determine the performance of the surrounding key intersections during use of the alternative access routes (the 2018 construction scenario), compared to the existing intersection performance (the 2018 existing scenario). The results are summarised in Table 6.12.

Table 6.12 Intersection performance during use of the proposed modification

INTERSECTION	PEAK PERIOD	SCENARIO	AVERAGE DELAY (sec)	LoS	QUEUE LENGTH (m)
Enterprise Drive and Turpentine Road	AM	2018 existing	40	C	1
		2018 use of the alternative construction traffic access routes	46	D	2
		Difference	6	C–D	1
	PM	2018 existing	35	C	4
		2018 use of the alternative construction traffic access routes	36	C	5
		Difference	1	-	1

INTERSECTION	PEAK PERIOD	SCENARIO	AVERAGE DELAY (sec)	LoS	QUEUE LENGTH (m)
Enterprise Drive and Old Chittaway Road	AM	2018 existing	38	C	3
		2018 use of the alternative construction traffic access routes	41	C	3
		Difference	3	-	-
	PM	2018 existing	41	C	6
		2018 use of the alternative construction traffic access routes	51	D	11
		Difference	10	C-D	5
Enterprise Drive and Chittaway Road	AM	2018 existing	22	B	0
		2018 use of the alternative construction traffic access routes	26	B	1
		Difference	4	-	1
	PM	2018 existing	31	C	0
		2018 use of the alternative construction traffic access routes	35	C	1
		Difference	4	-	1
Enterprise Drive and Hereford Street	AM	2018 existing	31	C	8
		2018 use of the alternative construction traffic access routes	63	E	9
		Difference	32	C-E	1
	PM	2018 existing	31	C	14
		2018 use of the alternative construction traffic access routes	48	D	16
		Difference	17	C-D	2

Overall, the intersection modelling results indicate there would be a minor deterioration of intersection performance and increase in delays and queue length at three key intersections as a result of the construction traffic for the approved project using the proposed modification. However, the intersections have been assessed to have capacity to accommodate construction traffic volumes.

The Enterprise Drive and Turpentine Road intersection currently operates at a satisfactory LoS during both AM and PM peak hours. The average delays and queue lengths would only marginally increase during AM peak hour due to the construction traffic generated, which would cause the intersection to operate near capacity. Since only left-in and left-out movements are allowed for construction traffic, the generated traffic would not cause significant delays and queues at this intersection. Overall, this intersection is anticipated to operate satisfactorily.

The intersection of Enterprise Drive and Chittaway Road operates at a satisfactory LoS under the existing conditions. The intersection performance would remain unchanged during use of the alternative construction traffic access routes, except at the western half of the intersection at Enterprise Drive and Old Chittaway Road during PM peak hours. The change is caused by heavier eastbound right turning movements during PM peak hours associated with the right turn bans being implemented at the nearby Turpentine Road intersection.

The Enterprise Drive and Hereford Road intersection currently operates at a satisfactory LoS during both AM and PM peak hours. The average queue lengths are projected to increase during use of the of the alternative construction traffic access routes, which would cause the intersection to operate close to, or at capacity. This is largely attributed to right turn movements for vehicles exiting from Hereford Street onto Enterprise Drive. However, assessment of the intersection indicates it has spare capacity to accommodate the construction traffic volumes, without mitigation.

6.6.4 *ADDITIONAL SAFEGUARDS AND MANAGEMENT MEASURES*

Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant. The following additional safeguards and management measures are proposed to minimise and manage potential impacts to traffic, transport and access:

- The following restrictions would apply to construction vehicle movements for construction and use of the alternative access routes:
 - No heavy construction vehicle access through the Enterprise Drive and Turpentine Road intersection.
 - No right turn movements would be permitted for vehicles accessing Turpentine Road from Enterprise Drive.
 - No heavy vehicle access through the intersection of Enterprise Drive and Old Chittaway Road.
- The project construction traffic management plan (see section 7.6.4 of the project REF) would be updated to include the proposed modification. Traffic control would be defined and implemented to control traffic flow in accordance with the Traffic Management Plan.

6.7 HYDROLOGY, DRAINAGE AND FLOODING

This section summarises the findings of the *Flooding, drainage and water quality* technical assessment prepared by WSP in June 2018 for the proposed modification. The report is provided in Appendix E.

6.7.1 METHODOLOGY

The flooding, drainage and water quality assessment included a desktop review of previous studies and qualitative assessment of the proposed modification. A review of the following studies was undertaken to inform the assessment:

- *New Intercity Fleet Maintenance Facility Draft Pre-Concept Report* (AECOM, 2016b).
- *Ourimbah Creek Catchment Flood Study* (Catchment Simulation Solutions, 2013)
- *New Intercity Fleet Maintenance Facility Draft Constructability Report* (AECOM, 2016a)
- *Practical Consideration of Climate Change in Floodplain Risk Management, Department of Environment and Climate Change* (DECC, 2007).
- *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment* (WSP | Parsons Brinkerhoff, 2016g).
- *Tuggerah Lakes Estuary Report Card 2015* (Wyong Shire Council, 2015).

No water quality sampling has been undertaken as part of the assessment.

6.7.2 EXISTING ENVIRONMENT

6.7.2.1 REGIONAL HYDROLOGICAL ENVIRONMENT AND FLOODING

The proposed modification lies within the wider catchments of Lake Macquarie and Tuggerah Lakes. These catchments are susceptible to pollution due to surrounding urban development which is an issue, as the lakes are popular with recreational water activities. Development within this catchment must ensure there is negligible impact to water quality.

The proposed modification is bounded by Ourimbah Creek and its flood plains to the north and east, Bangalow Creek and Chittaway Creek in the west and the Main North Line in the south. The topography typically falls south to north from the Main North Line into the Ourimbah Creek catchment which is part of the Tuggerah Lake catchment.

Hereford Street is likely to be affected by overbank flooding from Ourimbah Creek. The residential areas of Kangy Angy are known to be isolated during flood events as low as the five per cent annual exceedance probability (AEP) due to Turpentine Road and Chittaway Road being inundated.

6.7.2.2 LOCAL DRAINAGE

Existing local drainage features are likely to include cross drainage culverts. There are no formal kerbs and gutters on the existing local roads. Rainfall runoff from the road surface would fall to the outer edge of the road and flow to the nearest cross drainage structure and drain to Ourimbah Creek via minor channels. The proposed works intersects an existing cess drain parallel to the Main North Line, which drains northwest to Ourimbah Creek.

6.7.2.3 EXISTING WATER QUALITY

Data for Ourimbah Creek and the Wyong River (refer to Appendix E) indicated water quality regularly exceeds ANZECC guidelines for total nitrogen and ammonia levels and is considered unsuitable for recreational swimming because of high faecal coliforms and enterococci levels. Ourimbah Creek is identified as under stress due to vegetation clearing, urban development, water extraction and stock access to creeks, which have resulted in erosion, bank collapse and weed invasion.

Tuggerah Lakes is prone to the build-up of nutrients and sediment, causing high turbidity levels, as result of vegetation clearing and agricultural practices. It also collects bacteria such as enterococci and faecal coliforms because of sewage

and stormwater runoff. Tuggerah Lakes is estuarine and the balance of salt and fresh water is important for marine and bird life. The water quality has remained relatively consistent in recent years of data.

6.7.3 POTENTIAL IMPACTS

6.7.3.1 SUMMARY OF ASSESSED IMPACTS

The project REF identified that the potential impacts of the approved project would include:

- Minor changes to the available flood plain storage and drainage for a 1:100 AEP storm event due to the widening of the rail embankment and increase in impervious surfaces
- Erosion and sedimentation impacts during construction including potential changes to stream flow, impacts to fauna and water contamination due to land clearing during construction
- Water quality impacts from spills during construction and operation.

Following the project REF, a *Flood Study and Flood Impact Assessment* (AECOM, 2016c) was undertaken to further identify potential impacts and risks to the Project and surrounding property. The results of this assessment were discussed in the *Combined Submissions Report* (WSP | Parsons Brinckerhoff, 2017a). It identified that four areas of the approved project site boundary would be affected in a 1:100 AEP storm event. These areas included the turnout area at the connection to the Main North Line, the Chittaway Creek rail bridge crossing, the unnamed tributary creek crossing and the access road bridge area.

The size and location of the proposed detention basins were modified in the *Combined Submissions Report*, but the hydrology, drainage and flooding impacts were assessed to be generally the same as that discussed in the project REF. The design of the modified detention basins would be capable of discharging the main drainage system during a 1 in 100 year AEP flood plus 10 per cent for climate change.

6.7.3.2 ADDITIONAL IMPACTS

CONSTRUCTION

It is not anticipated that the proposed modification would have any significant regional or local flood impacts during construction.

Construction has the potential to impact Ourimbah Creek and the drainage line adjacent to the Main North Line due to sediment mobilisation from earthworks, runoff of chemicals, oil and grease from spills and nutrient flow during stormwater runoff. Therefore, the proposed modification works may adversely impact water quality within the Ourimbah Creek catchment and floodplain if activities are not appropriately managed. Management measures are particularly important for general earthworks, construction of drainage infrastructure, works in low lying areas, wet weather and during leaks or spills.

USE OF THE ALTERNATIVE ACCESS ROUTES

As the proposed modification involves only minor and temporary changes to existing conditions, it would have little to no impact on flooding during use of the alternative access routes.

Existing road conditions are to be retained along Hereford Street, and therefore there will be no change to regional flood behaviour. However, the flood immunity of Hereford Street is largely unknown, as it is outside the flood extent modelled in the pre-concept report prepared for the approved project (AECOM, 2016c). The excavation works for the proposed turning circle at the Chittaway Road rail underpass would increase overbank flooding at this location, however is likely to result in a reduction in flood levels external to the road reserve, due to the increase in floodplain storage at the cutting. Changes to local overland flow paths would be minor, and continue to drain to Ourimbah Creek.

Culverts would be installed within the existing cess drain adjacent to the Main North Line to maintain existing capacity during use of the alternative access routes.

Due to the short-term nature of the proposed modification works, it is predicted there will be no adverse effects due to climate change.

6.7.4 ADDITIONAL SAFEGUARDS AND MANAGEMENT MEASURES

The safeguards and management measures outlined in section 7.9.4 of the project REF and the project Erosion and Sediment Control Plan would be implemented to minimise impacts on flooding, drainage and water quality from the proposed modification. In addition, the following safeguards and management measures should be implemented.

- The Construction Environmental Management Plan (CEMP) for the approved project would be updated to include the alternate access road.
- Relevant management and mitigation measures for construction approved project, as detailed in the *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP | Parsons Brinkerhoff, 2016), would be implemented for the proposed modification.
- Any temporary flood diversion works would be adequately sized for a 2 year Average Recurrence Interval storm event, as recommended in the Blue Book (Landcom, 2004).
- The CEMP, and associated flood evacuation plan, would be updated to include the alternate access route prior to any work commencing on-site. It is known that part of the area is isolated during flood events as low as the 20% AEP. Contractors would be responsible for implementing their own flood emergency management plan.
- To reduce the potential impacts to surface water systems, no stockpiles would be located within high/medium flood risk areas or adjacent to culverts.
- The Chittaway Road turning circle would be stabilised to minimise erosion and scour which contribute to higher sediment and nutrient runoff.
- The banks and riparian vegetation of Ourimbah Creek (adjacent to the turning circle) would be protected during construction.

6.8 CUMULATIVE IMPACTS

Cumulative impacts were assessed in section 7.18 of the project REF. The following sections contain an assessment of the potential cumulative impacts of the modified project.

6.8.1 CUMULATIVE IMPACTS WITH THE APPROVED PROJECT

6.8.1.1 BIODIVERSITY

The proposed modification would result in the removal of 0.1 hectares of PCT 1568 – Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast, which was unable to be avoided. Overall, the combined area of native vegetation impact required for the modified project would be increased to 27.2 hectares.

The removal of an additional 0.1 hectares of potential habitat is less than 0.01 per cent that is considered to be currently available within the locality (five-kilometre radius) (see Appendix A). This incremental loss is considered unlikely to result in cumulative impacts to potential fauna habitat in the locality. The removal of an additional 0.1 hectares of native vegetation as a result of the proposed modification is considered to be consistent with impacts originally assessed in the SIS (WSP | Parsons Brinckerhoff, 2016c) and additional SIS (WSP | Parsons Brinckerhoff, 2017b).

With the implementation of safeguards and management measures detailed in section 6.2.4, no significant cumulative impacts to native vegetation and fauna habitat are anticipated.

6.8.1.2 NOISE AND VIBRATION

Enabling works for the heavy vehicle construction access route and use of the rail service road would exceed noise management levels. Exceedances of the noise management levels were similarly predicted in the project REF. However, the Noise and Vibration Impact Assessment identified up to 11 additional receivers not identified in the project REF where exceedances of noise management levels would occur as a result of the proposed modification.

Notwithstanding, the additional impacts would be short-term in nature, considered to be consistent with impacts assessed for the approved project, and not anticipated to result in significant, cumulative impact. However, to minimise the potential for cumulative noise impacts, noisy and OOH work for construction of the proposed modification would be coordinated to avoid similar activities occurring concurrently. Additional safeguards and management measures have been proposed in section 6.3.4 to minimise any impacts.

6.8.1.3 ABORIGINAL HERITAGE

The approved project site was assessed to have high Aboriginal archaeological potential, with one Aboriginal site subsequently identified during test excavations. Accordingly, an Aboriginal Heritage Impact Permit was obtained in accordance with the requirements of the NPW Act for the approved project.

One area of potential archaeological sensitivity was identified within the proposed modification study area adjacent to the proposed Chittaway Road turning area. The construction works would involve widening a section of Chittaway Road through excavating the soil to approximately one metre below the existing ground level.

As outlined in section 6.4.3, further archaeological investigation and Aboriginal stakeholder consultation is required, and an AHIP would be obtained for the proposed modification prior to any work potentially impacting on Aboriginal objects (if discovered).

The identification of an additional area of potential archaeological sensitivity is not considered to have any significant cumulative impacts.

6.8.1.4 NON-ABORIGINAL HERITAGE

Two potential heritage items were identified in the assessment of the approved project; the Main North railway (Main North Line) and former Old Chittaway Road. The proposed modification would not result in alterations to the railway or associated fabric, or impacts to the former alignment of Old Chittaway Road.

Cumulative impacts to non-Aboriginal heritage are anticipated due to the proposed modification are not anticipated.

6.8.1.5 TRAFFIC, TRANSPORT AND ACCESS

The approved project included the use of a new access bridge by construction traffic. The proposed modification would result in additional heavy vehicle traffic accessing the site by alternative routes as the new access bridge would be constructed concurrently with the maintenance facility. Overall, the intersection modelling results indicate there would be a minor deterioration of intersection performance and increase in delays and queue length at three key intersections as a result of the construction traffic for the approved project using the proposed modification.

Minor volumes of additional traffic would be generated for construction of the proposed modification, however this would occur prior to use of the alternative construction traffic access routes and the majority of project construction traffic, and cumulative impacts to traffic are not anticipated.

There would be minor impacts to additional intersections not identified in the project REF, however the volume of vehicles is not proposed to increase. It is therefore considered that the traffic, transport and access impacts associated with the modified project are unlikely to result in a significant additional impacts. Additional safeguards and management measures have been proposed in section 6.6.4 to minimise any potential impacts to traffic.

6.8.1.6 HYDROLOGY, DRAINAGE AND FLOODING

It is not anticipated that the proposed modification would have any significant regional or local flood impacts during construction. As the proposed modification involves only minor and temporary changes to existing conditions, it would have little to no impact on flooding during use of the alternative access routes.

The proposed modification is not considered to have additional cumulative impact on hydrology, drainage and flooding beyond those assessed in the project REF. Additional safeguards and management measures have been proposed in section 6.7.4 to minimise any impacts to hydrology, drainage and flooding.

6.8.2 POTENTIAL CO-OCCURRING DEVELOPMENTS

Consideration of potential cumulative impacts from co-occurring developments was provided in section 7.18.3 of the project REF. No additional cumulative impacts with the developments identified are anticipated for the proposed modification.

An additional review of Major Project applications within the Central Coast LGA was undertaken using the Department of Planning and Environments' Major Projects Register (DPE, 2018). No developments were identified which are likely to result in cumulative impacts with the proposed modification.

Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant to minimise potential cumulative impacts from co-occurring developments, no additional safeguards and management measures for cumulative impacts are proposed.

6.9 OTHER ENVIRONMENTAL ISSUES

As part of the environmental assessment of the approved Project, a number of other environmental impacts were considered. Table 6.13 provides a summary of these other environmental issues as previously identified in the project REF, and assessment of the potential change in impacts resulting from the proposed modification.

Table 6.13 Other environmental issues and assessment of the potential impacts resulting from the proposed modification

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Landscape and visual character	
Previously assessed impacts.	<p><i>A Landscape Character and Visual Impact Assessment (LCVIA)</i> was prepared by Clouston Associates for the approved project (Clouston Associates, 2016). The key landscape and visual character impacts included:</p> <ul style="list-style-type: none"> <li>— Temporary visual impacts associated with construction elements such as barricades, machinery, earthworks and stockpiles. <li>— Moderate visual impacts expected for rural properties close to the approved project site boundary who may have filtered views of the most prominent elements of the project. <li>— A moderate/high impact predicted on character of the woodland area landscape due to vegetation clearing. <li>— A moderate/high impact predicted on rural residential landscape due to presence of large industrial element and clearance of vegetation contributing to change in character of the landscape. <li>— Following exhibition of the project REF, a number of design changes were included in the project submissions report (Transport for NSW, 2017b). <li>— Safeguards and management measures were identified for the approved project to minimise impacts to landscape and visual character.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Additional impacts from the proposed modification.	<p>The proposed modification includes temporary access to the approved project through surrounding roads, and the existing environment is considered consistent with that considered in the LCVIA (Clouston Associates, 2016).</p> <p>The proposed modification would result in temporary visual impacts to surrounding receivers, including road users and residential properties, from construction plant and equipment. Additional impacts may occur for one receiver not previously considered in the LCVIA at 17 Chittaway Road, Kangy Angy. This receiver is located about 80 metres from the proposed modification, with only partial views to the proposed modification. These additional visual impacts from the proposed modification would be predominantly limited to temporary visual impacts from construction plant and vehicles utilising the access road.</p> <p>Minor visual impacts from earthworks and the removal of 0.1 hectares of vegetation would also occur. Vegetation would be allowed to re-establish after the completion of use of the temporary access, subject to landowner agreement, minimising the potential impact in the longer term.</p> <ul style="list-style-type: none"> — Use of the temporary access road would also result in additional impacts from vehicles accessing the project site until mid-2019. Access for light vehicles would occur during short periods at the start and end of shift periods. Heavy vehicles would access the project site as required. Views to project construction traffic is predominantly screened from surrounding receivers. Significant impacts from vehicle headlights are not anticipated, as work would predominantly undertaken during daylight hours and as no direct line of sight from the alternative access route to surrounding receivers has been identified. Further consideration of potential visual impacts would be undertaken during construction of the proposed modification to identify where site hoarding may be required.
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant. The following additional safeguards and management measures for landscape character and visual impacts are proposed:</p> <ul style="list-style-type: none"> — Further consideration of potential visual impacts would be undertaken during construction of the proposed modification — Hoarding/fencing would be installed around heavy vehicle alternative access route where practical, and where potential visibility from surrounding residential receivers to the proposed modification exists.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Socio-economic	
Previously assessed impacts.	<p>A range of potential socio-economic impacts were identified as part of the project REF including the following key impacts:</p> <ul style="list-style-type: none"> — Potential noise impacts to surrounding sensitive receivers during both construction and operation. — Benefits to the regional economy through creation of approximately 200 jobs during construction and operation of the project. — Improved flood free access for local residents through the provision of the new access road during times of flood when existing access points may be restricted (such as Turpentine Road).
Additional impacts from the proposed modification.	<p>The proposed modification would result in additional temporary noise impacts to surrounding receivers, discussed further in section 6.3.</p> <p>Construction of the turning circle on Chittaway Road would require use of part of a private property located at 17 Chittaway Road, Kangy Angy. Use of this portion of land would be negotiated with the landowner and the land returned to pre-existing conditions, or as otherwise agreed to with the landowner.</p> <p>Property access would be maintained during construction and use of the alternative access, however some disruption to road users along Chittaway Road would occur in areas where traffic management is required. However, the delays would be minor, and the impacts are not considered to be significant.</p> <p>Construction vehicles would utilise existing roads which service the surrounding industrial precincts. The additional traffic volumes would not result in adverse impact to businesses located in this area.</p> <p>Overall, the proposed modification is anticipated to have some additional temporary and minor socio-economic impacts, however these impacts would not be significant with the implementation of safeguards and management measures.</p>
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant.</p> <p>The following additional safeguards and management measures to those identified for the approved project are proposed:</p> <ul style="list-style-type: none"> — Additional consultation with sensitive receivers and adjacent residents about their concerns and suggestions for reducing impacts from the proposed modification. — Any private property impacted by the proposed modification would be returned to pre-existing conditions, or as otherwise mutually agreed to with the landowner.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Land use and property	
Previously assessed impacts.	<p>A range of land use and property impacts were identified as part of the Project REF including:</p> <ul style="list-style-type: none"> — Temporary leasing of land for construction activities, including Lot 82 DP 737040 and some portions of the Main North Line and Old Chittaway Road — Demolition of a residential structure at 11 Ourimbah Road — Permanent property acquisition of 12 properties of which: <ul style="list-style-type: none"> — Seven are currently owned by Central Coast Council and are vacant, vegetated land — One residential property (53 Orchard Road) would be wholly acquired. <p>Ongoing development of the roundabout during detailed design would be undertaken to minimise potential impacts to any adjoining land outside of the road reserve.</p>
Additional impacts from the proposed modification.	<p>No property acquisition is required for the proposed modification, however the proposed modification would result in additional temporary leasing of land, including:</p> <ul style="list-style-type: none"> — Partial lease of one residential property (17 Chittaway Road), including Lot 2 DP 1190957 and Lot 1 DP 187363 — An additional portion of the Main North Line, Lot 1 DP 1062275 — Land owned by Central Coast Council (unidentified lot adjacent to the Main North Line) encompassing the existing access track.
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant. The following additional safeguards and management measures to those identified for the approved project are proposed:</p> <ul style="list-style-type: none"> — Any private property impacted by the proposed modification would be returned to pre-existing conditions, or as otherwise agreed to with the landowner.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Groundwater	
Previously assessed impacts.	<p>A range of groundwater impacts were identified as part of the project REF including:</p> <ul style="list-style-type: none"> — Interception of groundwater during excavation works for the construction of the project due to the shallow groundwater table. This is expected to occur near Chittaway Creek crossing and the Main North Line, the eastern end of the location for the main fleet maintenance building and the location of the wheel lathe. — Contamination of groundwater from accidental spills and leakage of fuels, lubricants and oils during construction. — Impacts on the existing natural ecological function of groundwater dependent ecosystems.
Additional impacts from the proposed modification.	<p>Previous investigations noted that the water table across the sites is generally shallow, with ground water levels ranging from the existing surface level to approximately 4.7 metres below ground level within the approved project boundary (refer to section 7.10.1 of the project REF).</p> <p>The proposed modification is limited to shallow excavations and interaction with groundwater is not anticipated, and the proposed modification would not have any significant impact to groundwater.</p>
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, no additional safeguards and management measures for land use and property are proposed.</p>
Soils, geology and contamination	
Previously assessed impacts.	<p>A range of soil, geology and contamination impacts were identified as part of the Project REF including:</p> <ul style="list-style-type: none"> — Erosion and sediment runoff from the excavation works required for levelling the site and vegetation clearing — Disturbance of contaminated soil during excavation works — Contamination of soil from spills or leaks during operation. <p>These impacts were considered to be sufficiently mitigated by the safeguards and mitigation measures that were identified in the project REF.</p>

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Additional impacts from the proposed modification.	<p>Potential impacts to soils, geology and contamination from the proposed modification are consistent with the approved project.</p> <p>Soils within the proposed modification are consistent with those identified in section 7.11 of the project REF, and include Quaternary alluvium is (comprising sands, silts and clays), overlying quartz to quartz-lithic sandstone with minor red claystone associated with the Terrigal Formation.</p> <p>The proposed modification is considered to have a low potential to encounter contamination.</p> <p>The project REF identified a low probability of the occurrence of acid sulfate soils in soils greater than three metres in depth in areas surrounding Ourimbah Creek. The proposed modification does not include excavation of soils greater than three metres in depth.</p>
Additional safeguards and management measures.	Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, no additional safeguards and management measures for soils, geology and contamination are proposed.
Waste and resource management	
Previously assessed impacts.	<p>A range of waste and resource management impacts were identified as part of the project REF including:</p> <ul style="list-style-type: none"> — Generation of waste during construction such as green waste, spoil, construction and demolition waste, litter and liquid waste that would require reuse, recycling or disposal — Use of materials, fuel, energy and water during construction — Generation of waste during operation including litter, green waste, sewage and water, waste liquids (from train washing, graffiti removal, decanting of the toilets and other oils and chemicals) and general waste from maintenance activities. <p>These impacts were considered to be sufficiently mitigated by the safeguards and mitigation measures that were identified in the project REF.</p>
Additional impacts from the proposed modification.	The proposed modification would result in the generation of up to 900 m ³ of spoil, as well as green waste as well as minor quantities for general waste during construction. Spoil and green waste would be reused for the approved project or proposed modification, where suitable, or disposed to a licenced receiving facility.
Additional safeguards and management measures.	Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, no additional safeguards and management measures for waste and resource management are proposed.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Air quality	
Previously assessed impacts.	<p>A range of air quality impacts were identified as part of the project REF including:</p> <ul style="list-style-type: none"> — Generation of dust during construction leading to dust deposition, visible dust plumes and elevation PM₁₀ concentrations — Exhaust emissions from diesel-powered construction equipment and site equipment during operation. — These impacts were considered to be sufficiently mitigated by the safeguards and mitigation measures that were identified in the project REF.
Additional impacts from the proposed modification.	<ul style="list-style-type: none"> — Potential impacts to air quality from the proposed modification are consistent with those identified for the approved project. The road would be treated for stability and to reduce dust. A water cart would be utilised during construction of the proposed modification, where required to suppress dust.
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, the following additional safeguards and management measures for air quality are proposed:</p> <ul style="list-style-type: none"> — The proposed modification would be incorporated into the Air Quality Environmental Control Plan for the approved project. — A suitable pavement surfacing would be installed on unsealed roads for dust suppression. — A water cart would be used during construction and use of the alternative access routes, where required.
Climate change and greenhouse gases	
Previously assessed impacts.	<p>The project REF identified that there would be greenhouse gas emissions associated with consumption of construction materials, fuel and energy use, disposal of waste and use of equipment. This impact would be sufficiently mitigated by the safeguards and mitigation measures identified in the project REF.</p>
Additional impacts from the proposed modification.	<p>Construction of the proposed modification would result in additional greenhouse gas emissions, however these are minor and no additional impacts to those considered for the approved project are anticipated.</p> <p>Impacts to climate change and greenhouse gases from project construction traffic were considered for the approved project, and no additional impacts would be generated.</p> <p>Use of the alternative access would occur until mid-2019, and no potential impacts from climate change are anticipated.</p>

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Additional safeguards and management measures.	Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, no additional safeguards and management measures for climate change and greenhouse gases are proposed.
Bushfire	
Previously assessed impacts.	The project REF identified that the construction of the could result in the ignition of bushfires from hot works, construction vehicles and motor vehicles, leakage of chemicals, electrical faults and landscaping. During operation of the project, ignition of bushfires could occur through breakage of wires or poles for the power lines, maintenance and repair work, human activity and arson as well as lightening. The project infrastructure assessed to be most at risk of bushfire attack included the maintenance facility buildings, overhead line equipment and substation.
Additional impacts from the proposed modification.	<p>The proposed modification is located within bushfire prone land (Wyang Shire Council, 2011). Potential impacts from bushfires were considered for the approved project.</p> <p>With the implementation of safeguards and management measures, no impacts from construction and use of the alternative access on bushfire are anticipated.</p>
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, the following additional safeguards and management measures for bushfire are proposed:</p> <ul style="list-style-type: none"> — The proposed modification would be incorporated into the Bushfire Management Plan for the approved project, including emergency evacuation procedures.
Public utilities	
Previously assessed impacts.	<p>A range of impacts on public utilities were identified as part of the project REF including:</p> <ul style="list-style-type: none"> — The need to relocate existing services within the approved project site boundary including the existing 33 kV feeder line, Sydney Trains 66 kV line as well as the potable water supply, sewage, telecommunications and local electricity supply. — Potential damage to services and utilities, as well as injury to persons (construction workers or the community) in the unlikely event that cables, mains or pipelines are accidentally damaged during excavation, plant movement or general civil works.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Additional impacts from the proposed modification.	<p>The proposed modification does not include any relocation of services.</p> <p>Additional potential for damage to services and utilities may occur from the excavation within the road and rail corridor, however this would be minor with the implementation of safeguards and management measures identified for the approved project.</p> <p>Protection of above ground services would be installed where required to prevent potential damage from collision with construction vehicles.</p>
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, the following additional safeguards and management measures for public utilities are proposed:</p> <ul style="list-style-type: none"> — Protection of above ground services would be installed where required to prevent potential damage from collision with construction vehicles.
Hazard and risk	
Previously assessed impacts.	<p>A range of hazards were identified as part of the project REF including:</p> <ul style="list-style-type: none"> — During construction <ul style="list-style-type: none"> — Working in the vicinity of an operating rail corridor, live overhead wires and subsurface utilities — Impacts to soils and water quality as a result of spills — Transportation, use and storage of hazardous materials to and on site — Potential striking of services — Vehicle accidents and/or injury due to movement of construction plant, equipment and personnel — Handling of contaminated material — During operation <ul style="list-style-type: none"> — Natural events (flood and bushfire) and impacts of climate change — Utility failure (power or communication) — Train accident, including derailment, collision or impact — Stabling and associated buildings or train fire — Storage of hazardous materials — Potential spills from trains and other equipment and materials used for train cleaning.

ENVIRONMENTAL ISSUE	POTENTIAL IMPACTS IDENTIFIED AS PART OF THE PROJECT REF
Additional impacts from the proposed modification.	<p>Potential impacts to hazards and risk from the proposed modification are generally consistent with those considered for the approved project.</p> <p>The proposed modification includes use of an existing rail service road for project construction vehicles, resulting in an increased potential for impacts associated with plant and equipment working in the vicinity of an operating rail corridor, live overhead wires and subsurface utilities.</p> <p>The use of public roads would also increase the risk of vehicle accidents and/or injury due to potential interaction of construction and private vehicles, however as discussed in section 6.6, traffic control would be implemented where required to control vehicle movements.</p>
Additional safeguards and management measures.	<p>Safeguards and management measures identified for the approved project would be implemented for the proposed modification where relevant, the following additional safeguards and management measures for public utilities are proposed:</p> <ul style="list-style-type: none"> — Barriers would be installed for the length of rail service road to provide separation from the active rail corridor.

7 ENVIRONMENTAL MANAGEMENT

7.1 ENVIRONMENTAL MANAGEMENT SYSTEM

7.1.1 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

A CEMP has been prepared for the approved project and provides a centralised mechanism through which all potential environmental impacts would be managed.

The CEMP would be updated for the proposed modification, including construction and use of the proposed temporary access. The CEMP would include additional mechanisms for demonstrating compliance with the commitments made in this Addendum REF, the submissions report (to be prepared following the public display of the Addendum REF), and include (at a minimum) the following elements:

- Traffic management
- Noise and vibration management
- Air quality management (including dust suppression)
- Landscape and rehabilitation plan
- Community and stakeholder involvement
- Aboriginal and non-Aboriginal heritage management
- Water and soil management
- Flora and fauna and weed management
- Soil and erosion management
- Contamination and waste management.

7.1.2 OPERATIONAL ENVIRONMENTAL MANAGEMENT

No changes to operation of the approved project are included in the proposed modification.

7.2 MANAGEMENT AND MITIGATION MEASURES

The project REF (WSP | Parsons Brinckerhoff, 2016a) and combined submissions (WSP | Parsons Brinckerhoff, 2017a) report identified a range of environmental impacts that are likely to occur as a result of the project. Table 7.1 to Table 7.3 below provides a summary of the environmental management measures that Transport for NSW has proposed to manage the potential environmental impacts associated with the construction of the project.

The safeguards and management commitments documented have been revised with consideration of the proposed modification. New or amended measures that are proposed have been denoted with underlined text, while any environmental management measures which have been amended, proposed to be removed or have had text deleted from the measure have been shown with ~~strikethrough text~~.

Should the proposed modification be determined by Transport for NSW for approval, the finalised safeguards and management measures would guide subsequent phases of the project, including the works associated with the proposed modification. The nominated construction contractor would be required to undertake all works in accordance with these environmental management measures.

7.2.1 DETAILED DESIGN

Table 7.1 Detailed design environmental management measures

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	Biodiversity
A.1	During detailed design, opportunities to further reduce the clearing of native vegetation would be investigated.
	Noise and vibration
B.1	When additional details are available for substations and other mechanical plant, they would be assessed and designed so that overall noise emission of the Project with all mobile and fixed noise sources does not exceed the environmental noise objectives of the Project.
B.2	Noise mitigation for sources such as shunt vehicles; vehicle movement alarm systems; mechanical plant (including backup generator(s)) and PA systems would be addressed during the detailed design to ensure they meet the environmental noise objectives of the Project.
B.3	An acoustic enclosure or insulation for the substation would be considered during the detailed design so as to meet the relevant environmental noise objectives.
B.4	Alternative systems would be investigated for vehicle movement alarms, such as the use of visual alarms.
B.5	<p>The design and suitability of noise barriers would be determined where required. Noise barriers have been considered to reduce noise levels from train arrivals and departures in addition to standing trains. The final height and locations of any proposed barriers would be subject to further investigation. Currently proposed barriers for consideration include (refer to Figure 6-1 of the <i>Noise and Vibration Impact Assessment</i>):</p> <ul style="list-style-type: none"> — A barrier of approximately five metres high above the track along the standing tracks south of the maintenance shed. The side of the barrier facing the noise sources would be acoustically absorptive or the barrier should include a combination of a vegetated earth berm and barrier. — A barrier to the full height of the train wash building which extends to fully block line of sight from the train wash exit to 26 Turpentine Road. <p>Where noise barriers are considered to be the preferred treatment method, they would be required to be constructed so as to be solid and continuous with no gaps between the ground and barrier and between barrier panels. The barriers would be constructed of a material with a surface density of at least 12 kilograms per square metre</p>
B.6	The adoption of any proposed treatments measures at the source of residential receivers would be considered (such as architectural upgrades).
B.7	<p>Further assessment of the potential noise impacts associated with the proposed track cross overs should be undertaken using detailed analysis techniques, such as computer aided modelling, in order to confirm the extent of any trigger level exceedance and appropriate mitigation measures. This would be undertaken as part of the Operational Noise and Vibration Review for the Project.</p> <p>Mitigation measures which would be considered to mitigate any exceedances would include:</p> <ul style="list-style-type: none"> — Use of different types of turnouts which provide additional noise damping — Localised barrier screening in the vicinity of the turn outs — At-property treatments for affected receivers (where required).

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
Traffic, transport and access	
C.1	Transport for NSW would consult with both Roads and Maritime Services and the Central Coast Council regarding the detailed design requirements for the roundabout, including the requirements for road occupancy licence(s) or any requirements to amend the existing speed limit along Enterprise Drive.
C.2	The lighting design would be developed by a suitably qualified lighting designer and prepared in accordance with AS 1158 "Road Lighting" and AS 4282 "Control of the Obtrusive Effect of Outdoor Lighting".
Land use and property	
D.1	Opportunities to further minimise impacts to properties (i.e. reduction to the Project footprint) would be undertaken during detailed design.
D.2	Provision of a vegetated earth mound to the west of the flood free access would be considered with the aim of improving visual (and noise) screening of the maintenance facility from properties along Orchard Road.
Hydrology, drainage and flooding	
E.1	A detailed Flood Impact Assessment of the site would be undertaken to provide more certainty regarding the impact the Project on the regional flood and local drainage processes, and identify any required addition management and mitigation measures to minimise any potential flooding impacts.
E.2	A Hydrologic and Hydraulic assessment would be undertaken to confirm that additional structures with the same cross-sectional area as existing would not affect the existing drainage, and identify any required addition management and mitigation measures to minimise any potential stormwater and drainage impacts.
E.3	Where possible, all Project components would be design to be above the 1:100 AEP flood event (including climate change assumptions).
E.4	Culvert openings across the floodplain would be sized to minimise the impact on the existing floodplain and local drainage processes.
E.5	All culvert extensions would be designed to match the existing culvert openings to minimise impacts to the capacity of existing drainage infrastructure.
E.6	Scour protection would be provided at both ends of culvert extensions to reduce erosion and water quality impacts.
E.7	The proposed detention basins would be designed so as to reduce sediment loads and pollutants entering streams. These detention basins would be installed as early as possible during the construction phase of the Project.
E.8	Stormwater from heavily polluted areas such as workshop facilities should be treated with oil interceptors or other treatment measures discharged to sewers, where feasible.
Groundwater	
F.1	Additional investigation and assessment of dewatering requirements would be undertaken to assess the proposed excavation works.
F.2	Quantification of groundwater inflows to excavations and determination of extent of drawdown would be undertaken as part of the detailed design of the maintenance facility.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
F.3	A dewatering management plan would be prepared which would include information on the groundwater levels, excavation dimensions, quantification of amount of dewatering required and method of disposal of dewatered groundwater.
F.4	Consultation with DPI Water would be undertaken regarding any addition requirements, including licensing.
	Climate change and greenhouse gases
G.1	Detailed designs for the Project would take into consideration the potential effect of climate change on the Project, including drainage requirements and the potential for increased flood frequency.
G.2	Possible treatment measures which be considered during the detailed design phase would include: <ul style="list-style-type: none"> — Monitoring weather forecasts and specific weather warnings — Positioning fire extinguishers at site offices and within construction vehicles (in case of bushfires) — Being alert to fire warnings and notices — Keeping the construction site clear of debris wherever possible (in case of severe winds) — Considering specific measures for wet season as part of the broader ESCP — Ensuring major earthworks are planned to reasonably not coincide with periods of expected rainfall or high winds.
	Public utilities
H.1	A further detailed services search would be completed to ensure that construction does not damage existing services.
H.2	Consultation would be undertaken with all affected utility owners as part of the ongoing design of the Project.
	Cumulative impacts
I.1	The potential cumulative impacts associated with the Project would be further considered as the design develops and as further information regarding the location and timing of potential developments is released.

7.2.2 CONSTRUCTION

Table 7.2 Construction environmental management measures

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	General
J.1	A CEMP would be prepared prior to the commencement of construction. This plan would incorporate the mitigation measures outlined below.
J.2	Consultation with Central Coast Council would be undertaken under the requirements of the Infrastructure SEPP (as detailed in Chapter 6).
	Biodiversity
K.1	As part of CEMP for the Project, a Vegetation Management Plan (VMP) would be developed to address potential biodiversity impacts. The VMP would include a series of measures to ensure ecological impacts are minimised, including the mitigation measures listed below.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
K.2	<p>During construction, the following general measures would be implemented:</p> <ul style="list-style-type: none"> — All workers would be provided an environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity, and penalties for breaches. — The limits of clearing would be clearly demarcated on-site (where appropriate) prior to construction to avoid unnecessary vegetation and habitat removal. This could include the installation of fencing around the Project site footprint.
K.3	<p>Pre-clearing and construction protocols would be implemented including:</p> <ul style="list-style-type: none"> — An experienced fauna ecologist would check for the presence of flora and fauna species and habitat on site before clearing begins (such as the presence of bird nests) and would be present to supervise vegetation clearing and capture and relocate fauna where required. — Prior to construction, site personnel should be adequately informed of environmental management procedures including, but not limited to, issues related to flora and fauna management, weed control, erosion and sediment control (in accordance with Landcom's <i>Soil and Construction Managing Urban Stormwater</i>, March 2004). — Establish exclusion zones to protect vegetation and fauna habitat outside of the assessed and approved clearing limits, including the threatened ecological communities recorded within the study area (including Swamp Sclerophyll Forest, <i>Biconvex Melaleuca</i> and riparian areas). Vegetation to be retained are to be clearly defined on ground and 'no go zones' clearly signposted and fenced to prevent unauthorised clearing and vehicular and/foot traffic. — The limits of clearing would be clearly demarcated on-site (where appropriate) prior to construction to avoid unnecessary vegetation and habitat removal. This could include the installation of fencing around the Project site footprint. — Carefully clearing vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation. — Avoid excessive soil disturbance. — When accessing construction sites, contractors should only use designated access tracks.
K.4	<p>Flora and fauna control measures would be implemented including:</p> <ul style="list-style-type: none"> — Clearing of vegetation would be minimised, to only vegetation that is absolutely required to be removed in order to undertake work. — Noxious weeds would be managed in accordance with the <i>Noxious Weeds Act 1993</i>. — Protocols to prevent the introduction and/or spread of Chytrid fungus would be implemented. These protocols would be based on OEH Hygiene Protocol for the Control of Disease in Frogs.
K.5	<p>Weed species would be managed in order to control them from further spread. Management techniques may include immediate weed removal and disposal without stockpiling, disposal of weed-contaminated soils at appropriate weed disposal facilities and to ensure that all equipment is cleaned prior to and on completion of works to ensure weeds are not introduced or spread to other locations.</p>
K.6	<p>A Biodiversity Offset Strategy would be prepared in accordance with the BioBanking Assessment Methodology to offset impacts associated with the Project on biodiversity values in particular impacts to Swamp Sclerophyll Forest and <i>Melaleuca biconvexa</i>.</p>
K.7	<p>The Project would comply with all additional mitigation measures as identified in Section 7 of the SIS and Section 6.1 of Additional SIS.</p>

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
K.8	The project CEMP, Flora and Fauna Management Plan and threatened species management plans (including for Swamp Sclerophyll Forest, Biconvex Paperbark and Mahony’s Toadlet) would be updated to include the proposed modification.
K.9	The Biodiversity Offset Strategy for the project would be updated to include an additional 0.1 hectares of PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest High.
K.10	The potential for vehicular impacts to moving frogs would be mitigated by the separation of the proposed alternative access (on the rail service road) from potential Mahony’s Toadlet habitat by a frog exclusion fence to prevent potential injury or mortality.
Noise and vibration	
L.1	<p>As part of overall CEMP for the Project, a construction noise and vibration management plan (CNVMP) would be developed for the Project (including the proposed modification), prior to commencement of works. The management plan would include (but is not limited to) the following:</p> <ul style="list-style-type: none"> — Identified nearby residences and other sensitive land uses — Approved hours of work and what work would be undertaken — Substantial noise and vibration generating activities — Details of noise mitigation and management measures to be applied — Information for worker training to minimise noise impacts — Community consultation protocol(s) — Complaints handling protocol(s) — Processes for regular noise auditing during construction to monitor noise levels on site and identify whether additional mitigation measures are required to be implemented.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
L.2	<p>During construction, the standard mitigation measured contained within the Transport for NSW <i>Construction Noise Strategy</i> (CNS) would be used as the basis for the proposed mitigation measures to be included in the CNVMP. These measures would include:</p> <ul style="list-style-type: none"> — All employees, contractors and subcontractors would receive an environmental induction — No swearing or unnecessary shouting or loud stereos/radios would be allowed site — No dropping of materials from height, throwing of metal items and slamming of doors would be permitted — A noise monitoring program would be carried out for the duration of the works in accordance with the CNVMP and any approval and licence conditions — Where feasible and reasonable, construction would 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 — High noise and vibration generating activities would only be carried out in continuous blocks, not exceeding three hours each, with a minimum respite period of one hour between each block — Quieter and less vibration emitting construction methods would be used where feasible and reasonable — The noise levels of plant and equipment would have operating sound power or sound pressure levels that would meet the predicted noise levels — Noise emissions would be considered as part of the selection process — Simultaneous operation of noisy plant within discernible range of a sensitive receiver would be avoided where possible — The offset distance between noisy plant and adjacent sensitive receivers would be maximised, where possible — Plant used intermittently would be throttled down or shut down when not in use — Noise-emitting plant to be directed away from sensitive receivers, where feasible — Traffic flow, parking and loading/unloading areas would be planned to minimise reversing movements within the site — Non-tonal reversing beepers (or an equivalent mechanism) would be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out-of-hours work — Loading and unloading of materials/deliveries would occur as far as possible from sensitive receivers — Dedicated loading/unloading areas would be shielded if close to sensitive receivers — Delivery vehicles would be fitted with straps rather than chains for unloading, wherever possible — Stationary noise sources would be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained — Structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers would be used (where practicable) and consideration of site topography when siting plant would be undertaken.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
L.3	<p>To minimise noise levels, the following work practices would be implemented:</p> <ul style="list-style-type: none"> — Respite periods would be defined by those periods where the community is less sensitive to noise such as avoiding early morning and late afternoon. — Vehicles, obstacles and stockpiles would be used on site to provide shielding to receivers, especially for static noise sources such as generators, mulchers, mobile cranes and the piling rigs. — Minimising the potential for construction vehicles to access the site prior to 7.00am along the new access road.
L.4	<p>To minimise the risk of vibration impacts, the following would be considered:</p> <ul style="list-style-type: none"> — Where possible, the use of less vibration intensive methods of construction or equipment would be considered to reduce the potential for cosmetic damage — All equipment would be maintained and operated in an efficient manner, in accordance with manufacturer's specifications, to reduce the potential for adverse vibration impacts — Where work requiring the use of vibratory rollers is required within 75 metres of a receiver, a roller of less than 200kN rating would be used, where practical — Where work is required within close distances to sensitive receivers, site-specific safe working distances would be established on-site prior to the relevant vibration generating works commencing — If vibration intensive equipment is to be used within the safe working distances, attended vibration measurements would be undertaken when work commences to determine site specific safe working distances — Vibration intensive work would not proceed within the safe working distances unless a permanent vibration monitoring system is installed approximately one metre from the building footprint, to warn operators when vibration levels are approaching the peak particle velocity trigger levels.
L.5	<p>To minimise the potential for sleep disturbance, where night works are proposed to be undertaken, the following controls would be implemented where feasible and reasonable:</p> <ul style="list-style-type: none"> — Avoiding conducting noise intensive night works for more than two consecutive nights — Scheduling noise intensive activities to before 10.00pm — Schedule activities which are likely to cause maximum noise events such as deliveries, moving material or equipment and compacting works to avoid the night time period (10.00pm to 7.00am) — Educate workers on the importance of minimising noise and avoid creating short duration high noise level events — Inform surrounding residents by mail of planned works prior to the works commencing.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
L.6	<p>To minimise the potential impacts from impact piling associated with the construction of the access road bridge, the following measures would be implemented as part of the CNVMP:</p> <ul style="list-style-type: none"> — Using a wood block or other damper for the driving hammer — Selecting machines which minimise auxiliary noise sources — Shielding the impact area with a sleeve, where feasible — Providing appropriate respite periods between periods of impact piling — Carrying out intensive piling works before 10.00pm and after 7.00am on weekends — Consulting with the community to identify periods when they are less sensitive to impact piling works and working with these timings e.g. school examination periods or community events. This would include individual briefings, phone calls and specific notifications — Noise monitoring would be undertaken throughout the impact piling operations to monitor noise impacts from these activities.
L.7	The proposed modification would be incorporated into the construction noise and vibration management plan (CNVMP) for the approved project, prior to commencement of works.
L.8	Access to site be managed to minimise out of hours construction traffic as part of the CNVMP.
L.9	During the upgrade of the Chittaway Road rail underpass and drainage crossing, out of hours works should minimise use of noise intensive equipment (e.g. the smooth drum roller and powered hand tools). Minimising use of noise intensive equipment would result in all receivers complying with night time NMLs with the exception of 17 Chittaway Road. If the use of noisy equipment cannot be limited, monitoring at 17 Chittaway Road would be considered in accordance with the CNS.
L.10	Use of noise intensive equipment should also be minimised during rail service road widening works. Where noise intensive equipment are not used, all receivers will comply with night time NMLs except for 17 Chittaway Road and 139 Orchard Road. If the use of noise intensive equipment cannot be limited, monitoring at 17 Chittaway Road and 139 Orchard Road would be considered in accordance with the CNS.
L.11	<p>When using the rail service road, heavy vehicle access would be limited to the following movements to comply with NMLs with only marginal exceedance (up to 2dB above NMLs):</p> <ul style="list-style-type: none"> — Day time – 21 truck movements per hour. — Day time OOHW – 10 truck movements per hour. — Evening OOHW – 8 truck movements per hour. — Night time OOHW – 6 truck movements per hour.
L.12	<p>Where not feasible to and reasonable to limit the number of vehicle movements to those listed above, written approval is to be requested from TfNSW prior to an increase in vehicle movements. Any increase in vehicle movements (to a maximum of those listed below) would require a letterbox drop in accordance with the CNS:</p> <ul style="list-style-type: none"> — Day time OOHW – 84 truck movements per hour — Evening OOHW – 84 truck movements per hour — Night time OOHW – 12 truck movements per hour.
L.13	Noisy and OOH activities for construction of the proposed modification would be coordinated with the approved project to avoid similar activities occurring concurrently.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	Visual and landscape character
M.1	<p>The following measures would be considered with respect to landscape design and vegetation impacts for the New Intercity Fleet Maintenance Facility:</p> <ul style="list-style-type: none"> — Restricting vegetation clearing to those areas where it is necessary. Opportunities to minimise clearing would be identified as part of the ongoing development of the Project design — Ensuring a vegetation buffer of existing planting is left between within or outside the Project site boundary to provide visual screening of the facility where possible — Locating storage areas and associated works in cleared or otherwise disturbed areas away from sensitive native vegetation where possible — Avoiding stockpiling materials in areas supporting vegetation where possible — Trimming rather than the removal of trees should be considered where possible and to be conducted by a qualified arborist — Rehabilitating vegetated areas where ground is disturbed — Planting native trees and shrubs to screen built form and reduce the scale of the infrastructure — Reinforcing the local semi-rural landscape character through the use of appropriate native vegetation, including that from the identified endangered vegetation communities — Planting a graded screen of vegetation at varied heights that includes groundcover, shrub and tree layers to form an effective visual screen — Considering the use of advanced size trees for instant effect — Restoring areas disturbed by construction to match existing condition as far as practicable — Consider additional measures to reduce potential visual privacy impacts (such as overlooking of adjacent properties) from the new access road.
M.2	<p>The following measures would be considered with respect to the final materials and finishes for the New Intercity Fleet Maintenance Facility:</p> <ul style="list-style-type: none"> — All elements including lighting columns, roof lines, cladding etc. to be considered as a whole to simplify the structure and reduce clutter — Avoid reflective surfaces.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
M.3	<p>The lighting principles and recommended mitigation measures would be further developed as part of a lighting management plan for the facility to be developed as part of the detailed design of the Project.</p> <p>All lighting would be installed in a manner which minimises light spill to areas beyond the maintenance facility site boundary. Best practice lighting design principles should be applied including:</p> <ul style="list-style-type: none"> — Ensure the lighting design is in accordance with relevant Australian Standards which provides recommended maximum values of light technical parameters for the control of obtrusive light. Ensure light spill and light pollution externally are avoided in accordance with this Standard. — Appoint a qualified lighting designer who demonstrates a detailed understanding of lighting design and experience in the application of light within the interior architectural and exterior landscape environment. — Restrict lighting to the minimum required for operations, safety and security requirements. — Directional lighting techniques should be used to direct light away from sensitive viewpoints. — Indirect glare from reflective surfaces must be avoided. — Where luminaires are lighting a horizontal surface, mounting locations of luminaires should ensure that the angle of the luminaires do not exceed 30 degrees from the vertical and that the luminaires with an asymmetric light distribution are used where possible. — Where luminaires are lighting a vertical surface and the angle of adjustment justifies a greater than 45 degree position, ensure that direct views to the light source are eliminated or avoid lighting vertical surfaces. — When choosing lighting categories from Australian Standards, preference would be given to choosing lower light levels where appropriate (subject to meeting minimum requirements for elements such as the use of CCTV for security purposes). This would assist in avoiding unnecessary over-design of the lighting for the maintenance facility.
M.4	<p>Tree planting outside the works boundary would be considered to assist in visually screening the facility. Offset planting for the removed vegetation would be required and would be undertaken with specialist ecological advice.</p>
M.5	<p>Lower luminaire mounting heights (for example ground level or low level garden path-type lighting) should be provided along pedestrian paths within the car park (where possible and sufficient to meet required guidelines and standards). This lighting could be supplemented with higher mounting light poles utilising motion detectors.</p>
M.6	<p>The following strategies should be implemented for lighting of general areas of the maintenance facility:</p> <ul style="list-style-type: none"> — For exterior areas, lower luminaire mounting heights (ground level or low level up to three to five metres) should be provided to minimise potential direct views of luminaires — Lighting controls should be separated by tasks and task zones to allow for flexible control of illuminance levels — For floodlighting of the maintenance facility, the use of a smaller number of tall poles should be avoided in favour of additional lower mounted lighting, as this can cause obtrusive light effects.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
M.7	<p>The following measures would minimise light impacts:</p> <ul style="list-style-type: none"> — Shielding of the perimeter should be provided through the use of planting or structural elements to prevent direct views of lit surfaces, wherever practical — The maintenance shed doors should remain closed when activities are occurring inside the shed at night, wherever practical — For buildings which incorporate glazed/transparent façades, it is recommended that the internal lighting be dimmed down or designed with low glare luminaires to reduce the building luminance and direct views of the façade — Lighting for illuminated signage should be localised to ensure that, as far as practical, there is no light spill into adjacent areas, must eliminate glare and be designed such that luminance is minimised — When choosing lighting categories for public road lighting for adjacent roads including the new access bridge and roundabout from AS1158, preference should be given to choosing categories with lower light levels where appropriate while considering the lighting requirements for public safety — Security CCTV cameras would consider the use of Infra-red lights, where practical — Lighting for security would utilise full cut-off luminaires and glare control accessories, where practical — Lighting for security would apply lower mounting heights and use appropriate optics to minimise light spill, where practical.
M.8	<p>The following measures would minimise light impacts associated with road lighting:</p> <ul style="list-style-type: none"> — Road lighting (for the access road bridge and revised intersection arrangements) would be required to be designed to relevant standards including Central Coast Council, Roads and Maritime Services and Australian Standards — Road lighting to new bridge and access road would consider the use of full cut-off luminaires to minimise glare and light spill, where practical — Road lighting to adjacent street would considered the use of shorter poles to minimise direct views of luminaires and appropriate optics to reduce spill light — The use of speed bumps on the access road and internal roads should be avoided in order to minimise car headlight deflection above the horizontal.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
M.9	<p>Luminaires and lighting equipment for the Project should include the following to minimise light impacts:</p> <ul style="list-style-type: none"> — All external luminaires should include specifically designed optics, glare shields and accessories that minimise upward light spill and control light output to direct it where required — Full cut-off luminaires should be provided to minimise upward light spill above the horizontal — Appropriate beam angles on luminaires should be used to ensure lighting is focussed where required, that spill light is minimised and direct views into a light source are minimised — Luminaire correlated colour temperature (CCT) for all lamps to be consistent across the Project site. CCT to be between 3000K and 4500K, noting the warmer 3000K CCT tends to be less obtrusive at night — All external luminaires to include LED/fluorescent light sources — Light fittings must provide 60 percent of the lamp lumen output of the fitting in the peak intensity, as defined by the fitting beam angle.
M.10	<p>In relation to visual impacts, the following measures are proposed for the construction of the temporary alternative access routes:</p> <ul style="list-style-type: none"> — Further consideration of potential visual impacts would be undertaken during construction of the proposed modification — Hoarding/fencing would be installed around heavy vehicle alternative access route where practical, and where potential visibility from surrounding residential receivers to the proposed modification exists.
Non-Aboriginal heritage	
N.1	If the proposed development is changed to affect areas not included in the present report, further assessment of potential non-Aboriginal heritage impact would be undertaken.
N.2	Prior to commencement of works, a photographic archival record would be completed of the Turpentine Road/Chittaway Creek underpass. Copies of the record would be lodged with Sydney Trains, Central Coast Council, the local historical society and the Heritage Division, as required by these agencies.
N.3	Unexpected archaeological relics remain protected by the <i>Heritage Act 1977</i> . If a potential relic is found in the course of the work, work would cease in the vicinity, and the heritage Division of the Office of Environment and Heritage would be contacted for advice.
Aboriginal heritage	
O.1	If the extent and nature of the Project is altered, additional archaeological assessment would be undertaken to address this.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
O.2	<p>Due to the inability to adequately access and assess some parts of the site, an Aboriginal cultural heritage assessment report (ACHAR) would be completed for the areas of the Project site identified as having moderate or high potential for Aboriginal heritage. This would include Aboriginal community consultation and archaeological test excavation. This process would be undertaken in accordance with the following guidelines issued by the OEH:</p> <ul style="list-style-type: none"> — Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011) — Code of practice for archaeological investigation of Aboriginal objects in New South Wales (DECCW 2010) — Aboriginal cultural heritage consultation requirements for proponents (DECCW 2010).
O.3	<p>If the results of the ACHAR confirm that Aboriginal objects are present and would be harmed by the proposed development, it would be necessary to apply for an Aboriginal Heritage Impact Permit (AHIP) prior to commencement of works.</p>
O.4	<p>During construction, should Aboriginal heritage items be uncovered, all work within the vicinity would cease and the Project Manager and Transport for NSW staff would be notified. The Department of Planning and Environment would also be notified in accordance with the <i>National Parks and Wildlife Act 1974</i>. Investigation of the significance of the find and approval by a suitably qualified archaeologist would be required prior to recommencement of works.</p>
O.5	<p><u>In relation to Aboriginal heritage, the following measures are proposed for the construction of the alternative access routes:</u></p> <ul style="list-style-type: none"> — <u>In accordance with the OEH due diligence guidelines, further archaeological investigation and Aboriginal stakeholder consultation is required for the area of potential archaeological sensitivity adjacent to Chittaway Road. This should include:</u> <ul style="list-style-type: none"> — <u>Archaeological survey and test excavation conducted in accordance with the <i>Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales</i> (OEH, 2010a)</u> — <u>Comprehensive Aboriginal stakeholder consultation throughout the archaeological test excavation process, as outlined in the <i>Aboriginal cultural heritage consultation requirements for proponents 2010</i> (OEH, 2010b). This would include 28 days for stakeholders to review the draft test excavation methodology.</u> — <u>An AHIP would be required for the proposed modification prior to any work potentially impacting on Aboriginal objects.</u> — <u>If any unexpected Aboriginal objects, or potential objects, are uncovered during construction, work in the vicinity should cease, and OEH and Darkinjung LALC should be contacted in accordance with the unexpected finds protocol outlined in the project construction environmental management plan.</u>
	<p>Traffic, transport and access</p>
P.1	<p>A construction traffic management plan (CTMP) would be prepared as part of the pre-construction planning. The plan would be developed to address construction traffic and transport management and would also be used to develop site-specific traffic management measures once the construction methods and haulage routes are finalised.</p>
P.2	<p>Heavy vehicles would be restricted to the routes specified.</p>

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
P.3	Disruption on the local road network would be minimised through the use of nominated haulage routes which aim to avoid sensitive areas such as schools, where possible (particularly the Central Coast Rudolf Steiner School and Follyfoot Farm Child Care Learning Centre).
P.4	Signs would be provided at each access point to assist in deliveries to each work site.
P.5	Traffic controllers would be located at each access point, where required and direct vehicle movements, vehicle deliveries, pedestrians and cyclists.
P.6	Emergency response protocols would be included in the CTMP for construction traffic incidents. Police/emergency services would respond to emergencies.
P.7	A pre and post construction assessment of road pavement assets would be conducted in areas likely to be used by construction traffic.
P.8	The potential for flooding on construction vehicle access roads would be identified and alternative access roads identified (as required).
P.9	Environmental controls would be installed at access roads so that mud or gravel is not tracked onto the road network from the access roads by construction vehicles (as required).
P.10	Public communications would be conducted to warn the community and local residents of vehicle movements and anticipated effects on the local road network relating to the site works. These methods would be detailed in the CTMP.
P.11	Access to all private properties adjacent to the works would be maintained during construction.
P.12	During Project inductions, all heavy vehicle drivers would be provided with the emergency response plan for construction traffic incidents.
P.13	Road safety audit(s) would be undertaken (where required or deemed necessary).
P.14	Project staging, vehicle movement and scheduling, equipment and resourcing would be co-ordinated throughout construction.
P.15	<p><u>The following measures are proposed in relation to the temporary alternative access routes:</u></p> <ul style="list-style-type: none"> — <u>The following restrictions would apply to construction vehicle movements for construction and use of the alternative access routes:</u> <ul style="list-style-type: none"> — <u>No heavy construction vehicle access through the Enterprise Drive and Turpentine Road intersection.</u> — <u>No right turn movements would be permitted for vehicles accessing Turpentine Road from Enterprise Drive.</u> — <u>No heavy vehicle access through the intersection of Enterprise Drive and Old Chittaway Road.</u> — <u>The project construction traffic management plan (see section 7.6.4 of the project REF) would be updated to include the proposed modification. Traffic control would be defined and implemented to control traffic flow in accordance with the traffic management plan.</u>

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	Socio-economic
Q.1	<p>The following measure would be undertaken to minimise impacts to local amenity and character of the area during construction:</p> <ul style="list-style-type: none"> — Undertake consultation with sensitive receivers and adjacent residents about their concerns and suggestions for reducing the proposals impact, such as type of fencing, screening vegetation etc. — Ensure that consideration is given to lighting impacts from the proposal and that where possible lighting spill is directed away from surrounding residents — Develop and maintain a mechanism for recording and responding to complaints from the community with respect to air quality impacts on sensitive receptors — Consult with and inform all sensitive receptors regarding the timing of construction activities and provide advanced notice for activities which may be particularly dusty, noisy activities or which would involve night works — Develop and maintain a complaints register to monitor noise and vibration impacts on sensitive receivers.
Q.2	<p>The community would be notified in advance of any rail shutdown periods where works are proposed to be undertaken as part of the Project.</p>
Q.3	<p>The following measures would be undertaken to minimise impacts to business and other employment services during construction:</p> <ul style="list-style-type: none"> — Where possible, Transport for NSW would ensure that employment opportunities for the local and regional population are maximised — Where possible, Transport for NSW would look to target sectors where unemployment is greatest, and maximise opportunities (through training opportunities) for youths and indigenous members of the community.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
Q.4	<p>The following measure would be undertaken to minimise impacts to safety and security during construction:</p> <ul style="list-style-type: none"> — Best practices and processes would be adopted for safety and security in compliance with a Workplace Health and Safety Management Plan — All construction areas would be fenced off to restrict access to public — The facility would be designed to clearly delineate public areas from restricted areas — Clear sightlines would be provided throughout the maintenance facility, where possible — A lighting design which conforms to Australian and Sydney Trains standards and provides well-lit and uniform lighting to maintenance facility would be provided — Vegetation in and around the site would be maintained to a low height to improve surveillance opportunities — Where required, vandal resistant fittings and graffiti resistant surfaces would be considered as part of the detailed design — High security perimeter fencing and signage would be provided to deter unauthorised access to the maintenance facility, including suitable vehicle and pedestrian gates at appropriate locations around the perimeter of the site — High security locking devices, window treatments and electronic access control would be considered as part of the detailed design — Intruder alarm system(s) and closed-circuit television (CCTV) to monitor nominated restricted areas would be considered during detailed design — External lighting would be provided to vehicular and pedestrian movement areas, including roads, paths and car parks, in order to provide visibility and safety at night.
Q.5	<p>With respect to the temporary alternative access routes, the following measures are proposed:</p> <ul style="list-style-type: none"> — Additional consultation with sensitive receivers and adjacent residents about their concerns and suggestions for reducing impacts from the proposed modification — Any private property impacted by the proposed modification would be returned to pre-existing conditions, or as otherwise mutually agreed to with the landowner.
Land use and property	
R.1	<p>Consultation and communication would be undertaken with property owners near the Project about any changes to property access and local access during construction and operation.</p>
R.2	<p>Ongoing consultation and communication with directly affected property owners about potential property acquisition would be undertaken prior to commencement of construction. This would include the provision of information on the timing of acquisition and the process for property acquisition.</p>
R.3	<p>Property acquisition would be managed in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i>.</p>
R.4	<p>On completion of construction activities, land used for the temporary construction site, stockpiles and drainage sumps/basins would be revegetated and left in a stable condition. Where these properties have been leased by Transport for NSW, these properties would be returned to the original landowners following rehabilitation of the site(s).</p>

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
R.5	With respect to the temporary alternative access routes, any private property impacted by the proposed modification would be returned to pre-existing conditions, or as otherwise mutually agreed to with the landowner.
Hydrology, drainage and flooding	
S.1	Site offices, staff facilities and construction compound would be located at least above the 1:100 AEP flood level, including an allowance for climate change. This may require these temporary structures to be installed on fill pads or piers.
S.2	Any temporary flood diversion works would be sized for a 1:20 AEP event to allow for the proposed construction program.
S.3	A flood evacuation plan would be developed prior to any work commencing on-site as part of the construction documentation.
S.4	No stockpiles would be located within high/medium flood risk areas or adjacent to existing culverts in order to reduce the potential impacts to surface water systems.
S.5	The proposed pier locations for the new rail bridge crossings would be situated so as to minimise the Projects impact on surface water flows and flooding.
S.6	All track drainage would be designed to meet Transport for NSW standards and Engineers Australia's Australian Rainfall and Runoff.
S.7	The existing track drainage system would remain operational throughout the construction of the main line siding and turnouts within the facility.
S.8	<p>The following measures are proposed in relation to the temporary alternative access routes:</p> <ul style="list-style-type: none"> — The Construction Environmental Management Plan (CEMP) for the approved project would be updated to include the alternate access road — Relevant management and mitigation measures for construction approved project, as detailed in the <i>InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo</i> (WSP Parsons Brinkerhoff, 2016), would be implemented for the proposed modification — Any temporary flood diversion works would be adequately sized for a 2 year Average Recurrence Interval storm event, as recommended in the Blue Book (Landcom, 2004) — The CEMP, and associated flood evacuation plan, would be updated to include the alternate access route prior to any work commencing on-site. It is known that part of the area is isolated during flood events as low as the 20% AEP. Contractors would be responsible for implementing their own flood emergency management plan — To reduce the potential impacts to surface water systems, no stockpiles would be located within high/medium flood risk areas or adjacent to culverts — The Chittaway Road turning circle would be stabilised to minimise erosion and scour which contribute to higher sediment and nutrient runoff — The banks and riparian vegetation of Ourimbah Creek (adjacent to the turning circle) would be protected during construction.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
Groundwater	
T.1	A construction groundwater management plan would be prepared which would detail the control measures that aim to reduce potential impacts to groundwater. A groundwater monitoring program would be included in the plan, and outline the monitoring network and baseline requirements (number of piezometers, groundwater levels, and analytical suite) prior to the commencement of construction, enabling any changes to groundwater levels and quality during construction to be identified.
T.2	Excavation techniques and other mitigation measures would be implemented to minimise impacts to groundwater and reduce the take of water. Factors for consideration would include the duration the excavation would remain open, particularly in areas of expected higher inflows; the size of the excavation; the water table depth; and the material to be excavated.
T.3	Management and disposal of any encountered groundwater would occur in accordance with the waste classification guidelines (NSW EPA, 2014) and the water discharge and reuse guideline (Transport for NSW, 2017).
T.4	Preparation and implementation of hazardous material procedures would occur, including procedures for managing spills and refuelling.
Soils, geology and contamination	
U.1	An Erosion and Sedimentation Control Plan (ESCP) would be developed and maintained for the site in accordance with <i>Managing Urban Stormwater, Soils and Construction Guidelines</i> (Landcom, 2004). The plan would include site access controls preventing tracking of sediment from site, limiting the removal of groundcover and ensuring that the excavation works do not block natural drains or create undrained areas.
U.2	All material required for off-site disposal would be appropriately tested and classified against the Waste Classification Guidelines prior to being disposed of off-site (DECC, 2008).
U.3	Excavated material would be reassessed for reuse onsite.
U.4	Stabilised surfaces would be reinstated as quickly as practicable after construction.
U.5	Sediment would be prevented from moving off-site and sediment laden water prevented from entering any watercourse, drainage line or drainage inlet.
U.6	Site rehabilitation of disturbed areas would be undertaken progressively as activities are completed during the Project.
U.7	A hazardous material (hazmat) building survey be undertaken prior to demolition of any building structure, especially any structure likely to have been built (or include materials manufactured) before 1990.
U.8	The CEMP would include a contamination management plan and an asbestos management plan (if deemed to be required).
U.9	All fuels, chemicals and hazardous liquids would be stored within an impervious bunded area in accordance with Australian standards and EPA Guidelines.
U.10	Spill kits and a temporary refuelling bund would be installed and used onsite (where necessary).
U.11	If fill material is discovered during excavation works, the material should remain on-site where possible (where contaminant concentrations meet the National Environment Protection Council's <i>National Environment Protection (Assessment of Site Contamination) Measure 1999</i>).

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
U.12	Should any signs of contamination be identified during work within the site, the material would be tested against the National Environment Protection Council's National Environment Protection (Assessment of Site Contamination) Measure 1999, and managed accordingly.
U.13	Procedures for handling asbestos contaminated materials (if found on site), including record keeping, site personnel awareness and waste disposal would be undertaken in accordance with WorkCover requirements.
U.14	Characterisation of acid sulfate soil impacts in areas of known occurrence and preparation of an Acid Sulfate Soil Management Plan to manage potential impacts would be undertaken as part of the ESCP.
Waste and resource management	
V.1	All waste requiring off-site disposal would be classified in accordance with the OEH's <i>Waste Classification Guidelines</i> (DECCW 2009) prior to disposal. The following key waste mitigation and management strategies would be implemented throughout the construction of the Project and would be governed by the CEMP:
V.2	Removal of wastes from site would only be undertaken by a licensed contractor with appropriate approvals by the NSW DECCW under the POEO Act.
V.3	Construction materials would be purchased in accordance with an established procurement strategy that prioritises the selection of materials that utilise best practice recycled materials and sustainability ratings.
V.4	Where possible construction wastes would be diverted from landfill and recycled or reused within the Project areas or with an appropriate recycling contractor.
V.5	Sewage waste would be disposed of by a licensed waste contractor in accordance with Sydney Water and OEH requirements.
V.6	Construction materials that contain minimal embodied energy would be utilised.
V.7	Working areas would be maintained, kept free of rubbish and cleaned up at the end of each working day.
Air quality	
W.1	<p>A Dust Management Plan would be produced as part of the overall CEMP. This would identify specific construction activities with potential to impact air quality and contain details of the site-specific mitigation measures to be applied. Additional guidance on the control of dust at construction sites in NSW is provided as part of the NSW EPA Local Government Air Quality Toolkit.</p> <p>As part of the Dust Management Plan, a survey of the condition of existing buildings within the vicinity of the Project site would be undertaken to identify the extent of existing dust prior to commencement of construction works. The proposed list of properties to be assessed would be determined during detailed design and would require approval by Transport for NSW.</p>
W.2	A mechanism for making, recording and responding to all air quality complaints from the community would be put in place during construction. This would include provision of relevant contact details and making the complaint log available to the local authority if requested.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
W.3	<p>Regular inspections of the work site to monitor compliance with the Dust Management Plan would be carried out. This would include an increased frequency of monitoring when activities with a high potential to produce dust are being carried out or during prolonged dry or windy conditions.</p> <p>Dust and weather monitors would be required to be maintained at reasonable intervals along the length of the Project construction boundary in order to identify any potential exceedances of dust or other emissions.</p>
W.4	<p>Dust mitigation measures would be developed and implemented prior to and during construction including:</p> <ul style="list-style-type: none"> — Erection of solid screens around dusty activities where feasible — Planning of dusty work as far away as possible from sensitive receivers, where feasible — Use of wet methods and coverings for barriers and stockpiles — Water assisted dust sweepers would be used on the access and local roads to remove any material tracked out by the trucks — Dust suppression techniques such as ventilation during cutting, grinding or sawing activities would be used where required — Skips and chutes would be covered — An adequate supply of water would be maintained on site for dust/particulate matter suppression, including use of non-potable water where possible.
W.5	<p>Construction plant and equipment would be well maintained so that vehicular emissions would be within relevant air quality standards.</p>
W.6	<p>All on-road vehicles would comply with relevant legislative requirements, where applicable, and where not in use for long periods of time, vehicles would be switched off.</p>
W.7	<p>The use of diesel or petrol powered generators would be avoided and mains electricity or battery powered equipment used where practicable. Where the use of this equipment is required, shielding or enclose would be utilised where possible to minimise impacts.</p>
W.8	<p>During earthworks, visual inspections for dust in windy or dry periods would be undertaken. Dust generating activities should be avoided or minimised during these periods. Appropriate water suppression measures would be used on exposed surfaces and equipment that may be generating dust.</p>
W.9	<p>Should exceedances of dust monitoring be identified, all reasonable efforts to minimise impacts to surrounding property water supplies would be undertaken including (but not limited to):</p> <ul style="list-style-type: none"> — Washing/cleaning of roofs — Replacement of tank water (where there is a concern that this has been contaminated) — Replacement of filters etc.
W.10	<p>The following measures are proposed in relation to the temporary alternative access routes:</p> <ul style="list-style-type: none"> — The proposed modification would be incorporated into the Air Quality Environmental Control Plan for the approved project — A suitable pavement surfacing would be installed on unsealed roads for dust suppression — A water cart would be used during construction and use of the temporary alternative access routes, where required.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	Climate change and greenhouse gases
X.1	<p>During construction, the following mitigation measures would be implemented in order to reduce the amount of emissions:</p> <ul style="list-style-type: none"> — Purchasing electrical energy derived from a renewable energy source, where available — Using low greenhouse gas-intensive construction materials (where a suitable substitute for a high greenhouse gas-intensive material is available) — Procuring construction services and materials locally to minimise the distance travelled and therefore emissions of vehicles accessing the site — Ensuring that deliveries are managed in an efficient manner to minimise the number of trips required and therefore reduce the amount of emissions — Implementing energy-efficient work practices, such as switching off construction plant, vehicles and equipment when not in use to minimise idling — Regularly monitoring, auditing and reporting on energy, resource use and associated greenhouse gas emissions as part of the environmental reporting requirements specified within the CEMP — Selecting materials during construction planning to ensure products that reduce embodied carbon are considered and used — Ensuring clearance of vegetation be limited to the minimum that is required for the Project — Ensuring all vegetation cleared be disposed of at a registered compost facility in the Sydney area and that it is not to be sent to landfill or burnt.
	Bushfires
Y.1	A Bushfire Management Plan would be incorporated into the overall CEMP for the Project, including emergency contact numbers in the event of a bushfire or emergency.
Y.2	The construction of the Project would ensure that an asset protection zone (APZ) around the Project site is provided for the life of the development, comprising an area of physical separation between all built structures and potential bushfire hazards. This could include elements such as the new access road and the proposed detention basins.
Y.3	Appropriate access tracks would be maintained to all sections of the Project site during construction and operation to allow safe access, egress and a defensible space for emergency services in the event of a bushfire or emergency.
Y.4	The CEMP would include emergency evacuation procedures in the event of a bushfire or emergency. This would include a map of all potential access tracks to and from the site, in addition to the primary access route for site personnel.
Y.5	The CEMP would include identification of designated smoking zones for site personnel within the Project site during construction or operation of the maintenance facility.
Y.6	The emergency/evacuation plan for the site would be prepared in accordance with the relevant NSW Rural Fire Service Guidelines for the preparation of emergency/evacuation plan(s).
Y.7	Sources of gas and electricity would be located so as not to contribute to the risk of fire or impede the firefighting effort.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
Y.8	In relation to the temporary alternative access routes, the proposed modification would be incorporated into the Bushfire Management Plan for the approved project, including emergency evacuation procedures.
	Public utilities
Z.1	<p>Should the location of any utilities be identified to be in conflict with the Project, a formal review of the proposed works at these location(s) would be undertaken in consultation with the construction contractor. Alternative arrangements would then be determined to provide the most beneficial outcome for the community, service provider and proposal in terms of safety and constructability. The strategy for the preferred hierarchy of utilities treatment as part of the Project would be as follows:</p> <ul style="list-style-type: none"> — Do nothing – avoid impact on utilities where possible — Protect – protect utilities in their existing locations where feasible — Modify access – modify manholes/chambers to provide side access outside the alignment of the Project, where these are located beneath the proposed alignment — Relocate – utilities to be relocated only where no other options are feasible or acceptable.
Z.2	The nominated construction contractor would be responsible for monitoring existing utilities to ensure they are protected properly from damage during construction.
Z.3	A contingency management plan would be prepared to detail contingency planning in case of service interruption.
Z.4	<p>All construction works which are near or around utilities would be carried out in accordance with relevant legislative requirements including, but not limited to:</p> <ul style="list-style-type: none"> — Work Health and Safety Act 2011 — Safety Regulation 2001 on Work near Underground Assets — Dial Before You Dig Asset Protection Guidelines.
Z.5	In relation to the temporary alternative access routes, protection of above ground services would be installed where required to prevent potential damage from collision with construction vehicles.
	Hazard and risk
AA.1	Any storage of hazardous materials, and refuelling/maintenance of construction plant and equipment, would be undertaken in clearly marked designated areas that are designed to contain spills and leaks with appropriate bunding.
AA.2	Machinery would be checked daily to ensure there is no leaking oil, fuel or other liquids.
AA.3	A Work Health and Safety Plan would be developed to manage construction safety hazards for the facility.
AA.4	Contingency plans would be developed to deal with any spills which might occur during construction.
AA.5	All hazardous materials spills and leaks would be reported immediately to site managers and Transport for NSW or Sydney Trains as required. Actions would be immediately taken to remedy spills and leaks.
AA.6	Chemical spill kits would be readily available and accessible to construction workers. Kits would be kept at site compounds and on specific construction vehicles. Environmental control maps and/or site maps would illustrate the location of the spill kits.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
AA.7	In relation to the temporary alternative access routes, barriers would be installed for the length of rail service road to provide separation from the active rail corridor.
	Cumulative impacts
AB.1	Transport for NSW and the nominated contractor would consult with the proponents of other major Projects in the area to avoid any potential cumulative impacts.
AB.2	Transport for NSW would consult with Road and Maritime Services and the OEH to identify potential opportunities to provide cumulative off-sets for the overall loss of <i>Melaleuca biconvexa</i> .

7.2.3 OPERATION

Table 7.3 Operational environmental management measures

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	Noise
AC.1	An Operational Noise and Vibration Review would be developed which would include management strategies designed to meet the environmental noise objectives for the Project and would include consideration of: <ul style="list-style-type: none"> — Alternative methodologies for horns, warning signals and horn testing at the facility — Standing of trains outside of the maintenance building and on standing tracks six and seven during evening and night periods — Restrictions on external cleaning during the evening and night period — Strategies to control other noise sources such as shunt vehicles; vehicle movement alarm systems; mechanical plant (including backup generator(s)) and PA systems.
AC.2	The maintenance shed would be constructed to achieve a sound insulation performance no less than 26dB R _w (weighted sound reduction index).
AC.3	The maintenance shed doors would remain closed when activities are occurring inside the sheds, where reasonable.
AC.4	As part of the Operational Noise and Vibration Review, surveys of existing properties with the potential for vibration impacts would be undertaken. These surveys would form a baseline for identification of potential impacts caused by the operation of the maintenance facility (for which rectification works may be required).
AC.5	Post-construction noise monitoring would be carried out during the operation to ensure compliance with the final noise goals for the facility.

ID NUMBER	ENVIRONMENTAL MANAGEMENT MEASURE
	Traffic, transport and access
AD.1	<p>The following management and mitigation measures would be implemented during operation, where these are reasonable and feasible:</p> <ul style="list-style-type: none"> — Limiting of vehicle trips to outside of the road network peak hour for improved safety and intersection operation, where possible or practicable — Scheduling delivery and service vehicles to the site out of peak hour periods, where possible or practicable — Informing staff and visitors to the site of the preferred travel route and primary site access — Monitoring intersection access and obtain feedback from staff on its operation — Monitoring any parking overflow on the surrounding road network (if any).
	Groundwater
AE.1	A hazardous material procedure, including procedures for managing spills and refuelling, would be developed and implemented to minimise groundwater contamination from chemical spills and leaks.
	Air quality
AF.1	During operation of the facility, ancillary service vehicles and maintenance equipment would be operated and maintained in accordance with the manufacturer's requirement and the POEO Act.
	Climate change and greenhouse gases
AG.1	A climate change risk management plan would be developed as part of the CEMP and would provide opportunities to manage climate change risks to the Project into the future as data on climate change impacts becomes more robust.
	Hazard and risk
AH.1	An incident emergency spill plan would be developed for the site. The plan would include measures to avoid spillages of fuels, chemicals, and fluids onto any surfaces or into any adjacent/nearby waterways. An emergency spill kit would be kept on site at all times.
AH.2	All staff would be made aware of incident emergency procedures and the location of emergency spill kits.
AH.3	The maintenance facility would be designed to comply with Sydney Trains operational safety, signalling and operating procedures. Operational hazards would be managed through Transport for NSW's standard procedures for hazard and risk that are currently in place across the entire rail network.

8 JUSTIFICATION AND CONCLUSION

8.1 JUSTIFICATION

Justification for the approved project was described in the project REF. The primary need for the approved project is a direct result of the current procurement of the New Intercity Fleet trains and the requirement to adequately maintain these trains.

In the project REF, it was proposed that access for construction vehicles for the approved project would also occur via the new access road, and associated road bridge, which would be constructed as part of the enabling/early works. Transport for NSW has since appointed a construction contractor (John Holland Group) that has undertaken further design and construction planning. As a result, the construction methodology has been refined and the new access roadway, bridge and maintenance facility will be constructed concurrently. This will mean the maintenance facility will be delivered as efficiently as possible and ensure that operations can commence in 2020 to support the introduction of the New Intercity Fleet. A temporary, alternative access road is therefore required to provide access for construction vehicles up until construction of the new access road bridge is completed, which is expected to occur in mid-2019.

Further discussion regarding the overall need and justification for the proposed modification has been provided in Chapter 2 of this Addendum REF.

8.2 SUSTAINABLE DEVELOPMENT CONSIDERATIONS

Transport for NSW is committed to ensuring that its Projects are implemented in a manner that is consistent with the principles of ecologically sustainable development (ESD). Section 9.2 of the project REF summarised how the four principles of ESD were addressed through the design and assessment processes for the approved project.

The proposed modification would adopt the environmental management measures for the approved project (where relevant) and is considered to be consistent with the approved project's adherence with the principles of ESD.

8.3 CLAUSE 228 CONSIDERATIONS

Consideration of Clause 228 of the *Environmental Planning and Assessment Regulation 2000* for the approved project was included in the project REF (WSP | Parsons Brinckerhoff, 2016a). Table 8.1 provides a summary checklist of matters to be considered against the additional impacts from the proposed modification.

Table 8.1 Clause 228 considerations

	CLAUSE 228 CONSIDERATIONS	ADDITIONAL IMPACT
a	Any environmental impact on a community? Some adverse effects on the local community are anticipated during the construction and use of the proposed modification, particularly in relation to construction noise and vibration, heavy vehicle movements, visual amenity and dust generation during certain weather conditions.	Short-term negative
b	Any transformation of a locality? The proposed modification is temporary and no significant transformation of the locality is anticipated. Temporary visual and noise impacts would be managed through the mitigation measures described in sections 6.2.3 and 6.9 and Chapter 7.	Short-term negative

	CLAUSE 228 CONSIDERATIONS	ADDITIONAL IMPACT
c	<p>Any environmental impact on the ecosystems of the locality?</p> <p>The Project would result in additional clearing of approximately 0.1 hectares of native vegetation, comprising Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast, which is not considered consistent with any listed community under the BC Act or EPBC Act.</p> <p>No impacts to threatened flora species, including Biconvex Paperbark (<i>Melaleuca biconvexa</i>) (listed under as Vulnerable under the TSC Act and BC Act) are anticipated for the proposed modification.</p> <p>Impacts to threatened fauna, including Mahonys Toadlet, are not anticipated.</p> <p>Biodiversity impacts associated with the proposed modification are further discussed in section 6.2 and Appendix A. Impacts on flora and fauna would be managed through a management measures detailed in section 6.2.4 and 7.2.</p> <p>No significant impact on a threatened species listed as Vulnerable under both the TSC Act and EPBC Act are anticipated, and a SIS is not required for the proposed modification.</p>	Nil
d	<p>Any reduction of the aesthetics, recreational, scientific or other environmental quality or value of a locality?</p> <p>The proposed modification would not result in a reduction to the aesthetic, recreational, scientific or other environmental quality of the locality due to small area of additional vegetation clearing required for construction.</p>	Nil
e	<p>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>No formal or potential non-Aboriginal heritage items have been identified within the study area, and no impact by the proposed modification is anticipated.</p> <p>There are no known Aboriginal heritage items identified within the proposed modification (refer to section 6.4), however a portion of the proposed modification has been identified as having moderate archaeological potential. Excavation work may uncover or harm previously undiscovered Aboriginal objects. Further investigation would be undertaken to confirm the presence of Aboriginal heritage. Measures would be adopted during construction to manage and protect any unexpected Indigenous items, should such items be uncovered (refer to Table 8.2).</p> <p>Overall, the proposed modification is not anticipated to have a substantial effect on the aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance of the locality.</p>	Nil
f	<p>Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)?</p> <p>The proposed modification would require clearing of an additional 0.1 hectares of vegetation. This habitat may act as potential habitat for threatened fauna species however the incremental loss is not considered to be significant. There is also potential risk of fauna injury or death during construction and use of the temporary access, including Mahony's Toadlet. Additional measures to mitigate the effects of the construction and use of the temporary access are described in section 6.2.4.</p>	Nil

	CLAUSE 228 CONSIDERATIONS	ADDITIONAL IMPACT
g	<p>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>As discussed in (c) and (f) above, there would be requirement for clearance of native vegetation for the construction of the proposed modification. Parts of this vegetation are consistent with threatened ecological communities and may include threatened fauna and flora species. There is also potential risk of fauna injury or death during construction and use of the temporary access, including Mahony's Toadlet,</p> <p>Measures to mitigate the effects of the construction and operation of the proposed modification are described in section 7.2.</p>	Nil
h	<p>Any long-term effect on the environment?</p> <p>The proposed modification is temporary and is not anticipated to have any long-term effect on the environment.</p> <p>Mitigation measures to minimise the adverse impacts on the natural vegetation of the area are described in section 6.2.4.</p>	Nil
i	<p>Any degradation of the quality of the environment?</p> <p>The proposed modification would detract from the quality of the environment, particularly from noise and vibration during construction and use of the temporary access. These impacts are expected to be manageable through the implementation of the safeguards and management measures outlined in this REF.</p>	Short-term negative
j	<p>Any risk to the safety of the environment?</p> <p>Any additional construction safety hazards would be managed by the Work Health and Safety Plan. Management measures have been proposed to minimise risks associated with encountering contaminated land, groundwater as well as their subsequent disposal. Through implementation of the proposed management and mitigation measures within this Addendum REF, it is not anticipated that the proposed modification would result in any substantial risks to the safety of the existing environment.</p>	Nil
k	<p>Any reduction in the range of beneficial uses of the environment?</p> <p>Areas disturbed for the proposed modification would be rehabilitated to their original state, or as otherwise agreed with the landowner.</p> <p>With the implementation of the proposed management and mitigation measures within this Addendum REF, it is not anticipated that the proposed modification would result in any reduction in the range of beneficial uses of the environment.</p>	Nil
L	<p>Any pollution of the environment?</p> <p>There is minor potential for water and soil pollution during the construction and use of the temporary access. There would also be some exceedances in noise levels. These impacts are expected to be manageable through the implementation of the safeguards and management measures outlined in section 7.2 of this Addendum REF.</p>	Short-term negative

	CLAUSE 228 CONSIDERATIONS	ADDITIONAL IMPACT
m	<p>Any environmental problems associated with the disposal of waste?</p> <p>Waste generated by the proposed modification would be managed through the waste hierarchy established under the <i>Waste Avoidance and Recovery Act 2001</i>. All waste requiring off-site disposal would be classified in accordance with the NSW Office of Environment and Heritage's <i>Waste Classification Guidelines 2009</i> prior to disposal.</p>	Short-term negative
n	<p>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</p> <p>There would be no substantial increase in demand on resources that would likely become in short supply as a result of the proposed modification.</p>	Nil
o	<p>Any cumulative environmental effect with other existing or likely future activities?</p> <p>Cumulative environmental effects of the New Intercity Fleet Maintenance Facility Project with other known developments within the study area have been assessed in section 6.8.</p> <p>No cumulative environmental effects are anticipated for the proposed modification.</p>	Nil
p	<p>Any impact on coastal processes and coastal hazards, including those under Projected climate change conditions?</p> <p>The proposed modification is located away from the immediate coastline, it is not anticipated to impact on coastal processes or coastal hazards, including those projected under climate change conditions.</p>	Nil

8.4 CONSIDERATION OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Table 8.2 provides a summary checklist of matters of national environmental significance to be considered under the Commonwealth EPBC Act.

Table 8.2 Check-list of EPBC Act matters

	EPBC ACT MATTER	IMPACT
a	<p>Any impact on a World Heritage property?</p> <p>There are no World Heritage properties in the vicinity of the proposed modification.</p>	Nil impact
b	<p>Any impact on National Heritage Places?</p> <p>There are no National Heritage Places in the vicinity of the proposed modification.</p>	Nil impact
c	<p>Any impact on wetlands of international importance (declared Ramsar wetlands)?</p> <p>There are no wetlands of international importance in the vicinity of the proposed modification.</p>	Nil impact
d	<p>Any impact on Commonwealth listed threatened species and ecological communities?</p> <p>As discussed in section 6.2, impacts to threatened flora species, including Biconvex Paperbark (<i>Melaleuca biconvexa</i>) and EECs listed under the EPBC Act have been avoided for the proposed modification.</p>	Nil impact

	EPBC ACT MATTER	IMPACT
e	<p>Any impact on Commonwealth listed migratory species?</p> <p>No migratory species were recorded within the proposed modification, however a number of migratory species under the EPBC Act have the potential to occur within the vicinity of the proposed modification. No impact on these species from the proposed modification is anticipated.</p>	Nil impact
f	<p>Any impact on a Commonwealth marine area?</p> <p>The proposed modification is not located in the vicinity of a Commonwealth marine area.</p>	Nil impact
g	<p>Any impact on Commonwealth land?</p> <p>The proposed modification would not affect Commonwealth land.</p>	Nil impact
h	<p>Any impact on the Great Barrier Reef Marine Park?</p> <p>The proposed modification is not located in the vicinity of the Great Barrier Reef Marine Park.</p>	Nil impact
i	<p>Does any part of the Project involve a nuclear action?</p> <p>No nuclear actions are proposed as part of the proposed modification.</p>	Nil impact
j	<p>Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?</p> <p>The proposed modification would not be undertaken by the Commonwealth or a Commonwealth agency.</p>	Nil impact

8.5 SIGNIFICANCE OF THE ENVIRONMENTAL IMPACTS

The potential impacts of the approved project were considered in accordance with the requirements of the EP&A Act (section 5.5), the EP&A Regulation (clause 228) and the EPBC Act.

As detailed in Table 8.1 and Table 8.2, the majority of potential adverse impacts from the proposed modification are likely to be short-term in nature. A key impact includes noise generated from construction and use of the proposed modification would exceed the applicable noise management levels at some additional nearby receivers. Mitigation measures have been proposed to minimise potential impacts.

Impacts to threatened species and ecological communities have been eliminated through design, which avoided sensitive areas of vegetation. The proposed modification would result in the clearing of an additional 0.1 hectares of native vegetation, however this impact is considered to be consistent with the impacts to biodiversity identified in the SIS (WSP | Parsons Brinckerhoff, 2016c) and additional SIS (WSP | Parsons Brinckerhoff, 2017b) prepared for the approved project, with no further assessment required. The proposed modification would have no additional impacts on matters of national environmental significance (refer to Table 8.2).

This Addendum REF has considered the potential additional impacts associated with the proposed modification and cumulative impacts of the modified project. With the implementation of suitable management and mitigation measures which have been identified as part of this environmental assessment and summarised in Chapter 7, the additional impacts associated with the proposed modification and cumulative impacts associated with the modified project, are not likely to significantly affect the environment.

8.6 CONCLUSION

The potential impacts of the proposed modification have been considered in accordance with the requirements of the EP&A Act (section 5.5), the EP&A Regulation (clause 228) and the EPBC Act.

The key potential impacts associated with the Project have been identified as comprising:

- Biodiversity – including the loss of 0.1 hectares of existing vegetation
- Noise and vibration – including impacts during both construction and use of the proposed modification
- Aboriginal heritage – including the potential to identify currently undiscovered Aboriginal artefacts within the footprint of the proposed modification
- Traffic and transport – which would primarily occur during the temporary use of the proposed modification
- Hydrology, flooding and groundwater – including the potential to be impacted by the 1:100-year flooding event.

Chapter 6 of this Addendum REF provides a detailed assessment of the likely effect of the proposed modification including the key impacts listed above.

Provided that the proposed safeguards and mitigation measures are implemented, the overall impacts associated with the proposed modification and the cumulative impacts of the modified project are not likely to significantly affect the environment. Accordingly, an EIS under Part 5 Division 5.2 of the EP&A Act is not required for the modified project.

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- WSP | Parsons Brinckerhoff 2016b, New Intercity Fleet Maintenance Facility Project – Biodiversity Assessment Report
- WSP | Parsons Brinckerhoff 2016c, New Intercity Fleet Maintenance Facility Project – Species Impact Statement

WSP | Parsons Brinckerhoff, 2016d, New Intercity Fleet Maintenance Facility Project – Noise and Vibration Impact Assessment

WSP | Parsons Brinckerhoff, 2016e, New Intercity Fleet Maintenance Facility Project – Additional Impact Piling Construction Assessment

WSP | Parsons Brinckerhoff, 2016f, New Intercity Fleet Maintenance Facility Project – Traffic and Transport Impact Assessment

WSP | Parsons Brinckerhoff 2016g, InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment

WSP | Parsons Brinckerhoff 2017a, New Intercity Fleet Maintenance Facility Combined Submissions Report

WSP | Parsons Brinckerhoff 2017b, New Intercity Fleet Maintenance Facility Project – Additional Species Impact Statement

WSP 2018a, New Intercity Fleet Maintenance Facility, Temporary Alternative Access - Ecological Constraints Report

WSP 2018b, New Intercity Fleet Maintenance Facility – Addendum assessment of additional construction activities and access routes

WSP 2018c, New Intercity Fleet Maintenance Facility - Addendum Traffic Impact Assessment

WSP 2018d, New Intercity Fleet Maintenance Facility – Addendum Flooding, drainage and water quality technical assessment

Wyong Shire Council 2011, Bushfire Prone Land Map

Wyong Shire Council 2013, Wyong Local Environmental Plan

Wyong Shire Council 2015, Tuggerah Lakes Estuary Report Card.

APPENDIX A

ECOLOGICAL CONSTRAINTS REPORT



TRANSPORT FOR NSW

JUNE 2018

TEMPORARY ALTERNATE ACCESS - ECOLOGICAL CONSTRAINTS REPORT

NEW INTERCITY FLEET
MAINTENANCE FACILITY,
KANGY ANGY

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Temporary Alternate Access - Ecological Constraints Report New Intercity Fleet Maintenance Facility, Kangy Angy

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GLOSSARY

AWS	All weather station
BAC	Biodiversity Assessment Calculator
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.
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
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 <i>Threatened Species Conservation Act 1995</i> and the <i>Environment Protection and Biodiversity Conservation Act 1999</i> and both the State Office of Environment and Heritage Office of Environment and Heritage (OEH) and Federal Department of the Environment and Energy (DoEE) 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.
Dead stag	Dead standing trees that provide habitat for fauna
Ecological community	An assemblage of species occupying a particular area.
Environmental weed	Any plant that is not native to a local area that has invaded native vegetation.
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
Department of the Environment and Energy (DoEE)	Former name of the Commonwealth Department of the Environment (DoE).
FM Act	NSW <i>Fisheries Management Act 1994</i>
Habitat	An area or areas occupied, or periodically or occasionally occupied by a species, population or ecological community, including any biotic or abiotic components.
Ha	Hectare
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.
LGA	Local Government Area

Likely	Taken to be a real chance or possibility (Department of Environment and Conservation 2004b).
Locality	The area within 10 kilometre of the study area.
Local population	The population that occurs within the study area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (Department of Environment and Climate Change 2007c).
Migratory species	Species protected as Migratory under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> . 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> .
NPandW Act	NSW <i>National Parks and Wildlife Act 1974</i>
Office of Environment and Heritage (OEH)	<p>Following the 2010 NSW elections the NSW Department of Environment Climate Change and Water (DECCW) was abolished, is now known as the Office of Environment and Heritage, and has been incorporated into the Department of Premier and Cabinet.</p> <p>Broadly, the Office of Environment and Heritage works towards a healthy environment cared for and enjoyed by the whole NSW community: manages the state’s natural resources, including biodiversity, soils and natural vegetation: manages natural and cultural heritage across the state’s land and waters: acts to minimise the impacts of climate change: promotes sustainable consumption, resource use and waste management: regulates activities to protect the environment: and conducts biodiversity, plant, environmental and cultural heritage research to improve decision making.</p>
Plant Community Type (PCT)	A NSW plant community type identified using the VIS classification system.
Protected species	Those species defined as protected under the <i>National Parks and Wildlife Act 1974</i> . Includes all native animals, and all native plants listed on Schedule 13 of the <i>National Parks and Wildlife Act 1974</i> .
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 2007c).
SIS	Species Impact Statement
Study area	The specific area that has been assessed for flora and fauna present.
Threatened biodiversity	<p>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>.</p> <p>Capitalisation of the terms ‘Threatened’ in this report refers to listing under the relevant State and/or Commonwealth legislation.</p>

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.
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i> repealed and replaced by the NSW <i>Biodiversity Conservation Act 2016</i> as of the 25 August 2017.
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 2007c).
Weeds of National Significance	In 1998, Australian governments endorsed a framework to identify which weed species could be considered (WONS) within an agricultural, forestry and environmental context. Thirty one WONS were identified through this process (Biosis Research 2003).

EXECUTIVE SUMMARY

WSP has been commissioned by Transport for NSW to prepare an Ecological Constraints Report for proposed modifications to the New Intercity Fleet Maintenance Facility project ('the approved project') at Kangy Angy in New South Wales. The proposed modifications include upgrades of existing roads surrounding the approved project area and an access road within the rail corridor to provide temporary access for construction vehicles associated with the approved project (proposed alternate access road). This Ecological Constraints Report is one of a number of technical reports supporting the Addendum Review of Environmental Factors (REF) for the modifications to the project.

This Ecological Constraints Assessment was used by Transport for NSW and the project construction manager during the site selection process to identify potential ecological constraints. Ecological constraints identified during the initial site inspection included:

- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed as Endangered under the NSW *Biodiversity Conservation Act 2016* (BC Act)
- River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed as Endangered under the BC Act
- Populations of *Melaleuca biconvexa* (Biconvex Paperbark) listed as Vulnerable under the BC Act and Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Mahony's Toadlet (*Uperoleia mahonyi*) habitat listed as Endangered under the BC Act
- Other non-threatened native vegetation, which provided habitat for threatened fauna species such as Regent Honeyeater, Swift Parrot, Grey-headed Flying-fox and Little Lorikeet.

Following the initial site inspection an ecological constraints workshop was undertaken to discuss potential opportunities to avoid, minimise and mitigate impacts to these ecological constraints wherever possible.

The initial site inspection and ecological constraints workshop enabled all threatened ecological communities, *Melaleuca biconvexa* populations and Mahony's Toadlet habitat to be avoided. Residual impacts associated with the proposed alternate access tracks (clearing and trimming of 0.1 hectares of non-threatened native vegetation, being PCT 1568), which were unable to be avoided, will be mitigated further wherever practicable during the construction phases of the project.

A consistency assessment of the residual impacts on biodiversity against the projects current approvals (i.e. EPBC Act approval (EPBC 2016/7681) and final concurrence approval (Additional SIS) from the Chief Executive of the NSW Office of Environment and Heritage) was undertaken. The additional impact of 0.1 hectares of non-threatened native vegetation is considered to be consistent with impacts originally assessed as part of the New Intercity Fleet Maintenance Facility Project - Species Impact Statement (WSP | Parsons Brinckerhoff 2016b) (SIS) and New Intercity Fleet Maintenance Facility Project - Additional Species Impact Statement (WSP | Parsons Brinckerhoff 2017) (Additional SIS).

1 INTRODUCTION

WSP has been commissioned by Transport for NSW (Transport for NSW) to prepare an Ecological Constraints Report for a proposed modification to the New Intercity Fleet Maintenance Facility project ('the approved project'). This Ecological Constraints Report has been prepared to assess the likely impacts of the proposed modification on biodiversity.

Figure 1.1 below provides an overview of the study area and locality of the proposed modification which is the subject of this Ecological Constraints Report.

1.1 PROJECT BACKGROUND

1.1.1 THE APPROVED PROJECT

In May 2014, the NSW Government announced its intention to invest in the procurement of the New Intercity Fleet, a fleet of trains that will carry Central Coast, Newcastle, the Blue Mountains and South Coast customers to and from Sydney. The introduction of the New Intercity Fleet will allow for the replacement of the older train fleets used currently to provide intercity services, improving the level of customer service, reducing operational costs and increasing capacity for intercity passengers. The primary need for the proposed New Intercity Fleet Maintenance Facility is a direct result of the procurement of the New Intercity Fleet trains and the need to adequately maintain them, as well as to improve current train operations across the Sydney metropolitan network.

The development of the New Intercity Maintenance Facility was determined by Transport for NSW in August 2017 and is described in greater detail the *New Intercity Fleet Maintenance Facility Review of Environmental Factors* (Transport for NSW, 2017a) (the 'project REF'), *New Intercity Fleet Maintenance Facility Combined Submissions Report* (Transport for NSW, 2017b) (the 'project submissions report') and *New Intercity Fleet Maintenance Facility Determination Report* (Transport for NSW, 2017b).

The key features of the approved project included construction and operation of (refer to Figure 1.1):

- The fleet maintenance building, and associated infrastructure
- Administration buildings and other facilities
- New railway track infrastructure, including a new rail bridge (consisting of two separate structures) over Chittaway Creek and Turpentine Road
- A new access roadway and bridge to the maintenance facility site off Enterprise Drive
- Relocation of the existing high voltage power transmission line and Combined Services Route.

1.1.2 BIODIVERSITY ASSESSMENTS

This Ecological Constraints Report should be read in conjunction with the following biodiversity technical reports prepared to assess the impacts of the approved project on biodiversity:

- New Intercity Fleet Maintenance Facility Project - Species Impact Statement (WSP | Parsons Brinckerhoff 2016b)
- New Intercity Fleet Maintenance Facility Project - Additional Species Impact Statement (WSP | Parsons Brinckerhoff 2017)
- New Intercity Fleet Maintenance Facility Project – Biodiversity Assessment Report (WSP | Parsons Brinckerhoff 2016a).

1.1.3 PROPOSED ALTERNATE ACCESS MODIFICATION

The proposed modification includes upgrades of existing roads surrounding the approved project site and an access road within the rail corridor to provide temporary access for light and heavy construction vehicles associated with the approved project.

Access for heavy vehicles would be derived via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road).

Access for light vehicles would be derived via Turpentine Road and Ourimbah Road, with no upgrades to the existing roads required for access.

The proposed modification includes:

- Widening of a small section of Hereford Street and Chittaway Road around the existing rail underpass to provide sufficient turning room for longer vehicles, including a turning area on the western side
- Upgrade of the existing rail service road, including widening create bi-directional road sections
- Construction of a temporary heavy vehicle access road connection between the maintenance facility site and the rail service access road.

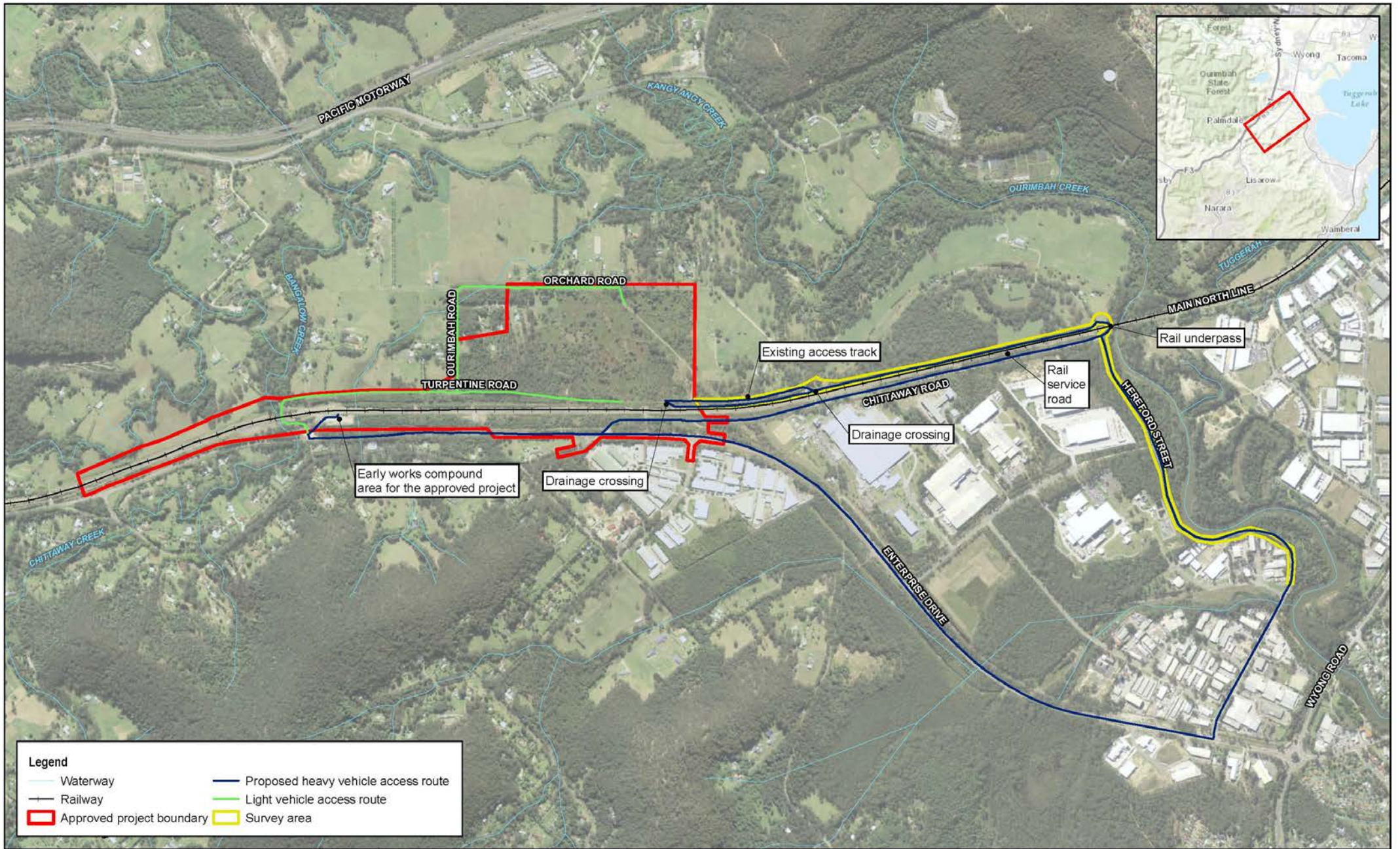
Further detail regarding the proposed scope of works associated with the proposed modification is provided in Chapter 3 of the addendum REF.

The location of the proposed modification and proposed access routes are shown in Figure 1.1.

1.2 AIMS

The aims of this Ecological Constraints Report are to examine and describe the biodiversity values and constraints within the study area to avoid and minimise impacts to biodiversity where possible. Specifically, the aims of this report are to:

- Identify the presence and/or likelihood of occurrence of threatened flora and fauna species/populations and their habitat that may occur within the study area
- Identify the vegetation communities found within the study area through a combination of field surveys, existing mapping and aerial photography interpretation
- Provide a vegetation map that identifies the distribution of all vegetation communities and highlights the presence of relevant threatened ecological communities listed under NSW and Commonwealth legislation
- Identify and map areas of biodiversity value within the subject site, based on a variety of ecological factors that can be utilised for consideration by Transport for NSW and the project construction manager to avoid and minimise impacts when determining the final development footprint
- Provide a consistency assessment of the proposed temporary alternate access track with current approved projects significance assessment for impacts to biodiversity under the NSW and Commonwealth legislations where relevant, and recommendations for additional approvals if required.



Legend

- Waterway
- Railway
- Approved project boundary
- Proposed heavy vehicle access route
- Light vehicle access route
- Survey area

Map: 2202522A_GIS_F134_A3
 Author: MitchellEm
 Date: 21/06/2018
 Approved by: -




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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 1.1
 Project locality and study area

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2 METHODOLOGY

The ecological constraints assessment included a review of previous biodiversity assessments, as well as desktop searches and historical records, field survey and ecological constraints workshop to discuss avoidance of the key constraints identified. This section outlines the specific methods used to survey and assess biodiversity within and surrounding the site.

2.1 PERSONNEL

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

Table 2.1 Study team

NAME	QUALIFICATIONS	POSITION AND ROLE
Alex Cockerill	Bachelor of Science (Hons), Accredited Biodiversity Assessment Method (BAM) Assessor (No. BAAS17020)	Principal Ecologist – technical review
Tanya Bangel	Bachelor of Science (Hons), Diploma Conservation and Land Management	Senior Ecologist – field surveys and reporting
Clementine Watson	Bachelor of Environmental Science and Management	Ecologist – reporting
Allan Richardson	Bachelor of Science (Hons)	Senior Ecologist – field surveys
Emily Mitchell	Bachelor Development Studies, Cert 4 Spatial Information Services	GIS consultant – map preparation

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 *National Parks and Wildlife Act 1974* (since repealed and replaced by Section 2.14 of the *NSW Biodiversity Conservation Act 2016* (BC Act)) (License Number: SL100630) as well as an animal research authority issued by the Department of Primary Industries.

2.2 NOMENCLATURE

Names of vegetation communities used in this report are based on the Plant Community Type (PCT) used in the NSW BioNet Vegetation Classification Database (Office of Environment and Heritage 2018b).

These names are cross-referenced with those used for threatened ecological communities listed under the BC Act and/or the EPBC Act. They are also cross-referenced with previous vegetation mapping (Bell 2002, 2009; Eco Logical Australia 2016; Somerville 2009) using dominant species and structure of the community.

Names of plants used in this document follow PlantNet (Royal Botanic Gardens 2018). Scientific names are used in this report for species of plant. Scientific and common names (where available) are provided in the plant list provided in Appendix A. The names of introduced species are denoted with an asterisk (*).

For threatened species of plants, the names used in the OEH Threatened Species Website (Office of Environment and Heritage 2018c) are also provided in Appendix A where these differ from the names used in the PlantNet database.

Names of vertebrate fauna follow the Australian Faunal Directory maintained by the Department of Environment and Energy (2018). Common names are used in the report for species of animal. Both common and scientific names are provided in the appendices.

For threatened species of animals, the names used in the OEH Threatened Species Website and NSW Department Primary Industries are provided (Office of Environment and Heritage 2018c).

2.3 DESKTOP ASSESSMENT

The aim of this background research was to identify threatened flora and fauna species, populations, ecological communities, Commonwealth listed migratory species or critical habitat recorded previously or predicted to occur near the study area.

This allowed the known habitat characteristics to be compared with those of the study area to determinate the likelihood of occurrence of each species or population. These results informed the identification of appropriate field survey effort focussed on the groups most likely to be present. This assessment included a review of:

- Research papers, books and other published data
- Topographic map and aerial photographs
- Previous vegetation mapping (refer to Section 2.4.1.1), ecological studies and other relevant studies of the study area and locality:
 - New Intercity Fleet Maintenance Facility Project - Species Impact Statement (WSP | Parsons Brinckerhoff 2016b)
 - New Intercity Fleet Maintenance Facility Project - Additional Species Impact Statement (WSP | Parsons Brinckerhoff 2017)
 - New Intercity Fleet Maintenance Facility Project – Biodiversity Assessment Report (WSP | Parsons Brinckerhoff 2016a).
- Database searches detailed in Table 2.2.

Table 2.2 Database searches

DATABASE	SEARCH DATE	AREA SEARCHES	REFERENCE
PlantNet Database	5/04/2018	Wyong Local Government Area	Royal Botanic Gardens (2018)
BioNet Atlas of NSW Wildlife	9/04/2018	10 x 10 kilometre centred on the subject site	Office for Environment and Heritage (2018); Office of Environment and Heritage (2018a)
EPBC Protected Matters Search tool	5/04/2018	10 x 10 kilometre centred on the subject site	Department of the Environment and Energy (2018)
NSW WeedWise	5/04/2018	Greater Sydney Priority Weeds Region	Department of Primary Industries (2018)

2.4 FIELD SURVEY

The site was initially inspected during the day light hours by a team of two ecologists on the 26 and 27 March 2018. Following the initial site inspection an ecological constraints workshop was completed on the 17 April 2018. The surveys primarily sought to identify ecological constraints within the proposed alternate access track study area and where possible avoid and minimise impacts of the project on biodiversity. The weather conditions during the survey period were warm (ranging between 16.1 and 31.9°C) and generally dry.

2.4.1 FLORA SURVEY

The floristic diversity and possible presence of threatened species was assessed using a combination of random meander, plot-based (quadrat/transect) surveys and targeted threatened flora surveys as detailed below.

2.4.1.1 FIELD VERIFICATION OF EXISTING VEGETATION MAPPING

Vegetation within the study area and locality had been previously mapped at the regional scale by four mapping projects being:

- The natural vegetation of the Gosford Local Government Area, New South Wales (Bell 2009)
- The natural vegetation of the Wyong Local Government Area, New South Wales (Bell 2002)
- Hunter, Central and Lower North Coast Vegetation Classification and Mapping (Somerville 2009)
- Wyong Vegetation Map 2016 (Eco Logical Australia 2016)
- Previous vegetation mapping undertaken for the approved project (refer to Section 2.3).

Field validation (ground-truthing) of the existing vegetation classifications undertaken by regional vegetation mapping of the site was completed to confirm the vegetation structure, dominant canopy species, native diversity, condition and presence of threatened ecological communities. Field data was compared and analysed against the regional vegetation mapping key diagnostic species to confirm each vegetation type. Field verification of the vegetation type, class and formation was used to identify vegetation zones and conditions in accordance with the BAM and NSW BioNet Vegetation Classification Database (Office of Environment and Heritage 2018b).

2.4.1.2 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 manner throughout the site recording species observed, boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation patch was generally proportional to the size of the patch and its species richness.

2.4.1.3 BAM QUADRAT/TRANSECT SITE SURVEYS

Eight quantitative (quadrat/transect) site surveys (Table 2.3) were undertaken in accordance with the BAM and as described below. Figure 2.1 illustrates the plot layout that was used at each plot site.

Table 2.3 Location and orientation of BAM quadrats and transects

PLOT ID	PLANT COMMUNITY TYPE	EASTING	NORTHING	BEARING
Q1	PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (low condition)	351893	6311514	217
Q2	PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (low condition)	351669	6311270	40
Q3	PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (low condition)	352166	6311828	220
Q4	PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter (low condition)	353318	6311798	120
Q5	PCT 1564 Blackbutt – Rough-barked Apple – Turpentine – ferny tall open forest of the Central Coast (moderate condition)	352964	6311632	285
Q6	PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (moderate condition)	352759	6311795	105

PLOT ID	PLANT COMMUNITY TYPE	EASTING	NORTHING	BEARING
Q7	Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation	352603	6311852	275
Q8	PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (moderate condition)	3522372	6312027	170

Note: Co-ordinate GDA94 Zone 56

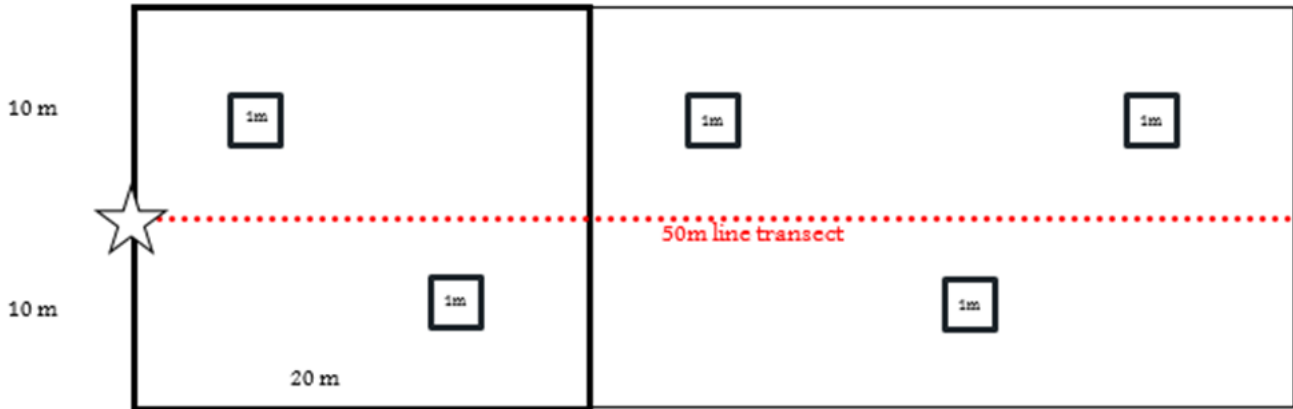


Figure 2.1 Schematic diagram illustrating the layout of the nested 20 x 50 metre, 20 x 20 metre and 1 x 1 metre sub-quadrats used for the assessment of condition attributes at each site

The following site attributes were recorded at each site:

- **Location** (easting – northing grid type MGA 94, Zone 56).
- **Vegetation structure and dominant species and vegetation condition.** Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer.
- **Native and exotic species richness** (within a 400 square-metres quadrat): This consisted of recording all species by systematically walking through each 20 x 20 metre quadrat. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded.
- **Number of trees with hollows** (1,000 square-metres quadrat): This was the frequency of hollows within living and dead trees within each 50 x 20 metre quadrat. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least 5 centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least 1 m above the ground and the (e) the centre of the tree was located within the sampled quadrat.
- **Number of large trees and stem size diversity** (1,000 square-metres quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metres from the ground) of all living trees (>5 centimetres DBH) within each 50 x 20 metre quadrat. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCT's benchmarks.
- **Total length of fallen logs** (1,000 square-metres quadrat): This was the cumulative total of logs within each 50 x 20 metre quadrat with a diameter of at least 10 centimetres and a length of at least 0.5 metres.
- **Litter cover:** This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter <10 centimetre which is detached from a living plant) from within five 1 x 1 metre sub-plots spaced evenly either side of the 50-metre central transect.
- **Evaluation of regeneration:** This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height \leq 5 centimetres).

2.4.1.4 CONDITION OF VEGETATION COMMUNITIES

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 and Heritage 2017). 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 vegetation broad condition states which were applied to vegetation within the study area are summarised in Table 2.4. These factors were defined by using factors such as levels of disturbance, weed invasion and resilience.

Table 2.4 Vegetation broad condition states

CONDITION CATEGORY	DESCRIPTION
High	Vegetation still retains the species complement and structural characteristics. The vegetation displays resilience to weed invasion due to intact groundcover, shrub and canopy layers. Native species diversity is relatively high. Weeds may exist in this vegetation type but exhibit <5 per cent foliage cover.
Moderate	Vegetation has generally retained a native canopy but the understorey and groundcover layers are generally co-dominated by exotic species that exhibit between 5–45 per cent foliage cover. The mid and low stratum may have been structurally modified because of previous clearing.
Low	Vegetation has retained a native canopy or the canopy cover is showing signs of regeneration. The understorey and groundcover layers are generally dominated or co-dominated by exotic species that exhibit between 46–70 per cent foliage cover. Native species diversity is generally relatively low and the mid and low stratum have been structurally modified due to weed incursions or clearing.

2.4.1.5 TARGETED MELALEUCA BICONVEXA SURVEYS

A random meander survey following Cropper (1993) was initially completed across the site to identify the species presence/absence. In areas where the species was detected, a more intensive survey in the form of parallel transects was carried out in accordance with the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage 2016b) and methodology used to assess *Melaleuca biconvexa* at the New Intercity Fleet Maintenance Facility Project to determine the extent of the population and the abundance of individuals present.

It is widely accepted that *Melaleuca biconvexa* reproduces from seedlings and multiple stems may arise from a single rootstock. Subsequently, it is difficult to estimate the population size from visual inspection (NSW Scientific Committee 2011a; Office of Environment and Heritage 2016a). To estimate the population size and abundance of *Melaleuca biconvexa* within the subject site two methods incorporating a broad visual abundance assessment and stem count were completed.

The visual abundance method was principally based on Duncan’s (2001) conservation assessment of abundance of each stand of *Melaleuca biconvexa* as High, Medium and Low and based on the following criteria:

- High: greater than 50 per cent cover abundance of *Melaleuca biconvexa*
- Medium: five to 50 per cent cover abundance of *Melaleuca biconvexa*
- Low: less than 5 per cent cover abundance of *Melaleuca biconvexa*.

To provide a more quantifiable estimate to the population size, a total stem count or estimate based on species density per hectare of *Melaleuca biconvexa* were completed for each age class classification. The three age classifications of *Melaleuca biconvexa* included:

- Mature/Intermediate: stem DBH at chest height greater than 200 millimetres and/or individual greater than six metres in height
- Immature: stem DBH at chest height less than 200 millimetres and individual less than six metres in height
- Saplings: stem DBH at chest height less than 200 millimetres and individual less than one metre in height.

The method used to determine the abundance of *Melaleuca biconvexa* was based upon the size of the population and density of individuals present. The two methods employed are described below.

- 1 Small population with low densities *Melaleuca biconvexa* (total stem count): performed parallel transects 20 metres apart counting all above ground stems of all age classes that had potential to be impacted upon by the project. Where possible each individual was marked using a GPS point with a five metre accuracy. Where dense thickets occurred a five metre radius counting all above stems were recorded and classified into the age class criteria.
- 2 Large populations with high numbers of *Melaleuca biconvexa* plant stems (estimate of stem count based on average densities): boundary of each large population was delineated and a total stem count of individuals of each age class were recorded from within a 20 x 20 metre quadrat. The number and position of quadrats completed varied dependent on the size and location of the population. The total stem count of individuals present was then calculated based on the average density of *Melaleuca biconvexa* and the area that it occupied within the subject site.

2.4.2 FAUNA SURVEY

Fauna surveys were limited to fauna habitat assessments (including habitat assessment for Mahony's Toadlet), identification of hollow bearing trees and opportunistic observations made whilst conducting flora surveys.

2.4.2.1 FAUNA HABITAT ASSESSMENT

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

- Structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources (including Koala feed trees)
- Presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles (including Dead stags)
- 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.

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.

2.5 LIKELIHOOD OF OCCURRENCE ASSESSMENT

The likelihood of threatened and migratory and threatened species populations occurring within the study area was assessed against the criteria outlined in Table 2.5.

Species subject to likelihood of occurrence assessments were those identified during the desktop and field based investigations and any additional species considered having the potential to occur in the professional opinion of contributors to this assessment.

Table 2.5 Likelihood of occurrence assessment

LIKELIHOOD OF OCCURRENCE	CRITERIA
Recorded	The species was observed in the subject site either during the current survey or during another recent survey.
High	<p>A species has a high likelihood of occurrence if:</p> <ul style="list-style-type: none"> — The subject site contains or forms part of a large area of high quality suitable habitat — Important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are abundant within the subject site — The species has been recorded recently in similar habitat in the locality — The subject site is likely to support a resident population or to contain habitat that is visited by the species during regular seasonal movements or migration.
Moderate	<p>A species has a moderate likelihood of occurrence if:</p> <ul style="list-style-type: none"> — The subject site contains or forms part of a small area of high quality suitable habitat — The subject site contains or forms part of a large area of marginal habitat — Important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are sparse or absent within the subject site — The subject site is unlikely to support a resident population or to contain habitat that is visited by the species during regular seasonal movements or migration but is likely to be used occasionally during seasonal movements and/or dispersal.
Low	<p>A species has a moderate likelihood of occurrence if:</p> <ul style="list-style-type: none"> — Potentially suitable habitat exists but the species has not been recorded recently (previous 10 years) in the locality despite intensive survey (i.e. the species is considered to be locally extinct) — The species is considered to be a rare vagrant, likely only to visit the subject site very rarely; e.g. during juvenile dispersal or exceptional climatic conditions (e.g. extreme drought conditions in typical habitat of inland birds).

2.6 CONSERVATION SIGNIFICANCE ASSESSMENT

To avoid and minimise impacts on biodiversity values located within the study area a conservational significance assessment was undertaken. This assessment involved identifying biodiversity values within the study area and assigning each value a conservational ranking based on a set conservational significance categories and principles.

Categories and principles used to rank biodiversity constraints within the subject site included:

- Presence of threatened ecological communities (including River-flat Eucalypt Forest and Swamp Sclerophyll Forest listed as Endangered under the BC Act)
- Presence of threatened species and native vegetation that provides habitat for threatened species such as *Melaleuca biconvexa* and Mahony's Toadlet
- Native remnant vegetation patches (size, connectivity and condition)
- Riparian vegetation
- Remnant vegetation habitat value i.e. core habitat, support for core habitat, urban remnant trees and other remnant vegetation (such as regrowth vegetation)
- Local and regional significance of remnant native vegetation.

The conservational significance assessment identified three conservational significance categories; high, moderate and low. The purpose of these categories was to identify areas of high, medium or low ecological constraints in aims of avoiding impact to these areas where possible.

Any highly disturbed areas with no or limited native vegetation have not been assigned to an ecological constraint class. These areas have minimal biodiversity restrictions, and are where proposed works should be prioritised over areas of native vegetation.

2.7 LIMITATIONS

No sampling technique can eliminate the possibility that a species is present on a site. 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 on site during surveys.

The data used in the assessment is based on results of the field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of survey, including the presence or otherwise of species.

Given the narrow nature of the study area some vegetation transects were located partially outside of the study area. These transects are however representative of the PCTs and condition of vegetation which occurred within the stud area.

3 EXISTING ENVIRONMENT

3.1 LANDSCAPE CONTEXT

The study area is partially located within the existing rail corridor which runs in a north-east direction. Within the rail corridor vegetation and associated habitats have been heavily modified by rail construction, modifications and maintenance and therefore largely occurred as regrowth vegetation experiencing high levels of edges effects. The remainder of the study area follows Hereford Street to the south. Vegetation immediately adjacent both sides of Hereford Street has been modified however, unlike the rail corridor, there were areas which had retained a mature canopy as well as native midstorey and understorey components.

Immediately surrounding the study area, the locality land uses include residential properties, commercial/industrial complexes, hobby farms, small to large areas of intact vegetation as well as rail, road and power infrastructure.

A summary of the landscape features for the site are provided below in Table 3.1.

Table 3.1 Landscape features

LANDSCAPE FEATURE	LAND FEATURE USED IN BIOBANKING
Local Government Area (LGA)	Central Coast Council
IBRA Bioregion, Subregion	Sydney Basin Bioregion, Wyong Subregion
Catchment Management Area (CMA)	Hunter/Central Rivers
Mitchell Landscape	Sydney – Newcastle Coastal Alluvial Plains
Botanical Subregion	Central Coast

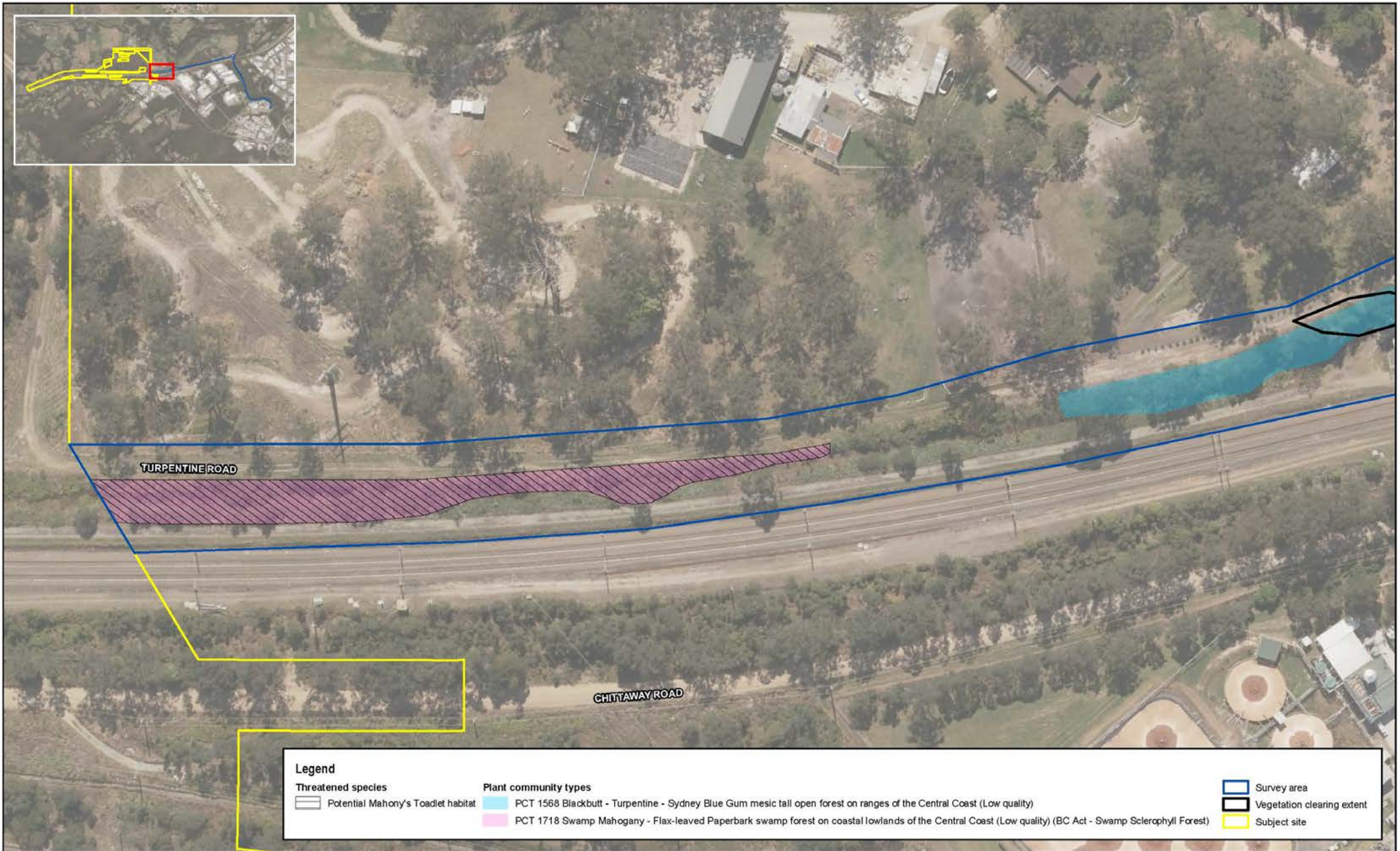
3.2 PLANT COMMUNITY TYPES

Four Plant Community Types (PCTs) and one non-native miscellaneous ecosystem were recorded within the study area. The majority of these PCTs were previously identified as occurring within the site by regional broadscale mapping projects. A summary of the PCTs identified within the study area are outlined below in Table 3.2.

Table 3.2 Vegetation communities mapped within the study area

PCT	WYONG LGA MAPPING (BELL, 2016)	THREATENED ECOLOGICAL COMMUNITY	EXTENT WITHIN STUDY AREA (HECTARES)	EXTENT WITHIN DEVELOPMENT FOOTPRINT (HECTARES)
PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	E-20 Alluvial Floodplain Shrub Swamp Forest	Swamp Sclerophyll Forest on Coastal Floodplains listed as Endangered under the BC Act	0.6	Nil
PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	W-9a Coastal Ranges Mesic Blackbutt Forest	Not listed	1.3	0.1

PCT	WYONG LGA MAPPING (BELL, 2016)	THREATENED ECOLOGICAL COMMUNITY	EXTENT WITHIN STUDY AREA (HECTARES)	EXTENT WITHIN DEVELOPMENT FOOTPRINT (HECTARES)
PCT 1564 Blackbutt – Rough-barked Apple – Turpentine – ferny tall open forest of the Central Coast	W-5h: Alluvial Riparian Blackbutt Forest	Not listed	0.3	Nil
PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter	W-37d Alluvial Floodplain Cabbage Gum Forest	River-flat Eucalypt Forest listed as Endangered under the BC Act	0.2	Nil
Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation	–	Not listed	3.5	0.3



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 Author: MitchellEm
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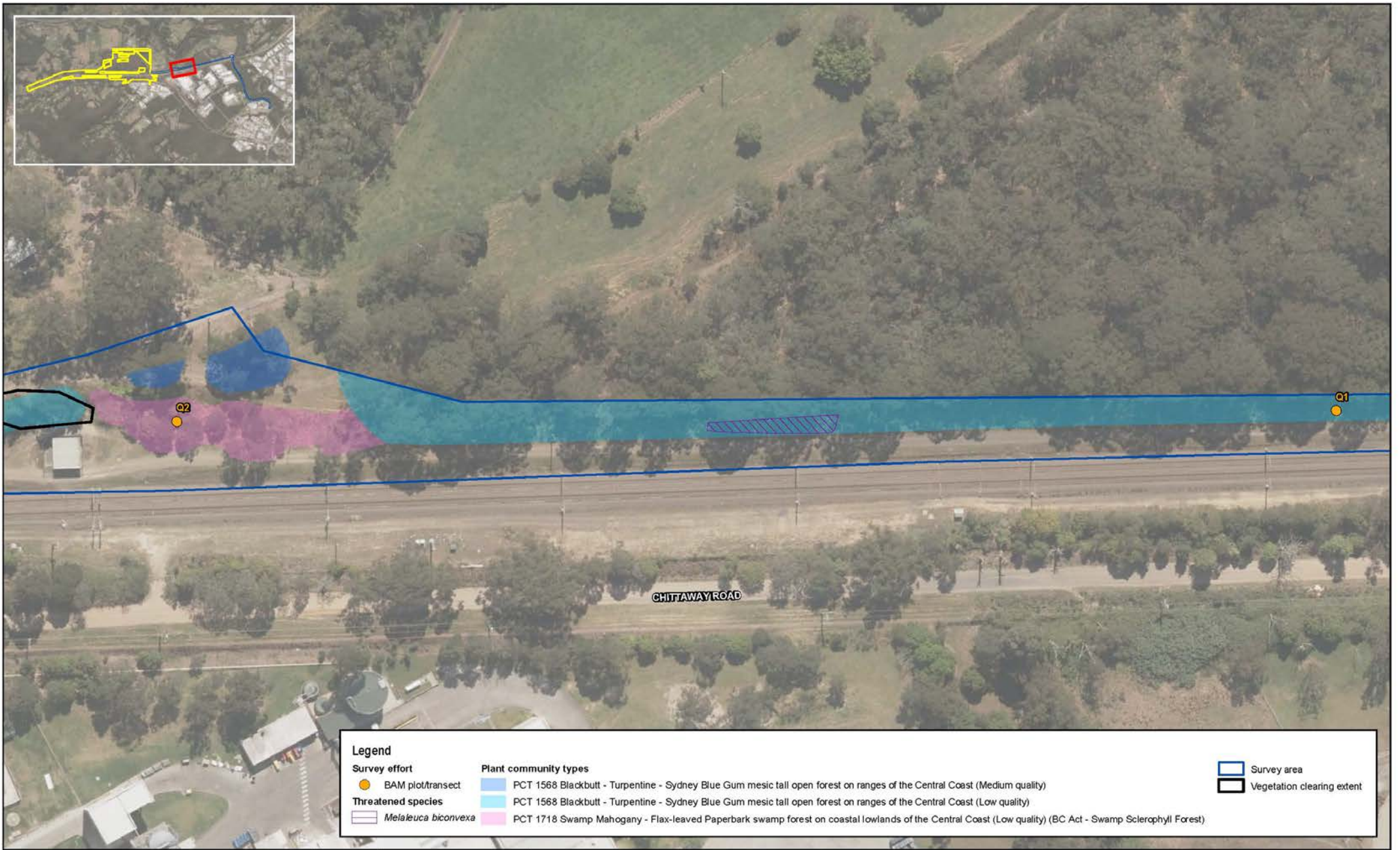
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Figure 3.1
 Biodiversity values within the study area
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Legend	
Survey effort	Plant community types
● BAM plot/transect	■ PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Medium quality)
Threatened species	■ PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Low quality)
■ <i>Melaleuca biconvexa</i>	■ PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (Low quality) (BC Act - Swamp Sclerophyll Forest)
	■ Survey area
	■ Vegetation clearing extent

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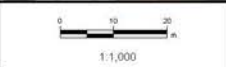
Figure 3.1
Biodiversity values within the study area
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Legend	
Threatened species	Plant community types
<i>Melaleuca biconvexa</i>	PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Low quality)
	PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (Low quality) (BC Act - Swamp Sclerophyll Forest)
	Survey area

Map: 2202522A_GIS_F135_A2	Author: MitchellEm
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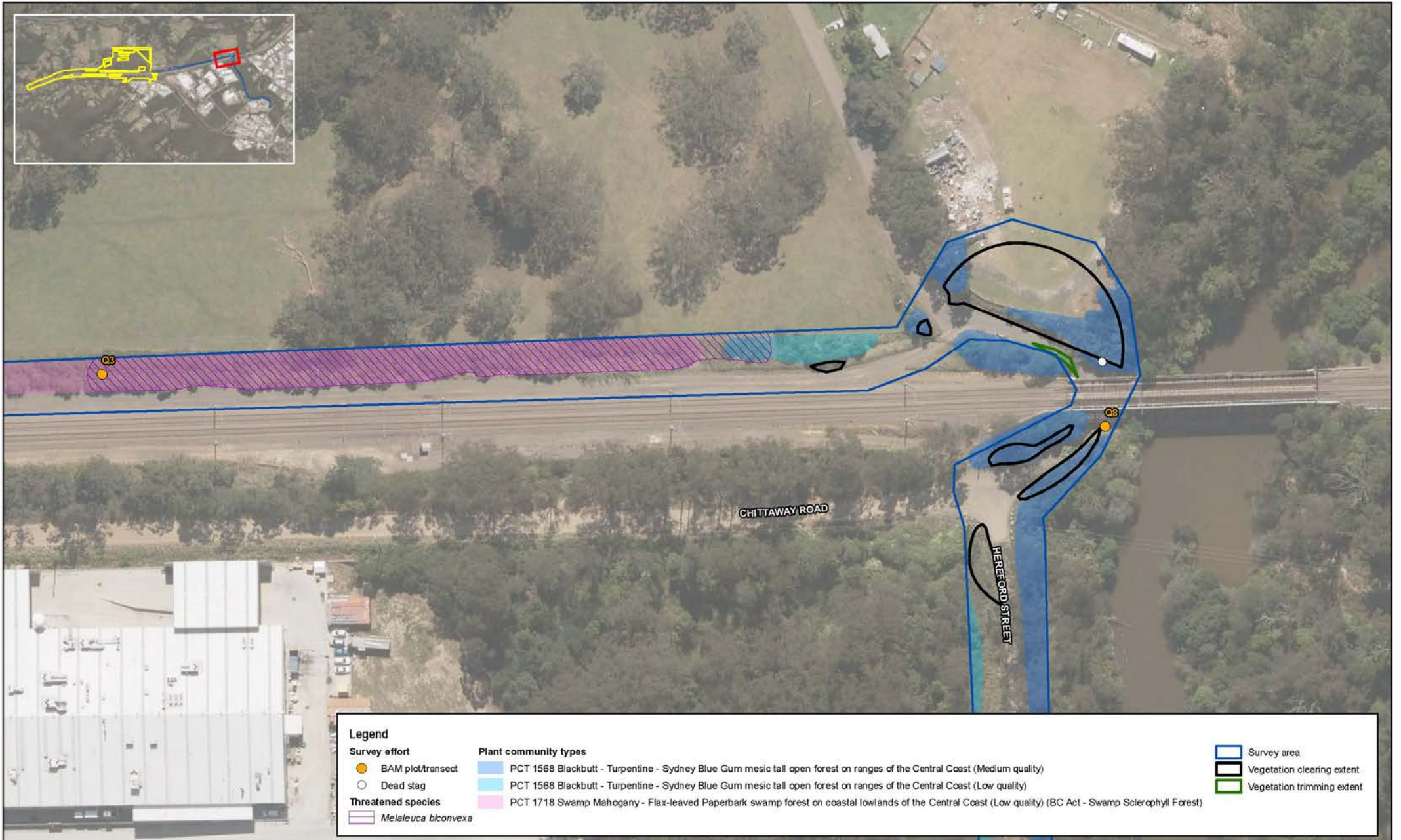
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Figure 3.1
 Biodiversity values within the study area
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Legend	
Survey effort	Plant community types
● BAM plot/transect	■ PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Medium quality)
○ Dead stag	■ PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Low quality)
Threatened species	■ PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (Low quality) (BC Act - Swamp Sclerophyll Forest)
■ <i>Melaleuca biconvexa</i>	
	■ Survey area
	■ Vegetation clearing extent
	■ Vegetation trimming extent

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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 3.1
 Biodiversity values within the study area
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Legend		Plant community types		Survey area
	BAM plot/transect		PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Medium quality)	
	Dead stag		PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Low quality)	
	Hollow-bearing tree			
Threatened species				
	<i>Melaleuca biconvexa</i>			

Map: 2202522A_GIS_F135_A2
 Author: MitchellEm
 Date: 28/05/2018
 Approved by: -



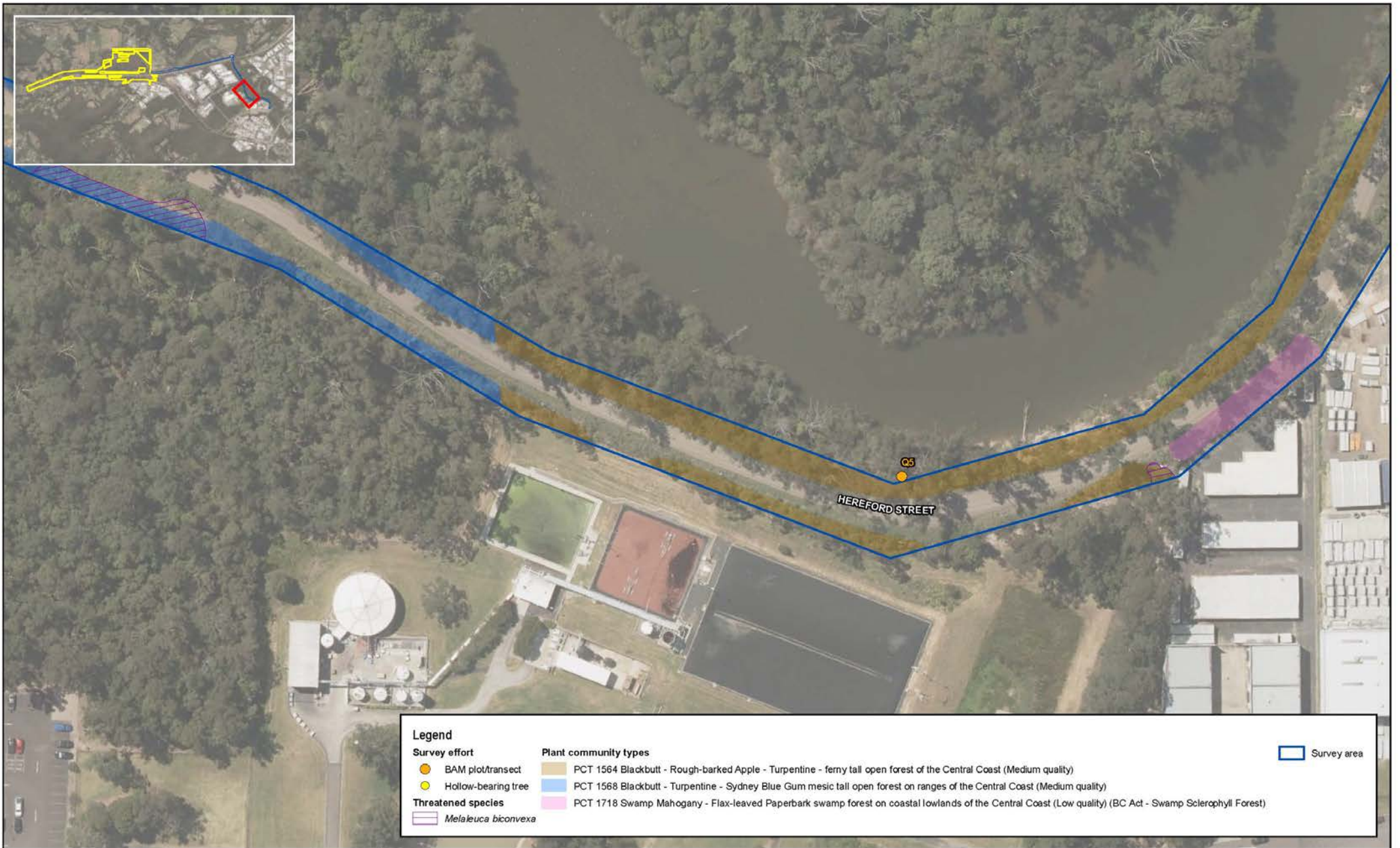
Data source: © Department of Finance, Services & Innovation 2017
 Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3



New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 3.1
 Biodiversity values within the study area
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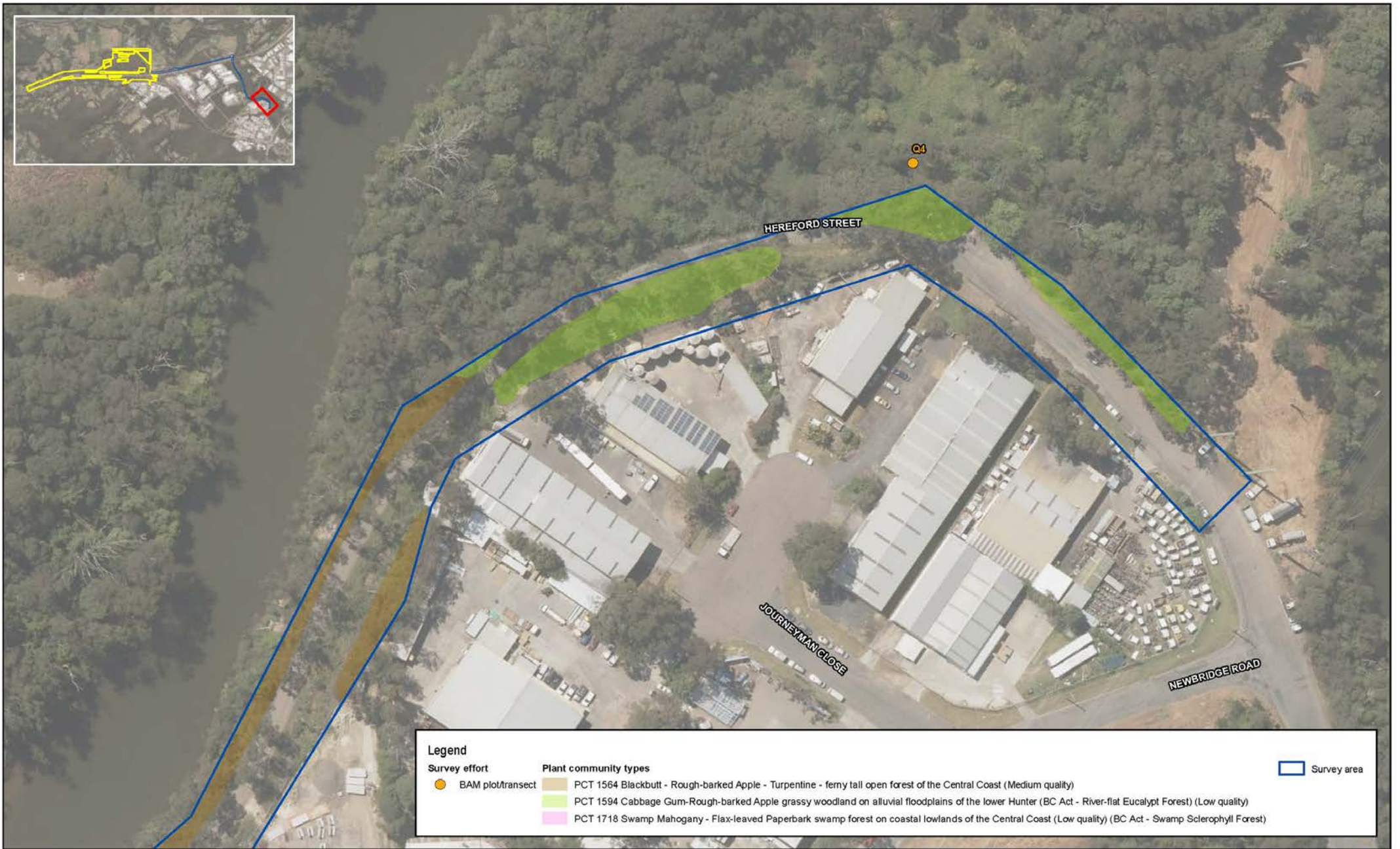
Map: 2202522A_GIS_F135_A2
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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 3.1
 Biodiversity values within the study area
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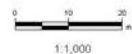


Map: 2202522A_GIS_F135_A2

Author: MitchellEm

Date: 28/05/2018

Approved by: -



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Coordinate system: GDA 1994 MGA Zone 56
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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 3.1
Biodiversity values within the study area
Page 7 of 7

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3.2.1 PCT 1718 SWAMP MAHOGANY – FLAX-LEAVED PAPERBARK SWAMP FOREST ON COASTAL LOWLANDS OF THE CENTRAL COAST

VEGETATION COMMUNITY DETAILS

Vegetation formation: KF_CH9 Forested Wetlands

Vegetation Class: Coastal Swamp Forests

PCT percentage cleared: 74

TEC: Swamp Sclerophyll Forest on Coastal Floodplains listed as Endangered under the BC Act

Broad scale mapping: E-20 Alluvial Floodplain Shrub Swamp Forest (Bell, 2016)

PCT JUSTIFICATION

Occurred in poorly drained clay and loamy soils on alluvial flats and drainage lines associated with the rail corridor. This vegetation type is consistent with the floristic, structural and landscape position as described for PCT 1718.

FLORISTICS AND STRUCTURE

Canopy: *Eucalyptus robusta*, *Angophora floribunda* and occasional *Casuarina glauca*.

Sub-canopy: *Melaleuca linariifolia*, *Callistemon salignus*, *Glochidion ferdinandi* var. *ferdinandi*, *Acacia irrorata* subsp. *irrorata* and a variety of *Melaleuca* species occasionally including *Melaleuca biconvexa*.

Shrub: *Leptospermum polygalifolium* subsp. *polygalifolium*, *Acacia longifolia*, *Breynia oblongifolia* and juvenile canopy and sub-canopy species.

Groundcover: *Gahnia clarkei*, *Entolasia stricta*, *Lomandra longifolia*, *Hypolepis muelleri*, *Baloskion tetraphyllum*, *Dianella caerulea* var. *producta* and *Imperata cylindrica* var. *major*.

VEGETATION ZONES

This vegetation type was recorded in one condition category:

Low condition – This condition was recorded along both the rail corridor and Hereford Street covering an area of 0.6 hectares. Two BAM plots (Q2, Q3) sampled this vegetation (Appendix A and Appendix B). Canopy was generally absent aside from the occasional semi-mature *Eucalyptus robusta*. Both understorey and groundcover components were generally present however heavily modified. Native species richness was generally low to moderate due to weed invasions associated with edge effects and regular maintenance.



PCT 1718 – low condition – containing *Melaleuca biconvexa* within rail corridor



PCT 1718 – low condition – within rail corridor

3.2.2 PCT 1568 BLACKBUTT – TURPENTINE – SYDNEY BLUE GUM MESIC TALL OPEN FOREST ON RANGES OF THE CENTRAL COAST

VEGETATION COMMUNITY DETAILS

Vegetation formation: KF_CH2B Wet Sclerophyll Forests (Shrubby sub-formation)

Vegetation Class: North Coast Wet Sclerophyll Forest

PCT percentage cleared: 40

TEC: Not listed as a TEC under BC Act or EPBC Act

Broad scale mapping: W-9a Coastal Ranges Mesic Blackbutt Forest (Bell, 2016)

PCT JUSTIFICATION

Tall forest with a mesic midstorey (particularly along Hereford Street) on sandstone derived soils. This vegetation type is consistent with the floristic, structural and landscape position as described for PCT 1568.

FLORISTICS AND STRUCTURE

Canopy: *Eucalyptus pilularis*, *Eucalyptus saligna* and *Angophora floribunda*.

Sub-canopy: *Syncarpia glomulifera* subsp. *glomulifera*, *Allocasuarina torulosa*, *Acmena smithii*, *Alphitonia excelsa* and *Commersonia fraseri*.

Shrub: *Glochidion ferdinandi* var. *ferdinandi*, *Notelaea longifolia*, *Breynia oblongifolia*, *Polyscias sambucifolia* subsp. long leaflets, *Pittosporum undulatum*, *Livistona australis*, *Pittosporum revolutum*, *Wilkiea huegeliana* and *Synoum glandulosum*.

Groundcover: *Calochlaena dubia*, *Lomandra longifolia*, *Dianella caerulea* var. *producta*, *Microlaena stipoides* var. *stipoides*, *Sigesbeckia orientalis*, *Opilmenus imbecillis*, *Blechnum cartilagineum*, *Doodia aspera* and *Gymnostachys anceps*. Climbers such as *Dioscorea transversa*, *Parsonsea staminea* and *Gynochthodes jasminoides* were also common.

VEGETATION ZONES

This vegetation type was recorded in two condition categories:

Moderate condition – This condition was recorded along the edges of Hereford Street covering an area of 0.6 hectares. Two BAM plots (Q6, Q8) sampled this vegetation (Appendix A and Appendix B). Vegetation condition showed evidence of all structural components with moderate edge effect influences associated with

Hereford Street and transmission easements. Native species richness was generally moderate to high.

Low condition – This condition was recorded predominantly along both the rail corridor and in small locations along Hereford Street covering an area of 0.7 hectares. One BAM plot (Q1) sampled this vegetation (Appendix A and Appendix B). Canopy was generally absent aside from the occasional semi-mature *Eucalyptus pilularis*. Both understorey and groundcover components were generally present however heavily modified. Native species richness was generally low to moderate due to weed invasions associated with edge effects and regular maintenance.



PCT 1568 – low condition – within rail corridor



PCT 1568 – moderate condition – along Hereford Street

3.2.3 PCT 1564 BLACKBUTT – ROUGH-BARKED APPLE – TURPENTINE – FERNY TALL OPEN FOREST OF THE CENTRAL COAST

VEGETATION COMMUNITY DETAILS

Vegetation formation: KF_CH2A Wet Sclerophyll Forests (Grassy sub-formation)

Vegetation Class: Northern Hinterland Wet Sclerophyll Forest

PCT percentage cleared: 1

TEC: Not listed as a TEC under BC Act or EPBC Act

Broad scale mapping: W-5h: Alluvial Riparian Blackbutt Forest (Bell, 2016)

PCT JUSTIFICATION

Tall forest dominated by *Eucalyptus pilularis* on sandstone derived soils along Ourimbah Creek. Whilst similar to PCT 1568, PCT 1564 exhibited drier characteristics (i.e. lacking a shrubby mesic midstorey). This vegetation type is consistent with the floristic, structural and landscape position as described for PCT 1564.

FLORISTICS AND STRUCTURE

Canopy: *Eucalyptus pilularis*, *Eucalyptus saligna*, *Angophora costata* and *Angophora floribunda*.

Sub-canopy: *Syncarpia glomulifera* subsp. *glomulifera*, *Allocasuarina torulosa*, *Acacia maidenii*, *Pittosporum undulatum*, *Acacia prominens* and *Exocarpus cupressiformis*.

Shrub: *Glochidion ferdinandi* var. *ferdinandi*, *Daviesia ulicifolia*, *Notelaea longifolia*, *Breynia oblongifolia*, *Polyscias sambucifolia* subsp. long leaflets, *Denhamia silvestris*, *Leucopogon lanceolatus* and *Myrsine variabilis*.

Groundcover: *Lomandra longifolia*, *Dianella caerulea* var. *producta*, *Entolasia stricta*, *Poa affinis*, *Imperata cylindrica* var. *major*, *Pseuderanthemum variabile*.

Echinopogon ovatus and *Pteridium esculentum*.

Climbers such as *Parsonsea staminea*, *Tylophora barbata*, *Eustrephus latifolius* and *Smilax australis* were also common.

VEGETATION ZONES

This vegetation type was recorded in one condition category:

Moderate condition – This condition was recorded along the edges of Hereford Street covering an area of 0.3 hectares. One BAM plot (Q5) sampled this vegetation (Appendix A and Appendix B). Vegetation condition showed evidence of all structural components with moderate edge effect influences associated with Hereford Street. Native species richness was generally high with minor weed incursions.



PCT 1564 – moderate condition – along Hereford Street

3.2.4 PCT 1594 CABBAGE GUM-ROUGH-BARKED APPLE GRASSY WOODLAND ON ALLUVIAL FLOODPLAINS OF THE LOWER HUNTER

VEGETATION COMMUNITY DETAILS

Vegetation formation: KF_CH9 Forested Wetlands

Vegetation Class: Coastal Floodplain Wetlands

PCT percentage cleared: 0

TEC: River-flat Eucalypt Forest on Coastal Floodplains listed as Endangered under the BC Act

Broad scale mapping: W-37d Alluvial Floodplain Cabbage Gum Forest (Bell, 2016)

PCT JUSTIFICATION

Open forest dominated by *Eucalyptus amplifolia* on alluvial terrace along Ourimbah Creek. This vegetation type is consistent with the floristic, structural and landscape position as described for PCT 1594.

FLORISTICS AND STRUCTURE

Canopy: *Eucalyptus amplifolia* and occasional *Eucalyptus saligna*, *Angophora floribunda* and *Eucalyptus tereticornis*.

Sub-canopy: *Acacia maidenii*, *Melaleuca linariifolia*, *Callistemon salignus*, *Glochidion ferdinandi* var. *ferdinandi* and *Acacia irrorata* subsp. *irrorata*.

Shrub: *Leptospermum polygalifolium* subsp. *polygalifolium*, *Breynia oblongifolia* and juvenile canopy and sub-canopy species.

Groundcover: *Gahnia clarkei*, *Carex appressa*, *Junus usitarius*, *Microlaena stipoides* var. *stipoides* and *Commelina cyanea*.

VEGETATION ZONES

This vegetation type was recorded in one condition category:

Low condition – This condition was recorded along the end of Hereford Street covering an area of 0.2 hectares. One BAM plot (Q4) sampled this vegetation (Appendix A and Appendix B). Canopy was present and dominated by *Eucalyptus amplifolia* however both the understorey and groundcover components were heavily disturbed and dominated by Lantana. Native species richness was generally low due to weed invasions associated with edge effects of the road.



PCT 1564 – low condition – along Hereford Street



PCT 1564 – low condition – along Hereford Street – understorey dominated by Lantana

3.2.5 MISCELLANEOUS ECOSYSTEM: HIGHLY DISTURBED AREAS WITH NO OR LIMITED NATIVE VEGETATION

VEGETATION COMMUNITY DETAILS

Vegetation formation: N/A

Vegetation Class: N/A

PCT percentage cleared: N/A

TEC: Not listed

Broad scale mapping: N/A

PCT JUSTIFICATION

This vegetation type is not associated with a PCT as it has been subjected to substantial physical, hydrological and chemical alterations and therefore is no longer consistent with any naturally occurring PCT. This miscellaneous ecosystem occurs throughout the study area as cleared lands dominated by weeds and/or exotic species. These areas occur as exotic grasslands with the occasional scattered planted tree predominantly along road and rail verges.

FLORISTICS AND STRUCTURE

Canopy: Generally absent aside from the occasional planted tree for example *Cinnamomum camphora** and *Callistemon* species.

Shrub: *Lantana camara**, *Solanum mauritianum** and the occasional *Leptospermum polygalifolium* subsp. *polygalifolium*, *Acacia longifolia* subsp. *longifolia* and *Breynia oblongifolia*.

Groundcover: Dominated by exotic species including *Setaria pumila**, *Paspalum quadrifarium**, *Setaria parviflora**, *Cynodon dactylon**, *Paspalum urvillei**, *Paspalum dilatum**, *Sida rhombifolia**, *Axonopus fissifolius** and *Andropogon virginicus**. Occasional disturb tolerant species such as *Imperata cylindrica* var. *major* were also recorded.

VEGETATION ZONES

This non-native vegetation type was recorded in one condition category:

Poor condition – This condition was recorded along the edges of Hereford Street and the road corridor. One BAM plot (Q7) sampled this vegetation (Appendix A and Appendix B). Canopy and midstorey components were generally absent aside the occasionally planted tree. Native species richness was generally low due to weed invasions associated (> 50 per cent exotic cover).



Miscellaneous ecosystem: highly disturbed areas with no or limited native vegetation within rail corridor



Miscellaneous ecosystem: highly disturbed areas with no or limited native vegetation along Hereford Street

3.3 PLANT SPECIES RECORDED

A high diversity of plant species were recorded from within the study area; both native and exotic. Native species diversity was generally higher within areas identified as PCT 1564 and PCT 1568 (Appendix A and Appendix B). Alternatively, native species diversity was lowest in areas immediately adjacent roads and the rail corridor which had been exposed to past clearing, regular vegetation maintenance and had high levels of weed invasion due to edge effects.

Generally, vegetation in moderate condition contained higher species richness (31 to 51 native species) whilst low to poor condition vegetation contained lower native species diversity (12 to 29 native species). An exception to this PCT 1568 (Q1) along the rail corridor which had high native species diversity however occurred as regrowth vegetation with no canopy (49 native species) (Appendix A and Appendix B).

3.3.1 PRIORITY WEEDS

Six species of plant identified within the site are listed as priority weeds under the NSW *Biosecurity Act 2015*. The priority weeds identified within the study area and the duty of land owners under the Act are outlined in Table 3.3.

Fifteen additional exotic species recorded weeds of concern identified by BAM as ‘High Threat Weeds’ were recorded on site and should be taken into consideration when managing weeds on site. These species included *Paspalum dilatatum**, *Ageratina adenophora**, *Andropogon virginicus**, *Erythrina sykesii**, *Ligustrum sinense**, *Paspalum urvillei**, *Paspalum quadrifarium**, *Araujia sericifera**, *Cinnamomum camphora**, *Ehrharta erecta**, *Ligustrum lucidum**, *Ochna serrulata**, *Senna pendula var. glabrata**, *Senecio madagascariensis** and *Tradescantia fluminensis**. All priority weeds listed in Table 3.3 are listed as ‘High Threat Weeds’.

Table 3.3 Priority weeds identified within the study area

SPECIES	DUTY	WONS
Bridal Creeper (<i>Asparagus asparagoides*</i>)	Prohibition on dealings – Must not be imported into the State or sold.	Yes
Ground Asparagus (<i>Asparagus aethiopicus*</i>)		Yes
Blackberry (<i>Rubus fruticosus</i> species aggregate*)	General Biosecurity Duty – All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes
Fireweed (<i>Senecio madagascariensis*</i>)		Yes
Lantana (<i>Lantana camara*</i>)		Yes
Willows (<i>Salix</i> species)		Yes

3.4 FAUNA HABITATS

The suitability, size and configuration of the fauna habitats correlated broadly with the vegetation communities, as summarised in Table 3.4. These areas provided habitat for a range of birds, herpetofauna and mammals, and vegetation communities within the study area and were observed to vary in suitability for native fauna from good to poor.

Habitat features recorded in the study area generally included those associated with swamp forest types occurring on flood plains in the Central Coast and wet sclerophyll forests occurring in sheltered gullies and drainage lines in the foot hills of near coastal ranges.

Table 3.4 Fauna habitat corresponding to vegetation communities

FAUNA HABITAT	CORRESPONDING VEGETATION COMMUNITIES
Forested Wetlands	<ul style="list-style-type: none"> — PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast — PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter.
Wet Sclerophyll Forest	<ul style="list-style-type: none"> — PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast — PCT 1564 Blackbutt – Rough-barked Apple – Turpentine – ferny tall open forest of the Central Coast.
Cleared land and scattered trees	<ul style="list-style-type: none"> — Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation.

3.4.1 FORESTED WETLANDS

Forested wetlands within the study area occurred as highly modified forests and regrowth lacking structural complexity. Along Hereford Street forested wetlands were limited to a single patch of isolated *Eucalyptus robusta* with an understorey dominated by exotic species. Along the rail corridor forested wetlands consisted of a scattered canopy of *Eucalyptus robusta*, *Angophora floribunda*, *Callistemon salignus* and Melaleuca species. Understorey components were generally scattered and co-dominated by exotic understorey species. This habitat type provided limited habitat features with little to no fallen timber, hollows or leaf litter recorded. This habitat type does however provide foraging habitat for seasonal blossom nomads and sheltering and foraging habitat for other small animals.

3.4.2 WET SCLEROPHYLL FOREST

This habitat type occurred as structurally intact forest and modified regrowth. Intact forest remnants occurred along Hereford Street where maintenance and clearing impacts were less whilst regrowth forms were largely limited to area within the rail corridor and immediately adjacent Hereford Street.

Structurally intact remnants of wet sclerophyll forest were dominated by a canopy of *Eucalyptus pilularis* (Blackbutt), *Eucalyptus saligna* (Sydney Blue Gum) and/or *Syncarpia gummifera* (Turpentine). This habitat contains the largest and most mature trees in the study area which are most likely to contain hollows, however very few hollows were observed within the study area. The canopy stratum of this forest type provided summer seasonal nectar foraging resources for nectarivorous birds, bats and arboreal mammals. The understorey and groundcovers were relatively open and sparse however contained fallen timber, leaf litter and other structural habitats likely to provide habitat for a range of bird, mammal, amphibian and bat species.

Regrowth wet sclerophyll forest generally lacked canopy cover however did contain regrowth Eucalypt and Melaleuca species. Understorey components were sparse to dense, and in areas dominated by Lantana, providing foraging and sheltering habitat for small animals, but displaces the natural structure provided by native vegetation.

3.4.3 CLEARED LAND WITH SCATTERED TREES

This habitat type occurs in areas that have been subject to substantial human disturbance such as clearing and maintenance associated with the existing rail corridor, Hereford Street and power transmission easements. This habitat type does not correspond to any native vegetation community.

Native vegetation in this habitat type is restricted to occasional trees, shrubs and groundcover plants within otherwise exotic vegetation.

This habitat is only likely to provide habitat for native and introduced fauna species that are adapted to open environments and tolerant of human disturbance. Many such native species (e.g. Noisy Miner, Sulphur-crested Cockatoo) have increased in abundance in response to human disturbance to the extent that they are now considered to be a threat to less adaptable species.

This habitat type is in poor condition and generally of very limited value to threatened fauna species.

4 THREATENED BIODIVERSITY

4.1 THREATENED ECOLOGICAL COMMUNITIES

Threatened ecological communities (Vulnerable, Endangered and Critically Endangered) are listed under the NSW *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Two Endangered ecological communities listed under the BC Act were identified within the study area being:

- Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- River-flat Eucalypt Forest on coastal floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

No threatened ecological communities listed under the FM Act or the EPBC Act were recorded from within the study area.

The threatened ecological communities recorded within the study area are discussed below in detail and the occurrence of each is provided in Figure 3.1.

4.1.1 SWAMP SCLEROPHYLL FOREST

Swamp Sclerophyll Forest is listed as Endangered under the BC Act. The entirety of vegetation identified as PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast recorded within the study area is considered consistent with this threatened ecological community as it conforms with the floristics, locality, landscape and geological characteristics as detailed in the *NSW Scientific Committee Final Determination for Swamp Sclerophyll Forest* (NSW Scientific Committee 2011b).

Specifically, vegetation classified as PCT 1718 within the study area occurred within the Central Coast Council LGA on alluvial flats and drainage lines within a coastal floodplain. The community was dominated by canopy of *Eucalyptus robusta* and dense canopy of Melaleuca species and *Callistemon salignus*. Whilst areas of this community were disturbed and heavily modified due to past clearing and high level of weed invasion characteristic species of this threatened ecological community were recorded throughout (refer to Appendix A). Based on landscape and floristic characteristics, all areas mapped as PCT 1718 are considered to form part of the *NSW Scientific Committee Final Determination for Swamp Sclerophyll Forest*.

4.1.2 RIVER-FLAT EUCALYPT FOREST

River-flat Eucalypt Forest is listed as Endangered under the BC Act. PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter recorded within the study area is considered consistent with this threatened ecological community as it conforms with the floristics, locality, landscape and geological characteristics as detailed in the *NSW Scientific Committee Final Determination for River-flat Eucalypt Forest* (NSW Scientific Committee 2005).

Specifically, vegetation classified as PCT 1594 within the study area occurred within the Central Coast Council LGA on a coastal floodplain (i.e. on alluvial terraces of Ourimbah Creek) as a tall open forest dominated by a canopy of *Eucalyptus amplifolia*, *Eucalyptus tereticornis* and the occasional *Eucalyptus saligna* and *Angophora floribunda*. Whilst the understorey was disturbed and heavily modified due to past clearing and high level of weed invasion, characteristic species of this threatened ecological community were recorded (refer to Appendix A). Based on landscape and floristic characteristics, all areas mapped as PCT 1594 are considered to form part of the *NSW Scientific Committee Final Determination for River-flat Eucalypt Forest*.

4.2 ENDANGERED POPULATIONS

Two Endangered populations listed under the BC Act are known to occur within the Wyong LGA which include:

- *Eucalyptus oblonga* population at Bateau Bay, Forresters Beach and Tumby Umbi in the Wyong LGA
- *Eucalyptus parramattensis* C. Hall. subsp. *parramattensis* in Wyong and Lake Macquarie LGAs.

Neither of these populations are considered likely to occur within the study area based on the lack of preferred habitat, the study area occurring outside species known distributions and as they were not recorded during previous or current surveys.

4.3 THREATENED PLANT SPECIES

One threatened flora species was recorded during surveys; *Melaleuca biconvexa*. This species was recorded in high numbers from three locations along the rail corridor and two locations along Hereford Street (Figure 3.1). It is estimated that approximately 694 *Melaleuca biconvexa* stems occur within the study area. Majority of stems recorded were within the intermediate age class with few mature individuals observed. Along the rail corridor this species generally dominated the midstorey and understorey where it occurred (Photo 4.1). No *Melaleuca biconvexa* individuals will be impacted by the proposed modifications.



Photo 4.1 *Melaleuca biconvexa* recorded along rail corridor

In addition to *Melaleuca biconvexa*, two other threatened flora species were identified as having potential habitat within the study area (Table 4.1); *Maundia triglochinos* and *Persicaria elatior*. Whilst potential habitat for these species occurs (PCT 1718 Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast) it is largely modified and marginal in quality. Neither of these species were recorded during targeted survey. Although surveys were undertaken outside the optimum survey period for *Maundia triglochinos* habitat for this species will not be impacted by the proposed modification and as such is not considered to be an affected species.

Table 4.1 Threatened species of flora recorded or considered to have potential habitat within the survey area

SCIENTIFIC NAME	COMMON NAME	BC ACT ¹	EPBC ACT ²	OPTIMUM SURVEY PERIOD (OEH, 2018)	LIKELIHOOD OF OCCURRENCE WITHIN STUDY AREA	AFFECTED SPECIES
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	All year	Recorded	No – whilst recorded no individuals will be impacted.
<i>Maundia triglochinos</i>	–	V	-	Nov – Mar	Moderate	No – no preferred habitat is to be impacted.
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Dec - May	Moderate	No – not recorded and no preferred habitat is to be impacted.

(1) E = Endangered, V = Vulnerable as listed on the BC Act

(2) E = Endangered, V = Vulnerable as listed on the EPBC Act

4.4 THREATENED ANIMAL SPECIES

No threatened species were recorded within the study area. It should be noted that fauna surveys undertaken for this report were limited to opportunistic sightings and fauna habitat assessments.

Whilst no targeted surveys were undertaken as part of this investigation, intensive surveys within the project boundary area (i.e. immediately adjoining the study area to the south west) were undertaken as part of the SIS and Additional SIS (WSP | Parsons Brinckerhoff 2016a) (WSP | Parsons Brinckerhoff 2016b) (WSP 2017). Fauna habitats surveyed as part of the SIS and Additional SIS were undertaken within proximity to and within similar habitats (of equal and better quality) of that occurring in the study area for the proposed modifications. During these surveys threatened species recorded included Varied Sittella, Little Lorikeet, Little Bentwing-bat, Eastern Bent-wing Bat, Southern Myotis, Grey-headed Flying-fox, Wallum Froglet and Mahony’s Toadlet. The following species are considered to have a moderate or higher likelihood of occurring within the study area based on field surveys habitat assessments and desktop assessment (Table 4.2).

Table 4.2 Threatened species of fauna considered to have potential habitat within the survey area

SCIENTIFIC NAME	COMMON NAME	BC ACT ¹	EPBC ACT ²	LIKELIHOOD OF OCCURRENCE WITHIN STUDY AREA
Amphibians				
Wallum Froglet	<i>Crinia tinula</i>	V	–	Moderate
Mahony's Toadlet	<i>Uperoleia mahonyi</i>	V	–	Moderate
Birds				
Regent Honeyeater	<i>Anthochaera phrygia</i>	E4A	CE	Moderate
Swift Parrot	<i>Lathamus discolor</i>	E1	CE	Moderate
Gang-Gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	–	Moderate
Glossy Black-Cockatoo	<i>Calyptorhynchus lathamii</i>	V	–	Moderate
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	–	High
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	–	High
Little Eagle	<i>Hieraaetus morphnoides</i>	V	–	Moderate
Square-tailed Kite	<i>Lophoictinia isura</i>	V	–	Moderate
Powerful Owl	<i>Ninox strenua</i>	V	–	Moderate
Mammals				
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V	–	Moderate
Spotted-tailed Quoll	<i>Dasyurus maculatus maculatus</i>	V	E	Moderate
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	–	Moderate
Little Bentwing-bat	<i>Miniopterus australis</i>	V	–	High
Eastern Bent-wing Bat	<i>Miniopterus schreibersii oceanensis</i>	V	–	High
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	–	Moderate
Southern Myotis	<i>Myotis macropus</i>	V	–	Moderate
Yellow-bellied Glider	<i>Petaurus australis</i>	V	–	Moderate
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	–	Moderate
Greater glider	<i>Petauroides volans</i>			Moderate
Koala	<i>Phascolarctos cinereus</i>	V	V	Moderate
Common Planigale	<i>Planigale maculata</i>			Moderate
Long-nosed Potoroo	<i>Potorous tridactylus</i>	V	V	Moderate
Eastern Chestnut Mouse	<i>Pseudomys gracilicaudatus</i>	V	–	Moderate
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	High

SCIENTIFIC NAME	COMMON NAME	BC ACT ¹	EPBC ACT ²	LIKELIHOOD OF OCCURRENCE WITHIN STUDY AREA
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	–	Moderate
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	–	Moderate
Reptiles				
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	V	–	Moderate
Stephen's Banded Snake	<i>Hoplocephalus stephensii</i>	V	–	Moderate

- (1) Listed as Vulnerable (V), Endangered (E1), Endangered Ecological Community (E3), Critically Endangered (E4A) under the NSW *Biodiversity Conservation Act 2016*.
- (2) Listed as Vulnerable (V), Endangered (E), Critically Endangered (CE) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

4.4.1 MAHONY'S TOADLET

Mahony's Toadlet (*Uperoleia mahonyi*) habitat in proximity of the current project area has only been confirmed by a single individual recorded from within the project boundary area (WSP 2017). Expert advice in relation to potential Mahony's Toadlet habitat occurring elsewhere within the project boundary area was sought from recognised Australian amphibian expert Arthur White. Areas associated with the original sighting location and subject to similar substrate conditions were assessed as potential Mahony's Toadlet habitat within the subject site. OEH assessment of the potential habitat footprint, in consultation with Arthur White, took a precautionary approach by means of extending the expert determined habitat area by a further 400 m buffer.

Potential habitat for Mahony's Toadlet, within areas being considered for the proposed alternate access track, has been identified as areas that fall within the extended habitat buffer assessed by OEH (Figure 3.1). The remainder of the study area, outside of the agreed 400 metre buffer, has been managed historically for road/rail infrastructure although a constructed drainage line occurs adjacent to Turpentine Road and the existing rail corridor access road.

The substrate habitats adjacent to the constructed drainage line are disturbed, managed areas perched above steep banks separating the drain bottom. Known and described (Clulow *et al.* 2016) Mahony's Toadlet habitat does not conform to these topographical parameters and therefore such habitat is considered unlikely to offer potential habitat for Mahony's Toadlet, as known Mahony's Toadlet habitat is defined by low relief topography subject to sandy substrates.

Assessment of habitats associated with Hereford Street, which may be subject to some widening for construction material transport vehicles, are not consistent with Mahony's Toadlet habitats occurring locally within the project area or the "type localities" for Mahony's Toadlet habitat described in the literature (Clulow *et al.* 2016). Although both Hereford Street and the project area habitats are of an alluvial nature underlain by quaternary deposits, Hereford Street is adjacent to the Ourimbah Creek which distributes alluvial substrate materials under much higher flow rates than the flat shelf-type alluvial context defining the project area habitats. As a consequence, the substrates associated with Hereford Street are perched and more varied, and onsite observations of soil substrate indicate a higher silt/clay content than those occurring in known sites for Mahony's Toadlet. The different alluvial context of Hereford Street has resulted in vegetation communities that are riparian/alluvial/mesic in nature in contrast to the general swamp sclerophyll nature of Mahony's Toadlet habitat occurring in the project area.

Therefore, based on the known habitat preferences for this species, it is considered unlikely that the habitats associated with Hereford Street would provide habitat opportunities for Mahony's Toadlet.

4.5 MIGRATORY SPECIES

Migratory species are protected under international agreements to which Australia are a signatory, including Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea-Australia Migratory Bird Agreement (RoKAMBA) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered Matters of National Environmental Significance and are protected under the EPBC Act.

Based on the EPBC Protected Matters search, other database searches, and onsite habitat assessments six migratory species were considered to have moderate likelihood of occurring within the study area. During WSP site investigations (WSP | Parsons Brinckerhoff 2016a) of the project development area, two migratory species were recorded; Rufous Fantail and Black-faced Monarch.

The 0.1 hectares of native vegetation (PCT 1568 – Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast) to be removed by the proposed modification is unlikely to be classified as ‘important habitat’ for any migratory species likely to occur within the study area as defined by the EPBC Act Policy Statement 1.1 *Principal Significant Impact Guidelines* (Department of the Environment and Heritage 2006) in that the site is unlikely to contain:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

Table 4.3 Migratory species recorded or considered to have the potential to occur within 10 kilometres of the study

COMMON NAME	SCIENTIFIC NAME	EPBC ACT ¹	LIKELIHOOD OF OCCURRENCE	AFFECTED SPECIES
Black-faced Monarch	<i>Monarcha melanopsis</i>	M	High	No
Cattle Egret	<i>Ardea ibis</i>	M	Moderate	No
Rainbow Bee-eater	<i>Merops ornatus</i>	M	Moderate	No
Rufous Fantail	<i>Rhipidura rufifrons</i>	M	High	No
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	M	Moderate	No
Spectacled Monarch	<i>Monarcha trivirgatus</i>	M	Moderate	No

(1) M=Migratory as listed on the EPBC Act

4.5.1 PELAGIC, ESTUARINE OR WETLAND FAUNA

Due to the projects location within a coastal floodplain, it occurs in relative proximity to pelagic, estuarine and wetland habitats. Therefore, records of these threatened species came up in database searches of the locality. There is no suitable habitat within the study area for threatened species dependent upon pelagic, estuarine and/or wetland species, and as such they have not been considered further.

5 CONSERVATION SIGNIFICANCE AND CONSTRAINTS

Conservation significance mapping of the site was undertaken to facilitate the avoidance and minimisation of impacts associated with the proposal on biodiversity. The level of conservation significance has been ranked based on the ecological attributes outlined within Table 5.1. Mapping of conservational significance within the study area is provided in Figure 5.1 and the implications of these constraints is discussed below in Sections 5.1 and 5.2.

Table 5.1 Ecological constraints ranking and subsequent conservational significance within the study area

ECOLOGICAL CONSTRAINT RANK AND CONSERVATIONAL SIGNIFICANCE	ECOLOGICAL ATTRIBUTES
High	<ul style="list-style-type: none"> — Core areas of moderate to high condition native vegetation (irrespective of threatened ecological community listing status); likely to be of high importance to populations of threatened species and/or to have high value for animal movement. — Large, contiguous patches of threatened ecological communities in moderate condition. — All moderate to high condition patches of threatened ecological communities. — Areas occupied by known populations of threatened flora species (i.e. <i>Melaleuca biconvexa</i>) or potential habitat for Mahony’s Toadlet.
Moderate	<ul style="list-style-type: none"> — Peripheral areas of non-threatened native vegetation in moderate to good condition; likely to be of moderate importance to populations of threatened species and/or to make a moderate contribution to local animal movement. — Medium-sized patches of threatened ecological communities in low condition. — Small low condition areas of threatened ecological communities which are contiguous with moderate and/or high condition patches.
Low	<ul style="list-style-type: none"> — Low species richness patches of regrowth native plants with low structural diversity; e.g. regrowth with little or no occurrence of over-storey (e.g. eucalypt) species for example along artificial drainage lines along rail corridor. — Very small, highly disturbed, isolated patches of threatened ecological communities with minimal native understorey.

5.1 AREAS CONTAINING CONSERVATIONAL VALUES

Whilst areas containing conservational significance occur within the study area (Figure 5.1) this does not entirely preclude works associated with the proposal from occurring. However, these areas are likely to be considered, by Local, State and Commonwealth regulatory authorities and stakeholders, to be the least suitable. Furthermore, any proposed works (including vegetation removal) within these areas would require assessment, mitigation and offsetting by means of consistency assessments with current project approvals for impacts to biodiversity under the BC Act and EPBC Act.

5.2 AREAS OF MINIMAL CONSERVATIONAL VALUE



All highly disturbed areas with no or limited native vegetation have not been assigned a conservational significance rating as they do not pose an ecological constraint. Proposed works within these areas do not require further ecological assessment.

Areas not classified with a conservational significance rating exhibit a dense cover of exotic grasses, planted vegetation areas of bare soil, buildings, paved areas and other miscellaneous materials and structures with little or no native vegetation and minimal habitat value. These areas also have a very low habitat structural diversity, generally lack important micro-habitat features and are hence of very low potential value as habitat for threatened species, populations and ecological communities.



Legend	
Conservation significance	Survey area
High	Vegetation clearing extent
Low	Subject site

Map: 2202522A_GIS_F136_A2
 Author: MitchellEm
 Date: 28/05/2018
 Approved by: -

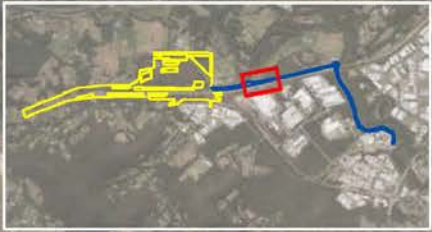
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New Intercity Fleet Maintenance Facility Project - Alternate access road



Figure 5.1
 Conservation significance and constraints
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Legend	
Conservation significance	Survey area
High	Vegetation clearing extent
Moderate	
Low	

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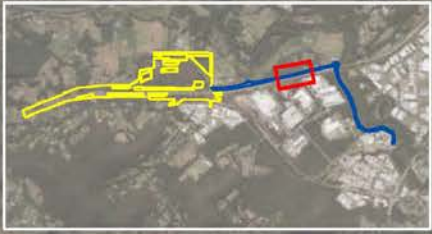
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Figure 5.1
 Conservation significance and constraints
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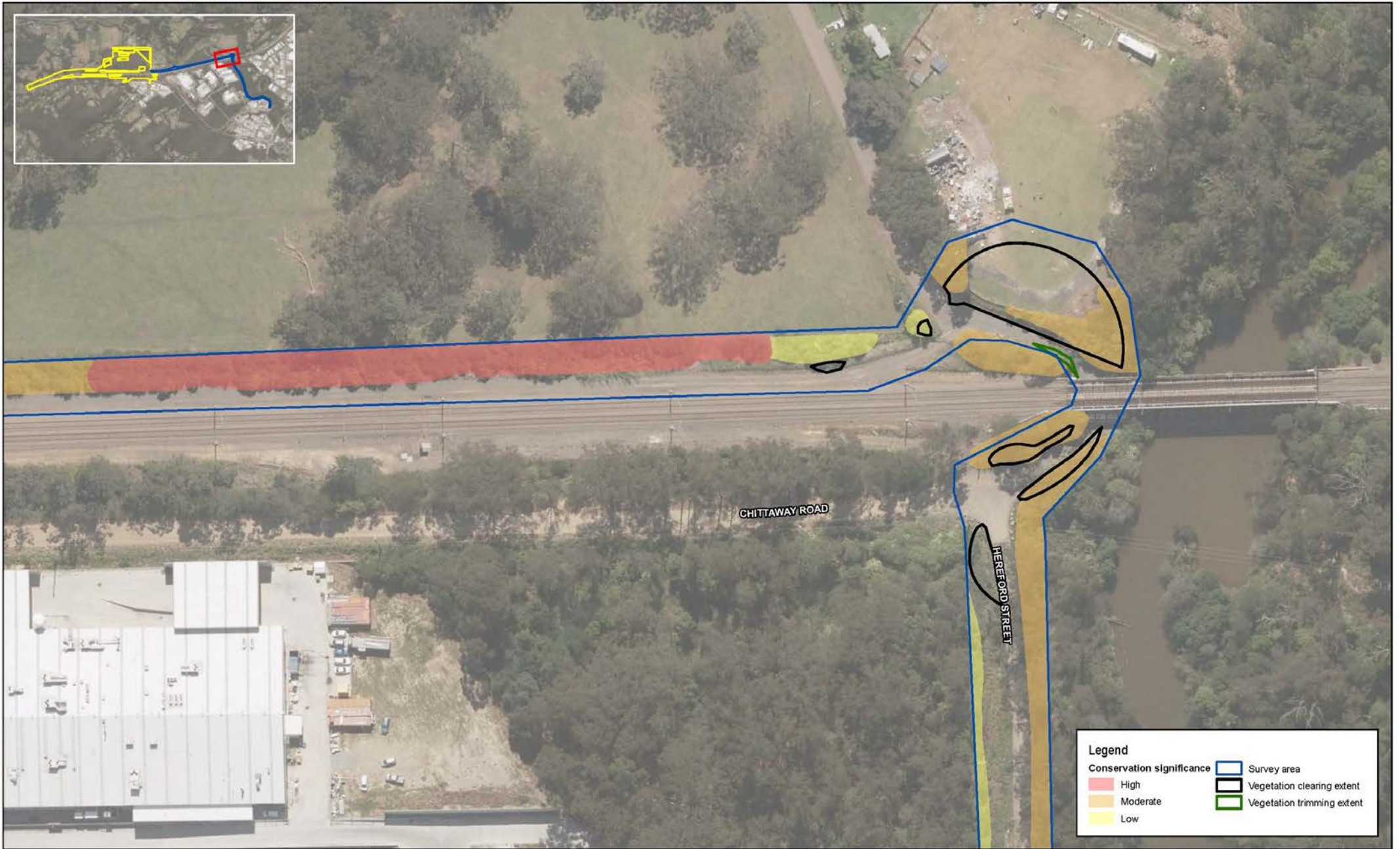
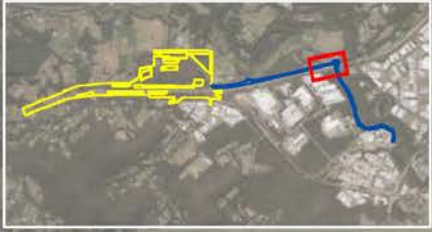
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Figure 5.1
Conservation significance and constraints
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Legend	
Conservation significance	Survey area
High	Vegetation clearing extent
Moderate	Vegetation trimming extent
Low	

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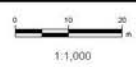
Figure 5.1
 Conservation significance and constraints
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Legend	
Conservation significance	Survey area
High	
Moderate	
Low	

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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 5.1
Conservation significance and constraints
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Legend	
Conservation significance	Survey area
High	
Moderate	
Low	

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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 5.1
Conservation significance and constraints
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Legend

- Conservation significance Survey area
- Moderate
- Low

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New Intercity Fleet Maintenance Facility Project - Alternate access road

Figure 5.1
Conservation significance and constraints
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6 MITIGATION MEASURES

The general principle to minimise impacts to biodiversity, should in order of consideration, endeavour to:

- Avoid impacts on habitat, through the planning process
- Minimise impacts on habitat, through the planning process
- Mitigate impacts on habitat, through the use of a range of mitigation measures.

Impacts to biodiversity have been avoided and minimised, wherever practicable, through the planning stages of this project. This was achieved by means of WSP ecologists initially undertaking a site walk over with Transport for NSW representatives and members of the project construction team to identify ecological constraints which occurred within the preliminary development footprint.

Following the site inspection, all areas of conservational significance and ecological constraints identified during the site inspection were mapped and overlaid on the design footprint (Figure 3.1 and Figure 5.1). Furthermore, an ecologist attended a constraints workshop (17 April 2018) to discuss potential opportunities, such as changes to the design footprint, to avoid impacts to biodiversity identified.

This process has enabled the project to entirely avoid additional impacts to all threatened ecological communities, populations of *Melaleuca binconvexa* and potential Mahony's Toadlet habitat.

Residual impacts associated with the proposed works (i.e. clearing and trimming of 0.1 hectares of PCT 1568), which are unable to be avoided, will be mitigated wherever practicable. As the impacts associated with the proposed works are considered consistent with those addressed in the SIS (WSP | Parsons Brinckerhoff 2016b) and Additional SIS (WSP | Parsons Brinckerhoff 2017) it is recommended that the same mitigation measures provided in these documents are implemented including the implementation of the project Construction Environment Management Plan and threatened species management plans (including those for Swamp Sclerophyll Forest, Biconvex Paperbark and Mahony's Toadlet) which have been prepared. A summary of these mitigation measures are provided in Table 6.1 and Section 7.1 below.

In addition to the mitigation measures provided in Table 6.1 and Section 6.1 it is recommended that potential vehicular impacts to moving frogs should be mitigated by the separation of the access track from potential Mahony's Toadlet habitat by a frog exclusion fence to prevent frogs from accessing the track.

Table 6.1 Proposed mitigation measures

IMPACT	MITIGATION MEASURE
Removal of native vegetation and fauna habitats	<ul style="list-style-type: none"> — Clearing of vegetation should be minimised, to only vegetation that is absolutely required to be removed in order to undertake work. — Implement clearing protocols, including: <ul style="list-style-type: none"> — Environmental manager or ecologist to undertake a pre-clearance survey to identify any habitat that may be present on limbs or in tree to be removed such as bird nests or fauna roosting. — Removal of any hollow bearing trees or limbs to be supervised by an ecologist in order to facilitate the relocation of any injured or displaced native fauna. — Check trees for the presence of bird nests and potentially arboreal mammals, prior to felling. — As far as practicable, animals found to be occupying trees would be allowed to leave before clearing. — Use a licensed fauna ecologist or wildlife carer with specific animal handling experience to carry out any fauna handling. — Establish exclusion zones to protect vegetation and fauna habitat outside of the assessed and approved clearing limits, including the threatened ecological communities recorded within the study area (including Swamp Sclerophyll Forest, Lowland Rainforest and Biconvex Melaleuca). — The limits of clearing would be clearly demarcated on-site prior to construction to avoid unnecessary vegetation and habitat removal. — Restrict equipment placement, storage and stockpiling of removed branches and trees to designated areas in cleared land.
<i>Melaleuca biconvexa</i>	<ul style="list-style-type: none"> — Exclusion zones should be established around areas containing threatened plant species. — All construction staff working in the vicinity of these threatened species should be informed of the location of these threatened flora species. — Measures detailed in the threatened flora management plan developed for the project should be followed.
Aquatic impacts	<ul style="list-style-type: none"> — Minimise the clearing of aquatic habitats to that which is necessary for the safe construction and operation of the proposed Project. — Incorporate existing drainage channels into design of proposed Project drainage channels where practicable. — Protect aquatic habitats and riparian zones where works are not required with exclusion zones. — Control and manage potential contaminants (fuels, oils, lubricants) from construction activities. — Install high visibility signs at freshwater aquatic sites occurring outside the proposal area, to inform workers of no go areas and that these areas are environmentally sensitive. This is particularly important during spring and summer when migratory shorebirds and waders use such habitats. — Design and construct waterway crossings in accordance with the DPI's fish passage requirements (Fairfull <i>et al.</i> 2003). — Riparian and fringing aquatic vegetation would be replanted in disturbed areas immediately after construction to stabilise creek banks.

IMPACT	MITIGATION MEASURE
Direct mortality	<ul style="list-style-type: none"> — Implementation of clearing protocols as per removal of native vegetation and fauna habitats. — Where practicable and feasible, one wall of proposed drainage detention basins could be graded or trimmed to provide a gradient that is amenable for fauna to escape on their own accord.
Impacts to groundwater dependent ecosystems (swamp forest)	<ul style="list-style-type: none"> — A groundwater management plan and monitoring program would be developed and implemented to address potential impacts to groundwater, if encountered. — Revegetate disturbed areas with native vegetation where appropriate.
Erosion and sedimentation	<ul style="list-style-type: none"> — Erosion and sediment controls should be implemented in accordance with the <i>Managing urban stormwater: soils and construction (Volume 1: Blue Book)</i> (Department of Environment and Climate Change 2008a). — Ensure that when trees are removed the stump and roots of the tree are retained to minimise ground disturbance and retain soil stability. — Ensure that bushrock is not disturbed when conducting vegetation removal. — Revegetate disturbed areas with native vegetation groundcover where appropriate. — Avoid excessive soil disturbance. — When accessing construction sites, contractors should only use designated access tracks.
Weed invasion	<ul style="list-style-type: none"> — Noxious weeds within the study area will be managed in accordance with the <i>Noxious Weeds Act 1993</i> and <i>Biosecurity Act 2015</i>. — Management techniques may include immediate weed removal and disposal without stockpiling, disposal of weed-contaminated soils at appropriate weed disposal facilities and to ensure that all equipment is cleaned prior to and on completion of works to ensure weeds are not introduced or spread to other locations.
Invasion and spread of pathogens and disease	<ul style="list-style-type: none"> — Protocols to prevent the introduction and/or spread of Chytrid fungus would be implemented. These protocols would be based on OEH Hygiene Protocol for the Control of Disease in Frogs. — Protocols and site hygiene to prevent the introduction and/or spread Myrtle rust would be implemented (i.e. vehicle and equipment wash down facilities).
General	<ul style="list-style-type: none"> — Ensure all workers are provided an environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity and penalties for breaches. — Prepare a flora and fauna management plan as part of the CEMP.
Residual impacts	<ul style="list-style-type: none"> — Develop an offset strategy to mitigate the impact of clearing native vegetation. This will fulfil the need to improve or maintain as required in the <i>Principles for the use of biodiversity offsets in NSW</i> (Office of Environment and Heritage 2016c).

6.1 REVEGETATION OF TEMPORARILY DISTURBED GROUND

Depending on the locality and final land use of areas cleared, mitigation measures generally employed during temporary construction would include the following:

- Landscaping and revegetation
- Site rehabilitation.

It is proposed that all areas of temporarily disturbed ground would be revegetated in accordance with a Flora and Fauna Management Plan (FFMP) included within the Construction Environmental Management Plan (CEMP). Replanting of affected vegetation is to use locally occurring native species. The FFMP would:

- Identify specific areas in the study area for rehabilitation
- Detail revegetation plan for identified areas
- Specify use of locally occurring native species with reference to designated vegetation community type
- Identify appropriate timing for rehabilitation works
- Detail relevant inspections during rehabilitation works
- Corrective actions and adaptive management
- Describe monitoring procedure to quantify success of rehabilitation works.

7 CONSISTENCY IMPACT ASSESSMENT

Transport for NSW and the project construction manager have employed the general principles of avoidance, minimisation and mitigation to reduce impacts to biodiversity wherever possible. In doing so, impacts associated with the proposed alternate access road, subject of this report, have been limited to the direct removal/modification of 0.1 hectares of native vegetation (PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast). Impacts to all threatened ecological communities, *Melaleuca biconvexa* as well as Mahony’s Toadlet and Wallum Froglet habitat have been avoided.

The project gained EPBC Act approval (EPBC 2016/7681) on the 15 May 2017 and final concurrence approval (Additional SIS) from the Chief Executive of the NSW Office of Environment and Heritage (OEH) on 29 August 2017.

Condition 3 of the EPBC Act approval (EPBC 2016/7681) states that ‘the action must not clear more than 19.6 ha of high quality swamp forest and 3.6 ha of wet open forest that is foraging habitat for the Swift Parrot and Regent Honeyeater’. The proposed modification will not remove any high quality swamp forest however will remove 0.1 hectares of wet open forest (PCT 1568) which constitutes habitat for these two species. The removal of 0.1 ha of PCT 1568 will result in the project’s final disturbance of wet forest to equate to 3.4 hectares (Table 7.1) which is within the EPBC Act approved clearing limits. As such, no additional significant impacts to EPBC Act listed matters will occur and no further EPBC Act approvals are required.

The vegetation clearing required by the proposed modification represents an incremental increase of 0.1 hectares to the project’s construction footprint of 27.1 hectares as approved by OEH. A summary of the direct impacts on native vegetation approved in the Additional SIS is provided below in Table 7.1.

Table 7.1 Additional SIS final concurrence approval (WSP | Parsons Brinckerhoff 2017)

PLANT COMMUNITY TYPE	VEGETATION FORMATION	VEGETATION CLASS	THREATENED ECOLOGICAL COMMUNITY	APPROVED PROJECT IMPACT (HECTARES)	ADDITIONAL ACCESS ROAD CLEARING REQUIRED (HECTARES)
PCT 1723 – Melaleuca biconvexa – Swamp Mahogany – Cabbage Palm swamp forest of the Central Coast	Forested Wetlands	Coastal Swamp Forests	Yes Swamp Sclerophyll Forest on Coastal Floodplains	22.6	Nil
PCT 1528 – Jackwood – Lilly Pilly – Sassafras riparian warm temperate rainforest of the Central Coast	Rainforests	Northern Warm Temperate Rainforests	No	1.2	Nil
PCT 1568 – Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	Wet Sclerophyll Forests (Shrubby sub-formation)	North Coast Wet Sclerophyll Forests	No	3.3	0.1
Total area of native vegetation impact required				27.1	27.2

The projects original impacts on biodiversity (i.e. removal of 27.1 hectares of native vegetation; including 3.3 hectares of PCT 1568) were assessed in accordance with the NSW *Threatened Species and Conservation Act 1995* (TSC Act) and Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (i.e. seven-part test of significance).

It should be noted that the NSW *Biodiversity Conservation Act 2016* (BC Act) came into effect on the 25 August 2017. This Act replaced the NSW *Threatened Species and Conservation Act 1995* (TSC Act), *Native Vegetation Act 2003* and parts of the *National Parks and Wildlife Act 1974*. Transitional provisions for pending or interim planning applications are outlined under Part 7 Reg 29(1)(b) of the Biodiversity Conservation (Savings and Transitional) Regulation 2017 which states that:

- (1) The former planning provisions continue to apply (and Part 7 of the new Act does not apply) to:
 - (b) *an environmental impact assessment that relates to the modification of an activity if the proponent commences to carry out the modified activity within 18 months after the commencement of the new Act.*

As such, the consistency assessment of impacts to biodiversity associated with the proposed modification (including impact assessments) have been considered in accordance with the former Section 5A of the EP&A Act with reference to the BC Act listed threatened species, populations and ecological communities.

The outcome of the original assessments detailed in the SIS and Additional SIS concluded that the project was likely to have a significant impact on the Swamp Sclerophyll Forest threatened ecological community, Mahony’s Toadlet and Wallum Froglet. Impacts to all other remaining threatened biodiversity were considered not significant (WSP | Parsons Brinckerhoff 2016b, 2017).

The native vegetation to be removed by the proposed modification (i.e. 0.1 hectares of PCT 1568) provides potential habitat for 30 threatened fauna species (Table 4.2). The incremental loss of 0.1 hectares of PCT 1568, given its location, condition and scale is not considered to alter the conclusions drawn from the original impact assessments (WSP | Parsons Brinckerhoff 2016b, 2017). The removal of 0.1 hectares of potential habitat is less than 0.01 per cent that is considered to be currently available within the locality (5-kilometre radius) (refer Table 7.2). As such, no threatened fauna species identified as having potential to occur within study area (Table 4.2) are considered likely to be significantly affected by the proposed removal of 0.1 hectares of native vegetation.

Table 7.2 Extent of habitat removal

FAUNA HABITAT DESCRIPTION	CORRESPONDING VEGETATION COMMUNITY	EXTENT WITHIN STUDY AREA	VEGETATION TO BE REMOVED	EXTENT WITHIN LOCALITY (5 KILOMETRE)
Wet Sclerophyll Forest	PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest High	3.3	0.1	3,369.8

The removal of an additional 0.1 hectares of native vegetation is considered consistent with impacts originally assessed as part of the SIS (WSP | Parsons Brinckerhoff 2016b) and Additional SIS (WSP | Parsons Brinckerhoff 2017).

If the proposed modification is to be approved the following recommendation is provided:

- Update the Biodiversity Offset Strategy to include an additional 0.1 hectares of PCT 1568 Blackbutt – Turpentine – Sydney Blue Gum Mesic Tall Open Forest High. For the removal of 0.1 hectares of PCT 1568, this will require an estimated two ecosystem credits, this was determined in accordance with BAM (Office of Environment and Heritage 2017).

8 CONCLUSION

Initial site inspections identified the following ecological constraints as occurring within the study area:

- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed as Endangered under the NSW *Biodiversity Conservation Act 2016* (BC Act).
- River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed as Endangered under the BC Act.
- Populations of *Melaleuca biconvexa* (Biconvex Paperbark) listed as Vulnerable under the BC Act and Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Mahony's Toadlet (*Uperoleia mahonyi*) habitat listed as Endangered under the BC Act.
- As well as other native vegetation, which provided habitat for a number of other threatened species such as Regent Honeyeater, Swift Parrot, Grey-headed Flying-fox and Little Lorikeet.

Ecological constraints were discussed in an ecological constraints workshop between a WSP ecologist as well as Transport for NSW and members of the project construction team, including potential opportunities to avoid, minimise and mitigate impacts to these ecological constraints wherever possible.

The initial site inspection and ecological constraints workshop enabled all threatened ecological communities, *Melaleuca biconvexa* populations and Mahony's Toadlet habitat to be avoided. Residual impacts associated with the proposed modification (clearing and trimming of 0.1 hectares of PCT 1568), which were unable to be avoided, will be mitigated further wherever practicable during the construction phases of the project.

A consistency assessment of the residual impacts on biodiversity against the projects current approvals (i.e. EPBC Act approval (EPBC 2016/7681) and final concurrence approval (Additional SIS) from the Chief Executive of the NSW Office of Environment and Heritage) was undertaken. It is considered that the additional impact of 0.1 hectares is consistent with impacts originally assessed as part of the SIS (WSP | Parsons Brinckerhoff 2016b) and Additional SIS (WSP | Parsons Brinckerhoff 2017).

Impacts associated with the proposed modification to Matters of National Significance are consistent with those originally assessed and within the approved clearing limits of the EPBC Act approvals which allows for clearing of up to 3.6 ha of wet open forest. As such, no additional significant impacts to EPBC Act matters are likely to occur as a result of the proposed modification and no further EPBC Act approvals are required.

The removal of an additional 0.1 hectares of native vegetation is considered consistent with impacts originally assessed as part of the SIS and Additional SIS which gained final concurrence from OEH. These assessments concluded that significant impacts associated within the project were limited to the Swamp Sclerophyll threatened ecological community, Mahony's Toadlet and Wallum Froglet. None of these threatened entities will be impacted upon and therefore no additional significant impacts will occur as a result of the proposed modification.

Furthermore, it is recommended that the Biodiversity Offset Strategy be revised to include the additional impact of 0.1 hectares of PCT 1568, which equates to two ecosystem credits, estimated in accordance with BAM (Office of Environment and Heritage 2017) .

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APPENDIX A

PLANT SPECIES RECORDED



Q1			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (low condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	351893	6311514	56
			69	49	4	10	11	9	4	11	20	8	Orientation	217	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			136.5	116.9	16.7	7.9	81.2	1.1	8.2	1.8	19.6	15.4	Stem classes		
<i>Hypolepis muelleri</i>	3	20	EG						3				80+	0	
<i>Pteridium esculentum</i>	5	30	EG						5				50-79	3	
<i>Conyza bonariensis</i>	0.1	15	EX								0.1		30-49	1	
<i>Hypochaeris radicata</i>	0.1	10	EX								0.1		20-29	1	
<i>Plantago lanceolata</i>	0.1	10	EX								0.1		10-19	0	
<i>Sida rhombifolia</i>	0.1	10	EX								0.1		5-9	2	
<i>Verbena bonariensis</i>	0.1	20	EX								0.1		<5	8	
<i>Verbena rigida</i>	0.1	2	EX								0.1				
<i>Cyperus brevifolius</i>	1	30	EX								1		Hollows	0	
<i>Setaria parviflora</i>	2	20	EX								2		Lenh of logs (m)	8	
<i>Centella asiatica</i>	0.1	20	FG					0.1					BAM Attributes 1x1m plot		
<i>Dianella caerulea var. producta</i>	0.1	15	FG					0.1							
<i>Dichondra repens</i>	0.1	20	FG					0.1					Litter cover	48	
<i>Pratia purpurascens</i>	0.1	10	FG					0.1					Bare ground	8	
<i>Commelina cyanea</i>	0.3	20	FG					0.3					Cryptogam	0	
<i>Microlaena stipoides var. stipoides</i>	0.5	10	GG				0.5						Vegetation	48	
<i>Cynodon dactylon</i>	3	50	GG				3								
<i>Oplismenus aemulus</i>	3	50	GG				3								
<i>Imperata cylindrica</i>	60	1000	GG				60								
<i>Lantana camara</i>	1	2	HT											1	
<i>Paspalum dilatatum</i>	2	20	HT											2	
<i>Rubus fruticosus agg.</i>	4	20	HT											4	
<i>Clematis aristata</i>	0.1	1	OG							0.1					
<i>Geitonoplesium cymosum</i>	0.1	3	OG							0.1					
<i>Glycine clandestina</i>	0.1	4	OG							0.1					
<i>Hardenbergia violacea</i>	0.1	2	OG							0.1					
<i>Pandorea pandorana subsp. pandor</i>	0.1	10	OG							0.1					
<i>Kennedia rubicunda</i>	0.2	20	OG							0.2					
<i>Parsonsia straminea</i>	0.5	20	OG							0.5					
<i>Breynia oblongifolia</i>	2	20	SG			2									
<i>Eucalyptus robusta</i>	0.5	4	TG		0.5										
<i>Glochidion ferdinandi var. ferdinanc</i>	15	30	TG		15										
<i>Billardiera scandens</i>	0.1	4	OG							0.1					
<i>Christella asiatica</i>	0.1	2	EG						0.1						
<i>Lindsaea microphylla</i>	0.1	10	EG						0.1						
<i>Galium aparine</i>	0.1	1	EX								0.1				
<i>Trifolium repens</i>	0.1	10	EX								0.1				
<i>Bidens pilosa</i>	0.2	20	EX								0.2				

Q1 cont.			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	351893	6311514	56
PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (low condition)			69	49	4	10	11	9	4	11	20	8	Orientation	217	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			136.5	116.9	16.7	7.9	81.2	1.1	8.2	1.8	19.6	15.4	Stem classes		
<i>Juncus cognatus</i>	0.2	10	EX								0.2				
<i>Euchiton sphaericus</i>	0.1	10	FG					0.1							
<i>Goodenia paniculata</i>	0.1	1	FG					0.1							
<i>Opercularia diphylla</i>	0.1	2	FG					0.1							
<i>Poranthera microphylla</i>	0.1	2	FG					0.1							
<i>Juncus usitatus</i>	0.1	10	GG				0.1								
<i>Lomanandra filiformis subsp. filiformis</i>	0.1	1	GG				0.1								
<i>Entolasia marginata</i>	0.2	10	GG				0.2								
<i>Entolasia stricta</i>	0.3	20	GG				0.3								
<i>Lomanandra longifolia</i>	2	4	GG				2								
<i>Panicum simile</i>	5	100	GG				5								
<i>Poa affinis</i>	7	200	GG				7								
<i>Paspalum quadrifarium</i>	0.1	1	HT									0.1			
<i>Ranunculus repens</i>	0.1	20	HT									0.1			
<i>Senecio madagascarensis</i>	0.2	20	HT									0.2			
<i>Axonopus fissifolius</i>	4	50	HT									4			
<i>Morinda jasminoides</i>	0.1	1	OG							0.1					
<i>Calochlaena dubia</i>	0.2	10	OG							0.2					
<i>Cyathea australis</i>	0.2	2	OG							0.2					
<i>Gompholobium latifolium</i>	0.1	1	SG			0.1									
<i>Leucopogon lanceolatus</i>	0.1	1	SG			0.1									
<i>Ozothamnus diosmifolius</i>	0.1	1	SG			0.1									
<i>Polyscias sambucifolia subsp. samb</i>	0.1	2	SG			0.1									
<i>Kunzea ambigua</i>	0.2	1	SG			0.2									
<i>Epacris pulchella</i>	0.3	20	SG			0.3									
<i>Melaleuca styphelioides</i>	1	1	SG			1									
<i>Acacia longifolia subsp. longifolia</i>	2	5	SG			2									
<i>Leptospermum polygalifolium subsp.</i>	2	5	SG			2									
<i>Tristaniopsis laurina</i>	0.2	1	TG		0.2										
<i>Eucalyptus pilularis</i>	1	10	TG		1										
<i>Hyparrhenia hirta</i>	4	50	HT									4			

Q2			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (low condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	351669	6311270	56
			54	29	4	3	4	6	3	9	25	8	Orientation	40	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			127.5	99.7	19.2	6.1	59	2.6	6.1	6.7	27.8	19.4	Stem classes		
<i>Hypolepis muelleri</i>	0.1	3	EG						0.1				80+	0	
<i>Pteridium esculentum</i>	4	40	EG						4				50-79	2	
<i>Nephrolepis cordifolia</i>	2	30	EG						2				30-49	1	
<i>Conyza bonariensis</i>	0.1	4	EX								0.1		20-29	2	
<i>Hypochaeris radicata</i>	0.1	10	EX								0.1		10-19	1	
<i>Plantago lanceolata</i>	0.1	10	EX								0.1		5-9	1	
<i>Sida rhombifolia</i>	0.5	20	EX								0.5		<5	24	
<i>Verbena bonariensis</i>	0.2	10	EX								0.2				
<i>Verbena rigida</i>	0.1	10	EX								0.1		Hollows	0	
<i>Cyperus brevifolius</i>	0.2	20	EX								0.2		Lenth of logs (m)	4	
<i>Setaria parviflora</i>	4	50	EX								4				
<i>Conyza sumatrensis</i>	0.2	5	EX								0.2		BAM Attributes 1x1m plot		
<i>Hydrocotyle bonariensis</i>	0.1	2	EX								0.1				
<i>Marrubium vulgare</i>	0.1	2	EX								0.1		Litter cover	60	
<i>Modiola caroliniana</i>	0.1	1	EX								0.1		Bare ground	18	
<i>Panicum maximum</i>	2	10	EX								2		Cryptogam	0	
<i>Pellaea viridis</i>	0.1	5	EX								0.1		Vegetation	24	
<i>Richardia humistrata</i>	0.3	20	EX								0.3				
<i>Solanum nigrum</i>	0.1	1	EX								0.1				
<i>Vicia sativa</i>	0.1	1	EX								0.1				
<i>Centella asiatica</i>	0.1	20	FG					0.1							
<i>Dianella caerulea var. producta</i>	0.1	2	FG					0.1							
<i>Dichondra repens</i>	2	100	FG					2							
<i>Pratia purpurascens</i>	0.1	30	FG					0.1							
<i>Commelina cyanea</i>	0.2	20	FG					0.2							
<i>Hydrocotyle sibthorpioides</i>	0.1	1	FG					0.1							
<i>Microlaena stipoides var. stipoides</i>	4	50	GG				4								
<i>Cynodon dactylon</i>	2	20	GG				2								
<i>Opismenus aemulus</i>	3	20	GG				3								
<i>Imperata cylindrica</i>	50	500	GG				50								
<i>Lantana camara</i>	5	10	HT										5		
<i>Paspalum dilatatum</i>	1	20	HT										1		
<i>Rubus fruticosus agg.</i>	4	15	HT										4		
<i>Ageratina adenophora</i>	0.2	10	HT										0.2		
<i>Andropogon virginicus</i>	2	50	HT										2		
<i>Erythrina sykesii</i>	0.2	1	HT										0.2		
<i>Ligustrum sinense</i>	5	10	HT										5		
<i>Paspalum urvillei</i>	2	20	HT										2		
<i>Clematis aristata</i>	1	30	OG							1					
<i>Geitonoplesium cymosum</i>	0.1	2	OG							0.1					
<i>Glycine clandestina</i>	0.1	2	OG							0.1					
<i>Hardenbergia violacea</i>	0.1	2	OG							0.1					
<i>Pandorea pandorana subsp. pandorana</i>	0.1	10	OG							0.1					
<i>Kennedia rubicunda</i>	0.1	10	OG							0.1					
<i>Parsonia straminea</i>	5	20	OG							5					
<i>Glycine tabacina</i>	0.1	10	OG							0.1					
<i>Hibbertia scandens</i>	0.1	1	OG							0.1					
<i>Breynia oblongifolia</i>	0.1	2	SG												
<i>Acacia irrorata subsp. irrorata</i>	5	4	SG			0.1									

Q2 Cont.			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (low condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	351669	6311270	56
			54	29	4	3	4	6	3	9	25	8	Orientation	40	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			127.5	99.7	19.2	6.1	59	2.6	6.1	6.7	27.8	19.4	Stem classes		
<i>Callistemon salignus</i>	1	1	SG			1									
<i>Eucalyptus robusta</i>	10	6	TG		10										
<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	8	20	TG		8										
<i>Angophora floribunda</i>	0.2	10	TG		0.2										
<i>Eucalyptus saligna</i>	1	1	TG		1										

Q3			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (low condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	352166	6311828	56
			27	12	1	1	5	1	1	3	7	4	Orientation	220	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			115.9	97.41	55.01	22.2	18.7	0.1	1	0.4	18.4	17.1	Stem classes		
<i>Oplismenus aemulus</i>	2	40	GG				2						80+	0	
<i>Lantana camara</i>	10	30	HT										10	50-79	0
<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	55	50	TG		55									30-49	0
<i>Stephania japonica</i> var. <i>discolor</i>	0.1	2	OG							0.1				20-29	0
<i>Microlaena stipoides</i> var. <i>stipoides</i>	2	50	GG				2							10-19	5
<i>Paspalum quadrifarium</i>	0.1	1	HT										0.1	5-9	2
<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	4	15	SG			4								<5	0
<i>Ligustrum sinense</i>	5	50	HT											5	
<i>Entolasia marginata</i>	0.1	1	GG				0.1							Hollows	0
<i>Lomandra longifolia</i>	4	30	GG				4							Lenh of logs (m)	0
<i>Calochlaena dubia</i>	0.2	2	OG							0.2					
<i>Pteridium esculentum</i>	1	20	EG						1					BAM Attributes 1x1m plot	
<i>Imperata cylindrica</i>	5	100	GG				5								
<i>Poa affinis</i>	0.5	10	GG				0.5							Litter cover	82
<i>Paspalum dilatatum</i>	2	40	HT										2	Bare ground	18.1
<i>Verbena rigida</i>	0.2	10	EX								0.2			Cryptogam	0
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	0.1	1	SG			0.1								Vegetation	2.2
<i>Dianella caerulea</i> var. <i>producta</i>	0.1	2	FG					0.1							
<i>Parsonia straminea</i>	0.1	5	OG							0.1					
<i>Eucalyptus pihularis</i>	0.1	2	TG		0.1										
<i>Callistemon salignus</i>	8	30	SG			8									
<i>Melaleuca linariifolia</i>	0.1	1	SG			0.1									
<i>Cirsium vulgare</i>	0.1	1	EX								0.1				
<i>Gahnia clarkei</i>	5	30	GG				5								
<i>Melaleuca biconvexa</i>	10	15	SG			10									
<i>Schoenus melanostachys</i>	0.1	1	GG				0.1								
<i>Sporobolus africanus</i>	1	20	EX								1				

Q4			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter (low condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	353318	6311798	56
			47	28	4	6	5	8	1	4	19	10	Orientation	120	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			100.9	53.5	25.2	10.7	12.4	3.7	0.1	1.4	47.4	45.4	Stem classes		
<i>Verbena rigida</i>	0.2	20									0.2		80+	1	
<i>Microlaena stipoides</i> var. <i>stipoides</i>	5	50					5						50-79	0	
<i>Oplismenus aemulus</i>	5	100					5						30-49	4	
<i>Lantana camara</i>	25	50										25	20-29	7	
<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	5	10			5								10-19	6	
<i>Ligustrum sinense</i>	15	100										15	5-9	2	
<i>Cirsium vulgare</i>	0.1	5									0.1		<5	0	
<i>Stephania japonica</i> var. <i>discolor</i>	1	50								1					
<i>Hypolepis muelleri</i>	0.1	2						0.1					Hollows	0	
<i>Conyza bonariensis</i>	0.1	4									0.1		Lenth of logs (m)	0	
<i>Sida rhombifolia</i>	0.2	20									0.2				
<i>Centella asiatica</i>	0.1	1						0.1					BAM Attributes 1x1m plot		
<i>Commelina cyanea</i>	3	40						3							
<i>Geitonoplesium cymosum</i>	0.2	20								0.2			Litter cover	83	
<i>Breytia oblongifolia</i>	0.5	10				0.5							Bare ground	11	
<i>Juncus usitatus</i>	0.2	5					0.2						Cryptogam	0.6	
<i>Morinda jasminoides</i>	0.1	4								0.1			Vegetation	2.6	
<i>Modiola caroliniana</i>	0.1	1									0.1				
<i>Solanum nigrum</i>	0.1	2									0.1				
<i>Acacia irrorata</i> subsp. <i>irrorata</i>	2	1													
<i>Eucalyptus saligna</i>	0.2	1			0.2										
<i>Acacia maidenii</i>	5	7			5										
<i>Araujia sericifera</i>	0.1	1													
<i>Asparagus aethiopicus</i>	0.1	1													
<i>Asparagus asparagoides</i>	0.1	1													
<i>Cayratia clematidea</i>	0.1	5								0.1					
<i>Cinnamomum camphora</i>	4	3													
<i>Cyperus gracilis</i>	0.2	20					0.2								
<i>Desmodium rhytidophyllum</i>	0.1	2						0.1							
<i>Echinopogon ovatus</i>	2	20					2								
<i>Ehrharta erecta</i>	0.1	10													
<i>Eucalyptus amplifolia</i>	15	8			15										
<i>Exocarpos cupressiformis</i>	1	1				1									
<i>Geranium homeanum</i>	0.1	1						0.1							
<i>Ligustrum lucidum</i>	0.1	1													
<i>Myrsine variabilis</i>	0.1	1				0.1									
<i>Ochma serrulata</i>	0.5	10													
<i>Oxalis latifolia</i>	0.1	1									0.1				
<i>Oxalis spp.</i>	0.1	1						0.1							
<i>Pittosporum undulatum</i>	7	15				7									
<i>Portulaca oleracea</i>	0.1	1						0.1							
<i>Senna pendula</i> var. <i>glabrata</i>	0.4	5													
<i>Setaria pumila</i>	1	10									1				
<i>Sigesbeckia orientalis</i>	0.1	1						0.1							
<i>Solanum mauritianum</i>	0.1	2									0.1				
<i>Vernonia cinerea</i>	0.1	1						0.1							
<i>Wilkiea huegeliana</i>	0.1	1				0.1									

Q5			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1564 Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast (moderate condition)			# spp 65	Count	Count	Count	Count	Count	Count	Count	Count	Count	352964	6311632	56
			51	8	15	9	7	1	11	14	8	Orientation	285		
Species	Cover	Abundance	Sum cover 115.9	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			102.9	49.1	13.9	35.5	1.1	2	1.3	13	10.5	Stem classes			
<i>Oplismenus aemulus</i>	0.5	10	GG			0.5						80+	0		
<i>Lantana camara</i>	0.1	2	HT									50-79	3		
<i>Glochidion ferdinandii</i> var. <i>ferdinandii</i>	1	5	TG	1								30-49	7		
<i>Ligustrum sinense</i>	0.1	4	HT									20-29	9		
<i>Stephania japonica</i> var. <i>discolor</i>	0.1	10	OG						0.1			10-19	14		
<i>Sida rhombifolia</i>	0.1	5	EX							0.1		5-9	6		
<i>Geitonoplesium cymosum</i>	0.1	10	OG						0.1			<5	0		
<i>Breynia oblongifolia</i>	0.1	3	SG		0.1										
<i>Acacia irrorata</i> subsp. <i>irrorata</i>	0.2	1	SG		0.2							Hollows	0		
<i>Eucalyptus saligna</i>	6	5	TG	6								Length of logs (m)	9		
<i>Acacia maidenii</i>	4	10	TG	4											
<i>Asparagus aethiopicus</i>	0.1	2	HT									0.1	BAM Attributes 1x1m plot		
<i>Echinopogon ovatus</i>	4	40	GG			4									
<i>Ehrharta erecta</i>	5	50	HT									5	Litter cover	92	
<i>Exocarpos cupressiformis</i>	4	10	SG		4								Bare ground	3	
<i>Ochna serrulata</i>	0.1	3	HT									0.1	Cryptogam	0	
<i>Pittosporum undulatum</i>	3	4	SG		3								Vegetation	5.4	
<i>Setaria pumila</i>	2	20	EX							2					
<i>Vernonia cinerea</i>	0.1	5	FG					0.1							
<i>Pteridium esculentum</i>	2	20	EG						2						
<i>Dianella caerulea</i> var. <i>producta</i>	0.5	20	FG					0.5							
<i>Imperata cylindrica</i>	10	100	GG			10									
<i>Paspalum dilatatum</i>	1	10	HT									1			
<i>Parsonia straminea</i>	0.2	15	OG							0.2					
<i>Entolasia marginata</i>	2	30	GG			2									
<i>Lomandra longifolia</i>	6	30	GG			6									
<i>Poa affinis</i>	5	50	GG			5									
<i>Eucalyptus pilularis</i>	20	20	TG	20											
<i>Callistemon salignus</i>	0.2	1	SG		0.2										
<i>Melaleuca linariifolia</i>	0.5	2	SG		0.5										
<i>Plantago lanceolata</i>	0.1	10	EX								0.1				
<i>Verbena bonariensis</i>	0.1	2	EX								0.1				
<i>Dichondra repens</i>	0.1	30	FG					0.1							
<i>Pratia purpurascens</i>	0.1	10	FG					0.1							
<i>Cynodon dactylon</i>	2	20	GG			2									
<i>Hardenbergia violacea</i>	0.1	20	OG							0.1					
<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	0.1	20	OG							0.1					
<i>Kennedia rubicunda</i>	0.1	3	OG							0.1					
<i>Trifolium repens</i>	0.1	1	EX								0.1				
<i>Bidens pilosa</i>	0.1	1	EX								0.1				
<i>Entolasia stricta</i>	1	10	GG			1									
<i>Leucopogon lanceolatus</i>	0.1	1	SG		0.1										
<i>Ozothamnus diosmifolius</i>	0.5	10	SG		0.5										
<i>Polyscias sambucifolia</i> subsp. <i>sambucifolia</i>	0.1	2	SG		0.1										
<i>Paspalum urvillei</i>	4	40	HT									4			
<i>Hibbertia scandens</i>	0.1	3	OG						0.1						
<i>Angophora floribunda</i>	5	5	TG		5										
<i>Acacia prominens</i>	3	10	TG		3										
<i>Allocasuarina torulosa</i>	10	15	TG		10										

Q5 cont.			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone	
PCT 1564 Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast (moderate condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	352964	6311632	56	
			65	51	8	15	9	7	1	11	14	8	Orientation	285		
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot			
			115.9	102.9	49.1	13.9	35.5	1.1	2	1.3	13	10.5	Stem classes			
<i>Allocasuarina torulosa</i>	10	15	TG		10											
<i>Backhousia myrtifolia</i>	1	3	SG			1										
<i>Brunoniella australis</i>	0.1	1	FG					0.1								
<i>Daviesia ulicifolia</i>	1	5	SG			1										
<i>Denhamia silvestris</i>	2	7	SG			2										
<i>Elaeocarpus reticulatus</i>	0.1	1	SG			0.1										
<i>Eustrephus latifolius</i>	0.1	5	OG							0.1						
<i>Livistona australis</i>	0.1	1	OG							0.1						
<i>Notelaea longifolia</i>	0.1	1	TG		0.1											
<i>Oxalis perennans</i>	0.1	1	FG					0.1								
<i>Persoonia linearis</i>	1	3	SG			1										
<i>Pittosporum revolutum</i>	0.1	3	SG			0.1										
<i>Pseuderanthemum variabile</i>	0.1	10	FG					0.1								
<i>Rytidosperma spp.</i>	5	100	GG				5									
<i>Senecio madagascariensis</i>	0.1	2	HT									0.1				
<i>Smilax australis</i>	0.1	1	OG							0.1						
<i>Tylophora barbata</i>	0.2	20	OG							0.2						

Q6			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (moderate condition)			# spp 53	Count 47	Count 12	Count 9	Count 7	Count 3	Count 2	Count 14	Count 6	Count 5	352759	6311795	56
Species	Cover	Abundance	Sum cover 111.2	Sum 87	Sum 41.8	Sum 17.6	Sum 18.5	Sum 0.3	Sum 2.1	Sum 6.7	Sum 24.2	Sum 24.1	BAM Attributes 20x50m plot		
<i>Oplismenus aemulus</i>	3	60	GG				3						80+	2	
<i>Lantana camara</i>	20	50	HT										50-79	2	
<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	0.5	10	TG		0.5								30-49	3	
<i>Ligustrum sinense</i>	1	10	HT										20-29	2	
<i>Stephania japonica</i> var. <i>discolor</i>	0.1	10	OG							0.1			10-19	7	
<i>Geitonoplesium cymosum</i>	0.1	10	OG							0.1			5-9	0	
<i>Breynia oblongifolia</i>	0.1	3	SG			0.1							<5	0	
<i>Eucalyptus saligna</i>	3	3	TG		3										
<i>Acacia maidenii</i>	0.1	2	TG		0.1										
<i>Ocina serrulata</i>	0.1	2	HT												
<i>Pittosporum undulatum</i>	0.1	1	SG			0.1									
<i>Pteridium esculentum</i>	2	20	EG												
<i>Dianella caerulea</i> var. <i>producta</i>	0.1	10	FG						0.1						
<i>Imperata cylindrica</i>	1	20	GG				1								
<i>Parsonsia straminea</i>	0.2	20	OG							0.2					
<i>Entolasia marginata</i>	4	50	GG				4								
<i>Lomandra longifolia</i>	0.5	10	GG				0.5								
<i>Poa affinis</i>	5	60	GG				5								
<i>Eucalyptus pihularis</i>	10	5	TG		10										
<i>Callistemon salignus</i>	2	2	SG			2									
<i>Dichondra repens</i>	0.1	20	FG						0.1						
<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	0.1	20	OG							0.1					
<i>Polyscias sambucifolia</i> subsp. <i>sambucifolia</i>	0.2	10	SG			0.2									
<i>Hibbertia scandens</i>	0.1	2	OG							0.1					
<i>Allocasuarina torulosa</i>	5	9	TG		5										
<i>Backhousia myrtifolia</i>	5	1	SG			5									
<i>Eustrephus latifolius</i>	0.1	1	OG							0.1					
<i>Livistona australis</i>	0.1	1	OG							0.1					
<i>Nothofagus longifolia</i>	0.2	2	TG		0.2										
<i>Pittosporum revolutum</i>	0.1	1	SG			0.1									
<i>Pseuderanthemum variabile</i>	0.1	10	FG						0.1						
<i>Smilax australis</i>	0.1	1	OG							0.1					
<i>Microlaena stipoides</i> var. <i>stipoides</i>	4	50	GG				4								
<i>Morinda jasminoides</i>	0.2	20	OG							0.2					
<i>Cayratia clematidea</i>	0.1	1	OG							0.1					
<i>Ligustrum lucidum</i>	2	2	HT									2			
<i>Wilkia huegeliana</i>	0.1	5	SG			0.1									
<i>Calochlaena dubia</i>	5	50	OG							5					
<i>Neprolepis cordifolia</i>	0.1	2	EG						0.1						
<i>Alphitonia excelsa</i>	1	1	TG		1										
<i>Cissus antarctica</i>	0.2	10	OG							0.2					
<i>Clerodendrum tomentosum</i>	4	20	TG		4										
<i>Commersonia fraseri</i>	5	30	SG			5									
<i>Dioscorea transversa</i>	0.2	30	OG							0.2					
<i>Endiandra sieberi</i>	6	5	TG		6										
<i>Guioa semiglauc</i>	5	5	TG		5										
<i>Melicope micrococca</i>	5	15	SG			5									
<i>Oplismenus imbecillis</i>	1	20	GG				1								
<i>Sarcopetalum harveyanum</i>	0.1	4	OG							0.1					

Q6 Cont.			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (moderate condition)			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count	352759	6311795	56
			53	47	12	9	7	3	2	14	6	5	Orientation	105	
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			111.2	87	41.8	17.6	18.5	0.3	2.1	6.7	24.2	24.1	Stem classes		
<i>Syagrus romanzoffiana</i>	0.1	1	EX								0.1				
<i>Syncarpia glomulifera subsp. glomulifera</i>	5	2	TG		5										
<i>Tradescantia fluminensis</i>	1	10	HT									1			
<i>Trochocarpa laurina</i>	2	3	TG		2										

Q7			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation			# spp 44	Count 22	Count 3	Count 8	Count 5	Count 4	Count 1	Count 1	Count 22	Count 7	352603	6311852	56
Species	Cover	Abundance	Sum cover 85.6	Sum 25.5	Sum 3.4	Sum 1	Sum 17.5	Sum 0.5	Sum 3	Sum 0.1	Sum 59.9	Sum 35.1	BAM Attributes 20x50m plot		
<i>Oplismenus aemulus</i>	0.2	10	GG				0.2						80+	0	
<i>Lantana camara</i>	10	20	HT										50-79	0	
<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	0.3	3	TG		0.3								30-49	0	
<i>Stephania japonica</i> var. <i>discolor</i>	0.1	3	OG							0.1			20-29	0	
<i>Breynia oblongifolia</i>	0.1	2	SG			0.1							10-19	0	
<i>Eucalyptus saligna</i>	0.1	2	TG		0.1								5-9	0	
<i>Pteridium esculentum</i>	3	30	EG						3				<5	10	
<i>Imperata cylindrica</i>	5	50	GG				5								
<i>Poa affinis</i>	0.1	1	GG				0.1						Hollows	0	
<i>Polyscias sambucifolia</i> subsp. <i>sambucifolia</i>	0.1	1	SG			0.1							Lenh of logs (m)	0	
<i>Microlaena stipoides</i> var. <i>stipoides</i>	0.2	10	GG				0.2								
<i>Sida rhombifolia</i>	0.1	20	EX								0.1		BAM Attributes 1x1m plot	M Attributes 1	
<i>Acacia irrorata</i> subsp. <i>irrorata</i>	0.1	1	SG			0.1									
<i>Setaria pumila</i>	10	80	EX								10		Litter cover	33	
<i>Vernonia cinerea</i>	0.1	20	FG					0.1					Bare ground	46	
<i>Paspalum dilatatum</i>	2	20	HT										Cryptogam	0.2	
<i>Plantago lanceolata</i>	0.1	2	EX								0.1		Rock	21	
<i>Verbena bonariensis</i>	0.2	20	EX								0.2				
<i>Cynodon dactylon</i>	12	100	GG				12								
<i>Paspalum urvillei</i>	5	20	HT											5	
<i>Denhamia silvestris</i>	0.1	1	SG			0.1									
<i>Senecio madagascariensis</i>	0.1	3	HT											0.1	
<i>Verbena rigida</i>	0.2	30	EX								0.2				
<i>Conyza bonariensis</i>	0.3	40	EX								0.3				
<i>Modiola caroliniana</i>	0.1	2	EX								0.1				
<i>Oxalis</i> spp.	0.1	10	FG					0.1							
<i>Sigesbeckia orientalis</i>	0.2	20	FG					0.2							
<i>Solanum mauritianum</i>	3	3	EX								3				
<i>Paspalum quadrifarium</i>	15	40	HT											15	
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	0.1	1	SG			0.1									
<i>Leptospermum polygalifolium</i> subsp. <i>polygalij</i>	0.3	2	SG			0.2									
<i>Setaria parviflora</i>	3	40	EX								3				
<i>Rubus fruticosus</i> agg.	2	20	HT											2	
<i>Marrubium vulgare</i>	0.1	3	EX								0.1				
<i>Pellaea viridis</i>	0.1	1	EX								0.1				
<i>Richardia humistrata</i>	2	30	EX								2				
<i>Andropogon virginicus</i>	1	10	HT											1	
<i>Bidens subalternans</i>	0.5	50	EX								0.5				
<i>Casuarina glauca</i>	3	10	TG		3										
<i>Cycloperum leptophyllum</i>	0.1	20	EX								0.1				
<i>Gamochaeta americana</i>	5	200	EX								5				
<i>Geranium solanderi</i>	0.1	2	FG					0.1							
<i>Pomaderris ferruginea</i>	0.1	1	SG			0.1									
<i>Rubus parvifolius</i>	0.2	20	SG			0.2									

Q8			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting	Northing	Zone
PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (moderate condition)			# spp 46	Count	Count	Count	Count	Count	Count	Count	Count	Count	352372	6312027	56
			31	5	6	5	2	5	8	15	7	Orientation	170		
Species	Cover	Abundance	Sum cover 121.4	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot		
			78.5	31.2	29.1	13.1	0.2	2	2.9	42.9	32.3	Stem classes			
<i>Oplismenus aemulus</i>	2	30	GG			2							80+	0	
<i>Lantana camara</i>	15	30	HT									15	50-79	2	
<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	4	5	TG		4								30-49	0	
<i>Stephania japonica</i> var. <i>discolor</i>	0.2	20	OG							0.2			20-29	0	
<i>Microlaena stipoides</i> var. <i>stipoides</i>	5	50	GG			5							10-19	0	
<i>Sida rhombifolia</i>	0.1	10	EX								0.1		5-9	0	
<i>Acacia irrorata</i> subsp. <i>irrorata</i>	0.1	1	SG			0.1							<5	0	
<i>Setaria pumila</i>	2	20	EX								2				
<i>Verbena bonariensis</i>	0.1	1	EX								0.1		Hollows	0	
<i>Coryza bonariensis</i>	0.1	10	EX								0.1		Length of logs (m)	34	
<i>Sigesbeckia orientalis</i>	0.1	20	FG					0.1							
<i>Paspalum quadrifarium</i>	4	30	HT									4	BAM Attributes 1x1m plot		
<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	2	1	SG			2									
<i>Rubus fruticosus</i> agg.	0.1	2	HT									0.1	Litter cover	65.8	
<i>Ligustrum sinense</i>	10	100	HT									10	Bare ground	27	
<i>Geitonoplesium cymosum</i>	0.1	10	OG							0.1			Cryptogam	0	
<i>Ochna serrulata</i>	0.1	1	HT									0.1	Vegetation	7.8	
<i>Entolasia marginata</i>	5	60	GG				5								
<i>Lomandra longifolia</i>	0.1	3	GG				0.1								
<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	0.1	5	OG								0.1				
<i>Eustrephus latifolius</i>	0.1	1	OG								0.1				
<i>Smilax australis</i>	0.1	3	OG								0.1				
<i>Morinda jasminoides</i>	0.2	10	OG								0.2				
<i>Wilkiea huegeliana</i>	2	5	SG			2									
<i>Calochlaena dubia</i>	2	30	OG								2				
<i>Clerodendrum tomentosum</i>	18	30	TG		18										
<i>Commersonia fraseri</i>	20	50	SG			20									
<i>Dioscorea transversa</i>	0.1	10	OG								0.1				
<i>Melicope micrococca</i>	2	5	SG			2									
<i>Oplismenus imbecillis</i>	1	20	GG				1								
<i>Acacia prominens</i>	0.2	2	TG		0.2										
<i>Hypolepis muelleri</i>	0.1	5	EG						0.1						
<i>Commelina cyanea</i>	0.1	10	FG					0.1							
<i>Cinnamomum camphora</i>	3	5	HT									3			
<i>Senna pendula</i> var. <i>glabrata</i>	0.1	1	HT									0.1			
<i>Tristaniaopsis laurina</i>	7	4	TG		7										
<i>Panicum maximum</i>	8	40	EX									8			
<i>Acmena smithii</i>	2	3	TG		2										
<i>Asplenium australasicum</i>	0.5	3	EG						0.5						
<i>Blechnum cartilagineum</i>	0.3	7	EG						0.3						
<i>Doodia caudata</i>	0.1	1	EG						0.1						
<i>Passiflora edulis</i>	0.1	2	EX								0.1				
<i>Pellaea falcata</i>	1	20	EG						1						
<i>Phytolacca octandra</i>	0.1	1	EX								0.1				
<i>Synoum glandulosum</i>	3	10	SG			3									
<i>Verbena officinalis</i>	0.1	1	EX								0.1				

APPENDIX B

BAM PLOT/TRANSECT FIELD DATA SUMMARY



B1 BAM PLOT/TRANSECT FIELD DATA SUMMARY

Table B.1 BAM plot/transect field data summary

PLOT	TREE RICHNESS	SHRUB RICHNESS	GRASS RICHNESS	FORB RICHNESS	FERN RICHNESS	OTHER RICHNESS	TREE COVER	SHRUB COVER	GRASS COVER	FORB COVER	FERN COVER	OTHER COVER	FALLEN LOGS	LITTER COVER	LARGE TREES	HOLLOWS	HTW COVER	CONDITION
PCT 1564 Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast¹																		
BM	8	13	9	11	3	9	59	29	41	8	2	10	80	62	1 (80)	-	-	BM
Q5	8	15	9	7	1	11	49.1	13.9	35.5	1.1*	2	1.3*	9*	92	0*	0	10.5	Moderate
PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast²																		
BM	9	15	6	8	5	13	73	52	8	4	15	20	14	66	3 (80)	-	-	BM
Q1	4	10	11	9	4	11	16.7*	7.9*	81.2	1.1*	8.2	1.8*	8	48	0*	0	15.4	Low
Q6	12	9	7	3	2	14	41.8	17.6	18.5	0.3*	2.1*	6.7	145	94.2	2	2	24.1	Moderate
Q8	5	6	5	2*	5	8	31.2	29.1	13.1	0.2*	2*	2.9*	34	65.8	0*	0	32.3	Moderate
PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast³																		
BM	5	10	7	6	2	5	24	19	57	3	2	2	44	44	5 (50)	-	-	BM
Q2	4	3	4	6	3	9	19.2	6.1	59	2.6	6.1	6.7	4*	60	2	0	19.4	Low
Q3	1*	1*	5	1*	1	3	55.01	22.2	18.7	0.1*	1	0.4*	0*	82	0*	0	17.1	Low
PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter⁴																		
BM	4	8	8	7	2	3	21	21	73	3	1	1	12	40	1 (50)	-	-	BM
Q4	4	6	5	8	1	4	25.2	10.7	12.4	3.7	0.1*	1.4	0*	83	1	0	45.4	Low
Miscellaneous ecosystem: Highly disturbed areas with no or limited native vegetation																		
Q7	3	8	5	4	1	1	3.4	1	17.5	0.5	3	0.1	0	33	0	0	35.1	Poor

- (1) Benchmark for PCT 1564 Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast (Sydney Basin IBRA bioregion)
(2) Benchmark for PCT 1568 Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Sydney Basin IBRA bioregion)
(3) Benchmark for PCT 1718 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (Sydney Basin IBRA bioregion)
(4) Benchmark for PCT 1594 Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter (Sydney Basin IBRA bioregion)

APPENDIX C

LIKELIHOOD OF OCCURRENCE –
THREATENED PLANT SPECIES



FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Araliaceae	<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	V	V	Occurs near Patonga and in the Royal National Park and inland to Glen Davis where it grows in dry sclerophyll woodland on sandstone (Department of Environment and Climate Change 2007a; Harden 1992, 1993).	OEH Profile search – Wyong sub-region	Low – the species is known to occur within dry sclerophyll woodland on sandstone habitats of which no similar habitats were recorded within the study area. In addition, the species has not been recorded within the locality (nearest record >15 kilometre from subject study area). Based on a lack of suitable habitat and absence of recent records, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Asclepiadaceae	<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E1	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes (Harden 1992). This species typically occurs at the ecotone between dry subtropical rainforest/woodland communities (James 1997; NSW National Parks and Wildlife Service 2002a).	OEH Profile search – Wyong sub-region	Low – this species is known to occur rainforest gullies, scrub and scree slope habitats at ecotones between sub dry subtropical forest/woodland of which marginal habitat was recorded within the study area. This species has not been recorded within the locality (nearest record >40 kilometre from the study area). Therefore, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Asteraceae	<i>Rutidosis heterogama</i>	Heath Wrinklewort	V	V	Occurs in coastal districts from Maclean to the Hunter Valley and inland to the Torrington region. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides (Harden 1992; Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – this species is known to occur within heath and moist open forest habitats of which no similar habitat was recorded within the study area. No specimens of this species have been previously recorded in the locality with the nearest record being located at Warnervale (approx. 10 kilometres from study area). Given the lack of suitable habitat and absence of records within the locality, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Asteraceae	<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 (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – the species is known to occur on frontal sand dunes of which no similar habitat was recorded within the study area. In addition, this species has not been recorded in the locality (nearest record approx. 10 kilometres from study area). Therefore, this species is considered unlikely to occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Convolvulaceae	<i>Wilsonia backhousei</i>	Narrow-leaved Wilsonia		V	Occurs chiefly in the Sydney district but also common at Jervis Bay (Harden 2000). A salt tolerant species, it is found in intertidal saltmarshes and sometimes on sea cliffs (NSW Scientific Committee 2000b).	OEH Profile search – Wyong sub-region	Low – this species is known to occur within intertidal saltmarshes and on sea cliffs of which no similar habitats were recorded within the study area. In addition, the study area is outside the species known distribution range (i.e. south of Wamberal in northern Sydney). Therefore, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).

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Dilleniaceae	<i>Hibbertia procumbens</i>	Spreading Guinea Flower		E1	Within NSW, known from several locations only on the Central Coast in the Gosford and Wyong local government areas. These populations are at Bumble Hill near Yarramalong in Wyong LGA; Kulnura, Strickland State Forest, Mangrove Mountain, Somersby, Calga/Mt White and Peats Ridge in the Gosford LGA; and near Mogo Creek to the west of Mangrove Creek Dam. The majority of known populations occur within Banksia ericifolia– <i>Angophora hispida</i> – <i>Allocasuarina distyla</i> scrub/heath on skeletal sandy soils. May also be found associated with 'hanging swamp' vegetation communities on sandy deposits (Office of Environment and Heritage 2014e).	OEH Profile search – Wyong sub-region	Low – this species is known to occur within scrub heath on skeletal soils of which no similar habitat was recorded within the study area. In addition the species has only been recorded in the surrounds (approx. 10 kilometre from study area). Therefore, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Elaeocarpaceae	<i>Tetratheca glandulosa</i>	Glandular Pink-bell	V	V	Occurs from Mangrove Mountain to the Blue Mountains where it grows in sandy or rocky heath or scrub (Harden 1992). Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gynea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest. Vegetation communities correspond broadly to Benson and Howell's Sydney Sandstone Ridgetop Woodland (Map Unit 10ar). Common woodland tree species include: <i>Corymbia gummifera</i> , <i>C. eximia</i> , <i>Eucalyptus haemastoma</i> , <i>E. punctata</i> , <i>E. racemosa</i> , and/or <i>E. sparsifolia</i> , with an understorey dominated by species from the families Proteaceae, Fabaceae, and Epacridaceae (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – suitable habitat for this species has not been recorded from the study area. This species has not been recorded from within the locality and is considered unlikely to occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Elaeocarpaceae	<i>Tetratheca 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 (Harden 2002). 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 (Payne et al. 2002).	Bionet Search, EPBC Search, OEI Profile search – Wyong sub-region	Low – the species is known to occur in dry sclerophyll forest with an understorey dense in grasses on well drained soils. Although swampy habitats did occur within the study area the understorey was dense and dominated by sedges which is unlikely to provide habitat for the species. The species has not been previously recorded within the locality (nearest records approx. 7 kilometres from the study area). Given this and the lack of suitable habitat, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).

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Epacridaceae	<i>Epacris purpurascens</i> <i>var. purpurascens</i>	-		V	Occurs in Gosford and Sydney districts where it grows in sclerophyll forest, scrub and swamps (Harden 2002). Usually found in sites with a strong shale influence (NSW National Parks and Wildlife Service 2002b).	project CERs, Bionet Search, OEH Profile search - Wyong sub-region	Low – the species is known to occur within sclerophyll forest and swamp habitats which are on soils with a strong shale influence on sandstone. This habitat type does not occur within the study area. Even though the species has been recorded from a single location within the locality (approx. 4 kilometres from the study area (2003) due to the lack of suitable habitat it is considered unlikely that this species would occur within study area. The local record of this species may be of doubtful taxonomic validity as no specimens accompanied the record (Dr Elizabeth Brown pers. comms.) Although this species is considered unlikely to occur it is considered a ‘subject species’ in this SIS as it is a species of consideration under the CERs for the project.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Euphorbiaceae	<i>Chamaesyce psammogeton</i>	Sand Spurge		E1	Occurs in coastal regions of NSW where it grows on sand dunes near the sea (Harden 2000). Grows on fore-dunes and exposed headlands, often with Spinifex (<i>Spinifex sericeus</i>) (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – the species is known to occur on sand dunes and exposed headlands of which no similar habitat was recorded within the study area. The species has not been recorded from the locality (nearest record approx. 9 kilometres from study area). Based on lack of suitable habitat and absence of records from the locality, this species is considered unlikely to occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Fabaceae (Caesalpinioideae)	<i>Senna acclinis</i>	Rainforest Cassia		E1	Occurs in coastal districts and adjacent tablelands of NSW from the Illawarra to Queensland. It grows in or on the edges of subtropical and dry rainforest (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – whilst the species was considered to have a moderate likelihood of occurring within the project’s approved study area based on potential habitat being present (i.e. PCT1528/HU742: Jackwood – Lilly Pilly – Sassafras riparian warm temperate rainforest on the Central Coast) no suitable habitat was recorded from within the proposed modification study area and as such is considered unlikely to occur or be impacted by the project.	No. This species is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568) which is not considered to be habitat for this species).
Fabaceae (Faboideae)	<i>Pultenaea glabra</i>	Smooth Bush-pea	V	V	Restricted to the higher Blue Mountains and has been recorded from the Katoomba-Hazelbrook and Mount Victoria areas. This species is primarily associated with riparian or swamp habitat areas in the mid to upper altitudes of the central Blue Mountains on sandstone derived soils. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone	EPBC Search	Low – the location is outside known distribution and no likely habitat was recorded within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Fabaceae (Faboideae)	<i>Pultenaea maritima</i>			V	<i>Pultenaea maritima</i> occurs in New South Wales and Queensland and is restricted to grasslands on exposed coastal headlands. Within NSW, the species has been recorded from Newcastle north to Byron Bay (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – species is known to occur within grassland and exposed heathland on coastal headlands of which no similar habitats were recorded within the study area. In addition, the study area is outside the species known distribution range (i.e. Newcastle to Byron Bay). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).

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Fabaceae (Mimosoideae)	<i>Acacia bynoeana</i>	Bynoes Wattle	V	E1	Occurs in the Cessnock area within Kurri Sand Swamp Woodland and south of Dora Creek-Morriset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils (Harden 2002). Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with <i>Corymbia gummifera</i> , <i>Eucalyptus haemastoma</i> , <i>E. gummifera</i> , <i>E. parramattensis</i> , <i>E. sclerophylla</i> , <i>Banksia serrata</i> and <i>Angophora bakeri</i> (NSW National Parks and Wildlife Service 1999a).	EPBC Search, OEH Profile search – Wyong sub-region	Low - species is known to occur within heath or dry sclerophyll forests on sandy soils of which no similar habitats were recorded within the study area. In addition, the species has not been recorded within the locality (nearest record >15 kilometre from study area). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Geraniaceae	<i>Pelargonium sp.</i> <i>Striatellum (G. W. Carr 10345), syn.</i> <i>Pelargonium sp.</i> , <i>Pelargonium sp. 1</i>	Omeo Stork's-bill	E	E1	Known to occur in New South Wales and Victoria in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes and in the transition zone between surrounding grasslands or pasture and the paludal and aquatic communities. During dry periods, the species is known to colonise exposed lake beds (NSW Scientific Committee 2010).	EPBC Search	Low – the species is known to occur in lakes and their transition zones of which no suitable habitat was recorded within the study area. The study area occurs outside the known distribution range of the species (i.e. Monaro and Lake Bathurst). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Juncaginaceae	<i>Maundia triglochoides</i>	-		V	Occurs north from Sydney. Grows in swamps, creeks or shallow freshwater 30 to 60 centimetres deep on heavy clay, low nutrients. Associated with wetland species such as <i>Triglochin procerum</i> (Harden 1993).	project CERs, Bionet Search, OEH Profile search – Wyong sub-region, PlantNet	Moderate – the species is known to occur within swamp, wetland and shallow freshwater habitats of which similar habitat occurs within the study area (PCT1718: Swamp Mahogany – Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast). The species has also been recorded within the locality (closest record approx. 2 kilometres to the north (1990)).	No. This species is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568) which is not considered to be habitat for this species).
Lamiaceae	<i>Prostanthera askania</i>	Tranquility Mintbush	E	E1	Occurs over a very restricted geographic range (of less than 12 kilometre) in the upper reaches of creeks that flow into Tuggerah Lake or Brisbane Water within the Wyong and Gosford local government areas. Eight populations are known from the catchments of Ourimbah Creek, Narara Creek, Dog Trap Gully, Chittaway Creek and Berkeley Creek. A further two populations are known from the Erina Creek–Fires Creek catchment. Occurs adjacent to, but not immediately in, drainage lines on flat to moderately steep slopes formed on Narrabeen sandstone and alluvial soils derived from it. Occurs in moist sclerophyll forest and warm temperate rainforest communities, and the ecotone between them. These communities are generally tall forests with a mesic understorey; Sydney Blue Gum <i>Eucalyptus saligna</i> and Turpentine <i>Syncarpia glomulifera</i> are usually present, though canopy species present can be highly variable (Office of Environment and Heritage 2014f).	project CERs, Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region, PlantNet	Low – whilst the species was considered to have a moderate likelihood of occurring within the project's approved study area based of potential habitat being present (i.e. PCT1528/HU742: Jackwood – Lilly Pilly – Sassafras riparian warm temperate rainforest on the Central Coast) no suitable habitat was recorded from within the proposed modification study area and as such is considered unlikely to occur or be impacted by the project.	No. This species is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568) which is not considered to be habitat for this species).

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Lamiaceae	<i>Prostanthera junonis</i>	Somersby Mintbush	E	E1	Grows in sclerophyll forest and woodland, usually near the coast, in sandy loamy soils, overlying sandstone. Occurs in Mangrove Mountain and Sydney districts (Harden 1992).	EPBC Search, OEH Profile search – Wyong sub-region	Low – the species is known to occur in open forest, low woodland and/or open scrub restricted to the Somersby Plateau. The study area does not contain potential habitat for the species and is outside the species known distribution range (approx. 11 kilometres east of the species northern distribution limit). Although the species has been recorded at the periphery of the locality no habitat occurs within the study area therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Lindsaeaceae	<i>Lindsaea fraseri</i>	Frasers Screw Fern		E1	Occurs upon poorly drained, infertile soils in swamp forest or open eucalypt forest, usually as part of a ferny understorey. Confined to the far north coastal areas (Royal Botanic Gardens 2009).	OEH Profile search – Wyong sub-region	Low – this species is known to occur within swamp forest or open eucalypt forest. Although potential habitat may occur, the study area is outside the species known distribution range (i.e. north coast – north of Arrawarra). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Myrtaceae	<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 (Harden 2002; NSW Scientific Committee 1998a).	OEH Profile search – Wyong sub-region	Low – the species is known to occur within open dry sclerophyll forest dominated by Eucalyptus haemastoma and Corymbia gummifera of which no suitable habitat was recorded within the study area. In addition, the study area is outside the species known distribution range (approx. 8 kilometres south of the southern distribution limit). Therefore, the species is considered unlikely to occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Myrtaceae	<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 (Fairley and Moore 2002; Harden 2002; Robinson 1994) Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (NSW Scientific Committee 1999a).	OEH Profile search – Wyong sub-region	Low – the species is known to occur in a variety of dry sclerophyll habitat types of which no similar habitats occur within the study area. In addition, the species has not been recorded within the locality (nearest record approx. 11 kilometre north east of the study area). Therefore, the species is considered unlikely to occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Myrtaceae	<i>Darwinia glaucophylla</i>	-		V	Restricted to the Gosford LGA where it occurs between Gosford and the Hawkesbury River around Calga, Kariong and Mt Karing. It grows in sandy heath, scrub and woodlands and is often associated with sandstone rock platforms or near hanging swamps and friable sandstone shallow soils. Associated species include: <i>Banksia ericifolia</i> , <i>Acacia terminalis</i> , <i>A. oxycedrus</i> , <i>Angophora hispida</i> , <i>Hakea teretifolia</i> , <i>Bauera rubioides</i> , and in woodland: <i>Corymbia gummifera</i> , <i>C. eximia</i> , <i>Eucalyptus haemastoma</i> and <i>E. punctata</i> (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – the species is known to occur in sandy heath, scrub and woodlands in association with hanging swamps and sandstone rock platforms of which no similar habitats were recorded within the study area. It is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).

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Myrtaceae	<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 (Office of Environment and Heritage 2016d). 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>) (Benson and McDougall 1998; Leigh et al. 1984).	EPBC Search, OEH Profile search – Wyong sub-region	Low – this species is known to occur within coastal heath and low open woodland on exposed sandy ridges of which no similar habitats were recorded within the study area. Although the species has been recorded within the locality, based on lack of suitable habitat it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Myrtaceae	<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 (Harden 2002). Endemic on low coastal ranges and tablelands of central NSW, Taree to Broke, also near Casino (Brooker and Kleinig 1999).	OEH Profile search – Wyong sub-region	Low – this species is known to occur in grassy woodland and dry eucalypt forest of which no similar habitats were recorded within the study area. In addition, this study area is outside the species known distribution range (i.e. north coast west of Maitland between Taree and Broke and also in Casino). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Myrtaceae	<i>Eucalyptus oblonga</i>	Narrow-leaved Stringybark		E2	This species is generally found in dry open forests on dry infertile soils on sandstone. The population at Bateau Bay does however occur on coastal sands (Office of Environment and Heritage 2016d).	Bionet Search, OEH Profile search – Wyong sub-region	Low – the species is known to occur in dry open forests of which no similar habitat was recorded within the study area. Although the species has been recorded infrequently within the locality, based on lack of suitable habitat it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).
Myrtaceae	<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 (Harden 2002).	OEH Profile search – Wyong sub-region	Low – the species is known to occur on low-nutrient sands subject to periodic inundation of which similar habitats occur within the study area. Although potential habitat may occur, the study area is outside the species known distribution range (southern distribution limit >30 kilometres from the study area). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568).

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Myrtaceae	<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Parramatta Red Gum		E2	Occurs from the upper Goulburn Valley to Hill Top where it grows in dry sclerophyll woodland on sandy soil (Harden 2002). Endangered population in the Wyong and Lake Macquarie LGAs.	OEH Profile search – Wyong sub-region	Low – the species is known to occur in sandy alluvium substrates that supports <i>Eucalyptus robusta</i> , <i>Corymbia gummifera</i> and <i>Melaleuca</i> species of which similar habitat was recorded within the study area. Although potential habitat may occur, the study area is outside the known distribution limit for the population (southern distribution limit >9 kilometre from the study area) which is centralised around Warnervale north of the Wyong River. Therefore, the species is considered unlikely to occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Myrtaceae	<i>Eucalyptus pumila</i>	Pokolbin Mallee	V	V	Now only known from a single stand near Pokolbin where it grows in sclerophyll shrubland on skeletal soil on sloping sandstone (Harden 2002). Previously recorded from Muswellbrook and Wyong (Brooker and Kleinig 1999).	PlantNet	Low – the species is known to occur in dry sclerophyll woodland with a canopy of <i>Eucalyptus fibrosa</i> , <i>Callitris endlicheri</i> and <i>Corymbia maculata</i> of which no similar habitats were recorded within the study area. In addition, the study area is outside the species known current distribution range (i.e. Hunter Valley; historic records are known from Wyong area however species has not been recorded recently in these area). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Myrtaceae	<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 (NSW Scientific Committee 1998c). Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects (Department of Environment and Climate Change 2008b; Harden 2002).	project CERs, Bionet Search, EPBC Search, OEI Profile search – Wyong sub-region, PlantNet	Recorded – this species has been previously recorded within the study area and has also been frequently recorded in high abundances within the locality.	No. This species was recorded within the study area, however no known individuals will be removed during the proposed works. Therefore this species is unlikely to be affected by the proposed works.
Myrtaceae	<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 (Office of Environment and Heritage 2014d).	OEI Profile search – Wyong sub-region	Low – the species is known to occur in heath and shrubland on outcropping granite, rhyolite and sandstone on cliffs of which no similar habitats were recorded within the study area. In addition, the species has not been recorded within the locality (nearest record >20 kilometres from the study area). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Myrtaceae	<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E1	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden 2002). 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 (Department of Environment and Climate Change 2008b).	project CERs, Bionet Search, EPBC Search, OEI Profile search – Wyong sub-region	Low – whilst the species was considered to have a moderate likelihood of occurring within the project's approved study area based on potential habitat being present (i.e. PCT1528/HU742: Jackwood – Lilly Pilly – Sassafras riparian warm temperate rainforest on the Central Coast) no suitable habitat was recorded from within the proposed modification study area and as such is considered unlikely to occur or be impacted by the project.	No. This species is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568) which is not considered to be habitat for this species)).

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Orchidaceae	<i>Caladenia porphyrea</i>	-		E1	Caladenia porphyrea has a highly restricted geographic distribution. It has been recorded from two localities in the Wyong local government area c. 2 kilometre apart (NSW Department of Environment and Conservation 2006).	OEH Profile search – Wyong sub-region	Low – the species habitat preferences are relatively unknown (recorded from only two locations within the Wyong LGA). This species is not recognised by the National Herbarium of NSW and is included under the taxonomic listing for Caladenia quadrifaria (Royal Botanic Gardens 2016). Habitat for this species is described as slopes and ridges in sclerophyll forest, often under Allocasuarina species in sandy or shallow clay loams. Additionally, a preliminary determination to remove the species from the TSC Act was submitted by the Scientific Committee on 4 December 2015. Given the swampy low-lying nature of the site, absence of records in then locality and that the species was not detected during previous orchid surveys conducted during the known flowering period (EMM 2015), it is considered unlikely that species may occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	V	E1	Occurs south of Swansea where it grows on clay loam or sandy soils (Harden 1993). Prefers low open forest with a heathy or sometimes grassy understorey (Bishop 2000). 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 (NSW Scientific Committee 2002).	project CERs, EPBC Search, OEH Profile search – Wyong sub-region	Low – the species is known to occur within grassy sclerophyll forest of which no similar habitat was recorded within the study area. A population of this species has been previously recorded from Porters Creek Wetland although despite regular searches no specimens have been recorded since 1999 (NSW Scientific Committee 2008). Habitat recorded for this population has been described as heathland with open forest on a hilltop associated with transitional vegetation of Spotted Gum/Smooth-barked Apple/Stringybark Open Forest and Low Swamp Forest Woodland (Wyong Shire Council 2000). Given the swampy low-lying nature of the site, absence of recent records in the locality and that the species was not detected during previous orchid surveys conducted during the known flowering period (EMM 2015), it is considered unlikely that species may occur within the study area. Notwithstanding the low likelihood of occurrence the species is identified in the project's CERs by the OEH for consideration as a 'subject species' for the SIS. Given this, Caladenia tessellata will be considered as a subject species for further assessment as part of this SIS.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Orchidaceae	<i>Corunastylis sp.</i> <i>Charmhaven</i>	-		CE	<i>Corunastylis sp.</i> Charmhaven (NSW896673) is currently only known from the former the Wyong Shire, now part of the Central Coast Council of NSW where it is restricted to a single location in the Gorokan/Charmhaven area in low woodland to heathland with a shrubby understorey and ground layer. Dominants include <i>Allocasuarina littoralis</i> , <i>Leptospermum juniperinum</i> , <i>Melaleuca nodosa</i> , <i>Callistemon linearis</i> and <i>Schoenus brevifolius</i> . (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – the species is known to occur within in low woodland or heath of which no similar habitat was recorded within the study area. In addition, the species has not been recorded within the locality (nearest record approx. 20 kilometre from study area). Based on lack of suitable habitat, the study area being outside the limits of the species known distribution and absence of records in the locality, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<i>Corybas dowlingii</i>	Red Helmet Orchid		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 200 m elevation and on well-drained gravelly soil (Jones 2006; Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – the species is known to occur on well-drained gravelly soil on south facing slopes of which no similar habitat was recorded within the study area. In addition, the study area is located outside the species known distribution range (approx. 30 kilometre south of the southern distribution limit) and has not been recorded within the locality. Therefore, it is considered unlikely that the species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<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 and 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 (Harden 1993; NSW National Parks and Wildlife Service 1999g).	EPBC Search, OEH Profile search – Wyong sub-region	Low – the species is known to occur in a variety of habitats within the Hunter–Central Rivers although the PCT vegetation associations recorded within the study area are not listed as essential habitat for this species (Office of Environment and Heritage 2016d). Further, this species has not been recorded within the locality, with the nearest record approx. 10kilometre from the study area at Somersby. Specimens at this location were recorded growing in sandstone heath woodland. Therefore, given the lack of records in the locality and the absence of essential PCT habitats, it is considered unlikely that the species may occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<i>Cymbidium canaliculatum</i>	Tiger Orchid		E2	In the Hunter Catchment, the endangered population of this species grows singularly or in clumps in tree hollows, commonly between two to six metres above the ground. Found in woodlands and dry sclerophyll forests dominated by <i>Eucalyptus albens</i> , and less commonly found on <i>E. dawsonii</i> , <i>E. crebra</i> , <i>E. moluccana</i> , <i>Angophora floribunda</i> and <i>Acacia salicina</i> . Scattered, non-endangered populations of this species exist across northern Australia, from NSW to Western Australia (NSW Scientific Committee 2006).	OEH Profile search – Wyong sub-region, OEH Profile search – Wyong sub-region	Low – the study area is not located within the Hunter Catchment as defined by Australia’s River Basins (1997) as outlined in the scientific determination for the species and therefore this population is not considered further.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Orchidaceae	<i>Dendrobium melaleucaphilum</i>	Spider Orchid		E1	Occurs in coastal districts, north from the lower Blue Mountains. It grows frequently on Melaleuca styphelioides, less commonly on rainforest trees or on rocks (Department of Environment and Conservation 2005d; Royal Botanic Gardens 2005).	OEH Profile search – Wyong sub-region	Low – whilst the species was considered to have a moderate likelihood of occurring within the project's approved study area based on potential habitat being present (i.e. PCT1528/HU742: Jackwood – Lilly Pilly – Sassafras riparian warm temperate rainforest on the Central Coast) no suitable habitat was recorded from within the proposed modification study area and as such is considered unlikely to occur or be impacted by the project. The study area is also outside the species current known distribution (nearest records approx. 200 kilometres from study area with a single historic record within locality (1935)).	No. This species is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568) which is not considered to be habitat for this species)).
Orchidaceae	<i>Diuris bracteata</i>	-	X	E1	Previously presumed extinct however in recent years extant populations from north-west of Gosford have been recorded and this area is now the only known area of occurrence of the species. All known plants fall within the Gosford and Wyong Local Government Areas. Occurs in Dry sclerophyll woodland and forest with a predominantly grassy understorey (Office of Environment and Heritage 2014b).	OEH Profile search – Wyong sub-region	Low – this species is known to occur only within with dry sclerophyll forest with predominantly grassy understoreys of which no similar habitat was recorded within the study area. Although the species has been previously recorded within the locality no habitat was recorded within the study area, therefore, the species is considered unlikely to occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<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 (Harden 1993) often on hilltops or slopes (Bishop 2000).	OEH Profile search – Wyong sub-region	Low – the species is known to occur on hilltops or slopes within sclerophyll forest in coastal and near-coastal districts of which no similar habitat was recorded within the study area. Although the species may have been recorded at the periphery of the locality no potential habitat for the species was recorded within the study area, therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<i>Genoplesium baueri</i>	Bauers Midge Orchid		V	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from northern Sydney suburbs. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments (Office of Environment and Heritage 2014a).	EPBC Search	Low – the species is known to occur within dry sclerophyll forest and moss over sandstone of which no similar habitat was recorded within the study area. In addition, the study area is outside the species known distribution range (approx. 30 kilometres north of the northern distribution limit). Therefore, the species is considered unlikely to occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Orchidaceae	<i>Genoplesium insigne</i>	Variable Midge Orchid	CE	E1	This terrestrial orchid occurs between Chain Valley Bay and Wyong in Wyong local government area. It grows in heathland and forest and is associated with <i>Themeda australis</i> amongst shrubs and sedges. Typically it occurs in dry sclerophyll woodland dominated by <i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> , <i>Angophora costata</i> and <i>Allocasuarina littoralis</i> (Department of Environment and Climate Change 2009).	OEH Profile search – Wyong sub-region	Low – the species is known with <i>Themeda triandra</i> (formerly <i>T. australis</i>) amongst shrubs and sedges in heathland and forest of which no similar habitat was recorded within the study area and the species has not been recorded within the locality (nearest record >15 kilometre from the study area). This species is now known from only three extant populations (Charmhaven and Chain Valley Bay), the two populations from Wyong and Toukley are now considered to be extinct. Given the lack of suitable habitat and absence of recent records from the locality, it is considered unlikely that this species would occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	E	V	Highly cryptic as only the flowers may occur above ground. It is more frequent in areas of soil disturbance, but further habitat characteristics or associated vegetation types are poorly known, possibly occurring in sclerophyll forests (Harden 1993).	EPBC Search	Low – within the Hunter–Central Rivers catchment management region essential habitat for this species is unknown however it is known to occur within wet sclerophyll grassy and shrubby forests in the Karuah Manning sub-region (Office of Environment and Heritage 2016d). The species has not been recorded within the locality (nearest record approx. 30 kilometre from the study area) and is not predicted or known from the Wyong sub-region (Office of Environment and Heritage 2016d). The absence of known or predicted habitat and lack of any records from the locality it is considered unlikely that the species may occur within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Orchidaceae	<i>Thelymitra sp. Adorata</i>	Wyong Sun Orchid		CE	Species known distribution occurs within five local populations within the Wyong Local Government Area. It occurs from 10–40 m elevation in grassy woodland or occasionally in derived native grassland on well-drained clay loam or shale derived soils. The majority of populations have been recorded within Dooralong Spotted Gum – Ironbark Forest with <i>Corymbia maculata</i> and <i>Eucalyptus paniculata</i> with a sparse understory of <i>Melelaueca nodosa</i> . May also be found in Alluvial Redgum Footslopes Forest and Alluvial Floodplain Shrub Swamp Forest which adjoin known habitat (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – species is known to occur on clay loam or shale derived soils in grassy woodland or occasionally derived native grassland (predominantly within Spotted Gum – Ironbark Forest) of which no similar habitat was recorded within the study area. Although the species is known to occur within the locality the study area does not contain potential habitat for the species, therefore it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Polygonaceae	<i>Muehlenbeckia costata</i>	Scrambling Lignum		V	This climber has sporadic distribution on North Coast and Northern and Central Tablelands, with one record near Newcastle in a SRA. Inhabits rocky sites at higher altitude, specifically coarse sands and peat in heath, mallee or open eucalypt woodland that exist on granite or acid volcanic outcrops. Responds to disturbance especially fire and clearing for powerlines ((Royal Botanic Gardens 2008).	OEH Profile search – Wyong sub-region	Low – the species is known to occur in a range of habitat types at high altitudes of which no similar habitat for the species was recorded within the study area. In addition, the study area is outside the species known distribution range (approx. 50 kilometre south of the southern distribution limit (1999)). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Polygonaceae	<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 (Department of Environment and Conservation 2005d; Harden 2000).	OEH Profile search – Wyong sub-region	Moderate – the species is known to occur in damp places and occasionally occur in swamp forest of which marginal habitat was recorded within the study area. The species has been recorded within the broader locality (nearest record >25 kilometre from the study area). Although the species has not been recorded within the locality potential habitat was recorded within the study area therefore the species is considered to have potential to occur within the study area.	No. This species is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568) which is not considered to be habitat for this species).
Proteaceae	<i>Grevillea parviflora subsp. 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 populations near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Harden 2002; NSW Scientific Committee 1998b).	EPBC Search, OEH Profile search – Wyong sub-region, PlantNet	Low – species is known to occur within dry sclerophyll woodlands of which no similar habitats were recorded within the subjects site. In addition, the species has not been recorded within the locality (nearest record >10 kilometre north of the study area). Therefore, the species is considered unlikely to occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Proteaceae	<i>Grevillea shiressii</i>		V	V	Known from two populations near Gosford, on tributaries of the lower Hawkesbury River north of Sydney (Mooney Mooney Creek and Mullet Creek). Both populations occur within the Gosford Local Government Area. There is also a naturalised population at Newcastle. Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils (Office of Environment and Heritage 2014c).	OEH Profile search – Wyong sub-region	Low – the species is known to occur along creek banks in wet sclerophyll forest on alluvial sandy or loamy soils of which similar habitat was not recorded within the study area. In addition, the species is not known from the Hunter–Central Rivers CMA and is outside of the species known distribution (nearest record approx. 12 kilometre). Therefore, the species is considered unlikely to occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Proteaceae	<i>Persoonia hirsuta</i>	Hairy Geebung	E	E1	The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. It has a large area of occurrence, but occurs in small populations. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone or very rarely on shale (Harden 2002; Office of Environment and Heritage 2015b). Often occurs in areas with clay influence, in the ecotone between shale and sandstone (James 1997).	OEH Profile search - Wyong sub-region	Low – species is known to occur within dry sclerophyll open woodlands of which no similar habitats were recorded within the study area. In addition, the study area is outside the species known distribution range (approx. 20 kilometre north of the northern distribution limit). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Restionaceae	<i>Baloskion longipes</i>	Dense Cord-rush	V	V	Dense Cord-rush has been recorded from the Kanangra-Boyd area to the Southern Tablelands but all populations are small. Commonly found in swamps or depressions in sandy alluvium (Office of Environment and Heritage 2015a).	EPBC Search	Low – the location is outside known distribution and no likely habitat was recorded within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).

FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE ⁴	AFFECTED SPECIES?
Rutaceae	<i>Asterolasia elegans</i>		E	E1	Known from only seven populations, north of Sydney in the Baulkham Hills, Hawkesbury and Hornsby LGAs; also likely to occur in the western part of Gosford LGA. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>), Smooth-barked Apple (<i>Angophora costata</i>), Sydney Peppermint (<i>Eucalyptus piperita</i>), Forest Oak (<i>Allocasuarina torulosa</i>) and Christmas Bush (<i>Ceratopetalum gummiferum</i>)(Office of Environment and Heritage 2015a).	EPBC Search	Low – this species is known to occur on Hawkesbury Sandstone in sheltered forest of which no suitable habitat was recorded within the study area. In addition, the study area is outside the species known distribution range (approx. 30 kilometre north of northern distribution limit). Therefore, it is considered unlikely that this species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Santalaceae	<i>Thesium australe</i>	Austral Toadflax	V	V	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be <i>Themeda australis</i> and <i>Poa</i> spp. (Department of Environment and Climate Change 2008b; Harden 1992).	EPBC Search	Low – the species is known to occur within grassland and grassy woodland on coastal headlands on away from the coast of which no suitable habitat was recorded within the study area. In addition, the species has not been recorded within the locality (nearest record >60 m from the study area). Therefore, it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Thymelaeaceae	<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	Confined to the coastal area of the Sydney and Illawarra regions. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain (Office of Environment and Heritage 2015a).	EPBC Search	Low – the location is outside known distribution and no likely habitat was recorded within the study area.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).
Zannichelliaceae	<i>Zannichellia palustris</i>	-		E1	Grows in fresh or slightly saline stationary or slowly flowing water (Royal Botanic Gardens 2005).	OEH Profile search - Wyong sub-region	Low – the species is known to occur in freshwater and slightly saline or slow flowing water (such as saltmarshes and freshwater lagoons) of which no suitable habitat was recorded within the study area. In addition, the study area is outside the species known distribution range (nearest records centralised around Newcastle region approx. 40 kilometre from the study area), therefore it is considered unlikely that the species would occur.	No. This species has a low likelihood of occurring within the study area and is not likely to be affected by the proposed development (which involves the removal of 0.1 hectares of native vegetation (PCT 1568)).

(1) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

(2) Listed as Vulnerable, Endangered or Critically Endangered under the NSW *Biodiversity Conservation Act 2016* (BC Act).

(3) Data source: project CERs = Kangy Angy Chief Executive Requirement subject species, EPBC Search = DoE's EPBC Protected Matters Search Tool; PlantNet = Royal Botanic Gardens PlantNet spatial database; OEH Profile Search – Wyong sub-region spatial search and BioNat search = OEH's BioNet Atlas of NSW Wildlife.

(4) Likelihood of occurrence as outlined in Table 2.5.

APPENDIX D

LIKELIHOOD OF OCCURRENCE –
THREATENED ANIMAL SPECIES



SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE WITHIN STUDY AREA ⁴	AFFECTED SPECIES?
Invertebrates							
<i>Petalura gigantea</i>	Giant Dragonfly		E1	Found in permanent wetlands, both coastal and upland from Moss Vale northwards to southern Queensland (Department of Environment and Conservation 2005d).	OEH Profile search – Wyong sub-region	Low – The Giant Dragonfly has been recorded from both coastal and upland permanent wetlands. The project study area did not comprise permanent wetland habitat and this species is considered to have a low likelihood of occurrence in the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
Fish							
<i>Epinephelus daemeli</i>	Black Cod	V	V	Adult black cod are usually found in caves, gutters and beneath bomboras on rocky reefs. They are territorial and often occupy a particular cave for life. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries. Black cod are opportunistic carnivores, eating mainly other fish and crustaceans. They can change from one colour pattern to another in just a few seconds. They are usually black in estuaries and banded around clear water reefs. Black cod are apparently slow growing. Smaller fish are mostly females, but they generally change sex to become males at around 100–110 cm in length. (Department of Primary Industries 2005).	EPBC Search	Low – No habitat is available for this species in the project study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Macquaria australasica</i>	Macquarie Perch	E		The natural range of Macquarie Perch included the upper and middle reaches of the Murray–Darling basin as well as the Shoalhaven and Hawkesbury Rivers. However, this species has recently been sighted in only a few localities within these river systems. Preferred habitat is deep holes covered with rocks, and spawning occurs above shallow running water. Macquarie Perch is a schooling species (Department of Environment and Climate Change 2007b).	EPBC Search	Low – The study does not occur in the known distribution for this species.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
Amphibians							
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E1	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 (Department of Environment and Conservation 2004a, 2005b).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Low – Expert advice received regarding the Green and Golden Bell Frog within the project boundary area found that there was no suitable foraging or sheltering habitats within the project area for this species. Assessment for breeding habitat found that there was a single depression that may be suitable under optimum conditions, but possible utilisation by the frogs is unlikely due to surrounding dense forest habitat that is not suitable for the Green and Golden Bell Frog. Given the study area contains poorer quality habitats more disjunct than that of the project boundary area this species is considered to have a low likelihood of occurring.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Litoria brevipalmata</i>	Green-thighed Frog		V	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain (Department of Environment and Climate Change 2009) . Breeding occurs following heavy rainfall in late spring and summer, with frogs aggregating around grassy semi-permanent ponds and flood-prone grassy areas. The frogs are thought to forage in leaf-litter. Isolated localities along the coast and ranges from the NSW central coast to south-east Queensland.	Bionet Search, OEH Profile search – Wyong sub-region	Low – Expert advice received regarding the Green-thighed Frog found that foraging habitat within the project boundary area for this species was of low quality, due to the small areas of potential habitat within unsuitable habitat types. Assessment of for breeding habitat found that there were no suitable ephemeral ponds within the project area for Green-thighed Frog. Given the study area contains poorer quality habitats n dis more disjunct than that of the project boundary area this species is considered to have a low likelihood of occurring.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog, Heath Frog	V	V	Distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern Victoria. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats (NSW Scientific Committee 2000a).	EPBC Search, OEH Profile search – Wyong sub-region	Low – Breeding habitat for Littlejohn's Tree Frog is associated with upper reaches of permanent rocky streams with fringing vegetation and perched swamps. Foraging habitat includes shrub and groundcover within 100 m of breeding habitat. The study area does not constitute breeding or foraging habitat and this species is considered to have a low likelihood of occurrence in the project study area.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.
<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 (Anstis 2002; NSW National Parks and Wildlife Service 2002c).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – The Wallum Froglet is typically associated with acidic swamps on coastal sandplains, occurring in sedgelands and wet heathlands. They are also occasionally found in swamp sclerophyll forest. Within the project study area, this species is considered to have a moderate likelihood of occurrence in Swamp Forest habitat.	No. This species is not likely to be affected by the proposed works as no habitat will be removed. The removal of 0.1 hectares of native vegetation (PCT 1568 – Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast) is not considered habitat for this species.
<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 (Cogger 2000; NSW National Parks and Wildlife Service 2001a).	EPBC Search, OEH Profile search – Wyong sub-region	Low – Giant Burrowing Frog is confined to sandstone ridgetop habitat and upland valleys where it is associated with small headwater and slow flowing/intermittent creek lines. Such habitat does not occur in the project study area and this species is considered to have a low likelihood of occurrence therein.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Mixophyes balbus</i>	Stuttering Frog	V	E1	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 (Cogger 2000; NSW Scientific Committee 2003).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Low – Although the Stuttering Frog occupies streams in rainforest or tall open wet forest in foothills and escarpment on the eastern side of the Great Dividing Range, within the Wyong sub-catchment area, this species is typically associated with relatively wide flat sections of first order (headwater) mountain streams at the top of a catchment, with populations known from higher altitudes in the Watagan Mountains. In the study area, Ourimbah Creek, does not occur as a first order stream and occurs at a low elevation, effectively on the floodplain of Ourimbah Creek. Further, whilst wet sclerophyll forest habitat associated with this creek was recorded it is in poor to moderate condition having been disturbed as a result of rail and road infrastructure. Accordingly, this species was considered to have a low likelihood of occurrence in the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E1	Terrestrial species which occurs in rainforests, Antarctic beech or wet sclerophyll forests. Feeds on insects and smaller frogs (Cogger 2000). The species is associated with permanent flowing drainages, from shallow rocky rainforest streams to slow-moving rivers in lowland open forest. It is not known to utilise still water areas (NSW Scientific Committee 1999b). More prevalent at lower altitudes and in larger streams than its congeners, although has been recorded up to 1000 metres asl. (NSW National Parks and Wildlife Service 1999g).	EPBC Search, OEH Profile search – Wyong sub-region	Low – The Giant Barred Frog is associated with permanent flowing drainages, from slow flowing rocky rainforest streams to slow-flowing rivers in lowland open forest. As no rainforest habitat occurs within the study area it is considered unlikely that the species would occur within the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Uperoleia mahonyi</i>	Mahony's Toadlet	E		Mahony's Toadlet is endemic to the mid-north coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks. Current observations indicate Mahony's Toadlet inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range.	Expert report	Moderate - Potential marginal habitat within and adjacent to the study area. One record single individual recorded from within the project boundary area (WSP 2017).	No. Whilst potential habitat occurs within the study area, the removal of 0.1 hectares of native vegetation (PCT 1568 – Blackbutt – Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast) is not considered habitat for this species and therefore the species is considered unlikely to be affected.
<i>Pseudophryne australis</i>	Red-crowned Toadlet		V	Occurs within 160 kilometre of Sydney where it is restricted to Hawkesbury Sandstone. It breeds in deep grass and debris adjacent to ephemeral drainage lines. When not breeding individuals are found scattered on sandstone ridges under rocks and logs (Cogger 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Low – The Red-crowned Toadlet is localised species that is largely restricted to the immediate vicinity of ephemeral creeks and gutters below sandstone ridges. Such habitat does not occur in the study area and this species is considered to have low likelihood of occurrence therein.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
Reptiles							
<i>Caretta caretta</i>	Loggerhead Turtle	EM	E1	Ocean dwellers that generally forage in deep water (NSW National Parks and Wildlife Service 2002c). Females come ashore during summer to lay eggs on beaches, with some nesting sites recorded in northern NSW (Office of Environment and Heritage 2016d).	OEH Profile search – Wyong sub-region	Low – The Loggerhead occur in coral reefs, bays and estuaries in tropical and warm temperate waters. Such habitats do not occur within the study area and the species would not occur therein.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Chelonia mydas</i>	Green Turtle	VM	V	The species has been recorded in coastal waters of all Australian states. Nesting has been recorded in the vicinity of Shark Bay and Lacépède Islands in Western Australia, Cobourg Peninsula in the Northern Territory, and in the Gulf of Carpentaria, Raine Island, and the Capricorn and Bunker Groups of islands on the southern Barrier Reef in Queensland (Cogger et al. 1993).	OEH Profile search – Wyong sub-region	Low – The Green Turtle occur in seaweed rich coral reefs and inshore seagrass pastures in tropical and subtropical areas of the Indo-Pacific region. Such habitats do not occur within the study area and the species would not occur therein.	No. This species is not likely to occur within the study area, and no habitat will be

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<i>Dermochelys coriacea</i>	Leatherback Turtle, Leathery Turtle	VM	E1	Marine species that can occur in bays, estuaries and rivers where they feed. Found in all coastal waters of Australia, but more commonly in temperate waters. Known to nest occasionally in Queensland (Cogger 2000).	OEH Profile search – Wyong sub-region	Low – the Leatherback Turtle is a highly pelagic species that ventures close to shore mainly during the nesting season, where they require sandy beaches to nest. Such habitats do not occur within the study area and the species would not occur therein.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake		V	A partly arboreal, nocturnal species found in a range of habitats from rainforest and wet sclerophyll forest to the drier eucalypt forests of the western slopes. Feeds largely on frogs and lizards (Cogger 2000).	Bionet Search, OEI Profile search – Wyong sub-region	Moderate – The Pale-headed Snake is a highly cryptic species, which can spend weeks at a time hidden in tree hollows. This species seeks shelter during the day between loose bark and tree trunks, or in hollow trunks and dead limbs of trees. Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a general paucity of tree hollows and understorey debris, potentially suitable habitat for this species occurred in swamp forest and wet open forest habitat types in the project study area.	No. Notwithstanding that marginal habitat occurs and would be removed by the project (0.1 ha of PCT 1568), due to the general lack of preferred coastal habitat (i.e. dry eucalypt forest and woodland), a paucity of important microhabitat elements (tree hollows), and a lack of records for this species in Sydney Basin bioregion, the Paleheaded Snake is not considered to be an 'affected species'.
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	V	E1	A nocturnal species that occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb and Shine 1994, 1998).	EPBC Search, OEI Profile search – Wyong sub-region	Low – The Broad-headed Snake is associated with exposed cliff edges and sandstone rock outcropping, where it shelters in rock crevices and under flat sandstone rocks during autumn, winter and spring. During summer, this species seeks shelter in hollows of large trees within 500 metres of their escarpment habitat. The project study area did not comprise habitat suitable for habitation by this species and it is considered to have a low likelihood of occurrence therein.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Hoplocephalus stephensii</i>	Stephen's Banded Snake		V	Found in coastal areas from Gosford district to southern QLD. Arboreal snake usually encountered in the wetter sclerophyll or rainforests which occur within its range (Cogger 2000).	Bionet Search, OEI Profile search – Wyong sub-region	Moderate – In the project study area, potentially suitable habitat for this species comprised swamp forest and wet open forest type habitats.	No. Although intermittent occurrences of Stephens Banded Snake in the study area cannot be discounted, due to the lack of records in the project locality, the paucity of important microhabitat elements (tree hollows), that this species was not accounted for during searches over different seasonal contexts, and given the abundance of similar or higher quality habitat in the locality, it is not considered likely that impacts associated with the project would not have a significant adverse impact on local populations. Accordingly, Stephens Banded Snake is not considered an 'affected species' and is not considered further in this report.
<i>Varanus rosenbergi</i>	Heath Monitor (Rosenberg's Goanna)		V	Found in coastal heaths, humid woodlands, and wet and dry sclerophyll forests. Mostly a terrestrial species it shelters in burrows, hollow logs and rock crevices (Cogger 2000).	OEI Profile search – Wyong sub-region	Low – Within the Hunter Central River Catchment Management Region, the Heath Monitor is associated with Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Western Slopes Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands and Sydney Coastal Heaths (Office of Environment and Heritage 2016d). Critical habitat components include termite mounds, within which this species nests. The study area did not comprise appropriate habitat types and lacked critical habitat components (termite mounds). Accordingly, this species is considered to have a low likelihood occurrence in the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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Birds							
<i>Ptilinopus superbis</i>	Superb Fruit-Dove		V	Occurs in rainforests and fringes, scrubs, mangroves and wooded stream-margins, lantana thickets, isolated figs, pittosporums, lily pillies and blackberries (Pizzey and Knight 2007).	Bionet Search, OEH Profile search – Wyong sub-region	Low. There is no suitable habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No. This species is not likely to be affected by the proposed works as no habitat will be removed.
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove		V	Occurs in subtropical and dry rainforests and occasionally in moist eucalypt forests and swamp forests where fruit is plentiful. They are thought to move locally as they follow the ripening fruit (NSW National Parks and Wildlife Service 2002c).	OEH Profile search – Wyong sub-region	Low. There is no suitable habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No. This species is not likely to be affected by the proposed works as no habitat will be removed.
<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 (Garnett and Crowley 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Low. There is no suitable habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No. This species is not likely to be affected by the proposed works as no habitat will be removed.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork		E1	Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garnett and Crowley 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Low – The Black-necked Stork forages in freshwater and estuarine wetlands and lakes. They breed in floodplain habitats in northern Australia south to the northern Hunter Region. Suitable breeding and foraging habitats do not occur within the study area. Therefore this species is considered unlikely to occur within the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E1	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. (Garnett and Crowley 2000; NSW National Parks and Wildlife Service 2002c).	EPBC Search, OEH Profile search – Wyong sub-region	Low – The Australasian Bittern is a wetland bird that frequents freshwater and brackish swamps, in which it forages and breeds. Such habitats do not occur within the vicinity of the study area so it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Ixobrychus flavicollis</i>	Black Bittern		V	Usually found in dense vegetation in and fringing streams, swamps, tidal creeks and mudflats, particularly amongst swamp she-oaks and mangroves. Feeds on aquatic fauna along streams, in estuaries and beside billabongs and pools. Breeding occurs in summer in secluded places in densely vegetated wetlands. It nests in trees that overhang the water (Garnett and Crowley 2000; NSW National Parks and Wildlife Service 2002c).	Bionet Search, OEH Profile search – Wyong sub-region	Low – Locally the Black Bittern uses the lower reaches of coastal creeks and rivers within rainforest habitat. There is no suitable habitat within the study area. However, rare occurrences within the study area cannot be discounted.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Pandion cristatus</i> (syn. <i>P. haliaetus</i>)	Eastern Osprey	M	V	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 (Pizzey and Knight 2007).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Low – The Osprey is a specialised fish hunting species generally using shallow estuary or coastal embayment's. They nest in the top of a prominent tree or man-made structure. There are no suitable nesting sites or hunting habitats for this species within the study area, therefore it is not considered likely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<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 (Garnett and Crowley 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – The Square-tailed Kite occurs locally on a seasonal basis and moves widely within its home range. It forages and breeds in woodland habitats, so much of the study area is suitable for its foraging habits, due to the presence of passerine bird habitat. Although rare locally, the study area is likely to represent part of the foraging range for individuals occurring locally.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.

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<i>Hamirostra melanosternon</i>	Black-breasted Buzzard		V	Distributed throughout most of inland Australia and prefers arid scrubland, and open woodlands. Feeds on small mammals and birds (Garnett and Crowley 2000).	OEH Profile search – Wyong sub-region	Low – The Black-breasted Buzzard is an inland species occurring in arid and semi-arid habitats. Movements to coastal areas are likely due to drought driven movements out of their core distribution areas. Local records are accidental and rare and there is no habitat within the study area that it is dependent upon. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		*V	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 (Pizzey and Knight 2007).	Bionet Search, OEH Profile search – Wyong sub-region, Bionet Search (species under preliminary determination)	Low – although the White-bellied Sea-Eagle occurs widely in the locality of the site it favours wetland and estuarine habitats for foraging and requires large trees for nest sites. The study area does not contain suitable habitat, which is important for the life-cycles of this species.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Circus assimilis</i>	Spotted Harrier		V	The Spotted Harrier occurs throughout the Australian mainland in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant and Higgins 1993). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The diet of the Spotted Harrier includes terrestrial mammals, birds and reptiles, occasionally large insects and rarely carrion (Department of Environment Climate Change and Water 2010).	OEH Profile search – Wyong sub-region	Low – The Spotted Harrier is a western plains species that sometimes extends its range to near coastal locations, notably to the north in the Lower Hunter Region. Local records for this species in the study area's locality are likely very intermittent and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VM	CE	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 metres 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 (Garnett and Crowley 2000).	OEH Profile search – Wyong sub-region	Low – There are no records for the Red Goshawk locally and this species has been absent from the central NSW coastal area for many years. This species is rare in far northern NSW and its stronghold is in northern Australia. Due to its status in the study area region and the lack of local records, this species is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Hieraetus morphnoides</i>	Little Eagle		V	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet (Marchant and Higgins 1993).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – The Little Eagle occurs in the study area locality and moves widely within its home range. It forages and breeds in open woodland habitats, so much of the study area is not suited to its foraging habits, due to dense understory strata. Nevertheless, open and managed habitats within the study area may represent part of the foraging habitat of local individuals, so its potential intermittent occurrence within the study area cannot be discounted.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.

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<i>Falco subniger</i>	Black Falcon		V	Widely, but sparsely, distributed in New South Wales, mostly occurring woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. It is usually associated with streams or wetlands, visiting them in search of prey and often using standing dead trees as lookout posts. Habitat selection is generally influenced more by prey densities than by specific aspects of habitat floristics or condition, although in agricultural landscapes it tends to nest in healthy, riparian woodland remnants with a diverse avi-fauna (NSW Scientific Committee 2013).	Bionet Search, OEH Profile search – Wyong sub-region	Low – The Black Falcon generally has a much more westerly distribution than the study area locality. Nevertheless, during certain climatic conditions individuals move into near coastal areas, particularly in the Hunter Region to the north. Although this species is relatively aerial in its habits, the study area does not contain habitat suited to its hunting habits for ground frequenting birds. There are no local records and unsuitable habitat therefore it is considered unlikely that the Black Falcon would occur within the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Burhinus grallarius</i>	Bush Stone-curlew		E1	Inland habitat consists of open forest and woodlands with few, if any, shrubs, and short, sparse grasses of less than 15 cm in height, with scattered fallen timber, leaf litter and bare ground present (Department of Environment and Conservation 2006). In coastal areas, structurally similar elements of tidal and estuarine communities (Casuarina woodlands, saltmarsh and mangroves) provide suitable habitat (Price 2004). 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 (Department of Environment and Conservation 2006).	Bionet Search, OEH Profile search – Wyong sub-region	Low – The Bush Stone-curlew is an open woodland bird found locally in Brisbane Waters National Park and near shoreline and open habitats around Brisbane Waters in the Gosford local government area. The majority of the site does not contain suitable open understorey habitat for this species and there are no known records in the vicinity of the study area. Nevertheless, rare occurrences in the open managed habitats of the study area, but any potential occurrences would likely be as a consequence of accidental movements.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Rostratula australis</i> (syn. <i>R. benghalensis</i>)	Australian Painted Snipe (Painted Snipe)	VM	E1	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 (Garnett and Crowley 2000).	EPBC Search, OEH Profile search – Wyong sub-region	Low – The Australian Painted Snipe occurs in freshwater and brackish wetlands throughout Australia, although they appear to be highly nomadic in response to the distribution of water as a consequence of their use of soft substrates for foraging purposes. There is no suitable habitat for this species within the study area.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Turnix maculosus</i>	Red-backed Button-quail		V	The Red-backed Button-quail is a cryptic species and its specific ecology is poorly documented. The species is nocturnal and crepuscular and feeds on insects and seeds. They normally hide and freeze rather than flushing, although individuals will fly for short distances before dropping back to cover. Red-backed Button-quail may be encountered individually, in pairs or in small family groups. Red-backed Button-quail inhabit grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 mm or more of summer rain. Observations of populations in other parts of its range suggest the species prefers sites near water, including grasslands and sedgeland near creeks, swamps and springs, and wetlands. Red-backed Button-quail usually breed in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter (Marchant and Higgins 1993).	OEH Profile search – Wyong sub-region	Low – The Red-backed Button-quail frequents coastal grasslands where they feed on grass seeds. There are no known records for the species locally and habitats within the study area are not suitable, therefore it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo		V	Occurs in eucalypt woodland and forest with Casuarina/Allocasuarina spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key Allocasuarina species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garnett and Crowley 2000; NSW National Parks and Wildlife Service 1999b).	OEH Profile search – Wyong sub-region	Moderate – Locally the Glossy Black-Cockatoo occurs widely feeding on the nuts of Allocasuarina sp. trees. Allocasuarina torulosa (Forest Oak), which is a feed tree species for Glossy Black-Cockatoos occurs within the study area and they occur locally, so their presence within the study area cannot be discounted on at least an intermittent basis.	No. Although intermittent occurrences of Glossy Black-Cockatoos in the study area cannot be discounted, there is a low density of feed trees although the study area is considered unlikely to provide important habitat for the species. Due to the abundance of similar and much higher quality foraging habitat elsewhere in the locality it is considered very unlikely that impacts on potential Glossy Black-Cockatoo habitat onsite would have a significant adverse impact upon local populations. Accordingly, the Glossy Black-Cockatoos is not considered an ‘affected species’ and is not considered further in this report.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		V	Occurs in wetter forests and woodland from sea level to an altitude over 2000 metres, timbered foothills and valleys, coastal scrubs, farmlands and suburban gardens (Pizzey and Knight 2007).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Locally the Gang-Gang Cockatoo is generally a montane forest bird primarily feeding on the nuts of eucalypt trees. There is foraging habitat within the study and they occur locally, so their presence within the study area cannot be discounted on at least an intermittent basis.	No. Although intermittent occurrences of Gang-Gang Cockatoos in the study area cannot be discounted, due to the abundance of similar and much higher quality foraging habitat elsewhere in the locality it is considered very unlikely that impacts on potential Gang-Gang Cockatoo foraging habitat onsite would have a significant adverse impact upon local populations. Accordingly, the Gang-Gang Cockatoo is not considered an ‘affected species’ and is not considered further in this report.
<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 (Higgins, P.J. 1999).	Bionet Search, OEH Profile search – Wyong sub-region	High – The Little Lorikeet was recorded feeding on Swamp Mahogany blossom in the project development area (WSP Parsons Brinckerhoff 2016a).	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.
<i>Lathamus discolor</i>	Swift Parrot	CE	E1	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 Acacia pycnantha, is indicated. Sites used vary from year to year. (Garnett and Crowley 2000),(Swift Parrot Recovery Team 2001).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Moderate – Suitable seasonal foraging habitat occurs throughout the study area for Swift Parrots in the form of winter flowering tree species, notably Swamp Mahogany and Forest Red Gum and the Swift Parrot has been recorded in the subject site in the past. Local occurrences of Swift Parrots are highly dependent upon the distribution of blossom resources and they may not occur in some favourable locations for a number of years.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The removal of 0.1 ha of potential foraging habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS.

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<i>Neophema pulchella</i>	Turquoise Parrot		V	The Turquoise Parrot inhabits eucalypt and cypress-pine open forests and woodlands (commonly box or box-ironbark) with native grasses, sometimes with a low shrubby understorey, often in undulating or rugged country, or on footslopes. It also lives in open woodland or riparian gum woodland, and often near ecotones between woodland and grassland, or coastal forest and heath. The Turquoise Parrot requires live or dead trees, stumps and logs for nesting, trees and shrubs for shelter, and seeding grasses and forbs (often beneath trees) for food. The Turquoise Parrot's nest is a cavity in a live or dead tree, stump or log, or even fence post often within 1–2 m of the ground. Hollows average about 0.5 m deep, with an entrance hole of 10 x 7 cm, and a nest chamber 12 x 9 cm in diameter (Garnett and Crowley 2000; Higgins, P.J. 1999).	OEH Profile search – Wyong sub-region	Low – The Turquoise Parrot's stronghold is the central western slopes of NSW, but it does approach coastal areas in the Hunter Valley to the north and in the western extremity of the Central Coast region. It is unlikely to occur with the study area due to a lack of local records and suitable habitat.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<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 (Garnett and Crowley 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Although not recorded during onsite surveys for the SIS, Powerful owl records are relatively plentiful in the locality. The study area supports habitat suited to their favoured Ringtail Possum prey, and therefore the study area likely represents part of the foraging range of Powerful Owl individuals. The study area has a few hollow-bearing trees however none are of sufficient size to support breeding. Therefore, the study area is considered unlikely to support breeding habitat for a local pair.	The removal of 0.1 ha of potential foraging habitat is less than 0.01 per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.
<i>Ninox connivens</i>	Barking Owl		V	Occurs in dry sclerophyll woodland. In the south west it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett and Crowley 2000).	OEH Profile search – Wyong sub-region	Low – Barking Owl breeding territories occur to the south in the Gosford local government area and there are records to the west of Ourimbah. This species inhabits dry forest types, which are represented in the study area by relatively small patches of Blackbutt forest that are too small to support this species. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Tyto tenebricosa</i>	Sooty Owl		V	Occurs in wet eucalypt forest and rainforest on fertile soils with tall emergent trees. Typically found in old growth forest with a dense understorey but also occurs in younger forests if nesting trees are present nearby. It nests in large hollows within eucalypts and occasionally caves. It hunts in open and closed forest for a range of arboreal and terrestrial mammals including introduced species and sometimes birds (Garnett and Crowley 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Low. There is no preferred habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No. This species is not likely to be affected by the proposed works as no preferred habitat will be removed.
<i>Tyto novaehollandiae 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 (Garnett and Crowley 2000).	Bionet Search, OEH Profile search – Wyong sub-region	Low – The Masked Owl's diet consists predominantly of terrestrial mammals, which the study area has in abundance. Nevertheless, the density of understorey strata preclude hunting opportunities for this species within the study area and the site does not contain hollows suited to the breeding requirements of this species. Therefore, it is considered unlikely that the study area is important to local Masked Owl individuals.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)		V	Found in eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly in habits woodlands dominated by stringybarks or other rough-barked eucalypts. Nesting occurs in tree hollows (Department of Environment and Conservation 2005a).	OEH Profile search – Wyong sub-region	Low – The Brown Treecreeper is a western dry woodlands species that only rarely occurs in near coastal locations, notably to the north in the Lower Hunter Region. Local records for this species in the study area’s locality are likely accidental and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E1	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 (NSW National Parks and Wildlife Service 1997).	EPBC Search	Low – There are no records for the Eastern Bristlebird locally and this species is known to inhabit coastal and montane heathland habitats. As such habitat does not occur within the study area and there are no local records, this species is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Chthonicola sagittata</i> (syn. <i>Pyrrholaemus sagittatus</i>)	Speckled Warbler		V	Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett and Crowley 2000). The species has been shown to decrease in abundance as woodland area decreased, and it appears to be extinct in districts where no fragments larger than 100 hectares remain (Barrett, G.W et al. 1994). Isolation of Speckled Warbler populations in small remnants increases their vulnerability to local extinction as a result of stochastic events and decreases their genetic viability in the long term (NSW Scientific Committee 2001b).	Bionet Search, OEH Profile search – Wyong sub-region	Low – The Speckled Warbler is a western dry woodlands species that only rarely occurs in near coastal locations, notably to the north in the Lower Hunter Region. Local records for this species in the study area’s locality are likely accidental and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Anthochaera phrygia</i> (syn. <i>Xanthomyza phrygia</i>)	Regent Honeyeater	EM	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 cambagei</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) (Garnett and Crowley 2000).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Moderate – In recent years the Regent Honeyeater has become progressively rarer across its range, including the Central Coast region. The species is not resident in the region, but has in the past migrated to local habitats on an intermittent basis when local blossom resources are abundant. To the north at Morisset it has returned on a 4–5 year cycle and movements coincide with large aggregations of other honeyeaters. However, numbers have been in serious decline since 2002 and it hasn't returned to Morisset since the winter of 2011. Periodical occurrences on the Central Coast coincide primarily with <i>Eucalyptus robusta</i> (Swamp Mahogany) blossoming events. It has not been recorded as breeding in the subject site's locality, with the closest breeding activity recorded at Quorrobolong in the Hunter Valley 42 kilometre to north. Although Regent Honeyeaters are considered unlikely to breed within the study area, there is Swamp Mahogany on site, which may be visited intermittently when blossom resource distribution across the Regent Honeyeater's range pushes them into near coastal habitats. Although stands of Swamp Mahogany in the region continue to exist, this community is threatened by development in well populated coastal areas.	The removal of 0.1 ha of potential foraging habitat is less than 0.01 per cent of is currently available habitat within the locality (5 kilometre radius). No key tree species (such as <i>Eucalyptus robusta</i>) will be removed by the proposed modification. The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS.
<i>Epthianura albifrons</i>	White-fronted Chat		E2	The White-fronted Chat occupies foothills and lowlands below 1000 m above sea level (North 1904; Higgins et al. 2001; Barrett et al. 2003). In New South Wales the White-fronted Chat occurs mostly in the southern half of the state, occurring in damp open habitats along the coast, and near waterways in the western part of the state (Higgins et al. 2001). Along the coastline, White-fronted Chats are found predominantly in saltmarsh vegetation although they are also observed in open grasslands and sometimes in low shrubs bordering wetland areas. (North 1904; Higgins et al. 2001; Barrett et al. 2003). The population in the Sydney Metropolitan Catchment Management Authority region is listed as Endangered (Office of Environment and Heritage 2012).	OEH Profile search – Wyong sub-region, OEH Profile search – Wyong sub-region	Low – In coastal areas the White-fronted Chat occurs within saltmarsh and coastal floodplain habitats. Suitable habitats for this species don't occur within the study area so it is not considered likely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)		V	Occurs within areas of annual rainfall between 400–700 mm. Feed on insects, nectar and lerps (Garnett and Crowley 2000). It occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, Blakely's Red Gum and Forest Red Gum. Also inhabits open forests of smooth-barked gums, stringybarks, river sheoaks (nesting habitat) and tea-trees. Feeding territories are large making the species locally nomadic. It tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least five hectares (Office of Environment and Heritage 2012b).	OEH Profile search – Wyong sub-region	Low – The Black-chinned Honeyeater is a western woodlands species that only rarely occurs in near coastal locations, notably to the north in the Lower Hunter Region. There are no local records for this species in the study area's locality and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Grantiella picta</i>	Painted Honeyeater		V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus <i>Amyema</i> , 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 strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett and Crowley 2000).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Low – The Painted Honeyeater is a western dry woodlands species that does not extend its range into near coastal locations. There are no known records for this species in the study area's locality and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<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 (Department of Environment Climate Change and Water 2010).	Bionet Search, OEH Profile search – Wyong sub-region	High – The Varied Sittella was observed during on site surveys of the SIS in the project boundary area (WSP Parsons Brinckerhoff 2016a) where wooded habitats represent suitable habitat for its foraging requirements. Wooded habitat onsite also represents suitable breeding habitat opportunities.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.
<i>Pomatostomus temporalis temporalis</i>	Grey-Crowned Babbler (Eastern subspecies)		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 (Blakers et al. 1984; Schodde and Mason 1999).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 (Davidson and Robinson 1992).Grey-crowned Babblers are insectivorous and forage in leaf litter and on bark of trees (NSW Scientific Committee 2001a).	OEH Profile search – Wyong sub-region	Low – The Grey-crowned Babbler is a western dry woodlands species that only rarely occurs in near coastal locations, notably to the north in the Lower Hunter Region. There are no known records for this species in the study area's locality and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Petroica boodang</i>	Scarlet Robin		V	In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. It prefers an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (Department of Environment Climate Change and Water 2010; Higgins, P.J. and Peter 2002). The species has been found to be absent from remnants surrounded by cereal cropping, less common in isolated patches of 30 hectares or less (where there was no tree cover within 200 m and less than 20per cent cover within 1 kilometre), less common in sites surrounded by cattle grazing and more common in sites with native versus exotic grasses if ungrazed for more than 10 years (Barrett, G.W. et al. 2003).	OEH Profile search – Wyong sub-region	Low – The Scarlet Robin 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. The few records occurring in the wider locality are from elevated locations to the west and the study area does not contain the open woodland habitats that suite the breeding or wintering habits of this species. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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<i>Petroica phoenicea</i>	Flame Robin		V	In NSW the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats (Higgins, P.J. and Peter 2002). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank (NSW Scientific Committee 2010).	Bionet Search, OEH Profile search – Wyong sub-region	Low – Like the Scarlet Robin the Flame Robin breeds in elevated woodland habitats of the Great Dividing Range and its foothills. They also disperse from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds. The few records occurring in the wider locality are from elevated locations to the south of Broken Bay and the study area does not contain the open woodland habitats that suite the breeding or wintering habits of this species. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<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 (Garnett and Crowley 2000; Traill and Duncan 2000). The species appears unable to survive in remnants smaller than 100–200 hectares (Department of Environment and Conservation 2005c).	OEH Profile search – Wyong sub-region	Low – The Hooded Robin is a western woodlands species that only rarely occurs in near coastal locations, notably to the north in the Lower Hunter Region. There are no local records for this species in the study area’s locality and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Artamus cyanopterus</i>	Dusky Woodswallow		*V	The Dusky Woodswallow occurs widely in open woodlands and forests in eastern Australia south from the Atherton Tableland to southwestern Australia as far north as the vicinity of Perth (Pizzey and Knight 2012). It is absent from semi-arid and arid inland areas and typically favours open wooded habitats or clearing edges with a grassy understorey, although records occasionally occur in wetter forest contexts(Higgins, P.J. et al. 2006).	Bionet Search (species under preliminary determination)	Low - There is a low number of Dusky Woodswallow records occurring locally and this species was not observed during field surveys. Due to its relatively densely vegetated character the study area is considered unlikely to contain important habitat for locally occurring individuals.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.
<i>Stagonopleura guttata</i>	Diamond Firetail		V	Distributed through central and eastern NSW, extending north into southern and central Queensland and south through Victoria to the Eyre Peninsula, South Australia. In NSW, the species occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas (Blakers et al. 1984; Schodde and Mason 1999). Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range (Garnett and Crowley 2000). Firetails nest in trees and bushes, and forage on the ground, largely for grass seeds and other plant material, but also for insects (Blakers et al. 1984; Read 1994).	OEH Profile search – Wyong sub-region	Low – The Diamond Firetail is a western woodlands species that only rarely occurs in near coastal locations, notably to the north in the Lower Hunter Region. There are no local records for this species in the study area’s locality and habitat within the study area is not suitable. Therefore, it is considered unlikely to occur.	No. This species is not likely to occur within the study area, and no habitat will be affected by the proposed works.

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Mammals							
<i>Cercartetus nanus</i>	Eastern Pygmy-possum		V	Found in a range of habitats from rainforest through sclerophyll forest to tree heath. It feeds largely on the nectar and pollen of banksias, eucalypts and bottlebrushes and sometimes soft fruits. It nests in very small tree holes, between the wood and bark of a tree, abandoned birds' nests and shredded bark in the fork of trees (Turner and Ward 1995).	OEH Profile search – Wyong sub-region	Moderate – Eastern Pygmy-possum is found in a broad range of habitat types, but in most areas woodland and heath appear to be preferred. This species feeds largely on nectar and pollen from banksia, eucalypts and bottlebrushes, with soft fruits eaten when flowers unavailable. Although the study area lacked a diverse range of year-round nectar and pollen resources, this species occurrence cannot be discounted. Potentially suitable habitat for this species occurred in swamp forest and wet open forest habitat types.	Although the study area contained marginal habitat for the Eastern Pygmy-possum, such habitat is not considered important due to a lack of preferred woodland and heath type habitats in the study area, no observations in the project boundary area (SIS) during surveys using multiple survey techniques (camera trapping, arboreal trapping, hair tubes, nest box trapping and spotlight transects), lack of records in the locality (Office of Environment and Heritage 2016a), general paucity of hollow-bearing trees in the study area and abundance of similar or higher quality habitats in the locality and region. Therefore, the Eastern Pygmy-possum is not considered an 'affected species'.
<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 (Churchill 1998; Office of Environment and Heritage 2011). Breeding habitat (maternity roosts) is located in roof domes in sandstone caves (Office of Environment and Heritage 2011). Thought to forage below the forest canopy for small flying insects (Churchill 1998).	EPBC Search, OEH Profile search – Wyong sub-region	Moderate – Whilst the study area did not contain roosting or breeding structures for this species, suitable foraging habitat occurred in swamp forest and wet open forest habitat types.	No. Although caves may occur in the project locality (i.e. Ourimbah State Forest), the study area did not contain critical roost structures for the Large-eared Pied Bat. Whilst occasional foraging events cannot be discounted in the study area, based on the rare status of the species in the locality, evidenced by a low incidence of records, it is not likely that the Large-eared Pied Bat would be an 'affected species' as a consequence of the project.
<i>Dasyurus maculatus maculatus</i>	Spotted-Tailed Quoll (Southern Subspecies)	E	V	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 (NSW National Parks and Wildlife Service 1999g). 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 (NSW National Parks and Wildlife Service 1999e, 1999g).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	Moderate – The project study area would not support Spotted-tailed Quoll in isolation of larger tracts of surrounding contiguous forests. However, the study area is likely to form part of larger home range for an individual(s) of this species. Potential foraging habitat occurred in the form of swamp forest and wet open forest habitat types.	No. Whilst the study area may to be visited by Spotted-tailed Quoll on at least an intermittent basis, potential habitat therein would not be utilised in isolation of other areas and largely lacked an abundance of hollow-bearing trees and ground debris due to the disturbed nature of much of the study area. Due to the extensive and contiguous nature of similar or higher quality habitat available in the adjacent foothills and ranges, it is not likely that project related impacts would have an adverse effect on local populations of Spotted-tailed Quoll. Therefore, the Spotted-tailed Quoll is not considered an 'affected species' as a consequence of the project.
<i>Dasyurus viverrinus</i>	Eastern Quoll		E1	Found in a variety of habitats including dry sclerophyll forest, scrub, heathland and cultivated land. Lives in dens which consist of several chambers including underground burrows, hollow logs, rock piles and hay sheds (Strahan 1995).	OEH Profile search – Wyong sub-region	Low – Apart from being relatively common in Tasmania, this species is now considered extinct over much of its historical range in eastern NSW. This species is considered to have low likelihood of occurrence in the project study area.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.

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<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 (Churchill 2008).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a general paucity of tree hollows and young age cohort of canopy strata, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	No. The study area largely provided marginal and supplementary foraging habitat for this species, with preferred habitat likely occurring in areas of extensive and contiguous tall forests associated with the foothills and ranges adjacent to the project. Whilst intermittent foraging events cannot be discounted in the study area, it is not likely that the Eastern False Pipistrelle would be an ‘affected species’ as a consequence of the project due as there is a no records for the species in the broader project boundary area during targeted surveys (SIS), general paucity of hollow-bearing trees in the study area and extensive and contiguous nature of high quality tall forests in the foothills and ranges in the project locality and region.
<i>Isoodon obesulus</i>	Southern Brown Bandicoot	E	E1	Occurs in a variety of habitats in south-eastern Australia, including heathland, shrubland, dry sclerophyll forest with heathy understorey, sedgeland and woodland. Many of the habitats are prone to fire (NSW National Parks and Wildlife Service 1999d).	OEH Profile search – Wyong sub-region	Low – Within NSW the Southern Brown Bandicoot is almost exclusively restricted to the coastal fringe, from the Hawkesbury River in the north to the Victorian border in the south. As the project study area occurs outside (and to the north) the known distribution, the Southern Brown Bandicoot is considered to have a low likelihood of occurrence.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.
<i>Kerivoula papuensis</i> (syn. <i>Phoniscus papuensis</i>)	Golden-tipped Bat		V	Predominantly distributed throughout Indonesia, New Guinea and the Philippines, the species has been observed on the east coast of NSW and Victoria. Prefers moist dense vegetation in coastal forests, near to where wet and dry forests meet and often in the vicinity of creeks. Possibly prefers ecotonal habitats (such as creek lines) for feeding and passage and an ability to manoeuvre in dense vegetation (Strahan 1995).	Bionet Search, OEH Profile search – Wyong sub-region	Low – Suitable foraging habitat is unlikely to occur within the study area as rainforest habitat was not recorded.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.
<i>Macropus parma</i>	Parma Wallaby		V	Now extinct south of Gosford, and confined to high rainfall areas in the coast and ranges of central and northern NSW; from the Watagan Mountains to the Richmond and Border Ranges area, with the Washpool–Gibraltar Range and Bulga–Dingo Tops areas being areas of greatest importance. Occurs in wet sclerophyll forest and rainforest patches in moist sclerophyll forest, with a moist shrubby understorey, often associated with grassy areas. They are occasionally found in dry sclerophyll forest and rainforest edges are considered important refugia. Ecotones between open and closed forest are favoured, open areas are used for foraging, while areas of dense ground cover provide areas for shelter and protection from predators (NSW National Parks and Wildlife Service 1999g).	OEH Profile search – Wyong sub-region	Moderate – Potential habitat for Parma Wallaby in the study area included wet open forest and cleared land with scattered trees.	No. Although intermittent occurrences of Parma Wallaby in the locality cannot be discounted, due to the small extent of marginal wet open forest type habitats available in the study area, together with the extensive and contiguous nature of higher quality habitat in the adjacent foothills and ranges and not being recorded during surveys for the SIS, the Parma Wallaby is not considered an ‘affected species’ as a consequence of the project.
<i>Miniopterus australis</i>	Little Bentwing-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 (Strahan 1995).	Bionet Search, OEH Profile search – Wyong sub-region	High – Suitable foraging habitat for the Little Bentwing-bat occurs within the study area; comprising swamp forest and wet open forest habitat types. Potential roosting habitat, in the form of tree hollows were not observed to be abundant, however roosting habitat also potentially occurs under the existing rail bridge spanning Chittaway Creek and Turpentine Road. Five nursery/maternity colonies are currently known in Australia; none of which occur in project study area.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.

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<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat		V	Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Hunt in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands (Office of Environment and Heritage 2016d).	Bionet Search	High – The Eastern Bent-wing Bat was recorded via Anabat in wet open forest to the north of the project development area (WSP Parsons Brinckerhoff 2016a). Suitable foraging habitat occurred in the form of swamp forest and wet open forest habitat types.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.
<i>Mormopterus (Micronomus) norfolkensis</i>	Eastern Freetail-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 (Churchill 2008).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a relatively young cohort of canopy strata and general paucity of tree hollows, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	No. Although the occurrence of Eastern Freetail-bat within the study area cannot be discounted, it is considered that potential habitat in the study area may not constitute important habitat and therefore would not be an ‘affected species’ as a consequence of the project, due to no records for the species from six harp trap nights and six full night Anabat recordings (echolocation call is distinctive) during SIS targeted surveys of the project boundary area, potential habitat in the study area is not likely to constitute preferred habitat of an open-adapted species, canopy strata over much of study area was generally of an insufficient age class to provide an abundance of hollow-bearing trees, extensive and contiguous nature of higher quality habitat associated with coastal foothills and ranges, including Ourimbah State Forest and the Watagan range. Therefore, the Eastern Freetail-bat is considered unlikely to be an ‘affected species’ as a consequence of the project.
<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 (Churchill 2008). Breeding habitat likely to coincide with roosting habitat (Office of Environment and Heritage 2011).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate –Ourimbah creek and associated fringing wet sclerophyll forest vegetation represent potentially suitable habitat for this species and it may occur in the study area on at least an intermittent basis.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.

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<i>Petaurus australis</i>	Yellow-bellied Glider		V	Restricted to tall, mature eucalypt forest in high rainfall areas of temperate to sub-tropical eastern Australia. Feeds on nectar, pollen, the sap of eucalypts and sometimes insects. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and year round food resources are available from a mixture of eucalypt species (NSW National Parks and Wildlife Service 1999h, 2003c).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a relatively young cohort of canopy strata and general paucity of tree hollows, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	No. Although the study area may be used intermittently for foraging purposes or movement through the landscape, the Yellow-bellied Glider is not considered an ‘affected species’ due to the study area not constituting preferred habitat, not being recorded in the project boundary area during targeted surveys for the SIS, general paucity of hollow-bearing trees over much of the study area largely precludes habitats in the study area constituting important habitat, although occasional movements and/foraging events are always possible, extensive and contiguous nature of higher quality habitat associated with the foothills and sheltered gullies of the adjacent coastal ranges, where the majority of records in the locality occur (i.e. Ourimbah State Forest). Accordingly, project related impacts on the Yellow-bellied Glider are considered unlikely to have an adverse impact on populations in the locality.
<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, feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. It is found in abundance in montane eucalypt also favours forests with a diversity of eucalypts forest with relatively old trees and an abundance of hollows. It to cater for seasonal variation in food abundance.		Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a relatively young cohort of canopy strata and general paucity of tree hollows, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.
<i>Petaurus norfolcensis</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 (NSW National Parks and Wildlife Service 1999f).	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a relatively young cohort of canopy strata and general paucity of tree hollows, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	No. Although potential habitat for the Squirrel Glider was recorded in the study area (swamp forest and wet open forest), it is unlikely that impacts on this species would have an adverse impact on local populations due to the species not being recorded in the project boundary area during targeted surveys for the SIS but Sugar Glider (heard/observed), canopy strata over much of the study area generally being of an age-class insufficient for the development of hollows. Hollowbearing trees were not abundant in the study area, lack of previous records for this species in the study area and adjacent foothills and ranges. Although intermittent occurrences of Squirrel Glider cannot be discounted, due to the above reasons, the Squirrel Glider is not considered an ‘affected species’.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	E1	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or ‘colonies’ each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003a).	EPBC Search, OEH Profile search – Wyong sub-region	Low – The Brush-tailed rock Wallaby is found along the Great Dividing Range where they live on rocky escarpments and granite outcrops and cliffs that have caves and ledges for shelter and face north for warmth. Such habitats do not occur in the study area, and this species is considered to have a low likelihood of occurrence.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.

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<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 (Strahan 1995).	OEH Profile search – Wyong sub-region	Low – This species has a preference for open dry sclerophyll forests, particularly on ridges. Such habitats did not occur in the study area and this species is considered to have a low likelihood of occurrence therein.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.
<i>Phascolarctos cinereus</i>	Koala	V	V	Found in sclerophyll forest. Koalas have been observed to feed on the leaves of in excess of 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 include Forest Red Gum <i>Eucalyptus tereticornis</i> , Grey Gum <i>E. punctata</i> . In coastal areas, Tallowood <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 (NSW National Parks and Wildlife Service 1999c, 2003b).	OEH Profile search – Wyong sub-region	Moderate – Although records for the Koala in the project locality are few, Swamp forest habitats in the study area consisted of a canopy stratum of <i>Eucalyptus robusta</i> , which is preferred feed tree species for this species.	No. No habitat for the Koala will be impacted upon by the proposed modification as no preferred tree species will be removed (i.e. no <i>Eucalyptus robusta</i> will be removed).
<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 (NSW National Parks and Wildlife Service 2002c). Builds small saucer-shaped nests of grass and bark (Strahan 1995).	OEH Profile search – Wyong sub-region	Moderate – Potential habitat occurred in swamp forest and wet open forest habitat types.	No. Species was not recorded during targeted surveys undertaken as part of the SIS within the project boundary area. The Common Planigale was not recorded in the study area and the nearest record occurs in the Barrington Tops region. For this reason, the Common Planigale is not considered and ‘affected species’.
<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 mm. 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 (Johnston 1995; NSW National Parks and Wildlife Service 1999g).	EPBC Search, OEH Profile search – Wyong sub-region	Moderate – Potential habitat occurred in swamp forest and wet open forest habitat types.	No. Although intermittent occurrences of Long-nosed Potoroo locality cannot be discounted, the rare status in the locality, as evidenced by no previous records, together with the extensive and contiguous nature of habitat available in the locality and region, the Long-nosed Potoroo is not considered an ‘affected species’ as a result of the project.
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse		V	The species is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again (Strahan 1995).	OEH Profile search – Wyong sub-region	Moderate – Potential habitat occurred in swamp forest and wet open forest habitat types.	No. Based on targeted trapping survey results undertaken in the project boundary area as part of the SIS and the rarity of this species in the project locality, it is considered unlikely that project related impacts would have an adverse impact on this species. Accordingly, the Eastern Chestnut Mouse is not considered an ‘affected species’ and is not considered further in this report.

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<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 (Threatened Species Scientific Committee 2010).	Bionet Search, EPBC Search	Low – Across the species range, the New Holland Mouse is known to inhabit open heathland, open woodland with heathy understorey and vegetated sand dunes (Department of the Environment 2016). Further, soil type is considered to be an important indicator of habitat (Department of the Environment 2016), with deeper top soils and soft substrates being preferred. As much of the study area was characterised floodplain topography, perched above Ourimbah Creek, the underlying substrates are subject to variations in elevation, which formed a mosaic of low areas holding water, as well as more elevated areas less subject to waterlogging. Thus, it is considered that the New Holland Mouse would have a low likelihood of occurrence in the study area.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.
<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 (Churchill 2008; NSW National Parks and Wildlife Service 2001b).	Bionet Search, EPBC Search, OEH Profile search – Wyong sub-region	High – The Grey-headed Flying-fox was recorded flying over site during two nocturnal survey events. Although this species was not specifically recorded utilising habitat attributes associated with the study area, the Grey-headed Flying-fox is a blossom nomad known to travel large distances during nightly foraging events. Due the large numbers of <i>Eucalyptus robusta</i> within the study area, it is likely that the study area’s swamp forests would be used seasonally during flowering events. No evidence of Grey-headed Flying-fox camps was observed in the study area during field surveys.	The removal of 0.1 ha of potential habitat is less than 0.01per cent of is currently available habitat within the locality (5kilometre radius). The impacts associated with this incremental loss is considered to be consistent with impact assessments undertaken as part of the SIS and therefore not considered to result in a significant impact or significantly affect this species in the locality.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-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 (Churchill 2008).	OEH Profile search – Wyong sub-region	Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a general paucity of tree hollows and young age cohort of canopy strata, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	No. Although intermittent occurrences of Yellow-bellied Sheathtail-bat in the study area are possible, it is not considered an ‘affected species’ as a consequence of the project due to no records for the species from six harp trap nights and six full night Anabat recordings (echolocation call is distinctive) within the project boundary area as part of targeted SIS surveys, canopy strata over much of study area was generally of an insufficient age class to provide an abundance of hollow-bearing trees, propensity for this species to forage at high-speed largely precludes this species from foraging below the canopy strata in available habitats in the study area, foraging opportunities largely occurring above the canopy strata of available habitats in the study area, extensive and contiguous nature of higher quality habitat associated with coastal foothills and ranges, including Ourimbah State Forest and the Watagan range.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT ¹	BC ACT ²	HABITAT	DATA SOURCE ³	LIKELIHOOD OF OCCURRENCE WITHIN STUDY AREA ⁴	AFFECTED SPECIES?
<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 (Churchill 2008)	Bionet Search, OEH Profile search – Wyong sub-region	Moderate – Whilst habitat assessments suggest that the study area is recovering from previous widespread disturbance, including a general paucity of tree hollows and young age cohort of canopy strata, the study area provided suitable habitat in the form of swamp forest and wet open forest habitat types.	No. Although intermittent occurrences of Greater Broad-nosed Bat in the study area cannot be discounted, it is not considered an ‘affected species’ as a consequence of the project due to no records for the species from six harp trap nights and six full night Anabat recordings undertaken in the project boundary area for the SIS, small area of potential foraging habitat likely to be impacted, canopy strata over much of study area was generally of an insufficient age class to provide an abundance of hollow-bearing trees, lack of preferred habitat types, being woodland and dry forest that suit their direct flight, were not available in the study area, propensity of this species to forage slowly and directly largely precludes this species from foraging below the canopy strata of swamp forest type habitats in the study area, extensive and contiguous nature of higher quality habitat associated with coastal foothills, sheltered gullies and ranges, including Ourimbah State Forest and the Watagan range.
<i>Thylogale stigmatica</i>	Red-legged Pademelon		V	Distribution: Restricted to the coastal and subcoastal strip of eastern Australia, from the tip of Cape York in north Queensland, south to the Hunter Valley, just north of Newcastle in NSW. Populations are confined mainly to areas of high rainfall. Macrohabitat is coastal and sub-coastal rainforests and wet sclerophyll forest. Dense understorey and ground cover is important. Ecotones between open and closed forest are favoured. Microhabitat is open areas are used for foraging while areas of dense ground cover/understorey provide areas for shelter and protection from predators (NSW National Parks and Wildlife Service 1999g).	OEH Profile search – Wyong sub-region	Low – As the project study area occurs outside the known distribution of this species, the Red-legged Pademelon is considered to have a low likelihood of occurrence in the study area.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.
<i>Vespadelus troughtoni</i>	Eastern Cave Bat		V	A cave-dwelling species found in eastern Australia from Cape York to NSW. They inhabit tropical mixed woodland and wet sclerophyll forests on the coast and the dividing range, but extend into drier forests on the western slopes (Churchill 1998). Breeding habitat includes caves, rocky outcrops, cliffs, scarps and old mine workings. Roosting habitat includes breeding habitat types and very small crevices in rocky areas or boulder piles or old mine workings and Fairy martin nests. Foraging habitat includes suitable native vegetation within 5 kilometre of breeding habitat (Office of Environment and Heritage 2011).	OEH Profile search – Wyong sub-region	Low – This cave roosting species is usually associated with dry open forest and woodland near cliffs and rocky overhangs and is occasionally found along cliff-lines in wet eucalypt forest. However, the Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey. As the study area occurs outside the distribution of this species, the Eastern Cave Bat is considered to have a low likelihood of occurrence in the study area.	No. This species is not likely to occur within the locality, and no habitat will be affected by the proposed works.

(1) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

(2) Listed as Vulnerable, Endangered or Critically Endangered under the NSW *Biodiversity Conservation Act 2016* (BC Act).

(3) Data source: project CERs = Kangy Angy Chief Executive Requirement subject species, EPBC Search = DoE’s EPBC Protected Matters Search Tool; OEH Profile Search – Wyong sub-region spatial search and BioNat search = OEH’s BioNet Atlas of NSW Wildlife.

(4) Likelihood of occurrence as outlined in Table 2.5.

ABOUT US

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APPENDIX B

NOISE AND VIBRATION IMPACT ASSESSMENT



MEMO

TO: Ashe Earl-Peacock (TfNSW)
FROM: Tom Gouvernet (WSP) / Chris Marsh (WSP)
PROJECT: NIF Maintenance Facility
PROJECT NO.: ACG1522100
MEMO NO: AC007 Rev C
SUBJECT: **Addendum assessment of additional construction activities and access routes**
OUR REF: PS108239-NOI-MEM-007 RevC
DATE: **21 June 2018**

1. INTRODUCTION

This memo provides an assessment of a proposed temporary alternate access road (the proposed modification) for the construction of the New Intercity Fleet (NIF) Maintenance Facility at Kangy Angy (the facility).

This assessment is an addendum to the following technical noise and vibration impact assessments by WSP:

- NVIA - New Intercity Fleet Maintenance Facility Noise and Vibration Impact Assessment, dated 16 May 2016 (report reference: ACG1522100 Issue 3 001).
- Memo AC001 - Additional Impact Piling Construction Assessment, dated 19/07/2016 (included as Appendix F of the Combined Submissions Report).

The NVIA assessed construction activities based on the methodology that all construction vehicle access to the facility would be via the facility's purpose built vehicle access bridge over the existing Main North railway. The assessment assumed that the bridge is completed prior to any further construction activities taking place and access for construction vehicles would largely take place via the bridge.

The development of the facility has entered the detailed design phase and a construction contractor has been engaged. A change in construction methodology resulted in the bridge being built later than originally planned and resulted in the need for an alternate access for heavy vehicles to access the site. When the bridge is completed, construction vehicles will access the site via the bridge as assessed in the NVIA.

Alternate access for heavy vehicles would be via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road). Access for light vehicles would continue to be via Turpentine Road and Ourimbah Road, with no upgrades to the existing roads required for access.

Additional construction work is required to allow heavy vehicles to access the site via the rail service road and the existing underpass at Chittaway Road to allow for heavy vehicles to pass under the railway and turn onto the service road. The access to the underpass from the eastern side will be via Hereford Street. Light vehicles will temporarily access the site via Turpentine Road and Ourimbah Road and an access road off Ourimbah Road into the facility.

Figure 1.1 outlines the location of proposed works associated with the additional construction activities.

2. SENSITIVE RECEIVERS

New receivers have been assessed that were not captured as part of the NVIA. This is due to the proposed modification extending to the north of the approved project. The area surrounding the proposed modification is primarily commercial/industrial properties located to the east, with rural residences located to the west and suburban residences to the north and east. Detail of the receivers surrounding the work activity locations are as follows:

- Adjustments to the existing underpass, located at the Chittaway Road rail underpass indicated in Figure 1.1, where out of hours works will take place is located approximately 120m from a receiver at 17 Chittaway Road, Kangy Angy.
- Installation of a temporary ramp crossing a drainage line, located at the northern drainage crossing Turpentine Road indicated in Figure 1.1, which has residential receivers located to the west of the ramp, with the worst affected being 139 Orchard Road Kangy Angy (120m from the proposed works).
- Upgrade of the existing rail service road on the western (down) side of the Main North railway which has residential receivers located to the west of the facility and north of the service road, with the worst affected being and 139 Orchard Road Kangy and residences along Chittaway Road.

A full list of sensitive receivers is presented in Attachment 1.

3. NOISE MONITORING

3.1 NOISE MONITORING METHODOLOGY

Additional short term attended and long term unattended noise measurements were undertaken between 26 March 2018 and 13 April 2018 at 17 Chittaway Road, Kangy Angy to supplement measurements completed as part of the NVIA. This new location is assigned the ID of BG5. The noise measurements were conducted with reference to Australian Standard AS 1055 *Acoustics, Description and Measurement of Environmental Noise*. Table 3.1 describes the equipment used onsite for both the additional noise measurements and those undertaken as part of the NVIA.

Table 3.1 Noise measurement equipment

ASSESSMENT	ID	EQUIPMENT DESCRIPTION	MONITORING TYPE	LOCATION	MANUFACTURER & TYPE NO.	SERIAL NO.
NVIA	BG1	Environmental noise monitor	Unattended	11 Bridge Street, Ourimbah	Norsonic 140	1406502
NVIA	BG2	Environmental noise monitor	Unattended	19 Ourimbah Road, Kangy Angy	ARL EL-316	16-207-023
NVIA	BG3	Environmental noise monitor	Unattended	170 Old Chittaway Road, Fountaindale	ARL EL-316	16-707-005
NVIA	BG4	Environmental noise monitor	Unattended	139 Orchard Road, Kangy Angy	Svan 958	36659
Construction access addendum	BG5	Environmental noise monitor	Unattended	17 Chittaway Road, Kangy Angy	Svan 958	36693
NVIA & Construction access addendum	-	Environmental noise monitor	Attended	All	NTi – XL2	A2A-05718-E0

ASSESSMENT	ID	EQUIPMENT DESCRIPTION	MONITORING TYPE	LOCATION	MANUFACTURER & TYPE NO.	SERIAL NO.
NVIA & Construction access addendum	-	Calibrator	-	All	Rion NC-73	11248294

The measurement data was gathered over a period of typical traffic movement and activity in the area (i.e. outside of school holiday periods). The noise measurement equipment was fitted with windshields and were field calibrated before and after monitoring. No significant drifts in calibration ($\pm 1.0\text{dB}$) were noted.

The weather conditions at the time of the monitoring were recorded at Gosford Narara Research Station Automatic Weather Station (Bureau of Meteorology station number 061087), which is located approximately nine kilometres south-west of the project.

Periods of inclement weather (wind speeds greater than five metres per second and significant rainfall) and extraneous noise that were identified to adversely affect the noise measurements were excluded from the analysis of the data.

Operator attended noise measurements were conducted at the BG5 noise monitoring location on 26 March 2018. The primary purpose of the attended measurements was to characterise the existing ambient environment based on a short term noise measurement sample.

3.2 NOISE MONITORING RESULTS

The long term unattended noise measurement results, for both the additional measurements and those undertaken as part of the NVIA, are summarised in Table 3.2. The data are reported as the average equivalent continuous average sound levels ($L_{eq,15min}$) and rating background levels (RBL) as defined in the NSW *Noise Policy for Industry* (NPfI) (EPA, 2017). These unattended noise measurement results are used in the definition of criteria relevant to the construction access upgrade works. The additional short term attended noise measurement results are presented in Table 3.3. Refer to the NVIA for a summary of short term attended noise measurements undertaken at locations BG1 through to BG4.

Table 3.2 Unattended noise measurement results (dBA)

ID	DATE	ADDRESS	DAY $L_{eq,15min}$	DAY RBL	EVENING $L_{eq,15min}$	EVENING RBL	NIGHT $L_{eq,15min}$	NIGHT RBL
BG1	17 – 29/2/16	11 Bridge Street, Ourimbah	53	45	55	46	49	43
BG2	30/3 – 6/4/16	19 Ourimbah Road, Kangy Angy	60	44	52	40	43	35
BG3	17 – 29/2/16	170 Old Chittaway Road, Fountaindale	59	49	60	44	55	35
BG4	30/3 – 6/4/16	139 Orchard Road, Kangy Angy	59	47	59	48	57	45
BG5	26/3 – 13/4/18	17 Chittaway Road, Kangy Angy	64	40	64	40	62	39

Note: Day is defined as Monday to Saturday 7.00am to 6.00pm; 8.00am to 6.00pm Sundays and Public Holidays, Evening is 6.00pm to 10.00pm and Night is the remaining periods.

Table 3.3 Additional short term attended noise measurement results (residential measurements)

LOCATION	DATE	START TIME	L _{eq,15min} dBA	L _{90,15min} dBA	COMMENTS
BG5	26/3/18	3.27pm	60	43	Background noise audible at the measurement location consists of distant industrial noise (Sanitarium factory), possibly an exhaust fan or similar, estimated 37-38 dBA. Trees rustling and birds chirping also contribute to the background noise level. Ambient noise is impacted by trains from the nearby rail line. One train (four carriage V Set) was observed on the Down line, at a peak of 80 dBA for 4 seconds when crossing bridge.
BG5	13/4/18	4.45pm	61	42	Distant traffic from direction of Pacific Hwy was audible and contributed to the background noise level. Bird chirping and train noise contributed to the ambient noise level. Birds chirping had an intermittent impact with about, 60-67 dBA per chirp. Two trains on Down line, 83 dBA for 10 seconds (8 car V Set) and 79 dBA for 3 seconds (4 car OSCAR) were observed crossing the bridge. The Sanitarium factory was not audible.

4. ASSESSMENT CRITERIA

This addendum assessment has adopted assessment criteria for construction noise and vibration as detailed in the NVIA. The NVIA assessed construction noise emissions using the TfNSW *Construction Noise Strategy* and construction vibration using the *Assessing Vibration a Technical Guideline* for human comfort and for cosmetic damage; British Standard BS 7385-2: 1993 *Evaluation and measurement for vibration in buildings* and German Standard DIN 4150-3: 1999 *Structural Vibration - Part 3: Effects of vibration on structures*.

4.1 CONSTRUCTION

The criteria for construction noise has been defined as outlined in the NVIA. Table 4.1 summarises noise management levels (NML) as specified in the *Interim Construction Noise Guideline (ICNG)* (EPA, 2009) and how they are applied for residential receivers.

Table 4.1 Interim Construction Noise Guideline construction noise management levels for residential receivers and working hours

TIME OF DAY	NML $L_{eq,15min}^{1,2}$ dBA	HOW TO APPLY
Recommended standard hours: Monday–Friday 7 am–6 pm Saturday 8 am– 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured $L_{eq,15min}$ dBA 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 75 dBA	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 + 5 dB	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 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Note 2: The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Noise Policy for Industry (NPfI) (EPA 2017).

Table 4.2 lists the NMLs that have been adopted for new sensitive receivers as required by the ICNG, based on the background noise monitoring conducted. A list of receivers and the corresponding representative background noise monitoring location is provided in Appendix A.

Table 4.2 Noise management levels at sensitive land uses

NOISE MONITORING LOCATION	NML $L_{eq,15 \text{ min}}$ dBA			
	DAY	DAY (OOHW) ²	EVENING (OOHW) ²	NIGHT (OOHW) ²
Residential receivers				
BG1	55	50	50	48
BG2	54	49	45	40
BG3	59	54	49	40
BG4	57	52	53	50
BG5	50	45	45	44
Non-residential receivers (NMLs apply when premises are in use)				
Industrial	75 (external)			
Commercial	70 (external)			
Child care centre ¹	55 (external)			
School	55 (external)			

Note 1: Based on the maximum recommended internal noise level as specified in *AS 2107 Recommended design sound levels and reverberation times for building interiors*. An external noise level has been specified based on an outside to inside correction of 10 dB, assuming windows are partially open for ventilation.

Note 2: Out of hours work (OOHW)

4.2 SLEEP DISTURBANCE

As per the NVIA, a sleep disturbance screening criteria of $RBL+15$ dB and L_{max} 65 dBA have been adopted for the additional receivers.

4.3 OFF-SITE ROAD TRAFFIC

The proposed modification comprises alternative access for construction vehicles accessing the facility. Heavy vehicles would utilise Enterprise Drive, Chittaway Road and Hereford Street. Light vehicles would utilise Turpentine Road and Ourimbah Road. As outlined in the NVIA, the *Road Noise Policy* (RNP) (EPA 2011) has been used to assess the noise from off-site traffic generated by the impact of the construction access roads.

Table 4.3 presents the road traffic noise criteria relevant to this scope of works from the RNP for land use developments with a potential to create additional traffic on an existing local road.

Table 4.3 Road Noise Policy assessment criteria

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	DAY (7.00AM TO 10.00PM)	NIGHT (10.00PM TO 7.00AM)
Local road	Existing residences affected by additional traffic on local roads generated by land use developments	$L_{eq,1hr}$ 55 dBA	$L_{eq,1hr}$ 50 dBA

4.4 VIBRATION

The criteria for construction and operation has been defined as outlined in the NVIA. The criteria for short term vibration on structures and human amenity are summarised in Tables 4.4 and 4.5 respectively.

Table 4.4 - Guideline values for short term vibration on structures (DIN 4150-3), guideline values for velocity, (mm/s)

TYPE OF STRUCTURE	1Hz TO 10Hz	10Hz TO 50Hz	50Hz TO 100Hz
Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particularly sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

Table 4.5 - Vibration limits (human exposure), Vibration dose value, $m/s^{1.75}$

LOCATION	ASSESSMENT PERIOD	PREFERRED VALUES	MAXIMUM VALUES
Critical areas	Day or night time	0.10	0.20
Residences	Day time	0.20	0.40
Residences	Night time	0.13	0.26
Offices, schools, educational institutions, and places of worship	Day or night time	0.40	0.80
Workshops	Day or night time	0.80	1.60

5. CONSTRUCTION NOISE ASSESSMENT

5.1 METHODOLOGY

A description of the activity and the relevant noise assessment method for each activity, as agreed with TfNSW, is outlined in Table 5.1. It should be noted that the use of the rail service road is classified as construction noise under the ICNG as it is a private road. The RNP is only used with reference to the ICNG when assessing noise from construction traffic on public roads. Therefore, the noise generated by construction traffic along the rail service road is assessed as construction noise during the night time period as a worst case scenario.

Table 5.1 Construction scenario assessment method

ACTIVITY ID	TIME PERIODS	DESCRIPTION	LOCATION	ASSESSMENT METHOD
1	Standard hours and OOHW	Adjustments to existing underpass and upgrade of the existing rail service road on the western (down) side of the Main North railway	Chittaway Road underpass and rail service road between underpass and facility	Quantitative

5.2 QUANTITATIVE ASSESSMENT SCENARIOS

A model of the project site was prepared using the SoundPLAN 7.4 implementing the *ISO 9613:1996 Acoustics – Attenuation of sound during propagation outdoors* calculation method.

A three dimensional representation of the physical environment within the project area was simulated. Modelling inputs for each scenario included ground contours, locations of sensitive receivers, noise-generating equipment as well as any other inputs which have an effect on the noise environment, such as the buildings surrounding the alternate access routes.

The following assumptions were used in the modelling:

- All noise sources were modelled as operating individually, with the impacts of the loudest and quietest equipment for each scenario assessed and presented as a range.
- Ground absorption set at 0.5 for industrial, suburban, and short grassed areas, and 0.75 for woodland areas.
- All noise sources modelled at 2m from ground level in free field.
- Receiver heights 1.5m above ground level.
- Heavy vehicles using the rail service road were assessed as 84 trucks per hour travelling at 10km/h

The following scenarios outlined in Table 5.2 have been modelled as part of the quantitative assessment.

Table 5.2 Modelling scenarios

SCENARIO ID	ACTIVITY	LOCATION	TIME PERIOD	PLANT MODELLED
1	Activity 1 – adjustments to the existing Chittaway Road rail underpass. Includes clearing, earthworks and road construction.	Passing under the 4m clearance bridge (located at the rail underpass indicated in Figure 1.1)	SH	Excavator Skidsteer Tipper truck Semi trailer hi-ab Smooth drum roller Grader Watercart Franna crane Cherry picker Powered hand tools (chainsaws/pruners)
2	Activity 1 – installation of a temporary drainage crossing next to the rail service road. Includes clearing, ramp installation, earthworks and culvert installation	Located at the northern drainage crossing on Turpentine Road indicated in Figure 1.1	SH	Same as scenario 1
3	Activity 1 - upgrade of the rail service road. Includes clearing, earthworks and road construction.	Rail service road between Chittaway Road and the site	SH OOHW	Same as scenario 1
4	Use of rail service road	Rail service road between Chittaway Road and the site	SH OOHW	Truck (84 per hour)

The potential for machinery to emit noise is quantified as the Sound Power Level (SWL) expressed in decibels (dB re 1×10^{-12} W). At the receiver, the noise is quantified as the Sound Pressure Level (SPL) expressed in dB re $20 \mu\text{Pa}$. The SWLs used in the modelling are from *AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites* and WSP data and are shown in Table 5.3.

Table 5.3 Source SWLs

SOURCE ITEM	SWL (dBA)
Smooth drum roller	114
Grader	110
Water cart	108
Powered hand tools	114
Tipper truck	108
Excavator	100
Skidsteer	110
Semi trailer hi-ab	108
Franna crane	110
Cherry picker	102
Truck	109

5.3 PREDICTED NOISE LEVELS

The predicted noise levels for each assessed scenario for $L_{eq,15min}$ descriptors during standard and outside of standard construction hours. Predicted L_{max} results for night work are presented in Attachment 2. For $L_{eq,15min}$, where noise levels exceed the criteria, they are shaded as follows:

- Grey – Night time OOHW criteria exceeded
- Blue – Evening time OOHW criteria exceeded
- Green – Day time OOHW criteria exceeded
- Yellow – Day time SH criteria exceeded

For L_{max} , where noise levels exceed the criteria, they are shaded as follows:

- Grey – Sleep screening or sleep disturbance criteria exceeded

Noise contour maps of the predicted noise levels for each scenario are presented in Attachment 3.

5.4 QUANTITATIVE ASSESSMENT

Within the assessment of the updated scope of works:

- Scenario 1 shows exceedance at only one residential receiver during standard hours. This residential receiver is located at 17 Chittaway Road, 110m from the site of proposed works and use of the loudest equipment exceeds the daytime criteria by 10dB.
- For Scenario 2 only one sensitive receiver exceeds NMLs during the standard hours. This receiver is residential, located 120m from the proposed works at 139 Orchard Road and is predicted to exceed by up to 9dB.
- The upgrade of the rail service road (Scenario 3) shows four exceedances during standard hours. The use of the rail service road (Scenario 4) shows five exceedances during standard hours. These exceedances are all residential

receivers, and are located along Chittaway Road and at 139 Orchard Road. The most affected receiver is 17 Chittaway Road, which when using the loudest equipment was predicted to exceed the standard hours NML by 13dB during widening works, and 7dB when trucks are using the service road.

- Use of the rail service road shows 29 exceedances of the night time NMLs at sensitive receivers when using the loudest equipment. Ten (10) of these receivers were not previously identified in the NVIA. The exceedances were predicted at the following receivers:
 - 54, 62, 72, 80, 84, 92, 106, 110, 118, 139 Orchard Road Kangy Angy
 - 100, 110, 120 Berkeley Road Fountaindale
 - 150, 161, 165, 170 Old Chittaway Road Fountaindale
 - 7, 16, 23, 27, 35 Station Road Fountaindale
 - 17, 36, 37, 61 Chittaway Road Kangy Angy
 - 196, 348 Pacific Highway Kangy Angy
 - 32 Lillygrove Lane Fountaindale
- Widening works on the rail service road show 26 exceedances of the night time NMLs at sensitive receivers when using the loudest equipment. These are the same receivers as those impacted by use of the road with the exception of the following receivers which do not exceed night time NMLs:
 - 100 Berkeley Road Fountaindale
 - 196 Pacific Highway Kangy Angy
 - 32 Lillygrove Lane, Fountaindale
- Both out of hours widening works and use of the rail service road also shows four exceedances of the sleep disturbance criteria. The exceedances were predicted to occur at the following receivers:
 - 139 Orchard Road Kangy Angy
 - 17, 36, 61 Chittaway Road Kangy Angy

6. CONSTRUCTION VIBRATION ASSESSMENT

Table 6.1 presents indicative safe working distances from structures for the most significant vibration generating plant.

Table 6.1 Indicative vibration levels

ITEM	INDICATIVE SAFE WORKING DISTANCE, COSMETIC DAMAGE, M	INDICATIVE SAFE WORKING DISTANCE, HUMAN COMFORT, M
Vibratory roller < 300 kN (typically 7-13 t)	15	100
Excavator	2	N/A

Note: Vibration levels are indicative only and may vary on site and are dependent on individual equipment, mode of operation and ground conditions.

No sensitive receivers were identified within 15 metres of equipment likely to produce significant vibration levels. As a result, cosmetic damage limits are expected to be satisfied for off-site receivers.

Furthermore the closest receives to the access road upgrades are at least 100m away and therefore impacts on human comfort from vibration are not expected.

7. OFF-SITE ROAD TRAFFIC

In the NVIA off site traffic noise impacts were assessed for the new access bridge which will connect Enterprise Drive to the facility. The proposed modification includes use of a temporary alternate access roads prior to the bridge being completed, including:

- Turpentine Road and Ourimbah Road – used by light vehicles only to access site.
- Enterprise Drive, Chittaway Road and Hereford Street to the rail service road –used by heavy vehicles only.

The temporary alternative access road has the potential to cause impacts at receivers nearest to the roads.

The rail service road is considered a private haul road and therefore is assessed as a construction noise source according to the ICNG within Section 5.

Assessment of construction road traffic noise on Enterprise Drive was assessed under the NVIA. The traffic along the proposed alternative routes on Turpentine Road, Ourimbah Road, Chittaway Road and Hereford Street have been assessed under the RNP as a local roads.

The noise level from the road source was calculated using the Calculation of Road Traffic Noise (CRTN) method (UK Welsh office, 1988) using the following assumptions consistent with the NVIA:

- Soft ground between the road and receivers with 0.75 acoustic absorptive coefficient.
- The CRTN low traffic correction was not used.
- Angle of view to the road of 160 degrees.
- Traffic speed of 50 kilometres per hour.
- Façade reflection correction of +2.5 metres.
- L10,1hr to Leq,1hr correction of 3 dB.

The parameters used in the calculation for the routes are outlined in Table 7.1. The traffic volumes represent the total daily traffic volumes expected to be generated by the project which have conservatively been modelled to occur in one hour.

Table 7.1 Traffic modelling parameters

ROUTE	LIGHT VEHICLES PER HOUR ¹	HEAVY VEHICLES PER HOUR ¹	WORST AFFECTED RECEIVERS
Turpentine Road	300	N/A	26 Turpentine Road – 95m
Ourimbah Road	300	N/A	12 Ourimbah Road – 45m
Hereford Street	N/A	84	4 Geoffrey Road – 290m
Chittaway Road	N/A	84	139 Orchard Road – 140m

1. Either the day or night period, total daily traffic assumed to occur in one hour as a worst case assumption.
2. Existing volumes on these roads were considered negligible as they are used only for access to properties on these roads and the traffic volume would be very small compared with the number of construction vehicles.

A summary of the predicted road traffic noise levels, compared against the RNP criteria is presented in Table 7.2.

Table 7.2 Predicted traffic road noise levels for the temporary alternate access road (dBA).

ROUTE	RECEIVER	RNP DAY CRITERIA	RNP NIGHT CRITERIA	PREDICTED TRAFFIC NOISE LEVEL
Turpentine Road	26 Turpentine Road	55 Leq,1hr	50 Leq,1hr	49 Leq,1hr
Ourimbah Road	12 Ourimbah Road	55 Leq,1hr	50 Leq,1hr	53 Leq,1hr
Hereford Street	4 Geoffrey Road	55 Leq,1hr	50 Leq,1hr	49 Leq,1hr
Chittaway Road	139 Orchard Road	55 Leq,1hr	50 Leq,1hr	53 Leq,1hr

The relative increase in traffic noise from all public roads would be limited as noise monitoring in the NVIA indicates that the background noise levels at residential properties are already exposed to road traffic noise levels from Enterprise Drive and the Pacific Motorway limiting the increase in traffic noise from all public roads in the vicinity. Furthermore, the assessment has considered a conservative number of vehicles travelling within a one hour period and actual construction traffic would be expected to be less.

The daytime criteria are predicted to be complied with at all receivers for all project related roads where all project related traffic occurs in one hour.

As it is considered unlikely that all of the project’s daily vehicle movements occur during one hour, where no more than 150 project light vehicles per hour travel on Ourimbah Road, the night time noise criteria are expected to be complied with.

Where no more than 42 project heavy vehicles per hour travel on Chittaway Road, the night time noise criteria are expected to be complied with at the nearest receivers.

8. NOISE MITIGATION AND MANAGEMENT

8.1 STANDARD MITIGATION MEASURES

The source noise mitigation measures outlined in Table 8.1 are recommended in accordance with the CNS in order to reduce the disturbance to the nearby receivers during the works.

Table 8.1 Source controls

ACTION REQUIRED	APPLIES	DETAILS
Construction hours and scheduling.	Noise Vibration	Where feasible and reasonable, construction will be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels will be scheduled during less sensitive time periods.
Construction respite period.	Noise Vibration	High noise and vibration generating activities may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block. No more than four consecutive nights of high noise and/or vibration generating work may be undertaken over any seven day period, unless otherwise approved by the relevant authority.
Equipment selection.	Noise Vibration	Quieter and less vibration emitting construction methods will be used where feasible and reasonable.
Maximum noise levels.	Noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Table 5.3

ACTION REQUIRED	APPLIES	DETAILS
Rental plant and equipment	Noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 5.3.
Use and siting of plant.	Noise	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down when not in use. Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration.	Noise Vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
Non-tonal reversing alarms.	Noise	Non-tonal reversing beepers (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Minimise disturbance arising from delivery of goods to construction sites.	Noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Site access points and roads as far as possible away from sensitive receivers will be used. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.

The noise mitigation path controls outlined in Table 8.2 will be implemented in accordance with the CNS in order to reduce the disturbance to the nearby receivers during the station upgrade.

Table 8.2 Path controls

ACTION REQUIRED	APPLIES	DETAILS
Shield stationary noise sources such as pumps, compressors, fans etc.	Noise	Stationary noise sources will be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receivers from noisy activities.	Noise	Use structures to shield residential receivers from noise such as site shed placement; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.

8.2 SPECIFIC MITIGATION MEASURES

The following site specific mitigation measures are recommended:

- Use of noisy equipment should be minimised during rail service road widening works. With only quieter equipment in use, all receivers will comply with night time NMLs except for 17 Chittaway Road and 139 Orchard Road. If the use of noisy equipment cannot be limited, monitoring at 17 Chittaway Road and 139 Orchard Road should be considered.
- When using the rail service road, heavy vehicle access should be limited to the following movements to comply with NMLs with only marginal exceedance (up to 2dB above NMLs):
 - Day time - 21 truck movements per hour.
 - Day time OOHW - 10 truck movements per hour.

- Evening OOHW - 8 truck movements per hour.
- Night time OOHW - 6 truck movements per hour.
- Where not feasible to and reasonable to limit the number of vehicle movements to those listed above, the following movements would trigger letter box drops as an additional mitigation measure under the CNS:
 - Day time OOHW – 84 truck movements per hour
 - Evening OOHW – 84 truck movements per hour
 - Night time OOHW – 12 truck movements per hour

8.3 ADDITIONAL MITIGATION

In circumstances where the site noise levels are predicted to be noticeable as defined by the CNS after all reasonable and feasible mitigation measures have been implemented, the CNS requires the following additional measures as outlined in Table 8.3.

Table 8.3 Additional mitigation measures

TIME PERIOD		ADDITIONAL MITIGATION MEASURES			
		$L_{Aeq(15\text{ minute})}$ NOISE LEVEL ABOVE RBL			
		0 TO 10 dB NOTICEABLE	10 TO 20 dB CLEARLY AUDIBLE	20 TO 30 dB MODERATELY INTRUSIVE	>30 dB HIGHLY INTRUSIVE
Standard Hours	Mon – Fri (7am – 6pm)	Nil	Nil	Letter box drop Monitoring	Letter box drop Monitoring
	Sat (8am- 1pm)	Nil	Nil	Letter box drop Monitoring	Letter box drop Monitoring
	Mon – Fri (6pm – 10pm)				Letter box drop Monitoring
Evening OOHW	Sat (7am - 8am) and (1pm - 10pm)	Nil	Letter box drop	Letter box drop Monitoring	Phone calls Specific notifications
	Sun/PH (8am – 6pm)				Respite offer Individual briefings
	Mon – Fri (10pm – 7am)			Letter box drop Monitoring	Letter box drop Monitoring
Night time OOHW	Sat 10pm - 8am)	Letter box drop	Letter box drop Monitoring	Phone calls Specific notifications	Phone calls Specific notifications
	Sun/PH (6pm – 7am)			Individual briefings	Individual briefings Alternative accommodation

Note: Respite Offers identified in Period 2 for clearly audible (10 to 20dBA) and moderately intrusive (20 to 30dBA) work shall only apply if works are expected to continue for more than 3 consecutive evenings for Period 1 or more than 2 consecutive nights for Period 2.

9. CONCLUSION

An assessment of a proposed temporary alternate access road (the proposed modification) for the construction of the New Intercity Fleet (NIF) Maintenance Facility at Kangy Angy (the facility) has been conducted. The assessment reviewed the predicted noise impacts at sensitive receivers surrounding the construction works associated with the proposed temporary alternate access routes.

While construction works during standard hours comply with a few exceptions, out of hours works are expected to be above the noise management levels for a number of receivers located adjacent to the construction area. The impacted receivers were quantified and up to 11 receivers were identified as being impacted that were not previously identified in the NVIA.

Mitigation and management measures were investigated considering at source controls such as limiting the number of vehicles using the rail service road and public roads used to access the site and minimising the use of noisy equipment. These mitigation and management measures have been recommended to reduce the noise levels at receivers to either comply with the NMLs or reduce them as far as reasonable and feasible.

Further investigation and consideration of mitigation is subject to reasonable and feasible consideration by Transport for NSW.

10. REFERENCES

Australian Standard, 1997, AS1055.1 Acoustics - Description and measurement of environmental noise - Part 1: General procedures.

Australian Standard, 2010, AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites.

British Standard, 1993, BS7385-2 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.

German Standard, Deutsches Institut für Normung, 1999, DIN 4150: Part 3 Structural vibration - Effects of vibration on structures.

International Organization for Standardization, 1996 ISO 9613 Acoustics -- Attenuation of sound during propagation outdoors.

NSW Environment Protection Authority (formerly Department of Environment and Conservation NSW), 2006, Assessing Vibration: A Technical Guideline.

NSW Environment Protection Authority (formerly Department of Environment, Climate Change and Water), 2009, Interim Construction Noise Guideline.

NSW Environment Protection Authority (formerly Department of Environment, Climate Change and Water), 2011, Road Noise Policy.

NSW Environment Protection Authority (formerly Department of Environment, Climate Change and Water), 2017, Noise Policy for Industry

Transport for NSW (Transport for NSW), 2016, Construction Noise Strategy.

NSW Environment Protection Authority, 2000, NSW Industrial Noise Policy.



ATTACHMENT 1 SENSITIVE RECEIVERS

ID	ADDRESS	RECEIVER TYPE
BG1	11 Bridge Street, Ourimbah	Residential
BG1	15 Bridge Street, Ourimbah	Residential
BG1	24 Bridge Street, Ourimbah	Residential
BG1	3 Bridge Street, Ourimbah	Residential
BG1	36 Bridge Street, Ourimbah	Residential
BG1	43 Bridge Street, Ourimbah	Residential
BG1	57 Bridge Street, Ourimbah	Residential
BG1	67 Pacific Highway, Kangy Angy	Residential
BG1	68 Pacific Highway, Kangy Angy	Residential
BG1	79 Pacific Highway, Kangy Angy	Residential
BG2	106 Orchard Road, Kangy Angy	Residential
BG2	12 Ourimbah Road, Kangy Angy	Residential
BG2	120 Berkeley Road, Fountaindale	Residential
BG2	16 Turpentine Road, Kangy Angy	Residential
BG2	19 Ourimbah Road, Kangy Angy	Residential
BG2	2 Orchard Road, Kangy Angy	Residential
BG2	26 Turpentine Road, Kangy Angy	Residential
BG2	50 Orchard Road, Kangy Angy	Residential
BG2	52 Howes Road, Ourimbah	Residential
BG2	54 Orchard Road, Kangy Angy	Residential
BG2	56 Bridge Street, Ourimbah	Residential
BG2	62 Orchard Road, Kangy Angy	Residential
BG2	72 Orchard Road, Kangy Angy	Residential
BG2	8 Orchard Road, Kangy Angy	Residential
BG2	80 Orchard Road, Kangy Angy	Residential
BG2	84 Orchard Road, Kangy Angy	Residential
BG2	92 Orchard Road, Kangy Angy	Residential
BG3	103 Old Chittaway Road, Fountaindale	Residential
BG3	105 Old Chittaway Road, Fountaindale	Residential
BG3	107 Old Chittaway Road, Fountaindale	Residential
BG3	11 Enterprise Drive, Fountaindale	Residential



ID	ADDRESS	RECEIVER TYPE
BG3	11 Manns Road, Fountaindale	Residential
BG3	11 Station Road, East Fountaindale	Residential
BG3	12 Lorikeet Lane, Fountaindale	Residential
BG3	121 Old Chittaway Road, Fountaindale	Residential
BG3	125 Old Chittaway Road, Fountaindale	Residential
BG3	127 Old Chittaway Road, Fountaindale	Residential
BG3	130 Old Chittaway Road, Fountaindale	Residential
BG3	137 Enterprise Drive, Ourimbah	Residential
BG3	14 Enterprise Drive, Fountaindale	Residential
BG3	141 Old Chittaway Road, Fountaindale	Residential
BG3	149 Old Chittaway Road, Fountaindale	Residential
BG3	150 Old Chittaway Road, Fountaindale	Residential
BG3	157 Old Chittaway Road, Fountaindale	Residential
BG3	16 Enterprise Drive, Fountaindale	Residential
BG3	16 Station Road, Fountaindale	Residential
BG3	161 Old Chittaway Road, Fountaindale	Residential
BG3	165 Old Chittaway Road, Fountaindale	Residential
BG3	170 Old Chittaway Road, Fountaindale	Residential
BG3	21 Enterprise Drive, Fountaindale	Residential
BG3	22 Manns Road, Fountaindale	Residential
BG3	23 Manns Road, Fountaindale	Residential
BG3	23 Station Road, Fountaindale	Residential
BG3	27 Station Road, Fountaindale	Residential
BG3	28 Lillygrove Lane, Fountaindale	Residential
BG3	3 Station Road, Fountaindale	Residential
BG3	32 Lillygrove Lane, Fountaindale	Residential
BG3	32 Old Chittaway Road, Fountaindale	Residential
BG3	33 Station Road, East Fountaindale	Residential
BG3	35 Station Road, Fountaindale	Residential
BG3	36 Lillygrove Lane, Fountaindale	Residential
BG3	39 Manns Road, Fountaindale	Residential
BG3	46 Old Chittaway Road, Fountaindale	Residential
BG3	48 Lillygrove Lane, Fountaindale	Residential

ID	ADDRESS	RECEIVER TYPE
BG3	58 Old Chittaway Road, Fountaindale	Residential
BG3	6 Lorikeet Lane, Fountaindale	Residential
BG3	60 Old Chittaway Road, Fountaindale	Residential
BG3	64 Old Chittaway Road, Fountaindale	Residential
BG3	7 Station Road, Fountaindale	Residential
BG3	78 Old Chittaway Road, Fountaindale	Residential
BG3	86 Old Chittaway Road, Fountaindale	Residential
BG3	89 Old Chittaway Road, Fountaindale	Residential
BG3	9 Lorikeet Lane, Fountaindale	Residential
BG3	96 Old Chittaway Road, Fountaindale	Residential
BG4	139 Orchard Road, Kangy Angy	Residential
BG5	100 Berkeley Road Fountaindale	Residential
BG5	11 Station Road, Fountaindale	Residential
BG5	110 Berkeley Road Fountaindale	Residential
BG5	110 Orchard Road Kangy Angy	Residential
BG5	118 Orchard Road Kangy Angy	Residential
BG5	15 Schubolt Road, Kangy Angy	Residential
BG5	16 Schubolt Road, Kangy Angy	Residential
BG5	17 Chittaway Road Kangy Angy	Residential
BG5	196 Pacific Highway Kangy Angy	Residential
BG5	2 Fowler Road Kangy Angy	Residential
BG5	209 Pacific Highway Kangy Angy	Residential
BG5	217 Pacific Highway Kangy Angy	Residential
BG5	225 Pacific Highway Kangy Angy	Residential
BG5	230 Pacific Highway Kangy Angy	Residential
BG5	28 Old Chittaway Road, Fountaindale	Residential
BG5	33 Station Road, Fountaindale	Residential
BG5	348 Pacific Highway Kangy Angy	Residential
BG5	36 Chittaway Road Kangy Angy	Residential
BG5	37 Chittaway Road Kangy Angy	Residential
BG5	4 Fowler Road Kangy Angy	Residential
BG5	61 Chittaway Road Kangy Angy	Residential
CCC	98 Old Chittaway Road, Fountaindale	Child Care Centre

ID	ADDRESS	RECEIVER TYPE
COM	1 Bounty Close Tuggerah	Commercial
COM	1 Catamaran Road, Fountaindale	Commercial
COM	1 Corella Close, Berkeley Vale	Commercial
COM	1 Co-wyn Close, Fountaindale	Commercial
COM	1 Journeyman Close Berkeley Vale	Commercial
COM	1 Newbridge Road Berkeley Vale	Commercial
COM	1 Pioneer Avenue Tuggerah	Commercial
COM	10 Ketch Close, Fountaindale	Commercial
COM	10 Reliance Drive Tuggerah	Commercial
COM	11 Catamaran Road, Fountaindale	Commercial
COM	11 Ketch Close, Fountaindale	Commercial
COM	11 Pioneer Avenue Tuggerah	Commercial
COM	11 Reliance Drive Tuggerah	Commercial
COM	1-2 Sanitarium Road Berkeley Vale	Commercial
COM	1-2 Sanitarium Road, Berkeley Vale	Commercial
COM	13 Catamaran Road, Fountaindale	Commercial
COM	13 Ketch Close, Fountaindale	Commercial
COM	13 Pioneer Avenue Tuggerah	Commercial
COM	13 Reliance Drive Tuggerah	Commercial
COM	14 Ketch Close, Fountaindale	Commercial
COM	14 Reliance Drive Tuggerah	Commercial
COM	15 Catamaran Road, Fountaindale	Commercial
COM	15 Ketch Close, Fountaindale	Commercial
COM	15 Newbridge Road Berkeley Vale	Commercial
COM	15 Reliance Drive Tuggerah	Commercial
COM	17 Catamaran Road, Fountaindale	Commercial
COM	17 Newbridge Road Berkeley Vale	Commercial
COM	17 Newbridge Road, Berkeley Vale	Commercial
COM	18 Reliance Drive Tuggerah	Commercial
COM	19 Newbridge Road, Berkeley Vale	Commercial
COM	19 Reliance Drive Tuggerah	Commercial
COM	2 Bounty Close Tuggerah	Commercial
COM	2 Bridge Street, Ourimbah	Commercial

ID	ADDRESS	RECEIVER TYPE
COM	2 Catamaran Road, Fountaindale	Commercial
COM	2 Colony Close Tuggerah	Commercial
COM	2 Corella Close Berkeley Vale	Commercial
COM	2 Journeyman Close Berkeley Vale	Commercial
COM	2 Ketch Close, Fountaindale	Commercial
COM	2 Teamster Close Tuggerah	Commercial
COM	20 Newbridge Road Berkeley Vale	Commercial
COM	20 Reliance Drive Tuggerah	Commercial
COM	22 Reliance Drive Tuggerah	Commercial
COM	23 Reliance Drive Tuggerah	Commercial
COM	25 Reliance Drive Tuggerah	Commercial
COM	255 Pacific Highway Kangy Angy	Commercial
COM	266 Pacific Highway Kangy Angy	Commercial
COM	2A Bounty Close Tuggerah	Commercial
COM	3 Bounty Close Tuggerah	Commercial
COM	3 Catamaran Road, Fountaindale	Commercial
COM	3 Colony Close Tuggerah	Commercial
COM	3 Corella Close Berkeley Vale	Commercial
COM	3 Fleet Close Tuggerah	Commercial
COM	3 Journeyman Close Berkeley Vale	Commercial
COM	3 Pioneer Avenue Tuggerah	Commercial
COM	3 Sanitarium Road, Berkeley Vale	Commercial
COM	3 Teamster Close Tuggerah	Commercial
COM	3A Catamaran Road, Fountaindale	Commercial
COM	3A Pioneer Avenue Tuggerah	Commercial
COM	4 Bounty Close Tuggerah	Commercial
COM	4 Catamaran Road, Fountaindale	Commercial
COM	4 Corella Close Berkeley Vale	Commercial
COM	4 Fleet Close Tuggerah	Commercial
COM	4 Journeyman Close Berkeley Vale	Commercial
COM	4 Ketch Close, Fountaindale	Commercial
COM	4 Reliance Drive Tuggerah	Commercial
COM	4 Teamster Close Tuggerah	Commercial

ID	ADDRESS	RECEIVER TYPE
COM	4A Reliance Drive Tuggerah	Commercial
COM	5 Bounty Close Tuggerah	Commercial
COM	5 Catamaran Road, Fountainsdale	Commercial
COM	5 Colony Close Tuggerah	Commercial
COM	5 Journeyman Close Berkeley Vale	Commercial
COM	5 Ketch Close, Fountainsdale	Commercial
COM	5 Pioneer Avenue Tuggerah	Commercial
COM	5 Reliance Drive Tuggerah	Commercial
COM	5-6 Fleet Close Tuggerah	Commercial
COM	5-7 Newbridge Road Berkeley Vale	Commercial
COM	5A Pioneer Avenue Tuggerah	Commercial
COM	6 Catamaran Road, Fountainsdale	Commercial
COM	6 Journeyman Close Berkeley Vale	Commercial
COM	6 Reliance Drive Tuggerah	Commercial
COM	6 Teamster Close Tuggerah	Commercial
COM	7 Ketch Close, Fountainsdale	Commercial
COM	7 Pioneer Avenue Tuggerah	Commercial
COM	7 Reliance Drive Tuggerah	Commercial
COM	7 Teamster Close Tuggerah	Commercial
COM	8 Catamaran Road, Fountainsdale	Commercial
COM	8 Ketch Close, Fountainsdale	Commercial
COM	8 Reliance Drive Tuggerah	Commercial
COM	8 Teamster Close Tuggerah	Commercial
COM	9 Catamaran Road, Fountainsdale	Commercial
COM	9 Corella Close Berkeley Vale	Commercial
COM	9 Ketch Close, Fountainsdale	Commercial
COM	9 Pioneer Avenue Tuggerah	Commercial
COM	9 Reliance Drive Tuggerah	Commercial
COM	9-10 Teamster Close Tuggerah	Commercial
COM	9-13 Newbridge Road Berkeley Vale	Commercial
COM	Sanitarium Factory	Commercial
SCH	10 Catamaran Road, Fountainsdale	School



ATTACHMENT 2 PREDICTED NOISE LEVELS

Predicted $L_{eq,15min}$ dBA noise levels for each scenario exceedances are coloured as follows:

- Grey – Night time (OOHW) criteria exceeded
- Blue – Evening time (OOHW) criteria exceeded
- Green – Day time (OOHW) criteria exceeded
- Yellow – Day time (SH) criteria exceeded

ID	ADDRESS	NML $L_{EQ,15MIN}$ dBA				PREDICTED SCENARIO NOISE LEVEL $L_{EQ,15MIN}$ dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
BG1	11 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	31
BG1	15 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	32
BG1	24 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	32
BG1	3 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	31
BG1	36 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	30
BG1	43 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	31
BG1	57 Bridge Street, Ourimbah	55	50	50	48	<30	<30	<30	30
BG1	67 Pacific Highway, Kangy Angy	55	50	50	48	<30	<30	<30 to 33	34
BG1	68 Pacific Highway, Kangy Angy	55	50	50	48	<30	<30	<30	33
BG1	79 Pacific Highway, Kangy Angy	55	50	50	48	<30	<30	<30 to 34	35
BG2	106 Orchard Road, Kangy Angy	54	49	45	40	<30	31 to 43	33 to 45	46
BG2	12 Ourimbah Road, Kangy Angy	54	49	45	40	<30	<30	<30 to 35	35
BG2	120 Berkeley Road, Fountaindale	54	49	45	40	<30	<30 to 38	<30 to 42	42
BG2	16 Turpentine Road, Kangy Angy	54	49	45	40	<30	<30	<30	31



ID	ADDRESS	NML $L_{EQ,15MIN}$ dBA				PREDICTED SCENARIO NOISE LEVEL $L_{EQ,15MIN}$ dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
BG2	19 Ourimbah Road, Kangy Angy	54	49	45	40	<30	<30 to 35	<30 to 39	40
BG2	2 Orchard Road, Kangy Angy	54	49	45	40	<30	<30	<30 to 33	34
BG2	26 Turpentine Road, Kangy Angy	54	49	45	40	<30	<30 to 32	<30 to 33	36
BG2	50 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 35	<30 to 39	39
BG2	52 Howes Road, Ourimbah	54	49	45	40	<30	<30	<30	30
BG2	54 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 36	<30 to 42	41
BG2	56 Bridge Street, Ourimbah	54	49	45	40	<30	<30	<30	31
BG2	62 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 37	<30 to 41	41
BG2	72 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 37	30 to 42	42
BG2	8 Orchard Road, Kangy Angy	54	49	45	40	<30	<30	<30 to 32	34
BG2	80 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 40	32 to 44	44
BG2	84 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 37	<30 to 41	42
BG2	92 Orchard Road, Kangy Angy	54	49	45	40	<30	<30 to 42	33 to 45	45
BG3	103 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30 to 32	34
BG3	105 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30 to 33	34
BG3	107 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30 to 33	34
BG3	11 Enterprise Drive, Fountaindale	59	54	49	40	<30	<30	<30	31
BG3	11 Manns Road, Fountaindale	59	54	49	40	<30	<30 to 35	<30 to 39	40
BG3	12 Lorikeet Lane, Fountaindale	59	54	49	40	<30	<30 to 32	<30 to 36	37
BG3	121 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 31	<30 to 35	36
BG3	125 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	31



ID	ADDRESS	NML L _{EQ,15MIN} dBA				PREDICTED SCENARIO NOISE LEVEL L _{EQ,15MIN} dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
BG3	127 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 33	<30 to 38	38
BG3	130 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 34	<30 to 38	39
BG3	137 Enterprise Drive, Ourimbah	59	54	49	40	<30	<30	<30	29
BG3	14 Enterprise Drive, Fountaindale	59	54	49	40	<30	<30	<30	29
BG3	141 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 33	<30 to 39	37
BG3	149 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 34	<30 to 37	38
BG3	150 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 37	30 to 42	42
BG3	157 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30 to 32	35
BG3	16 Enterprise Drive, Fountaindale	59	54	49	40	<30	<30	<30	29
BG3	16 Station Road, Fountaindale	59	54	49	40	<30	<30 to 40	34 to 46	44
BG3	161 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 37	<30 to 41	41
BG3	165 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 37	<30 to 42	41
BG3	170 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30 to 39	33 to 45	44
BG3	21 Enterprise Drive, Fountaindale	59	54	49	40	<30	<30	<30	29
BG3	22 Manns Road, Fountaindale	59	54	49	40	<30	<30 to 34	<30 to 37	39
BG3	23 Manns Road, Fountaindale	59	54	49	40	<30	<30 to 35	<30 to 36	38
BG3	23 Station Road, Fountaindale	59	54	49	40	<30	<30 to 39	31 to 43	43
BG3	27 Station Road, Fountaindale	59	54	49	40	<30	<30 to 41	33 to 45	44
BG3	28 Lillygrove Lane, Fountaindale	59	54	49	40	<30	<30 to 36	<30 to 39	40
BG3	3 Station Road, Fountaindale	59	54	49	40	<30	<30 to 35	<30 to 40	39
BG3	32 Lillygrove Lane, Fountaindale	59	54	49	40	<30	<30 to 37	<30 to 40	41



ID	ADDRESS	NML L _{EQ,15MIN} dBA				PREDICTED SCENARIO NOISE LEVEL L _{EQ,15MIN} dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
BG3	32 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	29
BG3	35 Station Road, Fountaindale	59	54	49	40	<30	<30 to 37	30 to 42	42
BG3	36 Lillygrove Lane, Fountaindale	59	54	49	40	<30	<30 to 35	<30 to 38	40
BG3	39 Manns Road, Fountaindale	59	54	49	40	<30	<30	<30	31
BG3	46 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	30
BG3	48 Lillygrove Lane, Fountaindale	59	54	49	40	<30	<30 to 34	<30 to 38	39
BG3	58 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	30
BG3	6 Lorikeet Lane, Fountaindale	59	54	49	40	<30	<30 to 32	<30 to 36	37
BG3	60 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	30
BG3	64 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	31
BG3	7 Station Road, Fountaindale	59	54	49	40	<30	<30 to 36	<30 to 41	41
BG3	78 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	31
BG3	86 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	31
BG3	89 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30 to 34	35
BG3	9 Lorikeet Lane, Fountaindale	59	54	49	40	<30	<30 to 34	<30 to 38	39
BG3	96 Old Chittaway Road, Fountaindale	59	54	49	40	<30	<30	<30	32
BG4	139 Orchard Road, Kangy Angy	57	52	53	50	<30 to 34	54 to 66	55 to 67	63
BG5	100 Berkeley Road Fountaindale	50	45	45	44	<30 to 32	<30 to 40	32 to 44	46
BG5	11 Station Road, Fountaindale	50	45	45	44	<30	<30 to 38	32 to 44	43
BG5	110 Berkeley Road Fountaindale	50	45	45	44	<30 to 33	<30 to 42	33 to 45	46
BG5	110 Orchard Road Kangy Angy	50	45	45	44	<30	34 to 46	34 to 46	48



ID	ADDRESS	NML $L_{EQ,15MIN}$ dBA				PREDICTED SCENARIO NOISE LEVEL $L_{EQ,15MIN}$ dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
BG5	118 Orchard Road Kangy Angy	50	45	45	44	<30 to 34	36 to 48	36 to 48	50
BG5	15 Schubolt Road, Kangy Angy	50	45	45	44	<30	<30	<30 to 34	35
BG5	16 Schubolt Road, Kangy Angy	50	45	45	44	<30	<30	<30 to 32	34
BG5	17 Chittaway Road Kangy Angy	50	45	45	44	48 to 60	<30 to 34	51 to 63	57
BG5	196 Pacific Highway Kangy Angy	50	45	45	44	<30 to 33	32 to 44	32 to 44	46
BG5	2 Fowler Road Kangy Angy	50	45	45	44	<30 to 32	<30	<30 to 33	36
BG5	209 Pacific Highway Kangy Angy	50	45	45	44	<30 to 32	<30 to 40	<30 to 40	44
BG5	217 Pacific Highway Kangy Angy	50	45	45	44	<30 to 32	<30 to 39	<30 to 40	44
BG5	225 Pacific Highway Kangy Angy	50	45	45	44	<30 to 33	<30 to 39	<30 to 40	44
BG5	230 Pacific Highway Kangy Angy	50	45	45	44	<30 to 34	<30 to 40	<30 to 41	44
BG5	28 Old Chittaway Road, Fountaindale	50	45	45	44	<30	<30	<30	29
BG5	33 Station Road, Fountaindale	50	45	45	44	<30	<30 to 37	<30 to 38	39
BG5	348 Pacific Highway Kangy Angy	50	45	45	44	35 to 47	<30 to 35	33 to 47	47
BG5	36 Chittaway Road Kangy Angy	50	45	45	44	38 to 50	<30 to 41	45 to 57	57
BG5	37 Chittaway Road Kangy Angy	50	45	45	44	36 to 48	<30 to 35	39 to 51	49
BG5	4 Fowler Road Kangy Angy	50	45	45	44	<30 to 38	<30	<30 to 38	38
BG5	61 Chittaway Road Kangy Angy	50	45	45	44	<30 to 39	31 to 43	41 to 53	54
CCC	98 Old Chittaway Road, Fountaindale	55	55	55	55	<30	<30	<30 to 33	34
COM	1 Bounty Close Tuggerah	70	70	70	70	<30 to 35	<30	<30 to 36	37
COM	1 Catamaran Road, Fountaindale	70	70	70	70	<30 to 32	39 to 51	46 to 58	56
COM	1 Corella Close, Berkeley Vale	70	70	70	70	30 to 42	31 to 43	48 to 60	59



ID	ADDRESS	NML L _{EQ,15MIN} dBA				PREDICTED SCENARIO NOISE LEVEL L _{EQ,15MIN} dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
COM	1 Co-wyn Close, Fountainsdale	70	70	70	70	<30	31 to 43	39 to 51	49
COM	1 Journeyman Close Berkeley Vale	70	70	70	70	<30	<30	<30	32
COM	1 Newbridge Road Berkeley Vale	70	70	70	70	<30 to 31	<30	<30 to 32	33
COM	1 Pioneer Avenue Tuggerah	70	70	70	70	<30 to 40	<30	<30 to 40	40
COM	10 Ketch Close, Fountainsdale	70	70	70	70	<30 to 35	41 to 53	43 to 55	54
COM	10 Reliance Drive Tuggerah	70	70	70	70	31 to 43	<30	31 to 43	42
COM	11 Catamaran Road, Fountainsdale	70	70	70	70	<30	32 to 44	38 to 50	49
COM	11 Ketch Close, Fountainsdale	70	70	70	70	<30 to 32	35 to 47	38 to 50	49
COM	11 Pioneer Avenue Tuggerah	70	70	70	70	<30 to 37	<30	<30 to 38	39
COM	11 Reliance Drive Tuggerah	70	70	70	70	31 to 43	<30	<30 to 42	42
COM	1-2 Sanitarium Road Berkeley Vale	70	70	70	70	<30	33 to 45	39 to 51	48
COM	1-2 Sanitarium Road, Berkeley Vale	70	70	70	70	<30 to 40	53 to 65	35 to 67	64
COM	13 Catamaran Road, Fountainsdale	70	70	70	70	<30	32 to 44	37 to 49	48
COM	13 Ketch Close, Fountainsdale	70	70	70	70	<30 to 33	38 to 50	44 to 56	52
COM	13 Pioneer Avenue Tuggerah	70	70	70	70	<30 to 36	<30	<30 to 35	35
COM	13 Reliance Drive Tuggerah	70	70	70	70	<30 to 41	<30 to 31	<30 to 41	41
COM	14 Ketch Close, Fountainsdale	70	70	70	70	<30 to 33	38 to 50	40 to 52	50
COM	14 Reliance Drive Tuggerah	70	70	70	70	31 to 43	<30	31 to 43	42
COM	15 Catamaran Road, Fountainsdale	70	70	70	70	<30	<30 to 42	34 to 46	46
COM	15 Ketch Close, Fountainsdale	70	70	70	70	<30 to 33	<30 to 41	37 to 49	48
COM	15 Newbridge Road Berkeley Vale	70	70	70	70	<30 to 42	<30 to 33	<30 to 42	38



ID	ADDRESS	NML L _{EQ,15MIN} dBA				PREDICTED SCENARIO NOISE LEVEL L _{EQ,15MIN} dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
COM	15 Reliance Drive Tuggerah	70	70	70	70	32 to 44	<30 to 31	<30 to 44	43
COM	17 Catamaran Road, Fountaindale	70	70	70	70	<30	<30 to 41	34 to 46	45
COM	17 Newbridge Road Berkeley Vale	70	70	70	70	31 to 43	<30 to 33	<30 to 43	43
COM	17 Newbridge Road, Berkeley Vale	70	70	70	70	30 to 42	<30 to 33	<30 to 41	43
COM	18 Reliance Drive Tuggerah	70	70	70	70	<30 to 40	<30	<30 to 40	40
COM	19 Newbridge Road, Berkeley Vale	70	70	70	70	30 to 42	<30 to 34	<30 to 42	43
COM	19 Reliance Drive Tuggerah	70	70	70	70	<30 to 41	<30	<30 to 40	40
COM	2 Bounty Close Tuggerah	70	70	70	70	<30 to 35	<30	<30 to 37	38
COM	2 Bridge Street, Ourimbah	70	70	70	70	<30	<30	<30	31
COM	2 Catamaran Road, Fountaindale	70	70	70	70	<30 to 33	36 to 48	46 to 58	53
COM	2 Colony Close Tuggerah	70	70	70	70	<30 to 42	<30	<30 to 42	42
COM	2 Corella Close Berkeley Vale	70	70	70	70	31 to 43	39 to 51	53 to 65	63
COM	2 Journeyman Close Berkeley Vale	70	70	70	70	<30 to 38	<30	<30 to 40	40
COM	2 Ketch Close, Fountaindale	70	70	70	70	<30 to 32	33 to 45	45 to 57	53
COM	2 Teamster Close Tuggerah	70	70	70	70	<30 to 41	<30	<30 to 41	41
COM	20 Newbridge Road Berkeley Vale	70	70	70	70	<30 to 40	<30 to 33	<30 to 41	42
COM	20 Reliance Drive Tuggerah	70	70	70	70	<30 to 39	<30	<30 to 40	39
COM	22 Reliance Drive Tuggerah	70	70	70	70	31 to 43	<30	<30 to 41	41
COM	23 Reliance Drive Tuggerah	70	70	70	70	31 to 43	<30	<30 to 42	42
COM	25 Reliance Drive Tuggerah	70	70	70	70	<30 to 37	<30	<30 to 38	39
COM	255 Pacific Highway Kangy Angy	70	70	70	70	<30 to 39	<30 to 40	<30 to 43	47



ID	ADDRESS	NML L _{EQ,15MIN} dBA				PREDICTED SCENARIO NOISE LEVEL L _{EQ,15MIN} dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
COM	266 Pacific Highway Kangy Angy	70	70	70	70	31 to 43	<30 to 39	<30 to 45	46
COM	2A Bounty Close Tuggerah	70	70	70	70	<30 to 36	<30	<30 to 37	37
COM	3 Bounty Close Tuggerah	70	70	70	70	<30 to 36	<30	<30 to 37	39
COM	3 Catamaran Road, Fountaindale	70	70	70	70	<30	40 to 52	46 to 58	56
COM	3 Colony Close Tuggerah	70	70	70	70	31 to 43	<30 to 32	31 to 43	43
COM	3 Corella Close Berkeley Vale	70	70	70	70	44 to 56	<30 to 36	38 to 67	62
COM	3 Fleet Close Tuggerah	70	70	70	70	<30 to 40	<30 to 32	33 to 45	44
COM	3 Journeyman Close Berkeley Vale	70	70	70	70	<30 to 38	<30	<30 to 38	37
COM	3 Pioneer Avenue Tuggerah	70	70	70	70	<30 to 36	<30	<30 to 37	39
COM	3 Sanitarium Road, Berkeley Vale	70	70	70	70	<30 to 38	32 to 44	38 to 50	52
COM	3 Teamster Close Tuggerah	70	70	70	70	<30 to 35	<30	<30 to 37	38
COM	3A Catamaran Road, Fountaindale	70	70	70	70	<30 to 34	40 to 52	46 to 58	57
COM	3A Pioneer Avenue Tuggerah	70	70	70	70	<30 to 40	<30	<30 to 40	40
COM	4 Bounty Close Tuggerah	70	70	70	70	<30 to 36	<30	<30 to 37	38
COM	4 Catamaran Road, Fountaindale	70	70	70	70	<30 to 31	<30 to 41	34 to 46	46
COM	4 Corella Close Berkeley Vale	70	70	70	70	<30 to 42	<30 to 34	31 to 43	43
COM	4 Fleet Close Tuggerah	70	70	70	70	34 to 46	<30 to 32	<30 to 44	44
COM	4 Journeyman Close Berkeley Vale	70	70	70	70	<30 to 42	<30	<30 to 41	41
COM	4 Ketch Close, Fountaindale	70	70	70	70	<30 to 32	37 to 49	45 to 57	55
COM	4 Reliance Drive Tuggerah	70	70	70	70	<30 to 38	<30	<30 to 38	38
COM	4 Teamster Close Tuggerah	70	70	70	70	36 to 48	<30 to 33	<30 to 48	46



ID	ADDRESS	NML $L_{EQ,15MIN}$ dBA				PREDICTED SCENARIO NOISE LEVEL $L_{EQ,15MIN}$ dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
COM	4A Reliance Drive Tuggerah	70	70	70	70	<30 to 38	<30	<30 to 39	39
COM	5 Bounty Close Tuggerah	70	70	70	70	<30 to 36	<30	<30 to 37	38
COM	5 Catamaran Road, Fountaindale	70	70	70	70	<30 to 33	37 to 49	47 to 59	55
COM	5 Colony Close Tuggerah	70	70	70	70	32 to 44	<30 to 32	<30 to 44	44
COM	5 Journeyman Close Berkeley Vale	70	70	70	70	30 to 42	<30 to 31	<30 to 41	42
COM	5 Ketch Close, Fountaindale	70	70	70	70	<30 to 34	44 to 56	46 to 58	57
COM	5 Pioneer Avenue Tuggerah	70	70	70	70	<30 to 39	<30	<30 to 40	40
COM	5 Reliance Drive Tuggerah	70	70	70	70	<30 to 39	<30	<30 to 38	39
COM	5-6 Fleet Close Tuggerah	70	70	70	70	31 to 43	<30 to 32	31 to 43	43
COM	5-7 Newbridge Road Berkeley Vale	70	70	70	70	<30 to 41	<30	<30 to 41	40
COM	5A Pioneer Avenue Tuggerah	70	70	70	70	<30 to 40	<30	<30 to 40	40
COM	6 Catamaran Road, Fountaindale	70	70	70	70	<30	<30 to 32	31 to 43	42
COM	6 Journeyman Close Berkeley Vale	70	70	70	70	<30 to 41	<30 to 33	<30 to 42	42
COM	6 Reliance Drive Tuggerah	70	70	70	70	<30 to 40	<30	<30 to 40	40
COM	6 Teamster Close Tuggerah	70	70	70	70	35 to 47	<30	34 to 46	44
COM	7 Ketch Close, Fountaindale	70	70	70	70	<30 to 32	42 to 54	43 to 55	55
COM	7 Pioneer Avenue Tuggerah	70	70	70	70	<30 to 38	<30	<30 to 39	39
COM	7 Reliance Drive Tuggerah	70	70	70	70	<30 to 41	<30	<30 to 39	40
COM	7 Teamster Close Tuggerah	70	70	70	70	34 to 46	<30	33 to 45	43
COM	8 Catamaran Road, Fountaindale	70	70	70	70	<30	<30 to 40	34 to 46	44
COM	8 Ketch Close, Fountaindale	70	70	70	70	<30 to 34	42 to 54	44 to 56	56



ID	ADDRESS	NML $L_{EQ,15MIN}$ dBA				PREDICTED SCENARIO NOISE LEVEL $L_{EQ,15MIN}$ dBA			
		DAY (SH)	DAY (OOHW)	EVENING (OOHW)	NIGHT (OOHW)	1	2	3	4
COM	8 Reliance Drive Tuggerah	70	70	70	70	30 to 42	<30	30 to 42	42
COM	8 Teamster Close Tuggerah	70	70	70	70	<30 to 37	<30	<30 to 39	37
COM	9 Catamaran Road, Fountaindale	70	70	70	70	<30 to 32	32 to 44	40 to 52	49
COM	9 Corella Close Berkeley Vale	70	70	70	70	<30 to 39	<30 to 40	<30 to 42	46
COM	9 Ketch Close, Fountaindale	70	70	70	70	<30 to 32	41 to 53	44 to 56	55
COM	9 Pioneer Avenue Tuggerah	70	70	70	70	<30	<30	<30	31
COM	9 Reliance Drive Tuggerah	70	70	70	70	<30 to 42	<30	<30 to 40	40
COM	9-10 Teamster Close Tuggerah	70	70	70	70	<30 to 32	<30	<30 to 34	34
COM	9-13 Newbridge Road Berkeley Vale	70	70	70	70	<30 to 42	<30 to 31	<30 to 42	40
COM	Sanitarium Factory	70	70	70	70	<30	<30 to 37	31 to 43	42
SCH	10 Catamaran Road, Fountaindale	55	55	55	55	<30	<30	<30	31



Predicted L_{max} noise levels for each scenario – exceedances are coloured as follows:

— Grey – Sleep disturbance screening or disturbance criteria exceeded

BG	ADDRESS	CRITERIA L_{MAX} dBA		SCENARIO L_{MAX} dBA	
		SLEEP DISTURBANCE SCREENING (RBL +15)	SLEEP DISTURBANCE CRITERIA	3	4
BG1	11 Bridge Street, Ourimbah	58	65	<30	33
BG1	15 Bridge Street, Ourimbah	58	65	<30	33
BG1	24 Bridge Street, Ourimbah	58	65	<30 to 31	34
BG1	3 Bridge Street, Ourimbah	58	65	<30	34
BG1	36 Bridge Street, Ourimbah	58	65	<30 to 31	34
BG1	43 Bridge Street, Ourimbah	58	65	<30	33
BG1	57 Bridge Street, Ourimbah	58	65	<30	31
BG1	67 Pacific Highway, Kangy Angy	58	65	<30 to 34	37
BG1	68 Pacific Highway, Kangy Angy	58	65	<30 to 33	36
BG1	79 Pacific Highway, Kangy Angy	58	65	<30 to 35	38
BG2	106 Orchard Road, Kangy Angy	50	65	34 to 46	49
BG2	12 Ourimbah Road, Kangy Angy	50	65	<30 to 37	40
BG2	120 Berkeley Road, Fountaindale	50	65	31 to 43	46
BG2	16 Turpentine Road, Kangy Angy	50	65	<30	33
BG2	19 Ourimbah Road, Kangy Angy	50	65	<30 to 40	43
BG2	2 Orchard Road, Kangy Angy	50	65	<30 to 37	40
BG2	26 Turpentine Road, Kangy Angy	50	65	<30 to 34	37
BG2	50 Orchard Road, Kangy Angy	50	65	<30 to 39	42
BG2	52 Howes Road, Ourimbah	50	65	<30	31



BG	ADDRESS	CRITERIA L _{MAX} dBA		SCENARIO L _{MAX} dBA	
		SLEEP DISTURBANCE SCREENING (RBL +15)	SLEEP DISTURBANCE CRITERIA	3	4
BG2	54 Orchard Road, Kangy Angy	50	65	<30 to 41	44
BG2	56 Bridge Street, Ourimbah	50	65	<30	33
BG2	62 Orchard Road, Kangy Angy	50	65	<30 to 42	45
BG2	72 Orchard Road, Kangy Angy	50	65	31 to 43	46
BG2	8 Orchard Road, Kangy Angy	50	65	<30 to 34	37
BG2	80 Orchard Road, Kangy Angy	50	65	34 to 46	49
BG2	84 Orchard Road, Kangy Angy	50	65	<30 to 41	44
BG2	92 Orchard Road, Kangy Angy	50	65	32 to 44	47
BG3	103 Old Chittaway Road, Fountaindale	50	65	<30 to 34	37
BG3	105 Old Chittaway Road, Fountaindale	50	65	<30 to 33	36
BG3	107 Old Chittaway Road, Fountaindale	50	65	<30 to 33	36
BG3	11 Enterprise Drive, Fountaindale	50	65	<30	32
BG3	11 Manns Road, Fountaindale	50	65	<30 to 39	42
BG3	11 Station Road, East Fountaindale	50	65	33 to 45	48
BG3	12 Lorikeet Lane, Fountaindale	50	65	<30 to 36	39
BG3	121 Old Chittaway Road, Fountaindale	50	65	<30 to 33	36
BG3	125 Old Chittaway Road, Fountaindale	50	65	<30	32
BG3	127 Old Chittaway Road, Fountaindale	50	65	<30 to 35	38
BG3	130 Old Chittaway Road, Fountaindale	50	65	<30 to 40	43
BG3	137 Enterprise Drive, Ourimbah	50	65	<30	30
BG3	14 Enterprise Drive, Fountaindale	50	65	<30	29



BG	ADDRESS	CRITERIA L _{MAX} dBA		SCENARIO L _{MAX} dBA	
		SLEEP DISTURBANCE SCREENING (RBL +15)	SLEEP DISTURBANCE CRITERIA	3	4
BG3	141 Old Chittaway Road, Fountaindale	50	65	<30 to 38	41
BG3	149 Old Chittaway Road, Fountaindale	50	65	<30 to 40	43
BG3	150 Old Chittaway Road, Fountaindale	50	65	<30 to 42	45
BG3	157 Old Chittaway Road, Fountaindale	50	65	<30 to 41	44
BG3	16 Enterprise Drive, Fountaindale	50	65	<30	30
BG3	16 Station Road, Fountaindale	50	65	35 to 47	50
BG3	161 Old Chittaway Road, Fountaindale	50	65	<30 to 41	44
BG3	165 Old Chittaway Road, Fountaindale	50	65	31 to 43	46
BG3	170 Old Chittaway Road, Fountaindale	50	65	34 to 46	49
BG3	21 Enterprise Drive, Fountaindale	50	65	<30	30
BG3	22 Manns Road, Fountaindale	50	65	<30 to 38	41
BG3	23 Manns Road, Fountaindale	50	65	<30 to 38	41
BG3	23 Station Road, Fountaindale	50	65	32 to 44	47
BG3	27 Station Road, Fountaindale	50	65	32 to 44	47
BG3	28 Lillygrove Lane, Fountaindale	50	65	<30 to 42	45
BG3	3 Station Road, Fountaindale	50	65	<30 to 40	43
BG3	32 Lillygrove Lane, Fountaindale	50	65	<30 to 40	43
BG3	32 Old Chittaway Road, Fountaindale	50	65	<30	30
BG3	33 Station Road, East Fountaindale	50	65	<30 to 40	43
BG3	35 Station Road, Fountaindale	50	65	<30 to 42	45
BG3	36 Lillygrove Lane, Fountaindale	50	65	<30 to 39	42



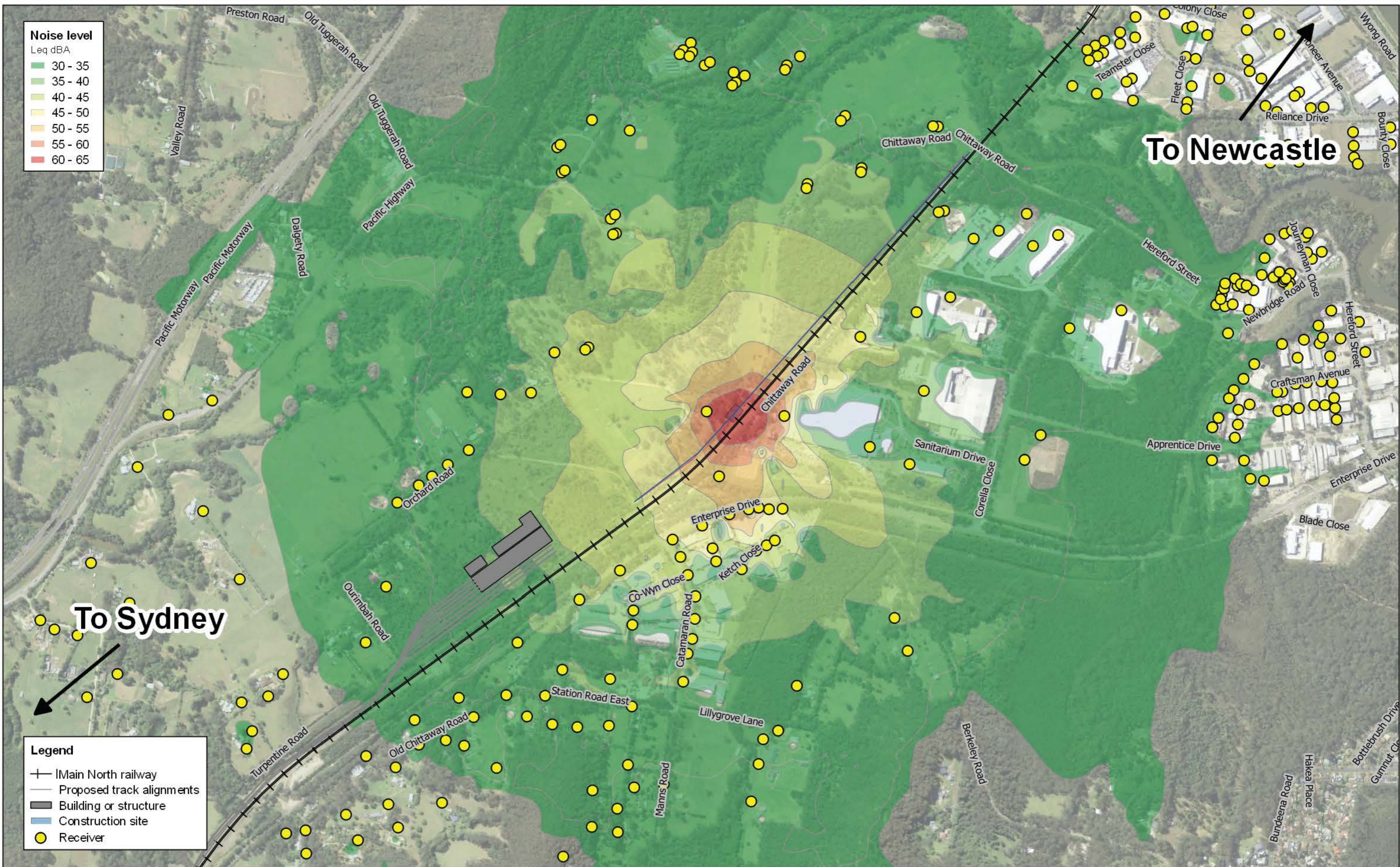
BG	ADDRESS	CRITERIA L _{MAX} dBA		SCENARIO L _{MAX} dBA	
		SLEEP DISTURBANCE SCREENING (RBL +15)	SLEEP DISTURBANCE CRITERIA	3	4
BG3	39 Manns Road, Fountaindale	50	65	<30 to 31	34
BG3	46 Old Chittaway Road, Fountaindale	50	65	<30	30
BG3	48 Lillygrove Lane, Fountaindale	50	65	<30 to 39	42
BG3	58 Old Chittaway Road, Fountaindale	50	65	<30	31
BG3	6 Lorikeet Lane, Fountaindale	50	65	<30 to 36	39
BG3	60 Old Chittaway Road, Fountaindale	50	65	<30	31
BG3	64 Old Chittaway Road, Fountaindale	50	65	<30	32
BG3	7 Station Road, Fountaindale	50	65	30 to 42	45
BG3	78 Old Chittaway Road, Fountaindale	50	65	<30	32
BG3	86 Old Chittaway Road, Fountaindale	50	65	<30	33.5
BG3	89 Old Chittaway Road, Fountaindale	50	65	<30 to 36	38.9
BG3	9 Lorikeet Lane, Fountaindale	50	65	<30 to 38	41.4
BG3	96 Old Chittaway Road, Fountaindale	50	65	<30	33.9
BG4	139 Orchard Road, Kangy Angy	60	65	52 to 64	67
BG5	100 Berkeley Road Fountaindale	54	65	31 to 43	46
BG5	110 Berkeley Road Fountaindale	54	65	32 to 44	47
BG5	110 Orchard Road Kangy Angy	54	65	35 to 47	50
BG5	118 Orchard Road Kangy Angy	54	65	36 to 48	51
BG5	15 Schubolt Road, Kangy Angy	54	65	<30 to 34	37
BG5	16 Schubolt Road, Kangy Angy	54	65	<30 to 33	36
BG5	17 Chittaway Road Kangy Angy	54	65	49 to 61	64



BG	ADDRESS	CRITERIA L _{MAX} dBA		SCENARIO L _{MAX} dBA	
		SLEEP DISTURBANCE SCREENING (RBL +15)	SLEEP DISTURBANCE CRITERIA	3	4
BG5	196 Pacific Highway Kangy Angy	54	65	33 to 45	48
BG5	2 Fowler Road Kangy Angy	54	65	<30 to 34	37
BG5	209 Pacific Highway Kangy Angy	54	65	<30 to 42	45
BG5	217 Pacific Highway Kangy Angy	54	65	<30 to 42	45
BG5	225 Pacific Highway Kangy Angy	54	65	<30 to 40	43
BG5	230 Pacific Highway Kangy Angy	54	65	<30 to 42	45
BG5	348 Pacific Highway Kangy Angy	54	65	35 to 47	50
BG5	36 Chittaway Road Kangy Angy	54	65	45 to 57	60
BG5	37 Chittaway Road Kangy Angy	54	65	39 to 51	54
BG5	4 Fowler Road Kangy Angy	54	65	<30 to 38	41
BG5	61 Chittaway Road Kangy Angy	54	65	40 to 52	55



ATTACHMENT 3 NOISE CONTOUR MAPS



Noise level
Leq dBA

30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65

Legend

+	Main North railway
—	Proposed track alignments
■	Building or structure
■	Construction site
●	Receiver

Map: ConAccess_02

Author: TJG

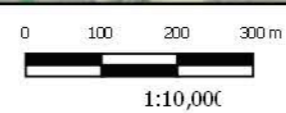
Date: 01/06/2018

Approved by: CXM

Notes: Predicted using ISO9613 method implemented in SoundPLAN 7.4. Receiver heights at 1.5m. Grid spacing 20m

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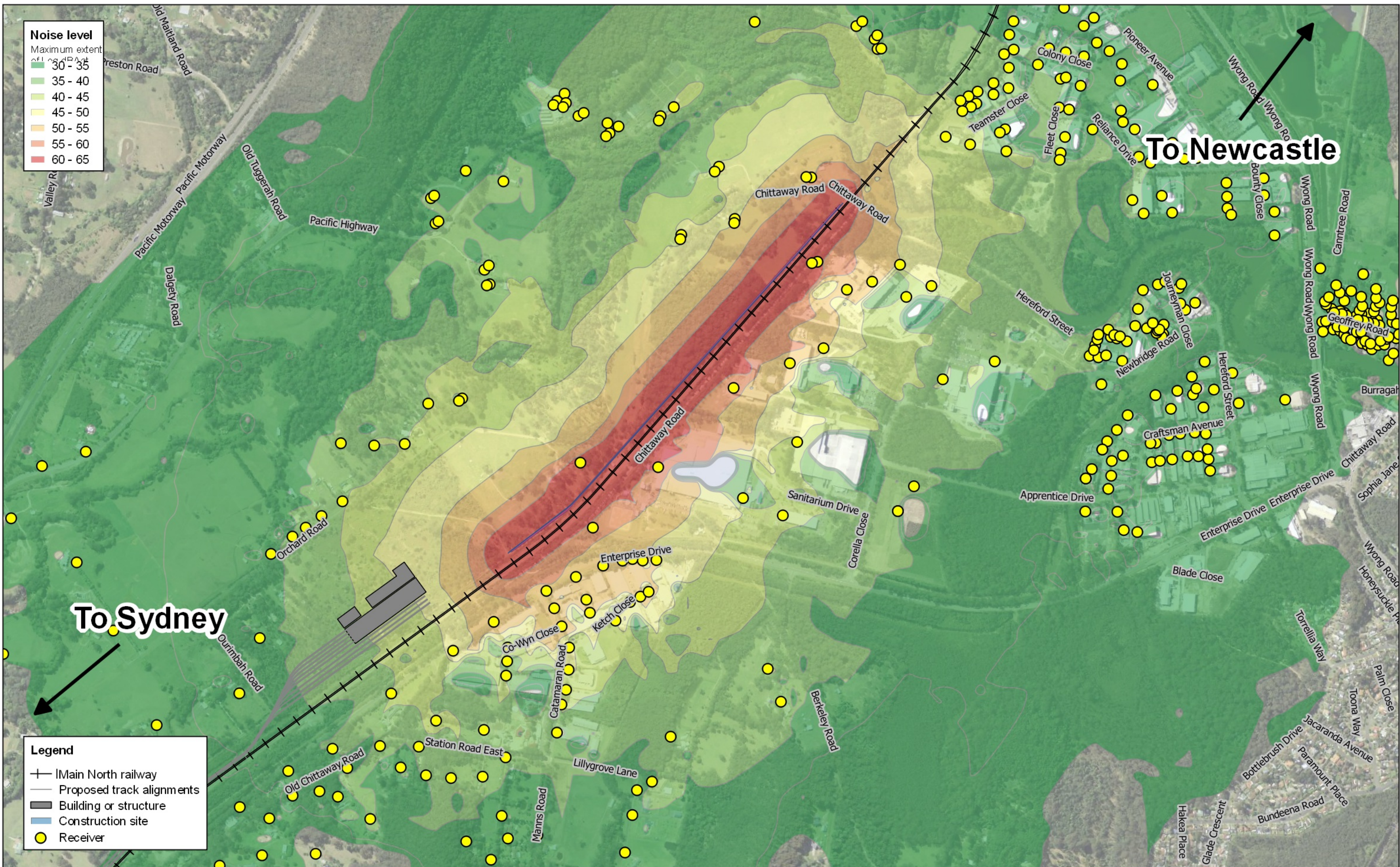
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New intercity fleet maintenance facility project

Scenario 2: Installation of temporary ramp crossing drainage line - Leq dBA

Indicative only - subject to detailed design



Noise level
 Maximum extent of Leq dBA at worst location

30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65

Legend

- +— Main North railway
- Proposed track alignments
- Building or structure
- Construction site
- Receiver

Map: ConAccess_04

Author: TJG

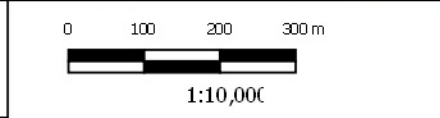
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Coordinate system: GDA 1994 MGA Zone 56

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New intercity fleet maintenance facility project

Scenario 3: Upgrade of existing rail service road - Maximum extent of Leq dBA at worst location

Indicative only - subject to detailed design

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APPENDIX C

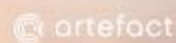
ABORIGINAL DUE DILIGENCE
ASSESSMENT AND NON- ABORIGINAL
HERITAGE ASSESSMENT



New Intercity Fleet Maintenance Facility, Kangy Angy – Alternative Access

Aboriginal Due Diligence Assessment
and Non- Aboriginal Heritage
Assessment

Report to WSP
June 2018



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1.0 INTRODUCTION

1.1 Background

Transport for New South Wales (TfNSW) is delivering a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet (NIF). The New Intercity Fleet Maintenance Facility Project (the approved project) was determined under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) in August 2017, with construction works scheduled to commence in 2018.

The approved project included a new access roadway and bridge to provide access during construction and operation of the maintenance facility. Delays to project commencement have resulted in the requirement for the new access roadway, bridge and maintenance facility to be constructed concurrently. A temporary, alternative access road is required to support the construction of the approved project (proposed modification).

The proposed modification includes modifications of existing roads surrounding the approved project boundary and an access road within the rail corridor to provide temporary access for construction vehicles associated with the approved project. Access for heavy vehicles would be via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road).

Access for light vehicles would be via Turpentine Road and Ourimbah Road, with no upgrades to the existing roads required for access. Proposed use of Turpentine Road and Ourimbah Road is consistent with the heritage assessments completed during the project approval (Artefact 2016a and 2016b). No further assessment for light vehicles using Turpentine Road and Ourimbah Road is required.

WSP, on behalf of TfNSW, have commissioned Artefact to complete preliminary Aboriginal and non-Aboriginal heritage assessment of the proposed modifications, as both fall outside previously assessed areas (in the Review of Environmental Factors [REF] and Combined Submissions Report), (the Approved Project boundary). This preliminary Aboriginal and non-Aboriginal heritage assessment is an addendum to the Aboriginal Archaeological Survey Report (ASR) (Artefact 2016a) and Non-Aboriginal Heritage Impact Assessment (Artefact 2016b) prepared for the approved project.

This report outlines the results of an Aboriginal heritage due diligence assessment prepared in accordance with the Office of Environment and Heritage (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (the OEH due diligence guidelines) (2010) and a preliminary non-Aboriginal (historical) heritage assessment.

1.2 Study area

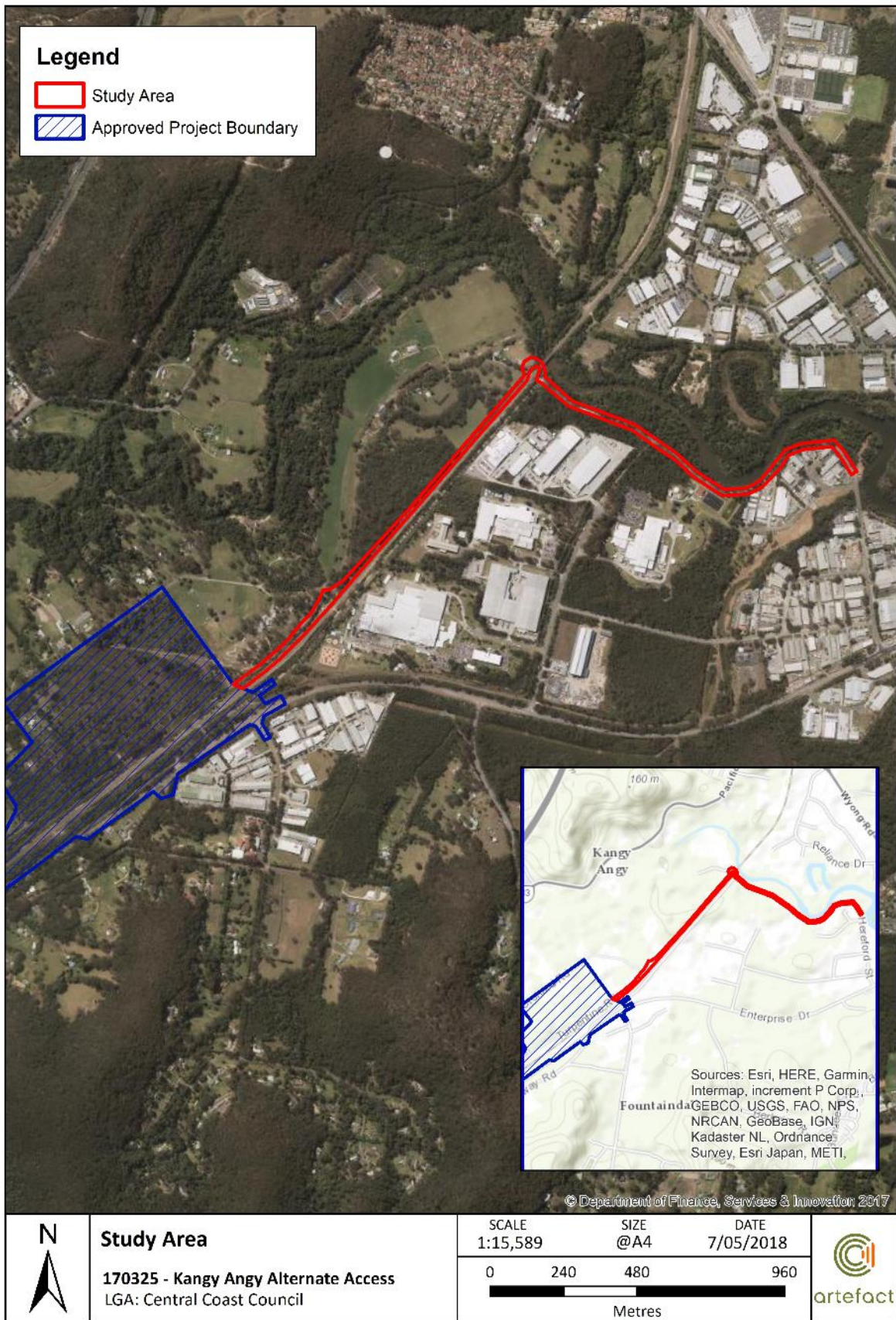
The study area is located within the suburb of Kangy Angy. The site is generally comprised of portions of the Main North Line rail corridor, grass covered pastoral land adjacent to an abandoned section of the Main North Line rail corridor, and portions of Chittaway Road and Hereford Street. The study area is shown in Figure 1.1.

The study area is located within the Central Coast Local Government Area (LGA) and is within the boundary of the Darkinjung Local Aboriginal Land Council (Darkinjung LALC). It is within the Parish of Tuggerah, County of Northumberland.

1.3 Authorship and acknowledgements

This report was prepared by Alyce Haast (Senior Heritage Consultant, Artefact) and Jenny Winnett (Senior Heritage Consultant, Artefact), with management input and review from Josh Symons (Principal, Artefact).

Figure 1.1: Study area



2.0 LEGISLATIVE CONTEXT AND HERITAGE LISTINGS

2.1 National Parks and Wildlife Act 1974

The *National Parks & Wildlife Act 1974* (the NP&W Act) provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Aboriginal occupation of NSW) and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community). A Section 90 Aboriginal Heritage Impact Permit (AHIP) is the only permit available to impact identified Aboriginal objects and/ or an identified Aboriginal place. An AHIP can only be issued by OEH.

The OEH due diligence guidelines were introduced in October 2010 by OEH. The aim of the guidelines is to assist individuals and organisations to exercise due diligence when carrying out activities that may harm Aboriginal objects and to determine whether they should apply for consent in the form of an AHIP.

A due diligence assessment should take reasonable and practicable steps to ascertain whether there is a likelihood that Aboriginal sites will be disturbed or impacted during the proposed activity. If it is assessed that sites exist or have a likelihood of existing within the activity area and may be impacted by the proposed activity, further archaeological investigations may be required along with an AHIP. If it is found to be unlikely that Aboriginal sites exist within the study area and the due diligence assessment has been conducted according to the due diligence guidelines, work may proceed without an AHIP.

2.2 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) is the primary item of State legislation affording protection to items of environmental heritage (natural and cultural) in NSW. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items are listed on the NSW State Heritage Register (SHR) and are given automatic protection under the Heritage Act against any activities that may damage an item or affect its heritage significance.

The Heritage Act also protects 'relics', which can include archaeological material, features and deposits.

Section 4 (1) of the Heritage Act (as amended 2009) defines 'relic' as follows:

"relic means any deposit, artefact, object or material evidence that:

(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and

(b) is of State or local heritage significance."

Sections 139-145 of the Heritage Act prevent the excavation or disturbance of land known or likely to contain relics, unless in accordance with an excavation permit.

Excavation permits are issued by the Heritage Council of NSW, or its Delegate, under Section 140 of the *Heritage Act* for relics not listed on the SHR, or under Section 60 for relics included within an SHR curtilage. An application for an excavation permit must be supported by an Archaeological Assessment and Research Design prepared in accordance with the NSW Heritage Division

archaeological guidelines. Minor works that will have a minimal impact on archaeological relics may be granted an exception under Section 139 (4) or an exemption under Section 57 (2) of the Heritage Act.

2.2.1 The State Heritage Register

The SHR was established under Section 22 of the Heritage Act and is a list of places and objects of particular importance to the people of NSW, including archaeological sites.

The SHR is administered by the Heritage Division of the OEH and includes a diverse range of over 25,000 items, in both private and public ownership. To be listed, an item must be deemed to be of heritage significance for the whole of NSW.

2.2.1.1 The State Heritage Register

No SHR listed items are located within the study area.

2.2.2 Section 170 Registers

The Heritage Act requires all government agencies to identify and manage heritage assets in their ownership and control. Under Section 170 (s170) of the Heritage Act, government instrumentalities must establish and keep a register which includes all items of environmental heritage of State or local significance that are owned, occupied or managed by that government body.

All government agencies must also ensure that all items entered on its register are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Minister on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of identified sites, items and objects and are based on relevant NSW heritage legislation and statutory guidelines.

In some cases, the s170 Register listings are reproduced in the State Heritage Inventory. Both the Roads and Maritime Services (RMS) and the Sydney Trains s170 Registers are also available online.

2.2.2.1 Section 170 Registers

No s170 listed heritage items are located within the study area.

2.3 Environmental Planning and Assessment Act 1979

The EP&A Act establishes a framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered prior to land development; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits.

2.3.1 Local Environment Plans

The EP&A Act also requires that Local Governments prepare planning instruments (such as Local Environment Plans [LEPs] and Development Control Plans [DCPs]) in accordance with the Act to provide guidance on the level of environmental assessment required. The current site falls within the boundaries of the Central Coast LGA following council amalgamation in 2016. As an interim measure the study area is subject to the Wyong Council LEP 2013.

2.3.1.1 Wyong LEP 2013

No heritage items listed on the Wyong Council LEP 2013 are located within the study area.

2.4 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legislative framework for the protection and management of matters of national environmental significance, that is, flora, fauna, ecological communities and heritage places of national and international importance. Heritage items are protected through their inscription on the World Heritage List, Commonwealth Heritage List or the National Heritage List. The National Heritage List has been established to list places of outstanding heritage significance to Australia. It includes natural, historic and Indigenous places.

The EPBC Act stipulates that a person who has proposed an action that will, or is likely to have; a significant impact on a World, National or Commonwealth Heritage site must refer the action to the Minister for the Environment and Energy (hereafter Minister). The Minister will then determine if the action requires approval under the EPBC Act. If approval is required, an environmental assessment would need to be prepared. The Minister would approve or decline the action based on this assessment.

2.4.1 World, National and Commonwealth Heritage listings

2.4.1.1 World Heritage List

No items listed on the World Heritage List are located within the study area.

2.4.1.2 National Heritage List

No items listed on the National Heritage List are located within the study area.

2.5 Summary of heritage listings

As outlined above, the following statutory heritage lists were searched:

- State Heritage Register
- Wyong LEP 2013
- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- Section 170 Heritage and Conservation Registers for RMS and Sydney Trains

The following non-statutory heritage lists were also searched:

- Register of the National Estate
- National Trust Register

No listed items were identified within or in close proximity to the study area.

3.0 ENVIRONMENTAL BACKGROUND

3.1 Landscape, geology and soils

The study area is located in the Central Coast Lowlands. The study area is comprised of Quaternary alluvium with the underlying bedrock consisting of the laminate, shale and sandstone of the Terrigal formation. While it is likely that the underlying bedrock exists at some depth across the majority of the study area it is likely found close to the surface in the central portion of the study area which is above the depositional environment of the surrounding flood plain.

The study area predominantly consists of the Wyong Soil Landscape which consists of alluvial plains and terraces, with local relief of 0-10 metres (m) and slopes of 0-3 percent (Murphy 1993). Soils are comprised of deep podzolic soils which is largely comprised of 10-40 centimetres (cm) of brownish black loam overlaying >200cm of mottled brownish grey clay. In some areas adjacent to waterways deep deposits of quartz sands can also be present.

Portions of the landscape within the study area have been heavily modified. Modifications are particularly evident within the Chittaway Road rail underpass which has been cut into the surrounding landscape.

3.2 Hydrology and vegetation

At its closest point, the study area is located approximately 5m from Ourimbah Creek, a third order water course. Much of the Ourimbah Creek catchment is prone to flooding, and much of the study area is subject to flooding during a 1:100 year, or even more frequent, flooding events. This is likely to be influenced, to some degree, by the historical development of the local area. However, the topography of the study area indicates that it is likely also to have been affected by flooding before European colonisation and land-clearing.

Ourimbah Creek itself is subject to severe stream bank erosion which has resulted in steep creek banks within the vicinity of the study area.

Ourimbah Creek runs east to discharge into Chittaway Bay within Tuggerah Lake, located approximately 3.2 kilometres (km) from the study area. Chittaway Bay is part of Tuggerah Lake, a shallow salt water lake with extensive sand dunes along its eastern side, and large areas of marsh land on its western margins (Dallas 1983: 4). Tuggerah Lake is an important breeding and feeding ground for birds, and is seasonally rich in fish and prawns (Vinnicombe 1980: x:6).

While the original vegetation has been cleared extensively for road, rail and pasture, it is likely the study area would have originally comprised a closed forest comprised of *Melaleuca linariifolia* and prickly-leaved paperbark (*Melaleuca styphelioides*), woollybutt (*Eucalyptus longifolia*) and swamp mahogany (*E. Robusta*).

4.0 ETHNOHISTORIC AND ARCHAEOLOGICAL BACKGROUND

4.1 Ethnohistoric context

Aboriginal people traditionally lived in small family or clan groups that were associated with particular territories or places. The language group spoken in the Wyong region is believed to be Darkinjung with the boundaries approximately extending from the Hawkesbury River northwards to Wollombi and the southern drainage of the Hunter River (Tindale 1974). However, it is likely that these boundaries changed over time. Investigations in the region indicate that habitation sites dating prior to 7,000 before present (bp) are present (Attenbrow 2010: 56). These sites were found in various landforms including mid-slopes of ridges, near the top of main broad ridges, and valley bottoms or alluvial flats.

British colonisation had a profound and devastating effect on the Aboriginal population of the Sydney region. In the early days of the colony, Aboriginal people were disenfranchised from their land as the British claimed areas for settlement and agriculture. During the early years of colonisation, these effects were unlikely to impact the Aboriginal groups outside of the Sydney region. The establishment of Newcastle in 1804 brought a European presence to the region and thus the area experienced the delayed effects of British colonisation. In 1828, conflict between European settlers and Aboriginal people in the Gosford region led to investigation by the local magistrate. It was found that a local landowner, William Cape, regularly threatened local Aboriginal people with his musket and provoked them to acts of violence (Kuskie 2008: 15).

Descendants of the Darkinjung language speakers continue to live in the region.

4.2 Registered Aboriginal sites

Note: The locations and details of Aboriginal sites are considered culturally sensitive information. It is recommended that this information, including the AHIMS data and GIS imagery, is removed from this report if it is to enter the public domain.

OEH maintains the Aboriginal Heritage Information Management System (AHIMS) database, a register of Aboriginal archaeological sites that have been recorded in New South Wales. An extensive search of the AHIMS database was undertaken on the 20 February 2018 (Client ID 328871) using the following parameters:

GDA 1994 MGA 56	E: 345800 – 355800
	N: 6305700 – 6315700
Buffer	0m
Number of sites	32

The search was conducted to develop an understanding of where Aboriginal sites are recorded within or in the immediate vicinity of the study area, and to gain information on the archaeological context of the area.

OEH lists 20 standard site features that can be used to describe a site registered with AHIMS with more than one feature able to be used to describe each site. The frequency of site features within the search area is summarised in Table 4.1.

Table 4.1: Frequency of site types from AHIMS data

Site feature	Frequency	Percentage
Art (Pigment or Engraved)	2	6.25%
Art (Pigment or Engraved), Grinding Groove	2	6.25%
Artefact	16	50%
Artefact, Art (Pigment or Engraved)	1	3.12%
Artefact, Grinding Groove	1	3.12%
Artefact, Shell	1	3.12%
Artefact, Stone Quarry	1	3.12%
Grinding Groove	5	15.62%
Grinding Groove, Water Hole	1	3.12%
Modified Tree (Carved or Scarred)	1	3.12%
Potential Archaeological Deposit (PAD)	1	3.12%
<i>Total</i>	<i>32</i>	<i>100%</i>

The site features recorded are likely to relate to the nature of past Aboriginal occupation of the area, but also to the impact of historical occupation on the archaeological record, and the nature of the archaeological investigation that has been undertaken so far. Most of the sites within the search area have been recorded across the surrounding Narrabeen Sandstone ridgelines to the north and south of the valley containing the study area. All of the site features associated with sandstone (grinding groove, art, water hole, quarry) are located in the hills. However, a number of sites have also been recorded on the alluvial land alongside Wyong and Ourimbah Creeks. The site feature recorded for all of these sites is 'artefact'.

No registered sites are located within the study area. Three archaeological sites are located within the vicinity of the study area and are described in Section 4.2.1.

One Aboriginal Place was identified within the extensive search. The Aboriginal Place is known as the Tuggerah Lakes Resting Place located approximately 4.5km north east of the current study area. The Aboriginal Place has been identified as a resource and gathering place. The site has been listed as an Aboriginal Place for use for future burials that may occur as part of repatriation efforts.

Figure 4.1 and Figure 4.2 shows the results of the extensive AHIMS site register search.

4.2.1 Site in the vicinity of the study area

4.2.1.1 *Ourimbah (AHIMS ID 45-3-1143)*

Ourimbah is located approximately 60m south east of the current study area. When recorded the site consisted of two chert flakes within a dispersed sand deposit approximately half an acre in size. The original recording noted that it was considered likely that the sand and artefacts had been dredged from Ourimbah Creek located 100m to the north east.

4.2.1.2 *Tangy Dangy (AHIMS ID AHIMS ID 45-3-1146)*

Tangy Dangy is located approximately 200m to the north-west of the current study area. When recorded, the site consisted of 24 flaked stone artefacts, made of chert, rhyolite and quartzite. These were located on the ground surface, over an area of 50m x 6m along a bulldozed track. The site was located approximately 250m from Ourimbah Creek, but was on a ridge which was interpreted as the bank of a former channel of Ourimbah Creek. The property owner had previously found an edge-ground axe on the same landform.

4.2.1.3 *Kangy Angy AS 01 (45-3-4017)*

Kangy Angy AS 01 (KA AS 01) is comprised of a low density subsurface artefact scatter identified from subsurface testing completed as part of the approved project. Four artefacts were recovered during subsurface testing. Artefacts were recovered from significant depth below the surface (300-900 millimetres (mm)). It was considered likely that a low density deposit of artefacts existed across the majority of the surrounding area due to the sites lack of disturbance.

Salvage excavation for KA AS 01 has recently been completed. In-depth analysis of the artefacts recovered have not yet been undertaken however preliminary findings have been compiled. Salvage excavation included the excavation of 34 square metres comprised of a dispersed grid of 1x1m pits and three open area pits in response to identified triggers. Excavation recovered 60 stone objects comprised of a variety of stone material including quartz, silcrete, chert and indurated mudstone/tuff (IMT). Findings of the salvage were considered to be comparable to the results of the test excavation.

Figure 4.1: Extensive AHIMS Search

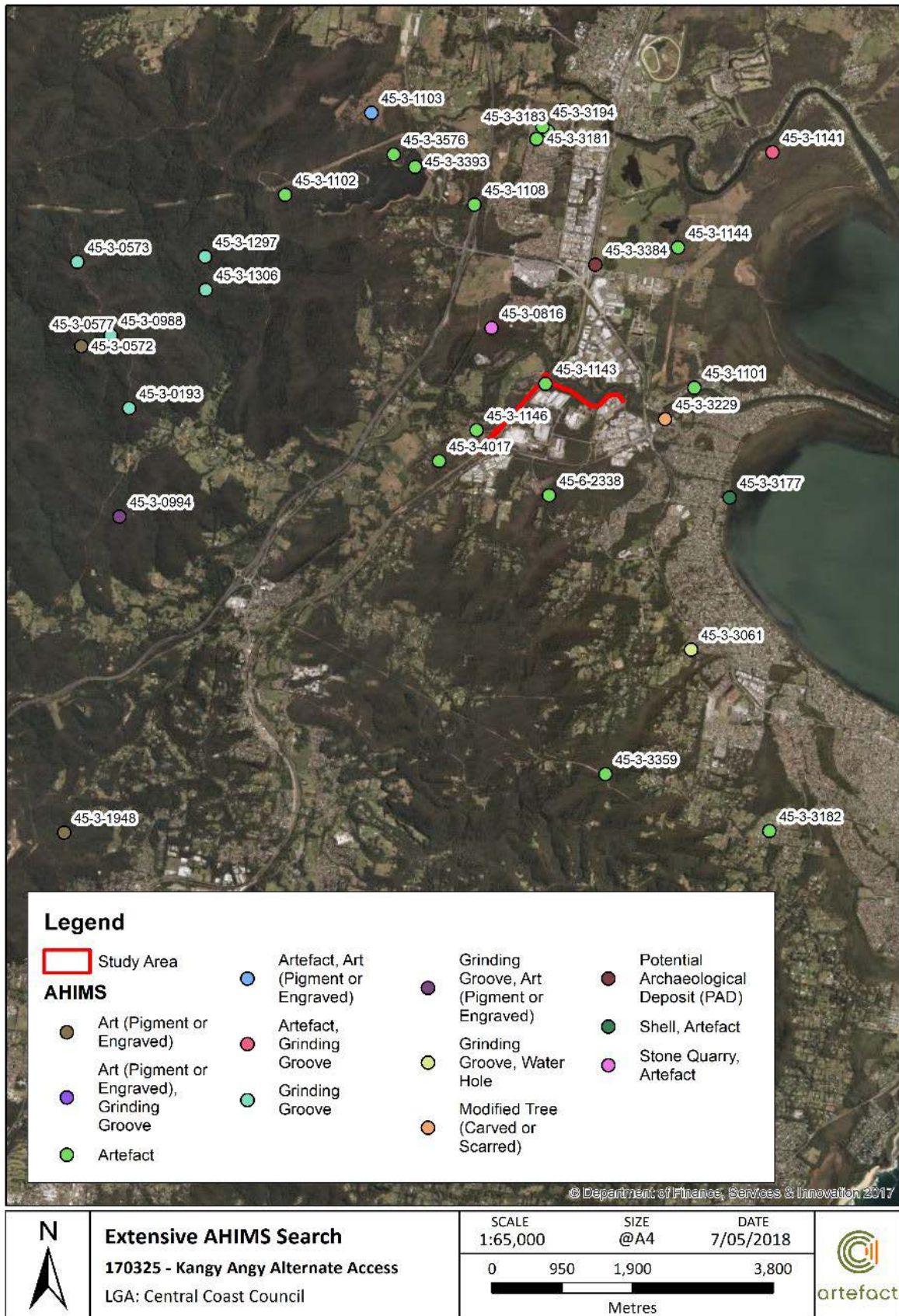
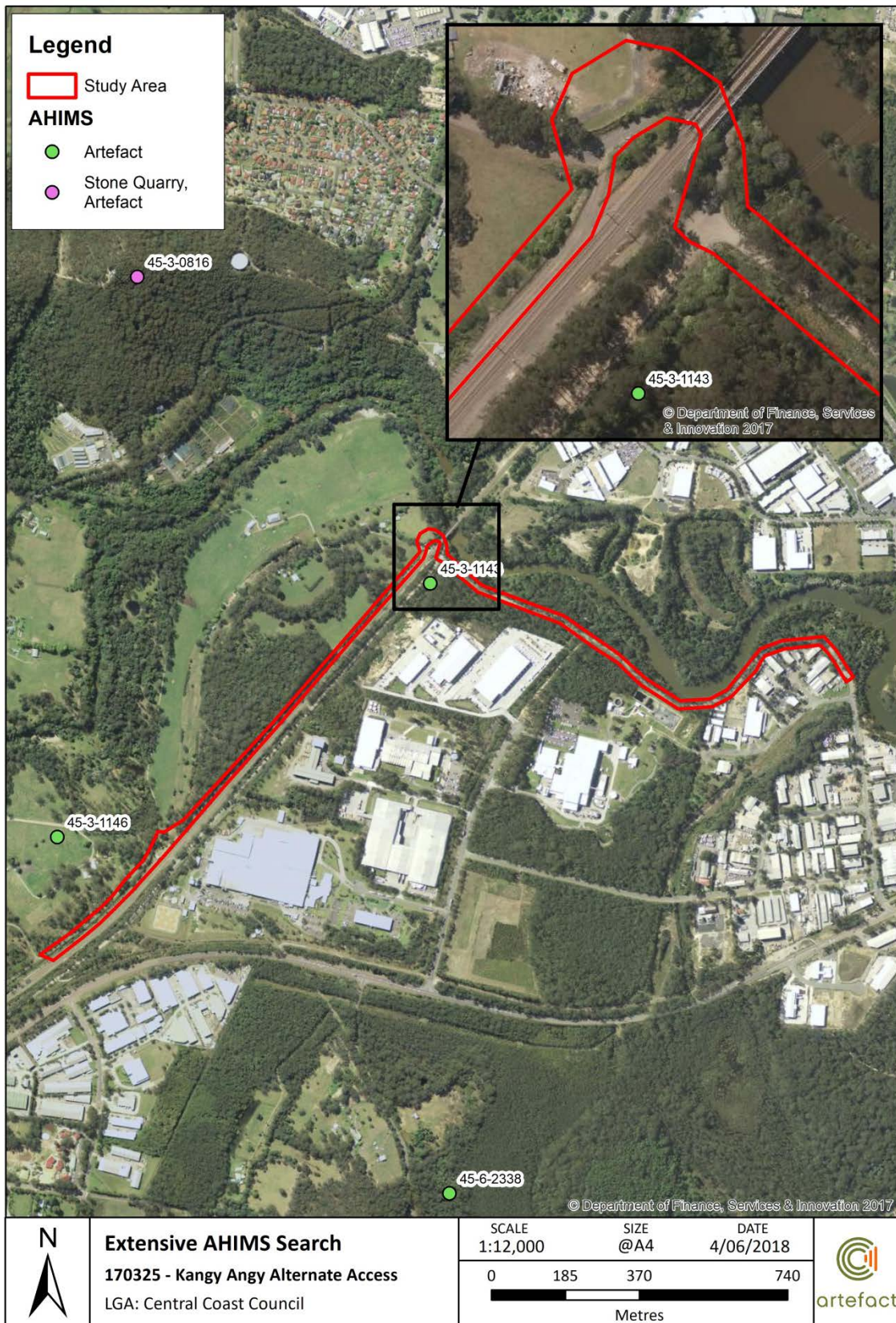


Figure 4.2: Sites in the vicinity of the study area



4.2.2 Previous archaeological investigation

A number of previous archaeological investigations have been undertaken in the region, and across the study area specifically. A comprehensive summary of previous studies within the region is summarised in the ASR (Artefact 2016) for the project. A summary of the ASR (Artefact 2016) for the project is included below:

4.2.2.1 NIF Maintenance Facility, ASR (Artefact 2016)

Artefact undertook an archaeological survey of the study area on 19 February 2016. The study area was divided into three survey units:

- Rail corridor, Turpentine Road and easement, Chittaway Road
- 55 Orchard Road (Lots 34-40 DP 2877), and Orchard Road
- 53 Orchard Road (Lot 41 DP 2877), 11 Ourimbah Road (Lot 32 DP 1033784), 12 Ourimbah Road (Lot 121 DP 874787), Ourimbah Road, Orchard Road and Schubolt Lane
- Enterprise Drive and Catamaran Drive

In general, ground surface visibility was very low. Most of the ground surface was covered with dense grass and low vegetation, and sealed road pavements were also present. The survey did not result in the identification of any Aboriginal objects.

It was concluded that the study area contained two areas of sensitivity: low and moderate. The area of low sensitivity was closely associated with the rail corridor and areas to the south between the rail corridor and Enterprise Drive, where it was evident that substantial earthworks for construction, upgrade and maintenance of the rail line and associated industrial and road development had been undertaken. The likelihood of retrieving archaeological material was considered to be low given the extent of disturbance.

The remainder of the study area was considered to have moderate sensitivity based on the observable lower levels of disturbance. Disturbance in the area was based on historical evidence that indicated the area had been cleared for pasture and the discrete construction of the small number of houses and outbuildings within the study area. Disturbances associated with these developments are considered moderate as the extent of disturbance would not have resulted in the complete removal of stratigraphic units that may retain archaeological material.

Based on the assessment of sensitivity in the ASR (Artefact 2016), the area demonstrating moderate sensitivity was delineated as Kangy Angy PAD 01 (KAPAD01).

Test excavation was subsequently undertaken within KAPAD01 recovering four artefacts. Artefacts were recovered from a significant depth below the surface (300-900 mm). It was considered likely that a low density deposit of artefacts existed across the majority of the surrounding area due to the sites lack of disturbance. Following testing the site extent previously identified as KAPAD01 was registered on the AHIMS site register as Kangy Angy Artefact Scatter 01 (KA AS 01) (AHIMS ID 45-3-4017).

5.0 HISTORIC BACKGROUND

5.1 Exploration and early land grants

During the first half of the 19th century, the wealth of timber resources in the Wyong region and its close proximity to Sydney attracted timber-getters, but permanent non-Indigenous settlement was slow to establish, due to the rugged topography of the area. Settlement began in the 1820s largely in response to the relaxation of laws prohibiting settlement beyond the immediate environs of the County of Cumberland, or north of the Hawkesbury River (David Scobie Architects 2010: 22).

During the 1820s and 1830s the land within the present Wyong area was divided between several land holders. Many of these grants however were not developed or even seen by their owners (David Scobie Architects 2010: 22). The study area was located within Portions 22, 23 and 90 of the Parish of Tuggerah located on Thomas Walker's and Thomas McQuoid's (or Macquoid) grants respectively.

Walker had arrived in Sydney in 1822 as a teenager to work with his uncle's whaling firm. By 1826, Thomas was the director and major shareholder in the newly opened Bank of Australia. Walker explored parts of Australia in 1837, travelling towards Port Phillip during which time he purchased significant holdings (Skehan 2011). It is likely Walker never inhabited the estate.

McQuoid had arrived in Sydney in 1829 to take up the post of Sheriff of the Supreme Court of NSW. It is likely McQuoid never inhabited the Ourimbah estate as by 1835 he had purchased Waniassa, an estate near present-day Canberra, and established his residence in Darlinghurst (Tuggeranong Homestead 2016).

By the 1830s much of the area remained largely unexplored, despite a handful of settlers moving to the area. Around this time groups engaging in illegal logging of valuable cedar were operating in the valleys to the west of Tuggerah Lake, in the vicinity of Wyong and Jilliby Creeks (Scott 1999: 13).

McQuoid died in 1841, and parish maps indicate that the property passed to John Edye Manning. Manning was Registrar of the Supreme Court, and owned a substantial amount of land in the Central Coast area ('History of Wyong Shire': 12). Manning was declared bankrupt in the 1840s depression; although his properties remained in the ownership of his family, development was sparse ('History of Wyong Shire': 21).

The earliest recorded use of Portion 90 was in the 1850s; at this time J.L Travers leased the property and established a saw mill (David Scobie Architects 2010: 27). The mill by 1855 was said to be 'in full operation and capable of cutting 20,000 feet of timber per week', and had become an important centre for the timber industry in Wyong. While the exact location of the saw mill is not known, no evidence of development within or close to the study area has been found for this period. Travers sold the lease in 1855 to William Jolly who continued the development of the mill, with the area becoming the centre of a developing settlement (David Scobie Architects 2010: 55).

5.2 Railway

In the early 1880s, a corridor running through the study area was acquired for the construction of the Main North Line. The Main North Line was constructed in two stages. The line between Strathfield and Hawkesbury River, known as The Short North, was opened in April 1887. The northern section of the line ran from the northern bank of the Hawkesbury River, near Wondabyne, through to Newcastle, and was opened in January 1888.

The station at Ourimbah was opened in 1887, and the station at Tuggerah in 1890. With the arrival of the railway in the late 1880s, the isolation of the area was eased, opening up the region to tourists

who visited on day trips and for holidays, and giving local farmers quick and reliable access to markets (Pry and Fenton 1998:21). The railway acted as a stimulus to development, and by the 1890s, citrus farming and dairying were growing industries in the region (Pittendrigh Shinkfield & Bruce 2007:13).

Construction of the railway required significant earthworks, involving both cut and fill.

Construction of the railway line appears to have required realignment of the eastern part of Chittaway Road running through the study area (Figure 5.2). The original alignment was located to the north of the railway line before turning in a southerly direction to follow the alignment of Ourimbah Creek in the eastern portion of the study area. It was realigned to run along the southern side of the railway line which rejoined the original alignment adjacent to Ourimbah Creek in the northern portion of the study area. In this area Chittaway Road was renamed to Hereford Street in 1993.

Excessive curves or gradients on the Main North Line were abandoned for new sections of track constructed in the 20th century. Examples of abandoned sections of track are located at Kangy Angy and Fassifern. At Kangy Angy, a long curving section of track, including a small sandstone cutting, was abandoned for a new more direct alignment constructed in the 1950s. The current study overlaps with a portion of the current Main North Line including the newly constructed Ourimbah River bridge and associated road underpass. An overlay of the study area on an aerial photograph taken in 1954 shows the abandoned section still in use whilst the new alignment is under construction (see Figure 5.3).

5.3 Fountaindale Estate subdivision and the Berkeley Vale Industrial Estate

In 1884 the *Crown Lands Act* signalled a shift in government policy towards the sale of small portions of Crown land. This was enacted to encourage a larger demographic of the population to purchase land away from Sydney and live off the land. Land speculators quickly followed the trend subdividing many large estates in the Wyong region from the 1880s (Strom 1983:21). This was encouraged by the construction of the Main North Line.

The northern part of Portion 90, including the southern portion of the study area, was subdivided as the Fountaindale Estate in 1889. The subdivision plan outlined 68 farming blocks and town allotments, and promised a railway station and town centre, neither of which eventuated. Sales brochures for the subdivision boasted that 'the soil being of the best quality the growing of fruit and vegetables will doubtless in the future constitute the leading industry of the region ...' (David Scobie Architects 2010: 22). The subdivision sold well in the 1890s and early 1900s despite the economic depression of the 1890s.

However, the 1954 aerial photograph indicates that, with the exception of the railway line, development of the study area was limited through to the mid-20th century (Figure 5.3 and Figure 5.4). The photograph shows the railway line through the study area. Chittaway Road is also shown, as an unsurfaced road, and there are some other tracks passing through. A small orchard appears to be present in the eastern portion of the study area but the majority of the study area and immediate surrounds is comprised of vegetation. By 1992 the area to the south of Chittaway Road had been redeveloped into an industrial precinct for which the surrounding area is currently used today.

Figure 5.1: Plan of Great Northern Railway (LPI, Crown Plan Ms 448 Sy R).

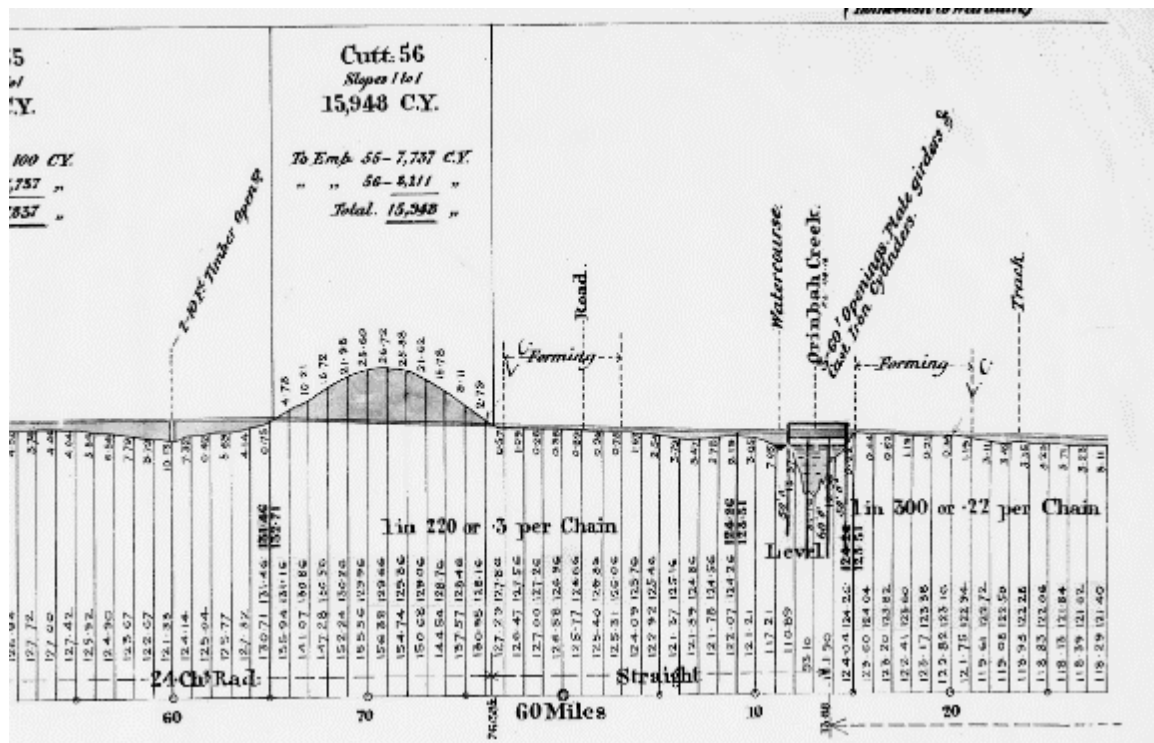


Figure 5.2: Detail of an 1889 plan showing the realignment of Chittaway Road, with the earlier alignment shaded blue, and the later shaded pink (LPI Crown Plan).

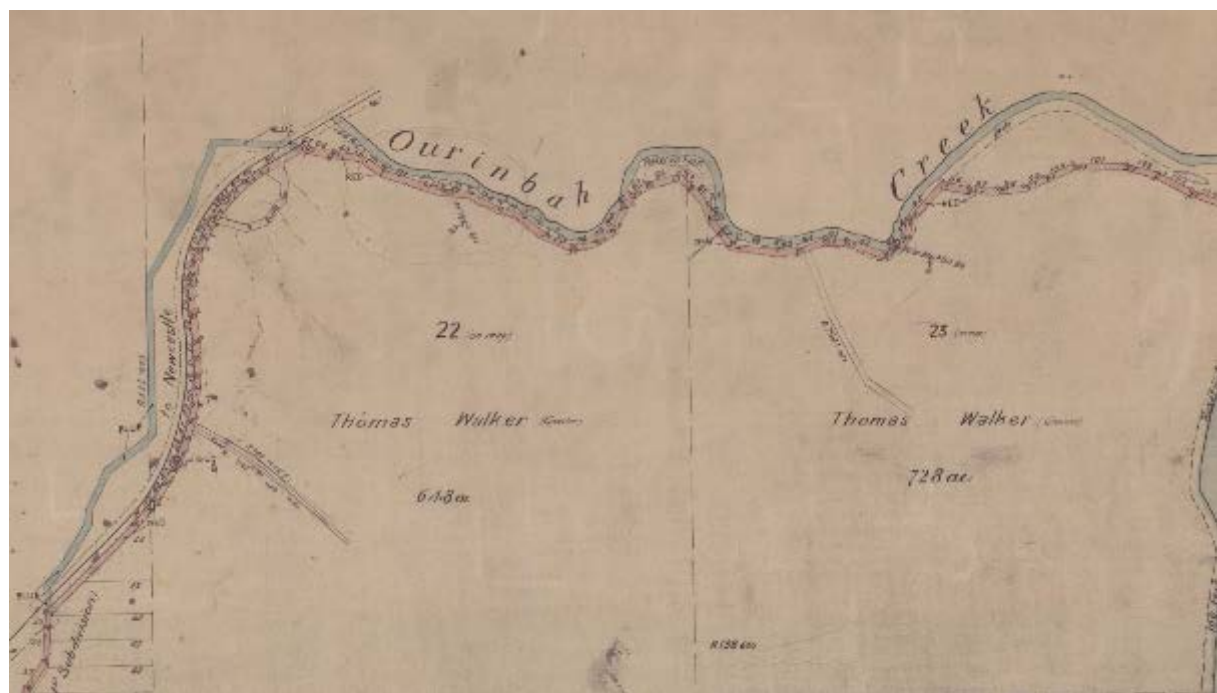


Figure 5.3: 1954 aerial photograph, with eastern portion of the study area outlined in red (LPI Aerial Imagery).

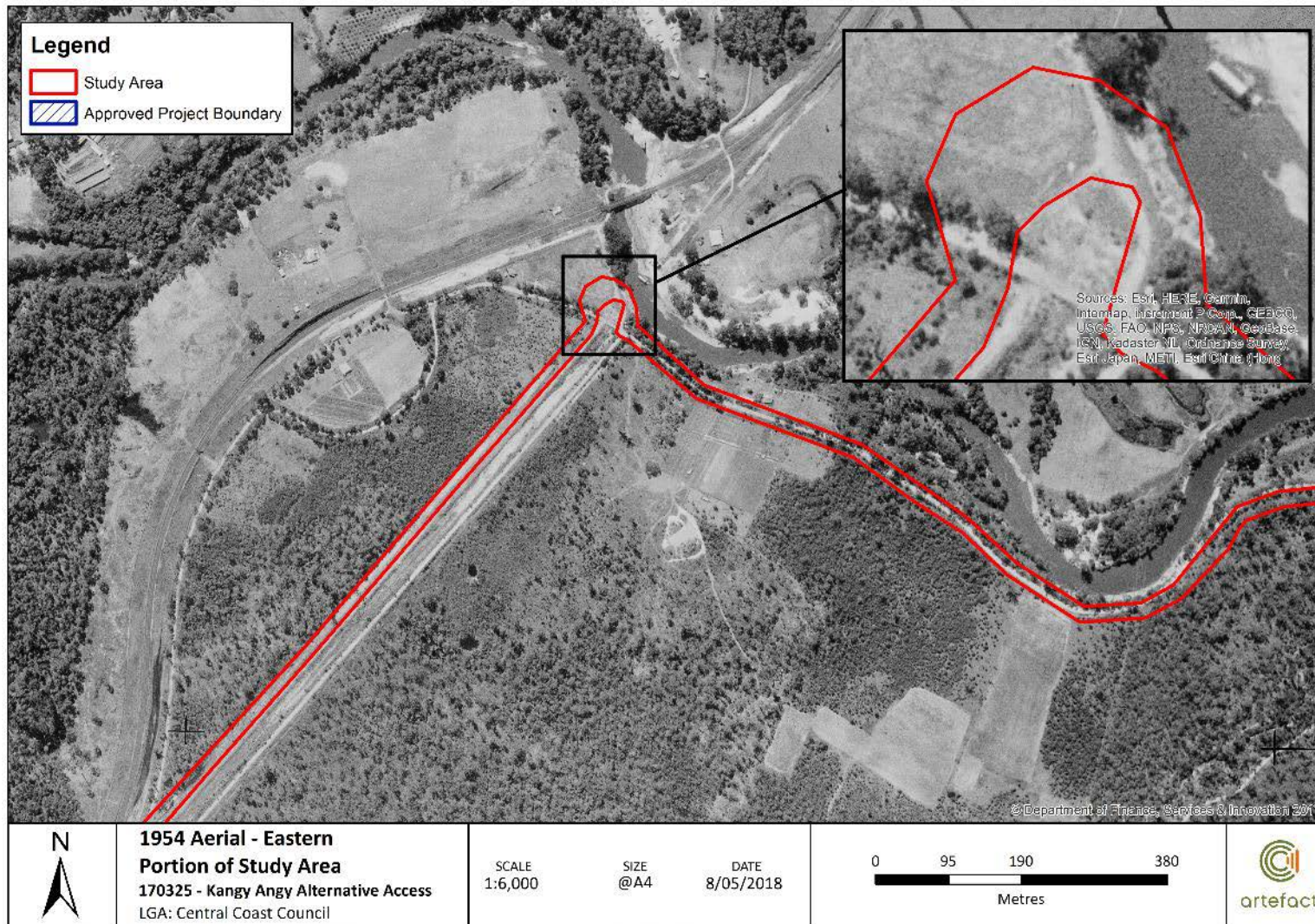


Figure 5.4: Current aerial of eastern portion of the study area

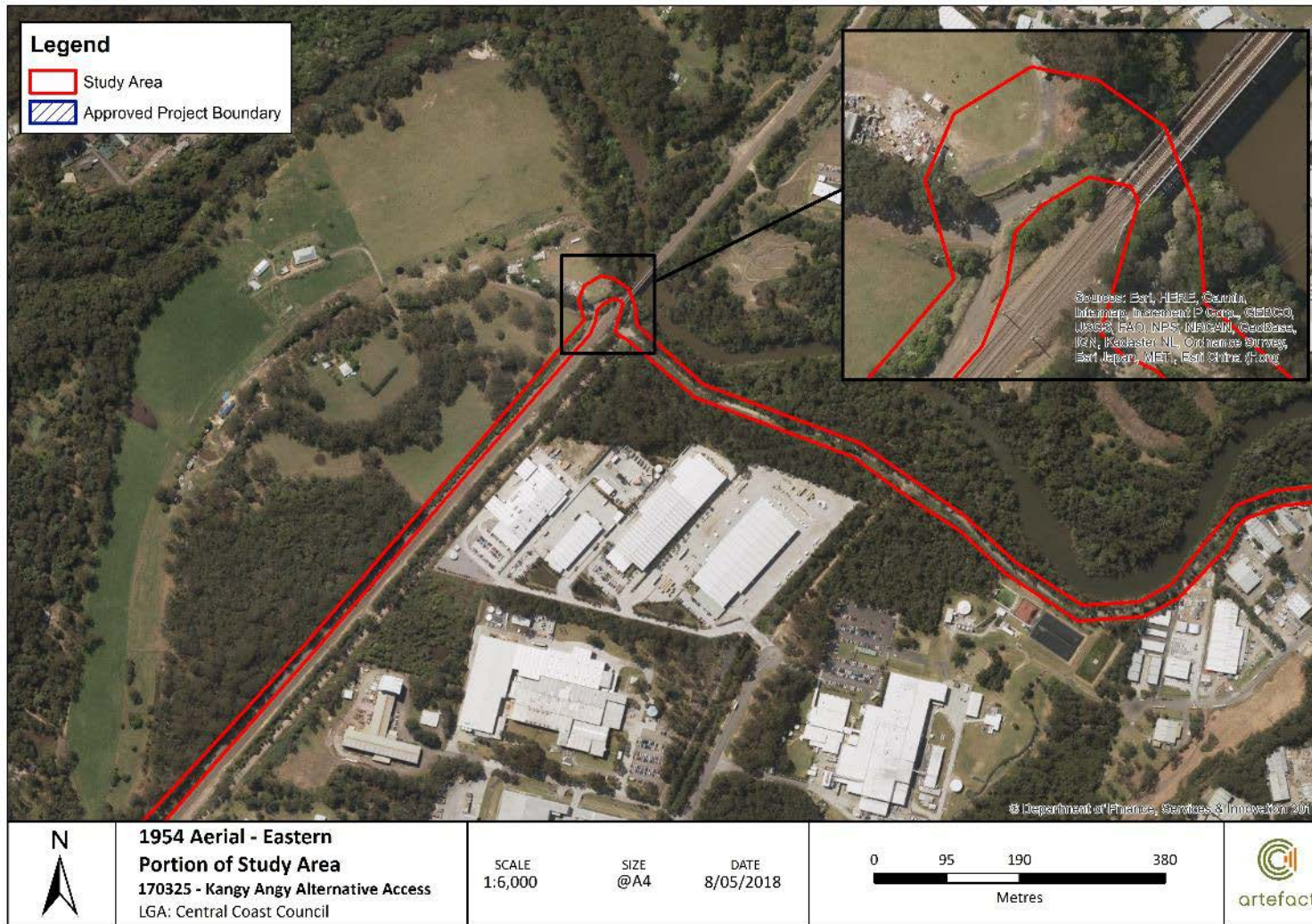


Figure 5.5: 1954 aerial photograph, with western portion of the study area outlined in red (LPI Aerial Imagery).

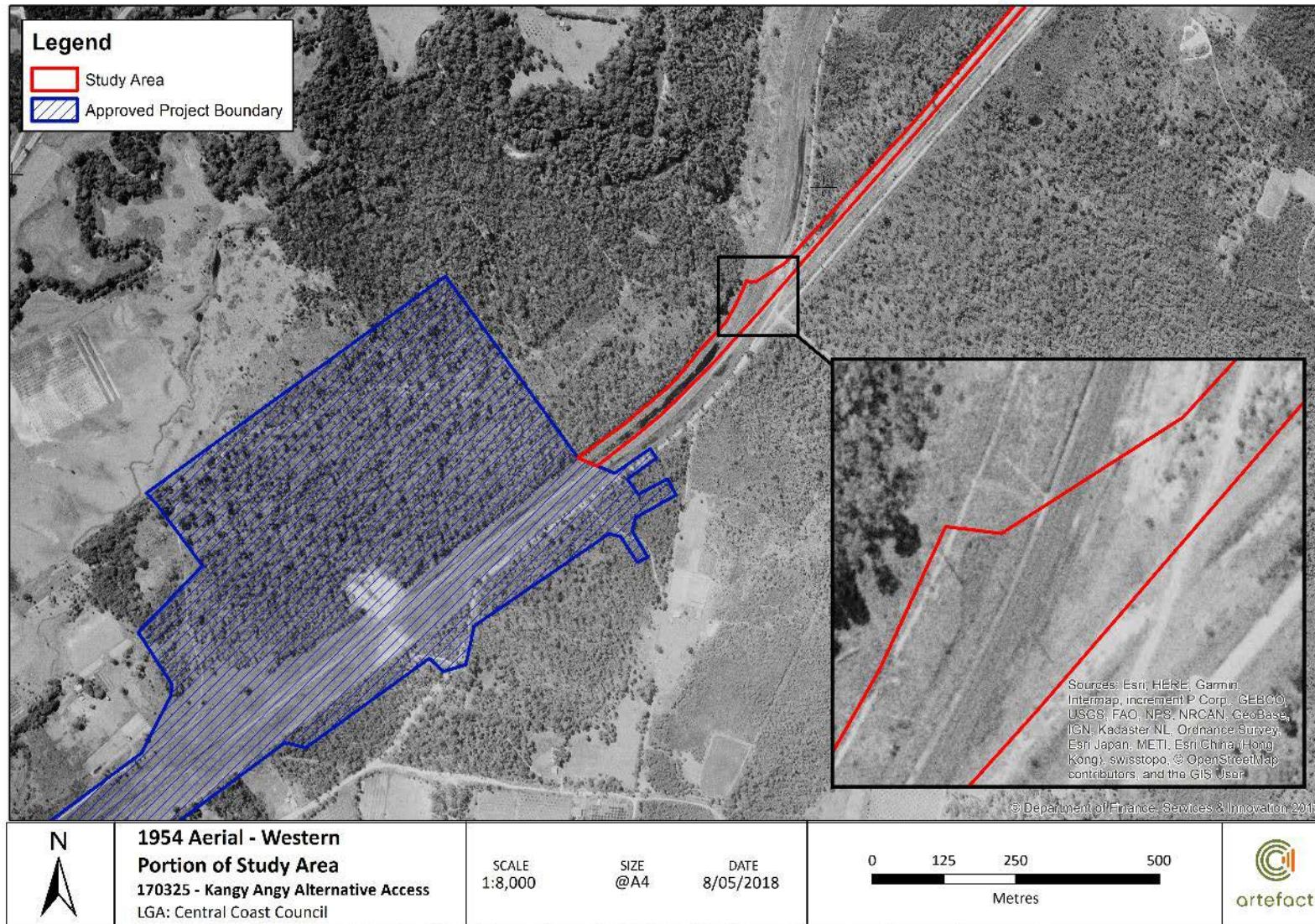
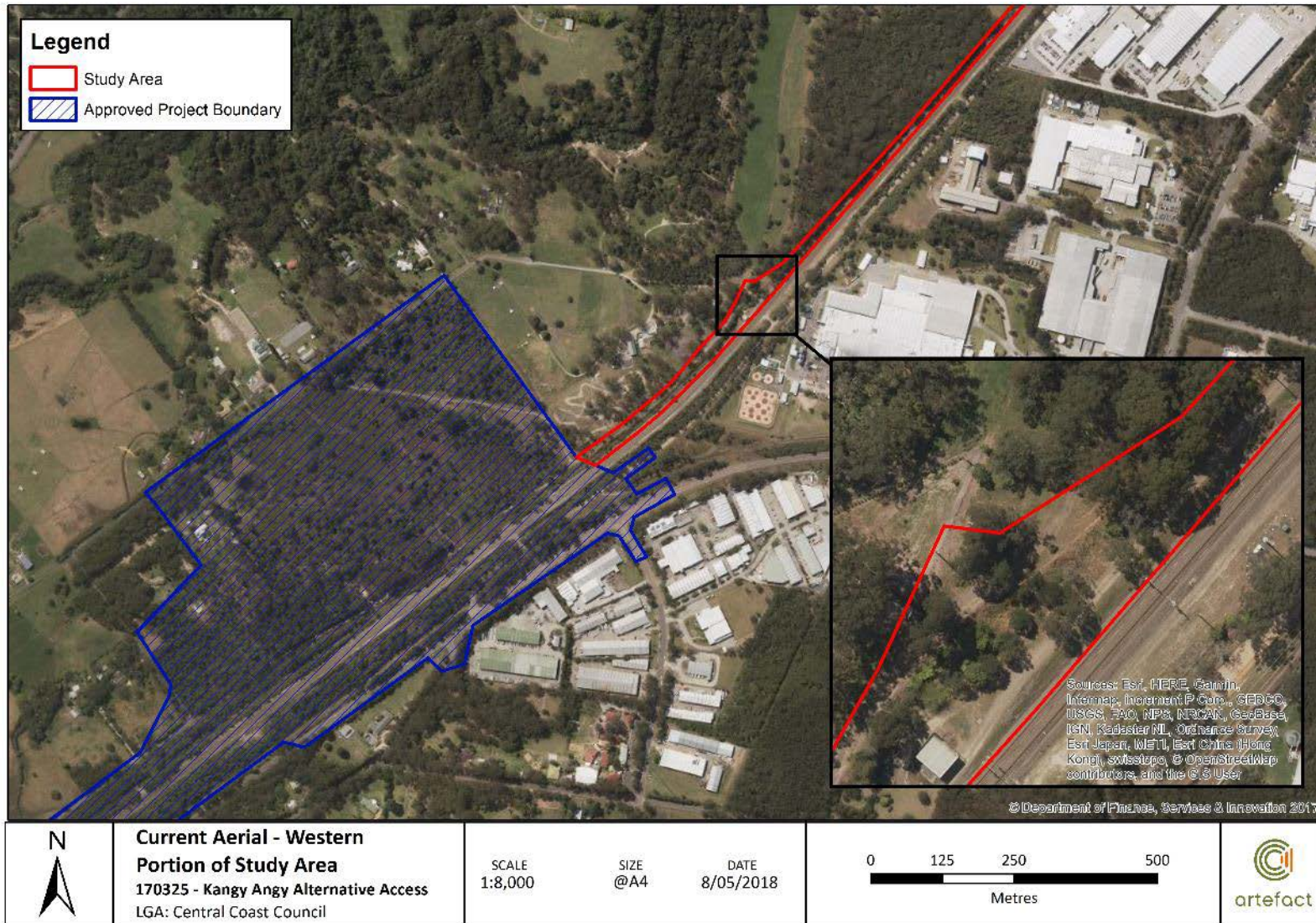


Figure 5.6: Current aerial of western portion of the study area



6.0 SITE INSPECTION

6.1 Inspection methodology

A site inspection was conducted on foot by Josh Symons (Principal, Artefact Heritage) and Alyce Haast (Senior Heritage Consultant, Artefact Heritage), on 26 March 2018. The main aims of the site inspection were to gain an overall impression of the intactness of the study area and identify whether Aboriginal objects or historical archaeological remains are likely to occur beneath the ground surface, and identify whether any built heritage items are located within or in the vicinity of the study area.

6.2 Site inspection results

6.2.1 Current rail corridor

The study area includes approximately 1.4km of existing vehicle access track adjacent to the down track of the Main North Line. This section is situated on an artificially raised embankment, built up on imported material. The western margin of the embankment is generally a steep, densely vegetated slope, with an adjacent artificial drainage channel. Evidence of the cutting associated with the earlier Main North Line alignment was noted immediately adjacent to the drainage channel extending to the north of the study area. The surface of the existing vehicle access track consists of imported crushed quarry gravels. No natural ground surface was observed within this portion of the study area.

The study area also included a portion of the Turpentine Road access track adjacent to the rail line. Evidence of efforts to stabilise the access track with imported materials was noted with the track heavily disturbed by vehicles tracks in wet weather.

The land immediately north of the rail corridor, and outside the study area, appears intact.

Exposures within the rail corridor were limited to vehicle tracks, the landform was assessed as heavily modified. No Aboriginal objects, potential heritage items or areas of archaeological potential were identified during the site inspection.

Plate 6.1: View of rail corridor including rail line and adjacent vehicle path



Plate 6.2: Detail of existing rail line including ballast base



Plate 6.3: View of raised portion of track adjacent to Chittaway Road underpass



Plate 6.4: Vegetation within rail corridor drainage



Plate 6.5: Drainage line adjacent to rail line



Plate 6.6: Existing culvert drainage adjacent to rail line



6.2.2 Hereford Street

Within the study area, Hereford Street is comprised of a 1.2km stretch of road located between Chittaway Road and Newbridge Road, Berkeley Vale. The road is comprised of an unmarked dual lane public road. The road corridor consists of bitumen pavement which has been slightly cut into the existing slope of the surrounding landform. Several concrete culverts are located along the road corridor. The majority of the northern side of the road is comprised of a heavily vegetated steep riverbank which includes several old growth trees. No cultural scarring was identified during survey. The southern side of the road has largely been subject to disturbance which likely occurred during the development of the road. Evidence of illegal dumping was observed within specific portions of the road corridor. No Aboriginal objects, potential heritage items, or areas of archaeological sensitivity were identified during the site inspection.

Plate 6.7: Eastern end of Hereford Street showing adjacent industrial land



Plate 6.8: Deposited soil on southern side of Hereford Street



Plate 6.9: View of Hereford Street immediately adjacent to Ourimbah Creek



Plate 6.10: Illegal dumping within creek bank



6.2.3 Chittaway Road

The study area includes the portion of Chittaway Road located immediately adjacent to the Main North Line including the existing rail underpass. The portion of the road to the west of the railway has been heavily cut in to the surrounding landform as part of the development of the rail bridge and underpass in the 1950s. The study area includes an open paddock area to the west of the existing road corridor. Disturbance within the paddock area appears to be limited to shallow disturbances associated with agricultural land use including the clearance of trees and the deposition of gravel on the topsoil. The open paddock area was identified as an area containing Aboriginal archaeological sensitivity, discussed further in Section 7.1.

Plate 6.11: Rail underpass, northern aspect



Plate 6.12: Rail underpass, western aspect



Plate 6.13: Chittaway Road underpass cut into the surrounding landscape



Plate 6.14: Paddock area adjacent to Chittaway Road underpass



7.0 ABORIGINAL HERITAGE

7.1 Aboriginal archaeological sensitivity

The archaeological sensitivity of an area is determined by its landform, its location and the level of disturbance. Certain landforms, such as gentle slopes and raised terraces, are conducive to Aboriginal occupation and the survivability of sub-surface archaeological deposits, while others, such as steep slopes, are not.

The location of appropriate landforms in relation to natural resources, in particular their proximity to permanent water sources, increases their archaeological potential. Correlations between site location and proximity to permanent water have been proven in previous archaeological investigations where the number of sites and their densities is highest in close proximity to watercourses. In areas where there is a high level of disturbance however, the archaeological sensitivity is lowered.

There are no registered Aboriginal sites within the study area although several sites are within close proximity (50m). The investigation undertaken for the present report did not result in the identification of any Aboriginal objects within the study area. The assessment identified one area of archaeological sensitivity (Figure 7.1). This area is considered to have been subject to substantially lower levels of disturbance compared with the surrounding area. Visual inspection of the soil profile associated with the area of sensitivity from the surrounding road cutting identified an intact soil profile consisting of a loam soil overlaying a clay base. The area of sensitivity is located approximately 25m from Ourimbah Creek on a raised terrace landform. Landscapes within 200m of waters are considered sensitive under the OEH due diligence guidelines.

The railway corridor section of the study area has been subject to substantial earthworks for construction, upgrade and maintenance of the railway line. It is considered likely that this work removed any earlier archaeological evidence that was present in this part of the study area. This portion of the study area is not considered to be archaeologically sensitive.

Hereford Street, Chittaway Road, the rail corridor and access track have been subject to extensive disturbance as part of road and rail development. While several portions are within 200m of Ourimbah Creek, it is considered that the earthworks associated with flattening the road surface, creating the rail underpass and the development of road side drainage would have resulted in extensive disturbance to the soil profile. These portions of the study area are not considered to be archaeologically sensitive.

Figure 7.1: Archaeological sensitivity of study area¹



¹ Please note area of sensitivity can be refined subject to detailed pedestrian survey of the land and subject to impacts as identified within detailed design.

8.0 NON-ABORIGINAL (HISTORICAL) HERITAGE

8.1 Historical archaeological potential

8.1.1 Land-use phasing

Phase 1 c.1829 – 1841: Thomas McQuoid's and Thomas Walker's grants. No evidence that McQuoid or Walker resided on the grant as they also owned estates and residences elsewhere. Archaeological remains are likely to be associated with the land clearance (tree boles, evidence of burning) and agricultural use (drains and swales, imported soils, fence lines, timber shelter structures).

Phase 2 1841 – c.1850: John Edye Manning. No evidence Manning resided on the grant, or undertook substantial alteration to the property. It is likely that it was used for agricultural purposes during this phase.

Phase 3 c.1850: J. L. Travers saw mill. Based on early 20th century land-use, and the lack of development in later periods indicating a focus for settlement, it is unlikely the saw mill was located within the study area. Archaeological remains associated with a saw mill may include footings, timber or stone lined saw pits and yard surfaces.

Phase 4 c.1880: Acquisition of land and construction of the Main North Line, including the re-orientation of early road corridors (e.g. Chittaway Road). Archaeological remains may include evidence of former phases of the railway line, including ballast, drainage lines, swales and cuttings.

Phase 5 1889: Subdivision and the Fountaindale Estate. Aerial photographs from the mid-20th century indicate that the land was sparsely populated. It is unlikely that the subdivision was especially popular in the 19th century. Land use is likely to have included small farm and citrus orchards. Archaeological remains may include former structures associated with agricultural use, including water reservoirs, timber and iron stock shelters and fencing. Any residential remains are likely to date to the later 19th century, to mid-20th century, and may include footings, postholes, privies and wells or cisterns.

8.1.2 Discussion of archaeological potential

The study area is part of a series of properties that were granted in the c1830s, however, it is unlikely that archaeological remains associated with this early phase survive within the study area. The ongoing development of roads and the railway, combined with the ephemeral nature of archaeological remains associated with early agricultural development, suggests that there is nil to low potential for the study area to contain an intact archaeological resource associated with this phase.

The only development known to have taken place in the study area in the period before the construction of the railway line in the 1880s was the creation of Chittaway Road, the original alignment of which is consistent with the current alignment of Hereford Street. Surface materials used on the road are likely to have been ephemeral, with the original road being unsurfaced. The road was impacted by the construction and ongoing maintenance of the railway, and archaeological evidence is therefore unlikely to remain.

The present fabric of the railway line indicates that the rail, sleepers and underlying ballast have been replaced since construction. There is low potential that evidence of former railway infrastructure, including earlier drainage structures and associated goods sheds/sidings, survives within the study area. The majority of the current study area is located within the portion of the Main North Line constructed in the 1950s.

There is low potential that evidence of former structures associated with the later 19th and mid-20th century agricultural and residential development of the Fountaindale Estate may remain within the study area. These remains are likely to consist of the footings or former structures, water reservoir structures, privies, rubbish pits and postholes associated with fence lines and outbuildings.

Development within the study area since the 1950s has largely related to the upgrade of the rail network as well as the formalisation of the existing road network.

8.1.3 Significance assessment

Heritage significance is assessed in accordance with the criteria outlined in the significance assessment guidelines provided by the Heritage Division of the Office of Environment and Heritage (Heritage Office 2001). The criteria specified by the Heritage Division encompass the four values identified in the *Burra Charter*; historical significance, aesthetic significance, scientific significance and social significance (Australia ICOMOS 2013); and also consider representativeness and rarity values. The heritage assessment guidelines also include two thresholds (state or local) for assessing the relative level of significance of heritage items.

Overall, the study area has low potential to contain an intact archaeological resource. There is nil to low potential for remains associated with early agricultural practises and land grants, the saw mill, former roads and later 19th century agricultural use to remains within the study area. Any remains are likely to be ephemeral, and unlikely to contribute to our understanding of the development of the study area. Remains are therefore unlikely to reach the local significance threshold.

There is low potential that archaeological remains associated with the 19th century residential development to survive within the study area. However, if these remains are found to be substantially intact, and contain artefactual remains with the ability to respond to research questions, they may reach the local significance threshold and be considered to be 'relics', as defined by the *Heritage Act 1977* (amended 2009).

8.2 Potential built heritage items

There are no listed heritage items within or in proximity to the study area. However, the investigation undertaken for the present report resulted in the identification of several items which may be of some heritage significance. These are discussed below.

8.2.1 Main North Line

The central portion of the study area includes a section of the current Main North Line. The construction of the Main North Line in the late 1880s was of great importance in the development of the state. In the local region, it played a significant role in opening the area to settlement and allowing local produce to reach the market. The majority of the line within the study area was developed as part of upgrades completed in the 1950s however a portion of the study area crosses the original railway alignment where it diverges from the current line. The majority of the abandoned section of the original alignment, including potential heritage elements such as the brick lined overbridge and sandstone cutting, are located outside the study area. Most of the fabric associated with the portion of original alignment still in use will have been replaced over the course of time.

8.2.2 Chittaway Road

Chittaway Road was in existence by the late 1880s, when it was realigned to accommodate the construction of the railway line. It appears to have been one of the main roads through the local area.

The study area includes part of the original alignment which is consistent with the current alignment of Hereford Street. This part of the current alignment included in the study area was laid out in the late 1880s and remained unsurfaced through to at least the mid-20th century. Currently Hereford Street is comprised of a bituminised surface. There is moderate potential that remains of the earlier Chittaway Road are extant below the bituminised surface. Upgrades to the rail line in the 1950s are likely to have removed the portions of Chittaway Road within the vicinity of the Chittaway Road Rail underpass, fabric within this portion of the study area is unlikely to remain.

8.2.3 Significance assessment

The significance of the two potential heritage items is assessed in this section:

- Main North Line
- Chittaway Road.

8.2.3.1 Main North Line

The Main North Line, as it passes through the study area, is of state heritage significance in accordance with Criterion A. The Main North Line is of importance in the history of the state as it increased the speed and ease of communication, travel and transport between Sydney and the north. It was also important in the history of the local area specifically, allowing increased settlement of an area that was previously relatively inaccessible. Within the study area, this value is represented in the alignment of the railway, which follows the original alignment. However, original fabric is limited to the abandoned section of original alignment abutting the study area.

8.2.3.2 Chittaway Road

Chittaway Road is of local heritage significance in accordance with Criterion A. It relates to the sparse pre-railway development of the area and was one of the main routes through the district for the early settlers. Within the study area, this is represented by the location of part of the original alignment, portions of which may contain archaeological remains.

9.0 IMPACT ASSESSMENT

9.1 Proposed works

The proposed modification includes upgrade of existing roads surrounding the approved project boundary and an access road within the rail corridor to provide temporary access for construction vehicles associated with the approved project.

Access for heavy vehicles would be via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road).

Access for light vehicles would be via Turpentine Road and Ourimbah Road, with no upgrades to the existing roads required for access.

The proposed modification includes:

- Widening of a small section of Hereford Street and Chittaway Road around the existing rail underpass (see Figure 9.1 and Figure 9.2) to provide sufficient turning room for longer vehicles, including a turning area on the western side. These works would widen the existing road width to approximately 30m at the widest point of the proposed turning area.
- Modifications to the existing rail service road, including widening create bi-directional road sections
- Upgrade of an existing track next to the rail corridor to provide connection to the rail service road with construction of a temporary drainage line crossing for access to the rail service road (Figure 9.1).

No modifications are proposed for the remainder of Hereford Street however the proposed design notes that some inadvertent impact to the existing ground vegetation either side of the road surface may occur from increased traffic. Further detail regarding the proposed scope of works associated with the proposed modification is provided in Chapter 3 of the addendum REF.

9.2 Aboriginal heritage impact

No previously identified Aboriginal sites or Aboriginal objects were identified within the study area.

One area of archaeological sensitivity was identified within the study area. Proposed works within this portion of the study area include the widening of Chittaway Road to create a wider turning circle. Works will involve the excavation of the soil profile in line with the existing level of Chittaway Road approximately 2m below the existing ground level. Works would result in a direct impact to the area of sensitivity identified within the study area and result in a total loss of value.

While the majority of Hereford Street is located within a sensitive landform under the due diligence guidelines (within 200m of a waterway), the proposed works are limited to the utilisation of the existing bitumen road. The existing bitumen road and land within the immediate vicinity of the road pavement is considered to have been disturbed as part of ground modification for road construction. Subsequently it is considered that the proposed works associated with Hereford Street will not result in a loss of value to the associated area of sensitivity.

9.3 Non-Aboriginal heritage impact

The assessment of impact has been undertaken in accordance with the Heritage Division guidelines (Heritage Office & DUAP 2002), and the level of impact is assessed as outlined in Figure 9.1.

Table 9.1: Assessed scale of heritage impact

Level of impact	Description
Major	The proposed works would directly impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and/or associated aesthetic elements. This would permanently impact the integrity/intactness of the item and the heritage significance of the item would be lost.
Moderate	The proposed works would impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and/or associated aesthetic elements. Although the integrity/intactness of the item would be impacted, some defining elements of the item would be retained. Therefore, there is potential for the heritage significance of the item to be retained.
Minor	The proposed works would impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and/or associated aesthetic elements. However, these impacts are not considered to detract from the heritage significance of the item.
Nil/Negligible	The proposed works would not impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and associated aesthetic elements. The works are not considered to detract from the heritage significance of the item.

Two unlisted heritage items have been identified within the study area. The potential heritage impact is outlined below and summarised in Figure 9.1.

9.3.1 Main North Line

The proposed modification will not result in alterations to the current railway alignment or fabric. It will involve the construction of temporary ramps over the artificial drainage line on the northern side of the current Main North Line. Remains associated with the Main North Line within this portion of the alignment are limited to structural remains associated with the 1950s alterations to the rail line. The original alignment of the 1880s Main North Line intersects the study area where one of the proposed channel infill is situated. It appears that construction of the 1950s deviation and associated drainage channel has removed any remaining evidence of the original alignment in this area. Ground preparation works will be limited to areas of existing modification.

It is understood that the Chittaway Road Rail overbridge will not be impacted. It is considered that there will be nil impacts to fabric and nil impacts to archaeological remains. The item will be subject to negligible temporary visual impacts.

9.3.2 Chittaway Road

The proposed modification will involve use of the current Hereford Street which is consistent with the original alignment of Chittaway Road. There is low-moderate potential for remains associated with the

original construction of the road to be present below the current bitumen surface. Likely construction techniques of the road surface however suggest that any remains are likely to be ephemeral in nature. Proposed works would be limited to the use of the existing road surface and inadvertent damage to the existing ground vegetation from increased traffic. No impacts to the ground surface are proposed.

Earthworks will be undertaken in the vicinity of the current iteration of Chittaway Road which dates to c1950. While these works are in the vicinity of the original alignment no archaeological remains associated with the alignment is considered likely to be present.

Table 9.2: Summary of impacts

Item	Impacts to Fabric	Impacts to archaeological remains	Impacts to setting
Main North Line	Nil	Nil	Negligible
	Original fabric will not be subject to impacts	Archaeological remains are unlikely to be present within the portion of the study area subject to works	Impacts are consistent with the visual setting of the existing rail line
Chittaway Road	Nil	Nil	Nil
	The fabric to be affected is modern, there will be no impact to the fabric of the original alignment	No archaeological remains are likely to present within portions of the study area subject to earthworks	Proposed works are consistent with the current use and setting of the item

Figure 9.1: Proposed earthworks associated with project modifications - area of moderate archaeological sensitivity shown using orange hatching

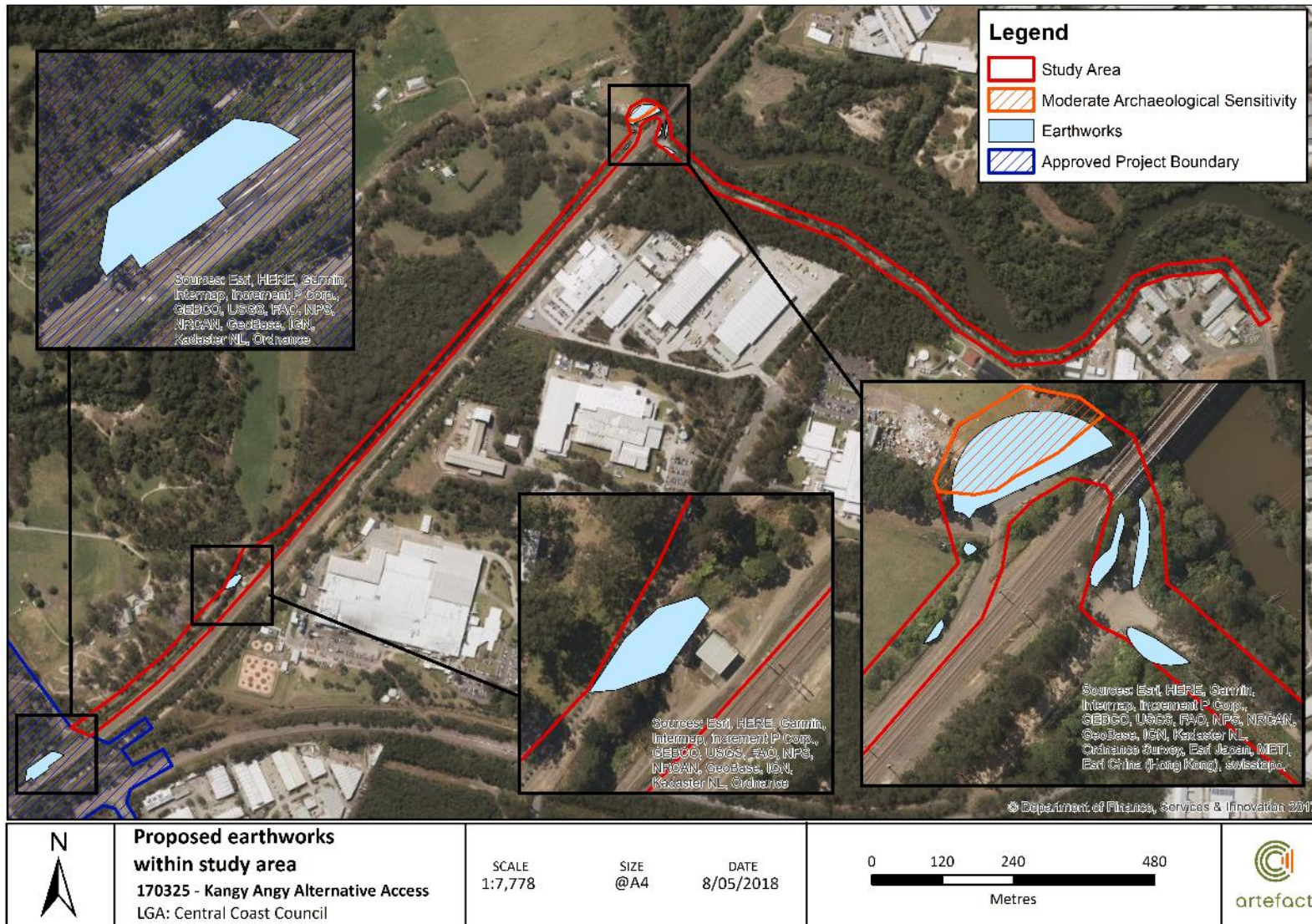
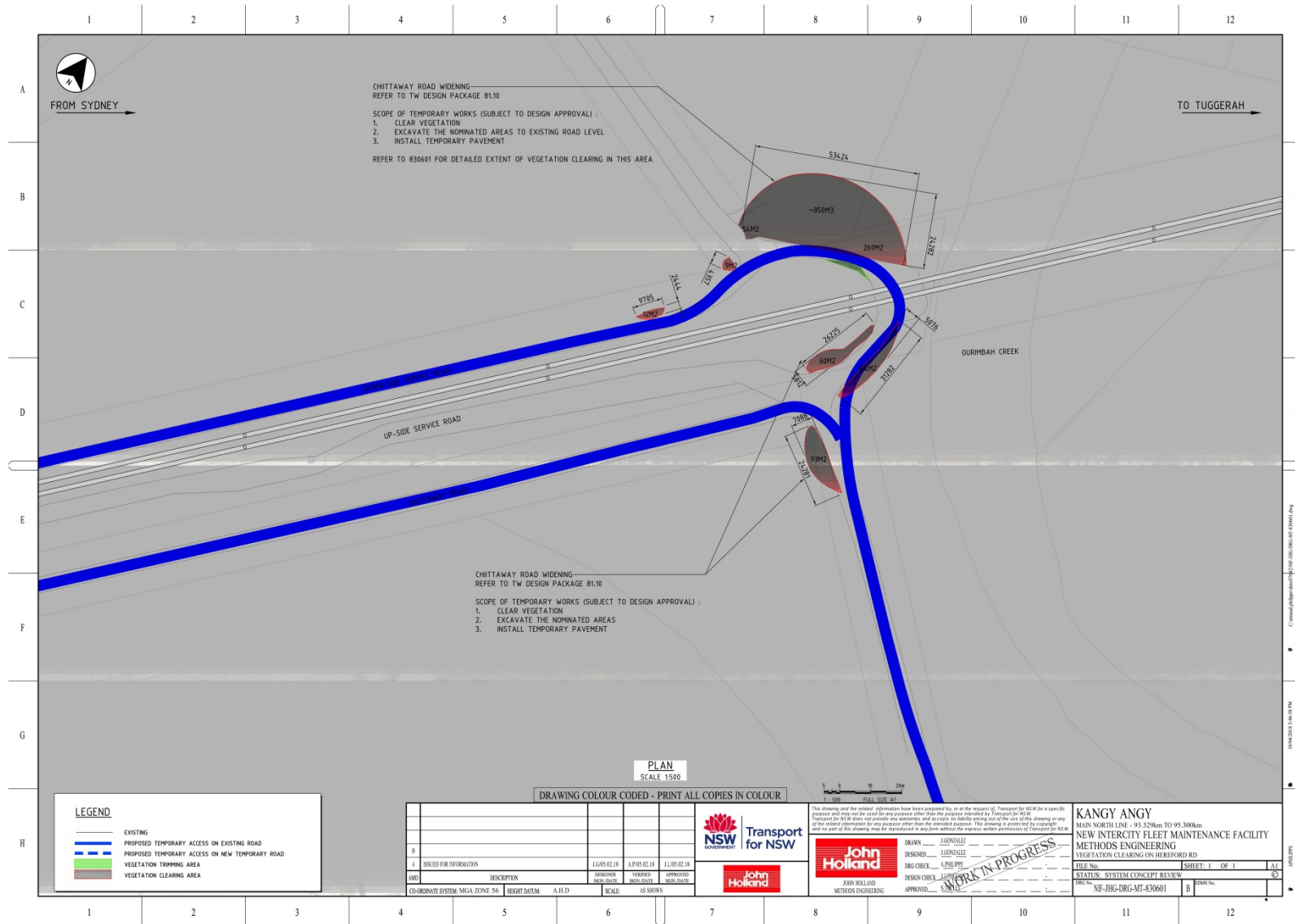


Figure 9.2: Design plans illustrating proposed earthworks as part of the Chittaway Road turning area



10.0 CONCLUSIONS AND RECOMMENDATIONS

The following recommendations regarding Aboriginal heritage are based on consideration of:

- Statutory requirements under the *National Parks and Wildlife Act 1974* as amended
- The results of the background research, site survey and assessment
- The likely impacts of the proposed works.

It was found that:

- No previously recorded Aboriginal sites are located within the study area
- One area of archaeological sensitivity has been identified within the study area adjacent to Chittaway Road (see Figure 7.1), this assessment is based on:
 - location on a raised landform with the likelihood of intact, well stratified deposits
 - low levels of disturbance
 - proximity to Ourimbah Creek
- The remainder of the study area has been significantly disturbed through earthworks associated with the development of the rail embankment and road corridors. The potential for intact archaeological deposits across this portion of the study area is considered low.
- The proposed works would involve potential impact to the identified area of sensitivity.
- There is nil-low potential for the study area to contain historic archaeological relics, as such no statutory approvals from NSW Heritage Division are required.

The following recommendations are made:

10.1 Aboriginal heritage

- In accordance with the OEH due diligence guidelines, an area of archaeological sensitivity where Aboriginal objects may occur beneath the ground surface has been identified within the paddock area located to the north of Chittaway Road (see Figure 7.1), and further archaeological investigation and Aboriginal stakeholder consultation is required
- It is recommended that further investigation must involve investigations in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH code of practice) (OEH 2010), including:
 - Archaeological survey and test excavation conducted in accordance with the OEH code of practice
 - Comprehensive Aboriginal stakeholder consultation throughout the archaeological test excavation process, as outlined in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH consultation requirements) (OEH 2010). This would include 28 days for stakeholders to review the draft test excavation methodology.
- If Aboriginal objects are identified during further archaeological investigation, an AHIP would be required prior to impacts occurring.

- Where no Aboriginal objects or areas requiring test excavation are identified during further archaeological investigation, an AHIP would not be required for the proposed modification, and works would be able to proceed under the unexpected finds protocol outlined in the project construction environmental management plan.
- If changes are made to the proposed modification that may result in impacts to areas not covered by this due diligence assessment, further archaeological investigation may be required.
- With exception of the area of archaeological sensitivity identified above (see Figure 7.1) no Aboriginal objects or areas of archaeological sensitivity were identified within the study area. Works within the remainder of the study area may proceed with caution, with no further Aboriginal archaeological investigation required. Unexpected Aboriginal objects remain protected by the *National Parks and Wildlife Act 1974*. If any such objects, or potential objects, are uncovered in the course of the activity, work in the vicinity should cease, and the Office of Environment and Heritage and Darkinjung Local Aboriginal Land Council be contacted.

10.2 Historical heritage

- Unexpected archaeological relics remain protected by the *Heritage Act 1977*. If a potential relic is found in the course of the work, work should cease in the vicinity, and the Heritage Division of the Office of Environment and Heritage should be contacted for advice.
- It is recommended that an Unexpected Finds Procedure be implemented for all excavation work. The unexpected finds procedure would include the following steps:
 - Ground workers involved with the earthworks should be informed of the kinds of remains that would require the presence of an archaeologist
 - If unexpected archaeological remains are encountered, works should cease, the unexpected find be protected and the project archaeologist notified
 - The archaeologist would attend site or request additional information in order to assess and investigate the suspected archaeological remains, and advise on any additional requirements.



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APPENDIX D

ADDENDUM TRAFFIC IMPACT ASSESSMENT



TRANSPORT FOR NSW

New Intercity Fleet Maintenance Facility

Review of Environmental Factors -
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New Intercity Fleet Maintenance Facility Review of Environmental Factors - Addendum Traffic Impact Assessment

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REV	DATE	DETAILS
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B	08/06/2018	Final
C	21/06/2018	Revised final

	NAME	DATE	SIGNATURE
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1 INTRODUCTION

1.1 PROJECT BACKGROUND

WSP was commissioned by Transport for NSW (TfNSW) to prepare a Traffic and Transport Impact Assessment (TTIA) for the proposed New Intercity Fleet (NIF) Maintenance Facility Project (hereafter, referred to as ‘the Project’) in 2016. The TTIA was one of a number of technical reports supporting the Review of Environmental Factors (REF) for the Project. The study confirmed that generated traffic from the Project would not cause a significant impact on existing road user including pedestrians, cyclists or public transport users. However, it was assumed that the intersection of Enterprise Drive and Chittaway Road would be upgraded as part of Project enabling works prior to main construction works of the New Intercity Fleet Maintenance Facility. For the intersection modelling analysis, it was also assumed that the generated traffic during the construction period would access the Project site through the new access roadway and bridge via the Enterprise Drive and Chittaway Road intersection only.

Delays to project commencement have resulted in the requirement for the new access roadway, bridge and maintenance facility to be constructed concurrently to allow the introduction of the New Intercity Fleet trains in 2020. As a consequence, WSP has been requested to reanalyse the intersection capacity within the study area incorporating the construction traffic movements prior to the completion of the new access roadway and bridge to the maintenance facility site off Enterprise Drive, as well as additional generated traffic for the enabling construction works in 2018.

1.2 PROPOSED MODIFICATION

The proposed modification includes upgrade of existing roads surrounding the approved project, comprising an access road within the rail corridor to provide separate temporary access routes for light and heavy vehicles associated with the project construction traffic. The proposed modification would include:

- Widening of Chittaway Road adjacent the existing rail underpass (near Ourimbah Creek) to provide sufficient turning room for longer vehicles, including a turning area on the western side
- Upgrade of the existing rail service access road
- Construction of a temporary heavy vehicle access road connection between the maintenance facility site and the rail service access road
- Banning right turn movements between Enterprise Drive and Turpentine Road for construction traffic.

Further details regarding the proposed scope of works associated with the proposed modification are provided in the main addendum REF document.

The location of the proposed modification and proposed access routes are shown in Figure 1.1.

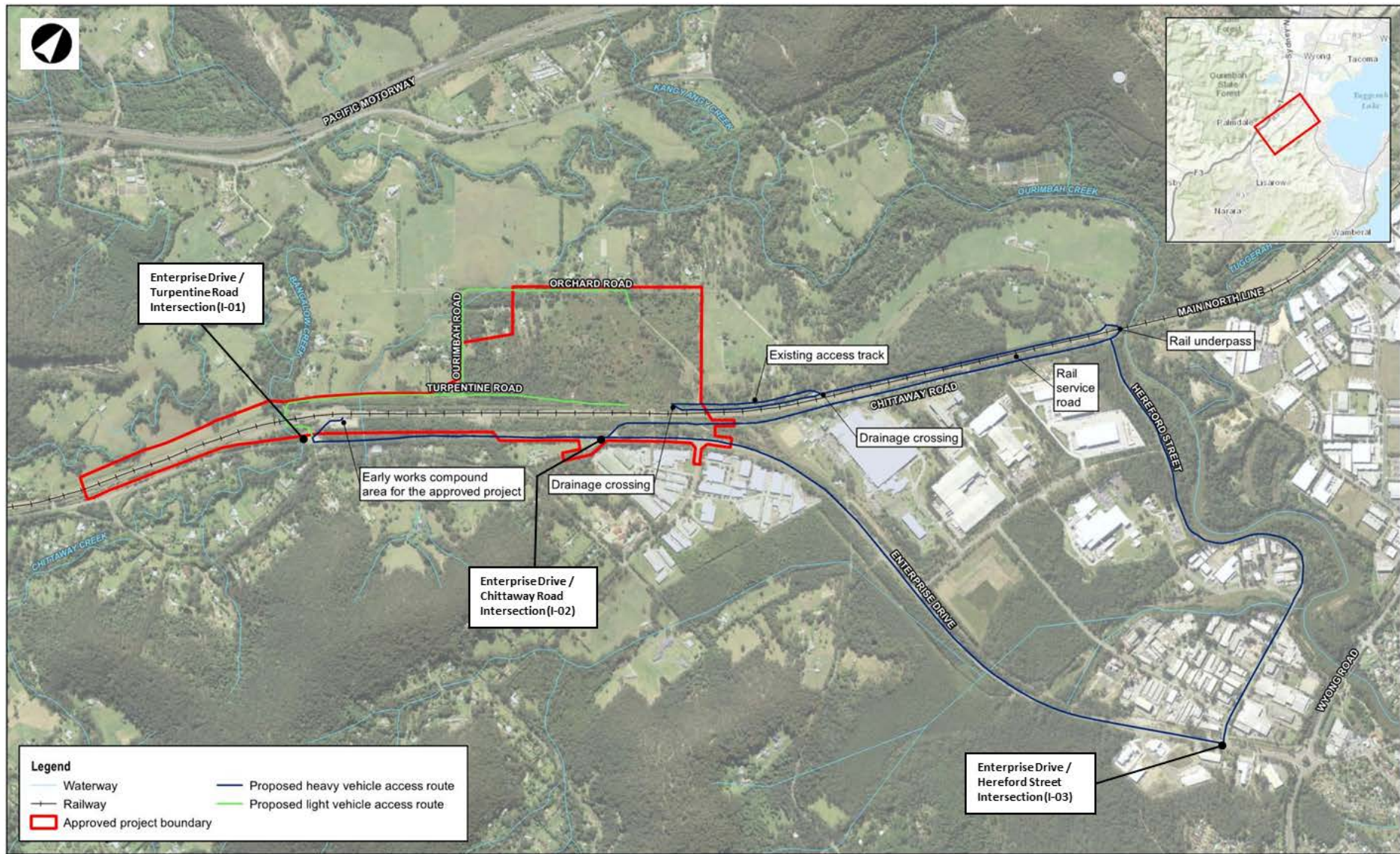


Figure 1.1 Location of the proposed modification and proposed access route

1.3 STUDY OBJECTIVE

The purpose of this traffic impact assessment is to analyse the intersection capacity within the study area including anticipated construction traffic to the NIF Maintenance Facility and enabling works during the construction period. SIDRA Intersection modelling software has been utilised to determine intersection performance at following intersections during a weekday AM and PM peak hour:

- Enterprise Drive and Turpentine Road (I-01)
- Enterprise Drive and Old Chittaway Road (I-02E)
- Enterprise Drive and Chittaway Road (I-02W)
- Enterprise Drive and Hereford Street (I-03).

2 ROAD NETWORK AND INTERSECTIONS ASSESSED

This section describes the existing road network and intersections assessed including traffic volumes, anticipated trip generation and trip distribution during the Project construction period and traffic modelling assumptions.

2.1 ROAD NETWORK

The road network within the study area as shown in Figure 1.1 includes the following:

Enterprise Drive is a regional road which runs generally in an east-west direction between Wyong in the north and the Pacific Highway in the south. It is a two-lane, two-way undivided road with a posted speed limit of 90 kilometres per hour adjacent to the Project site. It has good horizontal alignment and 1 to 1.5 metres sealed shoulder lane marked with solid edge lines and bicycle logo pavement markings.

Chittaway Road runs along the eastern side of the railway track, linking Enterprise Drive to the south and Hereford Street to the north. This road has a sealed width which varies between four to five metres. The narrowness of the road offers minimal lateral clearance between passing vehicles.

Old Chittaway Road serves as a local access to residential properties on the southern side of Enterprise Drive and forms a priority controlled T-intersection with Enterprise Drive. It is a two-lane, two-way undivided road, approximately 5.5 metres wide with a posted speed limit of 60 kilometres per hour.

Turpentine Road, Ourimbah Road and Orchard Road are two-lane, two-way undivided no-through local access roads that connect approximately 25 properties with the Enterprise Drive. These roads do not have a speed limit posted, although a 20 kilometre per hour speed limit has been applied adjacent to the railway overpass. Turpentine Road forms a priority controlled intersection with Enterprise Drive at the south-east section of the Project site.

Hereford Street is a two-lane, two-way undivided road and forms a give way controlled T-junction with Enterprise Drive in the south. It provides access to the industrial precinct located west to the Wyong Road/Enterprise Drive intersection. It has an approximate 12-metre-wide corridor with unrestricted on-street parking provided on both sides to its intersection with Newbridge Road. This road has a sealed width which varies between four to five metres north of Newbridge Road to Chittaway Road.

2.2 INTERSECTION TRAFFIC SURVEYS

Traffic surveys were undertaken for a weekday AM and PM peak period on Tuesday 27 March 2018 at the following three key intersections:

- Enterprise Drive and Turpentine Road (I-01)
- Enterprise Drive, Old Chittaway Road and Chittaway Road (I-02W and I-02E)
- Enterprise Drive and Hereford Street (I-03).

The weekday AM peak period surveys were conducted from 6.30 am to 9.30 am, and the weekday PM peak period from 3.30 pm to 6.30 pm. Data retrieved from the surveys indicate that the weekday AM peak hour generally occurs between 6.45 am and 7.45 am and the PM peak hour between 4.15 pm and 5.15 pm. Figure 2.1 shows the surveyed intersection turning volumes during the weekday AM and PM peak hours.

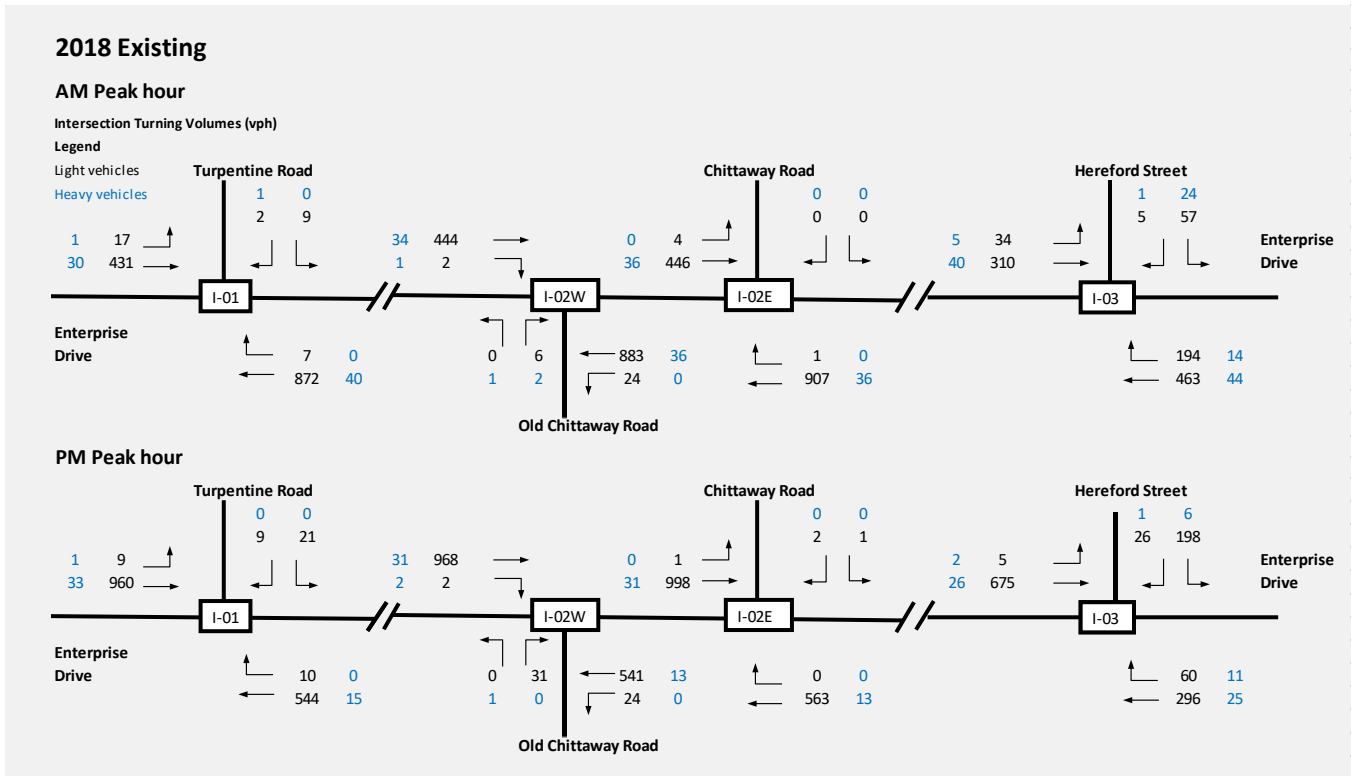


Figure 2.1 Existing intersection traffic volumes during the weekday AM and PM peak hours

2.3 SITE INSPECTION

A site inspection was undertaken on Wednesday 28 March 2018 by WSP staff to gain an appreciation of the road network and traffic conditions as well as to identify potential traffic or road safety issues related to proposed construction traffic haulage routes and access locations.

2.4 TRAFFIC MODELLING ASSUMPTIONS

WSP conducted an intersection performance assessment based on the following information and assumptions:

2.4.1 WORKING HOURS

The New Intercity Fleet Maintenance Facility construction works are planned to mobilise during 2018 and be completed by 2020. The hours of construction works would be as follows:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm Saturday
- No work on Sundays or public holidays, except for works undertaken during rail possessions.

2.4.2 TRIP GENERATION

The following construction related vehicle trips are anticipated:

- Four hundred light vehicles (200 in/200 out) for workers and 168 heavy vehicle movements (84 in/84 out) per day. It has been assumed that this represent a worst-case scenario during the construction period for the proposed modification.

- It is expected that higher light vehicle volumes (300 in/300 out) would be generated during rail possessions. However, rail possessions are normally conducted at weekends or holiday periods when background traffic is much lower than a typical weekday period. Therefore, anticipated daily construction volumes of four hundred light vehicles (200 in/200 out) during the standard construction period were adopted for this traffic assessment.
- Additional 20 light vehicles and 10 heavy vehicles would be generated for enabling works per day.
- Heavy vehicle movements would be spread throughout the working day.

The intersection survey results indicated that the weekday AM background peak occurs between 6.45 am and 7.45 am. This does not fully coincide with the Project peak in the AM as majority of construction workers would arrive to the site before 7.00 am. Therefore, for the purpose of this assessment it is assumed that 50 per cent of the Project construction light traffic would coincide with the weekday AM background traffic peak hour.

Similarly, the weekday PM background peak occurs between 4:15 pm and 5:15 pm which does not coincide with the Project peak in the PM as majority of construction staff may leave from the site after 6:00 pm. Therefore, for this assessment it is assumed that 25 per cent of the project construction light traffic would coincide with the PM background traffic peak hour.

Table 2.1 provides a breakdown of the anticipated trip generation by vehicle type that would be generated for the construction of the New Intercity Fleet Maintenance Facility as well as enabling works for daily and background peak hourly movements.

Table 2.1 Anticipated traffic volumes during the construction of the NIF Maintenance Facility and enabling works

Activities	Daily (One-way)		AM peak (One-way)		PM peak (one-way)	
	LV	HV	LV	HV	LV	HV
Construction – NIF maintenance facility	200	84	100	11	50	11
Enabling works	20	10	10	2	5	2

2.4.3 TRIP DISTRIBUTION

The origin-destination of haulage vehicles and construction workforce during the construction period has not been determined. WSP has assumed that the majority of construction traffic would travel from the nearby major centres of Newcastle and Wyong to the north and Gosford and Sydney to the south. Therefore, we have assumed an even 50 per cent north and 50 per cent south split at Enterprise Drive intersection accesses for this assessment.

2.4.4 RESTRICTED VEHICLE MOVEMENTS

The following access restrictions were identified as part of the proposed modification:

- At the Enterprise Drive and Turpentine Road intersection:
 - No heavy construction vehicle access through this intersection
 - Right turn movements would not be allowed between Enterprise Drive and Turpentine Road for construction traffic.
- At the Enterprise Drive and Chittaway Road intersection:
 - Chittaway Road will remain open to the public
 - Heavy vehicles may drive along Chittaway Road from Hereford Street to build the bridge abutment, but no heavy vehicle access through this intersection.

VEHICLE TRAVEL ROUTES

Based on the proposed modification and identified access restrictions, the following vehicle routes are proposed to and from the Project site during the construction period:

- Access for NIF maintenance facility construction for light vehicles would be via the Enterprise Drive and Turpentine Road intersection.
- Access for heavy vehicles (both NIF maintenance facility and enabling works) would be via the Enterprise Drive and Hereford Street intersection and a service road within the western portion of the rail corridor.
- Light vehicles for enabling works would access the site through Chittaway Road (50 per cent) and Hereford Street (50 per cent).
- Due to the proposed right turn restrictions at the intersection of Enterprise Drive and Turpentine Road, construction light traffic would be detoured via Old Chittaway Road as shown in Figure 2.2.

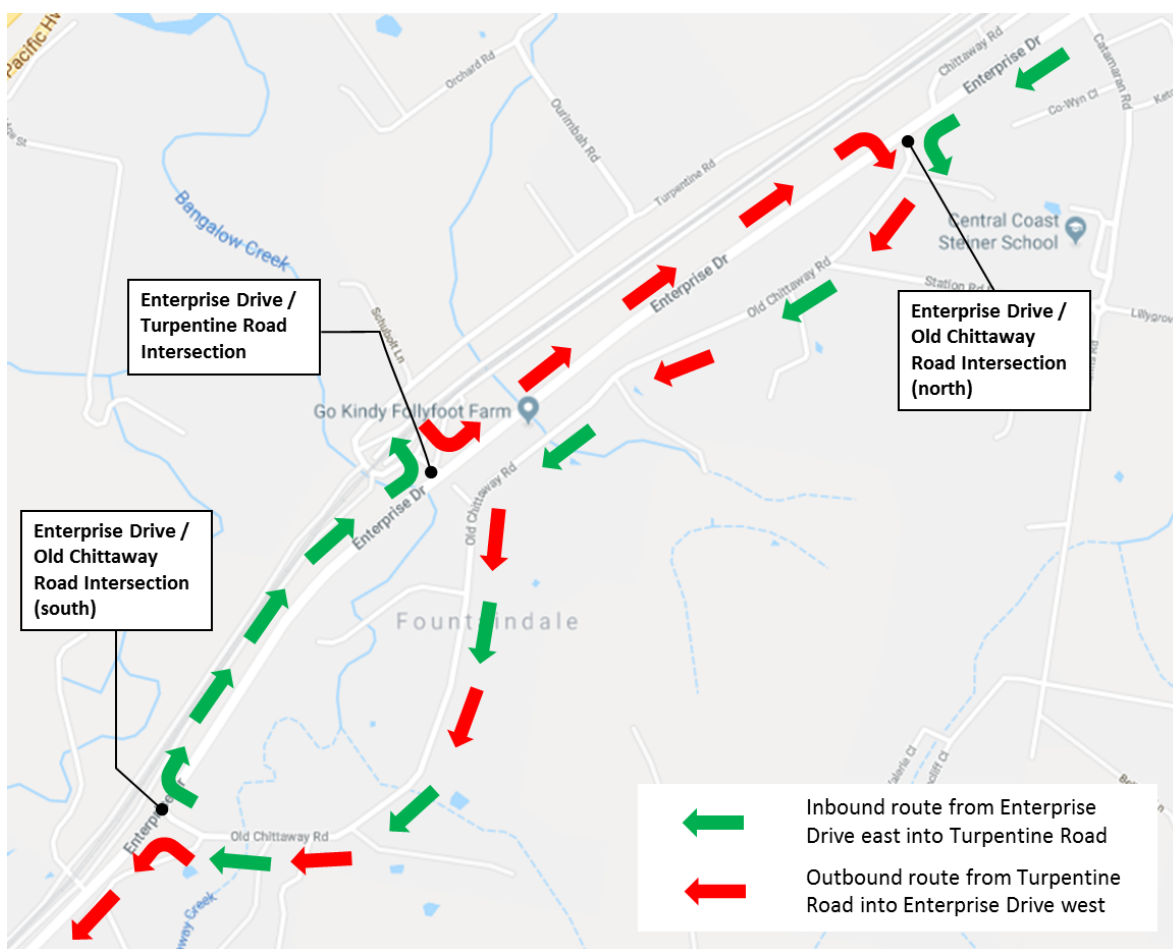


Figure 2.2 Proposed detour route for construction light traffic

3 PROJECT IMPACTS

This section details the intersection layouts modelled and their performance utilising the SIDRA modelling package. Three existing intersections have been assessed with and without construction traffic based information provided and assumptions made as described in section 2.

3.1 INTERSECTION ASSESSED

3.1.1 ENTERPRISE DRIVE AND TURPENTINE ROAD

This is a priority controlled Type BA (Basic) T-intersection which is two-lane two-way undivided on Enterprise Drive with no turning or passing facilities and two-lane two-way undivided and unmarked on Turpentine Road. Turpentine Road at Enterprise Drive has a widened pavement area which narrows further west of the intersection.

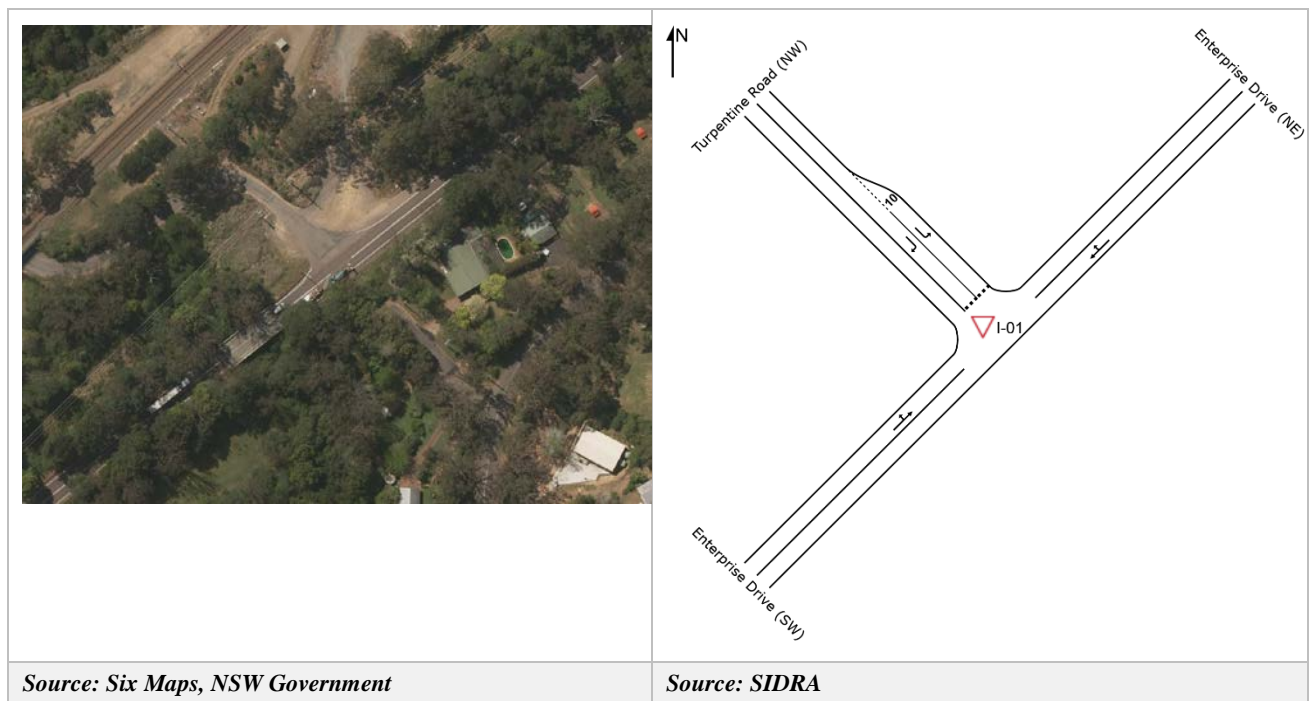


Figure 3.1 Enterprise Drive and Turpentine Road intersection location and layout

3.1.2 ENTERPRISE DRIVE AND CHITTAWAY ROAD

This is a staggered T-intersection with auxiliary left-turn (AUL) treatment provided on Enterprise Drive in the westbound direction for access to Old Chittaway Road (south-east). An acceleration lane is also provided on Enterprise Drive in the westbound direction from Old Chittaway Road (south-east) to facilitate left-turn merging traffic from Old Chittaway Road.

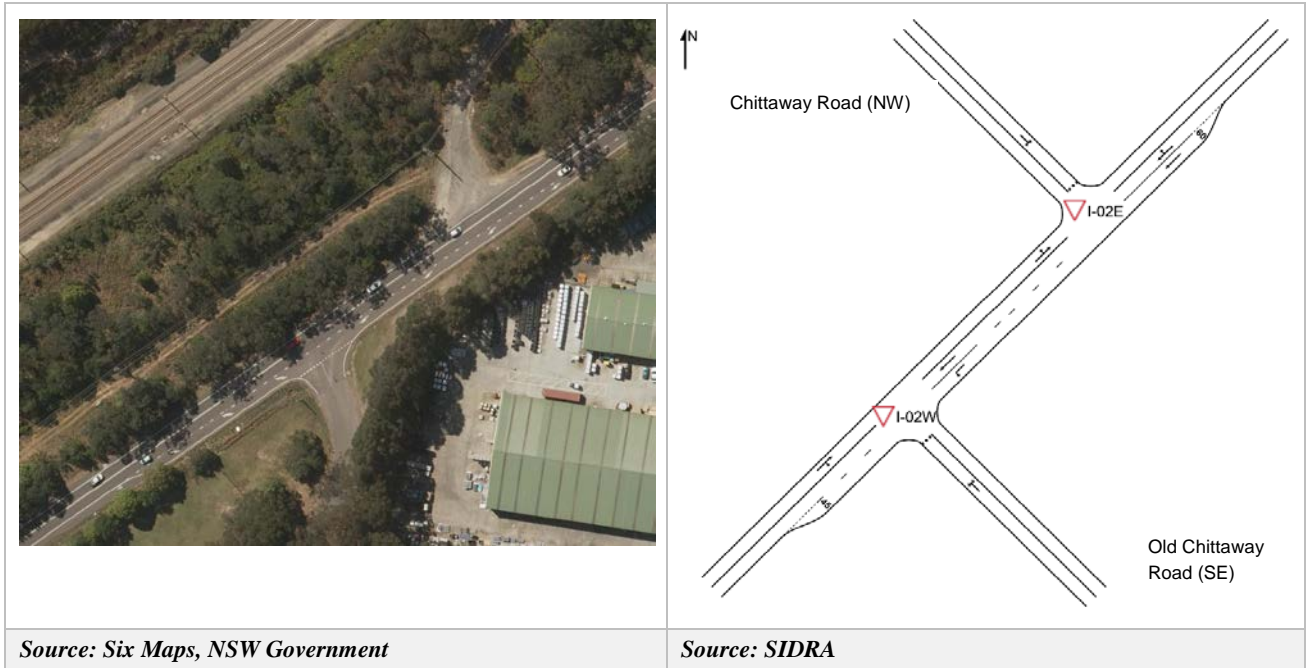


Figure 3.2 Enterprise Drive and Chittaway Road intersection location and layout

3.1.3 ENTERPRISE DRIVE AND HEREFORD STREET

This is a priority controlled Type CH (Channelised) T-intersection. A channelised right-turn (CHR) treatment is provided on Enterprise Drive in the westbound direction and an auxiliary left-turn (AUL) treatment is provided on Enterprise Drive in eastbound direction.

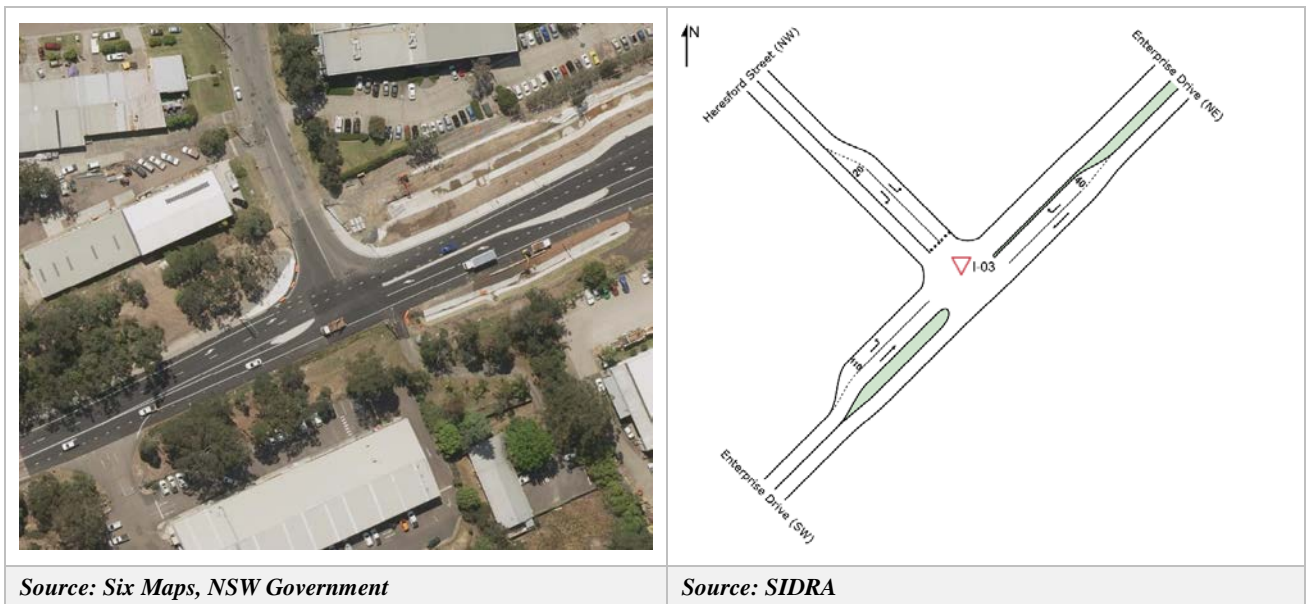


Figure 3.3 Enterprise Drive and Hereford Street intersection location and layout

3.2 INTERSECTION PERFORMANCE PARAMETERS

The SIDRA intersection traffic modelling software was utilised to determine intersection performance. This software provides several useful indicators to determine the level of intersection performance. These are known as Level of Service (LoS), Degree of Saturation (DoS), Average Delay (seconds), and queue length (metres). The LoS criteria for intersections is summarised in Table 3.1.

Table 3.1 Level of Service Criteria for Intersections

Level of Service	Average delay (seconds per vehicle)	Traffic signals, roundabout	Give-way and stop signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents would cause excessive delays. Roundabouts require other control mode.	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: Roads and Maritime Services Guide to Traffic Generating Developments (2002)

3.3 INTERSECTION PERFORMANCE

A comparison of the intersection modelling results for the 2018 existing and 2018 with construction scenarios is provided below. More detailed SIDRA outputs are attached in Appendix A.

Table 3.2 Summary of intersection performance in year 2018 with and without construction traffic

Site ID	Intersection	Peak period	Scenario	DoS ¹	Delay ²	LoS ³	Queue ⁴
I-01	Enterprise Drive and Turpentine Road	AM	2018 Existing	0.51	40	C	1
			2018 Construction	0.52	46	D	2
			Difference	0.01	6	C-D	1
		PM	2018 Existing	0.55	35	C	4
			2018 Construction	0.56	36	C	5
			Difference	0.01	1	-	1

Site ID	Intersection	Peak period	Scenario	DoS ¹	Delay ²	LoS ³	Queue ⁴
I-02W	Enterprise Drive and Old Chittaway Road	AM	2018 Existing	0.51	38	C	3
			2018 Construction	0.51	41	C	3
			Difference	-	3	-	-
		PM	2018 Existing	0.56	41	C	6
			2018 Construction	0.62	51	D	11
			Difference	0.06	10	C-D	5
I-02E	Enterprise Drive and Chittaway Road	AM	2018 Existing	0.50	22	B	0
			2018 Construction	0.54	26	B	1
			Difference	0.04	4	-	1
		PM	2018 Existing	0.57	31	C	0
			2018 Construction	0.59	35	C	1
			Difference	0.02	4	-	1
I-03	Enterprise Drive and Hereford Street	AM	2018 Existing	0.29	31	C	8
			2018 Construction	0.32	63	E	9
			Difference	0.03	32	C-E	1
		PM	2018 Existing	0.42	31	C	14
			2018 Construction	0.47	48	D	16
			Difference	0.05	17	C-D	2

- (1) DoS: Degree of Saturation
- (2) Delay: Average delay (second)
- (3) LoS: Level of Services
- (4) Queue: 95th percentile queue (m)

Despite the generated traffic for the NIF maintenance facility construction and enabling works in 2018, the intersection modelling results indicate there would be a minor deterioration of intersection performance and increase in delays and queue length at three key intersections as a result of the generated traffic for the NIF maintenance facility construction and enabling works in 2018. Further details are provided below.

3.3.1 ENTERPRISE DRIVE AND TURPENTINE ROAD INTERSECTION

SIDRA modelling results revealed that Enterprise Drive and Turpentine Road intersection operates at a satisfactory Level of Service (LoS) C during both AM and PM peak hours under the existing 2018 conditions. The average delays and the 95th percentile queue lengths would only marginally increase due to the generated traffic for construction and enabling works which result in a worsened LoS D during AM peak hour. Since only left-in and left-out movements are allowed for construction light traffic, the generated traffic would not cause a significant delays and queues at this intersection. Overall, this intersection is anticipated to operate satisfactorily during the construction and enabling peak periods.

3.3.2 *ENTERPRISE DRIVE AND CHITTAWAY ROAD INTERSECTION*

The staggered T-intersection at Enterprise Drive/Chittaway Road/Old Chittaway operates at LoS C or better under the existing conditions. The average delays and the 95th percentile queue lengths would only marginally increase due to the construction and enabling works except for the western half of the intersection at Enterprise Drive and Old Chittaway Road during PM peak hours. As a result, intersection performance remains unchanged except Enterprise Drive at Old Chittaway Road would deteriorate from the existing LoS C to LoS D during construction and enabling PM peak hours. This change is caused by heavier eastbound right turning movements during PM peak hours at this intersection utilised by the detour construction traffic associated with the right turn bans being implemented at the nearby Turpentine Road intersection.

3.3.3 *ENTERPRISE DRIVE AND HEREFORD STREET INTERSECTION*

SIDRA results indicate that intersection performance at Enterprise Drive and Hereford Street intersection is at a satisfactory LoS C during both AM and PM peak hours. The average delays and 95th percentile queue lengths are projected to increase during construction and enabling works which result in a worsened LoS E and LoS D during AM and PM peak hours, respectively. The critical movement which is the worst movement at this intersection has been identified as the right turn movement exiting from Hereford Street onto Enterprise Drive. It is further noted that the intersection performance is only adversely affected by the marginally increased right turn movements performed by heavy vehicles in comparison to the existing conditions. In addition, the Degree of Saturation (DoS) is projected below 0.5, indicating the existing intersection layout has considerable spare capacity to accommodate the construction traffic volumes.

4 CONCLUSION

The proposed New Intercity Fleet Maintenance Facility Project is anticipated to generate a considerable volume of traffic during the construction period. However, it is expected that existing intersections would not be experience significant delays and queues by generated traffic as majority of Project traffic would arrive or depart the Project site during the outside of the background peak hours.

The traffic assessment has found that the intersections within the study area would generally operate at a good or acceptable level. The heavy vehicle right turn movements from Hereford Street onto Enterprise Drive during construction and enabling work AM peak hours would result in this intersection operating close to capacity. Given the low number of movements, the traffic impact is considered low and could be easily accommodated on the surrounding road network. Therefore, the impacts on intersections are not considered to require mitigation measures. Temporary traffic control methods may be required.

Overall construction methods would seek to manage the construction traffic impacts for the following:

- Minimise the number of vehicle movements by efficient planning and reduce running empty trucks, for instance, balancing earthworks and recycling excavation materials
- Prepare road haulage routes as identified and monitor the implementation to minimise disruption on the local road network
- Minimise laying by of construction vehicles on road way by efficient communication and coordination. Use effective traffic control methods such as variable message signs (VMS) and on-site traffic controllers
- Undertake adequate notification to affected residents to allow advanced trip planning
- Consult with road authorities and relevant agencies to address public concerns
- Encourage carpooling and the use of public transport to work site
- Monitor intersection performance and safety and take appropriate actions when required.

APPENDIX A

SIDRA OUTPUTS



A1 2018 EXISTING AM PEAK

A1.1 I-01 ENTERPRISE DRIVE/TURPENTINE ROAD

MOVEMENT SUMMARY

▽ Site: I-01 [I-01 EX AM]

Enterprise Drive/Turpentine Road
2018 Existing AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Enterprise Drive (NE)											
5	T1	960	4.4	0.513	3.1	LOS A	0.2	1.3	0.02	0.39	67.9
6	R2	7	0.0	0.513	11.7	LOS A	0.2	1.3	0.02	0.39	68.1
Approach		967	4.4	0.513	3.2	NA	0.2	1.3	0.02	0.39	67.9
NorthWest: Turpentine Road (NW)											
7	L2	9	0.0	0.010	7.4	LOS A	0.0	0.2	0.46	0.61	58.4
9	R2	3	33.3	0.034	39.6	LOS C	0.1	0.8	0.92	0.97	29.8
Approach		13	8.3	0.034	15.4	LOS B	0.1	0.8	0.58	0.70	47.2
SouthWest: Enterprise Drive (SW)											
10	L2	19	5.6	0.270	7.6	LOS A	0.0	0.0	0.00	0.40	50.8
11	T1	485	6.5	0.270	3.1	LOS A	0.0	0.0	0.00	0.40	80.0
Approach		504	6.5	0.270	3.3	NA	0.0	0.0	0.00	0.40	78.8
All Vehicles		1484	5.1	0.513	3.3	NA	0.2	1.3	0.02	0.39	71.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project:

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A1.2 I-02W ENTERPRISE DRIVE/OLD CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02W [I-02W EX AM]

Network: 1 [2018 Existing AM]

Enterprise Drive/Old Chittaway Road West
2018 Existing AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total	Arrival Flows HV %	Deg. Satn %	Average Delay sec	Level of Service	95% Back of Queue Vehicles	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h		
SouthEast: Old Chittaway Road West (SE)													
1	L2	1	100.0	1	100.0	0.089	29.5	LOS C	0.2	2.2	0.91	0.96	27.1
3	R2	8	25.0	8	25.0	0.089	37.8	LOS C	0.2	2.2	0.91	0.96	9.4
Approach		9	33.3	9	33.3	0.089	36.9	LOS C	0.2	2.2	0.91	0.96	12.7
NorthEast: Enterprise Drive (NE)													
4	L2	25	0.0	25	0.0	0.014	3.6	LOS A	0.0	0.0	0.00	0.58	40.9
5	T1	967	3.9	967	3.9	0.509	0.0	LOS A	0.0	0.0	0.00	0.00	89.6
Approach		993	3.8	993	3.8	0.509	0.1	NA	0.0	0.0	0.00	0.01	88.8
SouthWest: Enterprise Drive (SW)													
11	T1	503	7.1	503	7.1	0.284	0.7	LOS A	0.4	2.7	0.04	0.00	86.3
12	R2	3	33.3	3	33.3	0.284	30.4	LOS C	0.4	2.7	0.04	0.00	70.2
Approach		506	7.3	506	7.3	0.284	0.9	NA	0.4	2.7	0.04	0.00	86.2
All Vehicles		1508	5.2	1508	5.2	0.509	0.6	NA	0.4	2.7	0.02	0.02	86.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A1.3 I-02E ENTERPRISE DRIVE/CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02E [I-02E EX AM]

Network: 1 [2018 Existing AM]

Enterprise Drive/Old Chittaway Road East
2018 Existing AM
Giveway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %	Total veh/h	HV %								
NorthEast: Enterprise Drive (NE)													
11	T1	993	3.8	993	3.8	0.503	0.0	LOS A	0.0	0.2	0.00	0.00	89.9
12	R2	1	0.0	1	0.0	0.503	11.5	LOS A	0.0	0.2	0.00	0.00	75.5
Approach		994	3.8	994	3.8	0.503	0.0	NA	0.0	0.2	0.00	0.00	89.9
NorthWest: Old Chittaway Road East (SE)													
1	L2	1	0.0	1	0.0	0.007	6.5	LOS A	0.0	0.1	0.71	0.74	47.8
3	R2	1	0.0	1	0.0	0.007	22.1	LOS B	0.0	0.1	0.71	0.74	18.1
Approach		2	0.0	2	0.0	0.007	14.3	LOS A	0.0	0.1	0.71	0.74	38.1
SouthWest: Enterprise Drive (SW)													
4	L2	4	0.0	4	0.0	0.275	3.6	LOS A	0.0	0.0	0.00	0.01	18.7
5	T1	507	7.5	507	7.5	0.275	0.0	LOS A	0.0	0.0	0.00	0.01	89.7
Approach		512	7.4	512	7.4	0.275	0.0	NA	0.0	0.0	0.00	0.01	88.9
All Vehicles		1507	5.0	1507	5.0	0.503	0.0	NA	0.0	0.2	0.00	0.00	89.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A1.4 I-03 ENTERPRISE DRIVE/HEREFORD STREET

MOVEMENT SUMMARY

 **Site: I-03 [I-03 EX AM]**

Enterprise Drive/Hereford Street
2018 Existing AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
NorthEast: Enterprise Drive (NE)												
5	T1	534	8.7	0.289	0.0	LOS A	0.0	0.0	0.00	0.00	59.9	
6	R2	219	6.7	0.252	8.2	LOS A	1.1	8.0	0.53	0.74	49.0	
Approach		753	8.1	0.289	2.4	NA	1.1	8.0	0.15	0.22	56.3	
NorthWest: Hereford Street (NW)												
7	L2	85	29.6	0.117	8.5	LOS A	0.4	3.7	0.47	0.70	45.7	
9	R2	6	16.7	0.046	30.8	LOS C	0.1	1.1	0.87	0.95	38.7	
Approach		92	28.7	0.117	10.0	LOS A	0.4	3.7	0.49	0.72	45.0	
SouthWest: Enterprise Drive (SW)												
10	L2	41	12.8	0.024	5.7	LOS A	0.0	0.0	0.00	0.57	53.1	
11	T1	368	11.4	0.203	0.0	LOS A	0.0	0.0	0.00	0.00	60.0	
Approach		409	11.6	0.203	0.6	NA	0.0	0.0	0.00	0.06	59.0	
All Vehicles		1254	10.7	0.289	2.4	NA	1.1	8.0	0.13	0.20	56.1	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A2 2018 EXISTING PM PEAK

A2.1 I-01 ENTERPRISE DRIVE/TURPENTINE ROAD

MOVEMENT SUMMARY

▽ Site: I-01 [I-01 EX PM]

Enterprise Drive/Turpentine Road
2018 Existing PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Enterprise Drive (NE)											
5	T1	588	2.7	0.333	3.8	LOS A	0.6	4.1	0.08	0.37	66.8
6	R2	11	0.0	0.333	20.7	LOS B	0.6	4.1	0.08	0.37	66.4
Approach		599	2.6	0.333	4.1	NA	0.6	4.1	0.08	0.37	66.8
NorthWest: Turpentine Road (NW)											
7	L2	22	0.0	0.057	13.8	LOS A	0.2	1.3	0.77	0.90	51.1
9	R2	9	0.0	0.087	34.9	LOS C	0.2	1.6	0.92	0.97	35.7
Approach		32	0.0	0.087	20.1	LOS B	0.2	1.6	0.82	0.92	45.2
SouthWest: Enterprise Drive (SW)											
10	L2	11	10.0	0.554	7.7	LOS A	0.0	0.0	0.00	0.39	50.3
11	T1	1045	3.3	0.554	3.1	LOS A	0.0	0.0	0.00	0.39	81.1
Approach		1056	3.4	0.554	3.2	NA	0.0	0.0	0.00	0.39	80.7
All Vehicles		1686	3.1	0.554	3.8	NA	0.6	4.1	0.04	0.39	74.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A2.2 I-02W ENTERPRISE DRIVE/OLD CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02W [I-02W EX PM]

Network: N101 [2018 Existing PM]

Enterprise Drive/Old Chittaway Road West
2018 Existing PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	OD Mov	Demand Flows Total veh/h	Arrival Flows HV % veh/h	Deg. Satn % v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h			
SouthEast: Old Chittaway Road West (SE)														
1	L2	1	100.0	1	100.0	0.296	16.7	LOS B	0.9	6.3	0.93	1.00	26.1	
3	R2	33	0.0	33	0.0	0.296	40.9	LOS C	0.9	6.3	0.93	1.00	8.7	
Approach		34	3.1	34	3.1	0.296	40.1	LOS C	0.9	6.3	0.93	1.00	9.6	
NorthEast: Enterprise Drive (NE)														
4	L2	25	0.0	25	0.0	0.014	3.6	LOS A	0.0	0.0	0.00	0.58	40.9	
5	T1	583	2.3	583	2.3	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	89.8	
Approach		608	2.2	608	2.2	0.304	0.2	NA	0.0	0.0	0.00	0.02	88.5	
SouthWest: Enterprise Drive (SW)														
11	T1	1052	3.1	1052	3.1	0.560	0.2	LOS A	0.3	2.2	0.02	0.00	88.8	
12	R2	4	50.0	4	50.0	0.560	22.8	LOS B	0.3	2.2	0.02	0.00	70.2	
Approach		1056	3.3	1056	3.3	0.560	0.3	NA	0.3	2.2	0.02	0.00	88.7	
All Vehicles		1698	2.9	1698	2.9	0.560	1.0	NA	0.9	6.3	0.03	0.03	85.2	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A2.3 I-02E ENTERPRISE DRIVE/CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02E [I-02E EX PM]

Network: N101 [2018 Existing PM]

Enterprise Drive/Old Chittaway Road East
2018 Existing PM
Giveway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %	Total veh/h	HV %				Vehicles veh	Distance m			
NorthEast: Enterprise Drive (NE)													
11	T1	606	2.3	606	2.3	0.309	0.1	LOS A	0.1	0.4	0.01	0.00	89.5
12	R2	1	0.0	1	0.0	0.309	21.3	LOS B	0.1	0.4	0.01	0.00	75.3
Approach		607	2.3	607	2.3	0.309	0.1	NA	0.1	0.4	0.01	0.00	89.4
NorthWest: Old Chittaway Road East (SE)													
1	L2	1	0.0	1	0.0	0.021	13.3	LOS A	0.1	0.4	0.89	0.95	38.6
3	R2	2	0.0	2	0.0	0.021	31.3	LOS C	0.1	0.4	0.89	0.95	12.1
Approach		3	0.0	3	0.0	0.021	25.3	LOS B	0.1	0.4	0.89	0.95	24.3
SouthWest: Enterprise Drive (SW)													
4	L2	1	0.0	1	0.0	0.567	3.6	LOS A	0.0	0.0	0.00	0.00	18.6
5	T1	1083	3.0	1083	3.0	0.567	0.0	LOS A	0.0	0.0	0.00	0.00	89.5
Approach		1084	3.0	1084	3.0	0.567	0.0	NA	0.0	0.0	0.00	0.00	89.4
All Vehicles		1695	2.7	1695	2.7	0.567	0.1	NA	0.1	0.4	0.00	0.00	89.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A2.4 I-03 ENTERPRISE DRIVE/HEREFORD STREET

MOVEMENT SUMMARY

Site: I-03 [I-03 EX PM]

Enterprise Drive/Hereford Street
2018 Existing PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
NorthEast: Enterprise Drive (NE)												
5	T1	338	7.8	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	60.0	
6	R2	75	15.5	0.157	12.3	LOS A	0.6	4.4	0.68	0.86	45.4	
Approach		413	9.2	0.182	2.2	NA	0.6	4.4	0.12	0.16	56.7	
NorthWest: Hereford Street (NW)												
7	L2	215	2.9	0.424	13.5	LOS A	1.9	13.8	0.73	0.97	44.6	
9	R2	28	3.7	0.191	30.7	LOS C	0.6	4.4	0.88	0.96	38.9	
Approach		243	3.0	0.424	15.5	LOS B	1.9	13.8	0.75	0.97	43.7	
SouthWest: Enterprise Drive (SW)												
10	L2	7	28.6	0.005	5.9	LOS A	0.0	0.0	0.00	0.57	52.4	
11	T1	738	3.7	0.388	0.1	LOS A	0.0	0.0	0.00	0.00	59.9	
Approach		745	4.0	0.388	0.1	NA	0.0	0.0	0.00	0.01	59.8	
All Vehicles		1401	5.3	0.424	3.4	NA	1.9	13.8	0.17	0.22	55.2	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A3 2018 ENABLING AND CONSTRUCTION AM PEAK

A3.1 I-01 ENTERPRISE DRIVE/TURPENTINE ROAD

MOVEMENT SUMMARY

▽ Site: I-01 [I-01 AM Enabling and Construction]

Enterprise Drive/Turpentine Road
2018 Enabling and Construction AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
NorthEast: Enterprise Drive (NE)												
5	T1	965	4.9	0.519	3.2	LOS A	0.2	1.6	0.02	0.39	67.9	
6	R2	7	0.0	0.519	13.5	LOS A	0.2	1.6	0.02	0.39	68.0	
Approach		973	4.9	0.519	3.2	NA	0.2	1.6	0.02	0.39	67.9	
NorthWest: Turpentine Road (NW)												
7	L2	9	0.0	0.010	7.4	LOS A	0.0	0.2	0.47	0.62	58.3	
9	R2	3	33.3	0.040	45.8	LOS D	0.1	0.9	0.93	0.97	27.8	
Approach		13	8.3	0.040	17.0	LOS B	0.1	0.9	0.59	0.71	45.8	
SouthWest: Enterprise Drive (SW)												
10	L2	124	0.8	0.335	7.5	LOS A	0.0	0.0	0.00	0.44	50.4	
11	T1	497	7.6	0.335	3.1	LOS A	0.0	0.0	0.00	0.44	78.3	
Approach		621	6.3	0.335	4.0	NA	0.0	0.0	0.00	0.44	72.3	
All Vehicles		1606	5.4	0.519	3.6	NA	0.2	1.6	0.02	0.41	69.3	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A3.2 I-02W ENTERPRISE DRIVE/OLD CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02W [I-02W Enabling and Construction AM]

Network: 1 [2018 Construction AM]

Enterprise Drive/Old Chittaway Road West
2018 Enabling and Construction AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Arrival Flows HV %	Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Old Chittaway Road West (SE)													
1	L2	1	100.0	1	100.0	0.096	30.2	LOS C	0.3	2.4	0.92	0.97	26.3
3	R2	8	25.0	8	25.0	0.096	40.7	LOS C	0.3	2.4	0.92	0.97	8.8
Approach		9	33.3	9	33.3	0.096	39.5	LOS C	0.3	2.4	0.92	0.97	12.1
NorthEast: Enterprise Drive (NE)													
4	L2	78	0.0	78	0.0	0.042	3.6	LOS A	0.0	0.0	0.00	0.58	40.9
5	T1	973	4.4	973	4.4	0.513	0.0	LOS A	0.0	0.0	0.00	0.00	89.6
Approach		1051	4.1	1051	4.1	0.513	0.3	NA	0.0	0.0	0.00	0.04	87.2
SouthWest: Enterprise Drive (SW)													
11	T1	515	8.2	515	8.2	0.294	0.8	LOS A	0.4	3.3	0.04	0.00	85.7
12	R2	3	33.3	3	33.3	0.294	33.3	LOS C	0.4	3.3	0.04	0.00	69.9
Approach		518	8.3	518	8.3	0.294	1.0	NA	0.4	3.3	0.04	0.00	85.6
All Vehicles		1578	5.7	1578	5.7	0.513	0.8	NA	0.4	3.3	0.02	0.04	85.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A3.3 I-02E ENTERPRISE DRIVE/CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02E [I-02E Enabling and Construction AM]

Network: 1 [2018 Construction AM]

Enterprise Drive/Old Chittaway Road East
2018 Enabling and Construction AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %	Total veh/h	HV %				Vehicles veh	Distance m			
NorthEast: Enterprise Drive (NE)													
11	T1	1051	4.1	1051	4.1	0.536	0.0	LOS A	0.1	0.8	0.01	0.00	89.6
12	R2	4	0.0	4	0.0	0.536	12.1	LOS A	0.1	0.8	0.01	0.00	75.3
Approach		1055	4.1	1055	4.1	0.536	0.1	NA	0.1	0.8	0.01	0.00	89.5
NorthWest: Old Chittaway Road East (SE)													
1	L2	1	0.0	1	0.0	0.008	6.5	LOS A	0.0	0.2	0.74	0.76	46.1
3	R2	1	0.0	1	0.0	0.008	25.5	LOS B	0.0	0.2	0.74	0.76	16.8
Approach		2	0.0	2	0.0	0.008	16.0	LOS B	0.0	0.2	0.74	0.76	36.3
SouthWest: Enterprise Drive (SW)													
4	L2	7	0.0	7	0.0	0.283	3.6	LOS A	0.0	0.0	0.00	0.01	18.7
5	T1	516	8.6	516	8.6	0.283	0.0	LOS A	0.0	0.0	0.00	0.01	89.6
Approach		523	8.5	523	8.5	0.283	0.1	NA	0.0	0.0	0.00	0.01	88.3
All Vehicles		1580	5.5	1580	5.5	0.536	0.1	NA	0.1	0.8	0.01	0.01	88.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A3.4 I-03 ENTERPRISE DRIVE/HEREFORD STREET

MOVEMENT SUMMARY

▽ Site: I-03 [I-03 Enabling and Construction AM]

Enterprise Drive/Hereford Street
2018 Enabling and Construction AM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
NorthEast: Enterprise Drive (NE)												
5	T1	589	7.9	0.318	0.0	LOS A	0.0	0.0	0.00	0.00	59.9	
6	R2	227	9.3	0.270	8.5	LOS A	1.2	8.9	0.54	0.76	48.6	
Approach		817	8.2	0.318	2.4	NA	1.2	8.9	0.15	0.21	56.3	
NorthWest: Hereford Street (NW)												
7	L2	91	33.7	0.128	8.7	LOS A	0.5	4.2	0.47	0.71	45.1	
9	R2	12	54.5	0.178	63.0	LOS E	0.5	5.4	0.94	0.98	28.4	
Approach		102	36.1	0.178	14.8	LOS B	0.5	5.4	0.53	0.74	41.6	
SouthWest: Enterprise Drive (SW)												
10	L2	49	23.4	0.031	5.8	LOS A	0.0	0.0	0.00	0.57	52.6	
11	T1	368	11.4	0.203	0.0	LOS A	0.0	0.0	0.00	0.00	60.0	
Approach		418	12.8	0.203	0.7	NA	0.0	0.0	0.00	0.07	58.7	
All Vehicles		1337	11.8	0.318	2.8	NA	1.2	8.9	0.13	0.21	55.5	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A4 2018 ENABLING AND CONSTRUCTION PM PEAK

A4.1 I-01 ENTERPRISE DRIVE/TURPENTINE ROAD

MOVEMENT SUMMARY

▽ Site: I-01 [I-01 PM Enabling and Construction]

Enterprise Drive/Turpentine Road
2018 Enabling and Construction PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
NorthEast: Enterprise Drive (NE)												
5	T1	598	3.7	0.341	3.9	LOS A	0.6	4.3	0.08	0.37	66.7	
6	R2	11	0.0	0.341	21.1	LOS B	0.6	4.3	0.08	0.37	66.4	
Approach		608	3.6	0.341	4.2	NA	0.6	4.3	0.08	0.37	66.7	
NorthWest: Turpentine Road (NW)												
7	L2	75	0.0	0.196	14.7	LOS B	0.7	4.6	0.80	0.93	50.1	
9	R2	9	0.0	0.091	36.4	LOS C	0.2	1.7	0.93	0.97	35.0	
Approach		84	0.0	0.196	17.2	LOS B	0.7	4.6	0.82	0.93	47.8	
SouthWest: Enterprise Drive (SW)												
10	L2	11	10.0	0.558	7.7	LOS A	0.0	0.0	0.00	0.39	50.3	
11	T1	1051	3.8	0.558	3.1	LOS A	0.0	0.0	0.00	0.39	80.9	
Approach		1061	3.9	0.558	3.2	NA	0.0	0.0	0.00	0.39	80.6	
All Vehicles		1754	3.6	0.558	4.2	NA	0.7	4.6	0.07	0.41	73.5	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A4.2 I-02W ENTERPRISE DRIVE/OLD CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02W [I-02W Enabling and Construction PM] Network: N101 [2018 Construction PM]

Enterprise Drive/Old Chittaway Road West
2018 Enabling and Construction PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Arrival Flows HV %	Total HV veh/h	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
SouthEast: Old Chittaway Road West (SE)													
1	L2	1	100.0	1	100.0	0.358	20.2	LOS B	1.1	7.6	0.95	1.01	23.4
3	R2	33	0.0	33	0.0	0.358	50.8	LOS D	1.1	7.6	0.95	1.01	7.2
Approach		34	3.1	34	3.1	0.358	49.8	LOS D	1.1	7.6	0.95	1.01	8.0
NorthEast: Enterprise Drive (NE)													
4	L2	25	0.0	25	0.0	0.014	3.6	LOS A	0.0	0.0	0.00	0.58	40.9
5	T1	593	3.4	593	3.4	0.311	0.0	LOS A	0.0	0.0	0.00	0.00	89.8
Approach		618	3.2	618	3.2	0.311	0.2	NA	0.0	0.0	0.00	0.02	88.5
SouthWest: Enterprise Drive (SW)													
11	T1	1083	3.5	1083	3.5	0.616	0.8	LOS A	1.5	10.7	0.11	0.02	84.9
12	R2	31	6.9	31	6.9	0.616	17.7	LOS B	1.5	10.7	0.11	0.02	71.6
Approach		1114	3.6	1114	3.6	0.616	1.2	NA	1.5	10.7	0.11	0.02	84.4
All Vehicles		1765	3.5	1765	3.5	0.616	1.8	NA	1.5	10.7	0.09	0.04	82.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A4.3 I-02E ENTERPRISE DRIVE/CHITTAWAY ROAD

MOVEMENT SUMMARY

Site: I-02E [I-02E Enabling and Construction PM] Network: N101 [2018 Construction PM]

Enterprise Drive/Old Chittaway Road East
2018 Enabling and Construction PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %	Total veh/h	HV %								
NorthEast: Enterprise Drive (NE)													
11	T1	614	3.3	614	3.3	0.315	0.1	LOS A	0.1	0.5	0.01	0.00	89.4
12	R2	1	0.0	1	0.0	0.315	22.9	LOS B	0.1	0.5	0.01	0.00	75.2
Approach		615	3.3	615	3.3	0.315	0.1	NA	0.1	0.5	0.01	0.00	89.3
NorthWest: Old Chittaway Road East (SE)													
1	L2	3	0.0	3	0.0	0.050	14.3	LOS A	0.1	0.9	0.89	0.95	38.0
3	R2	4	0.0	4	0.0	0.050	34.9	LOS C	0.1	0.9	0.89	0.95	11.9
Approach		7	0.0	7	0.0	0.050	26.1	LOS B	0.1	0.9	0.89	0.95	26.5
SouthWest: Enterprise Drive (SW)													
4	L2	1	0.0	1	0.0	0.585	3.6	LOS A	0.0	0.0	0.00	0.00	18.6
5	T1	1115	3.4	1115	3.4	0.585	0.0	LOS A	0.0	0.0	0.00	0.00	89.5
Approach		1116	3.4	1116	3.4	0.585	0.0	NA	0.0	0.0	0.00	0.00	89.4
All Vehicles		1738	3.3	1738	3.3	0.585	0.2	NA	0.1	0.9	0.01	0.00	88.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.0 %

Number of Iterations: 5 (maximum specified: 10)

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A4.4 I-03 ENTERPRISE DRIVE/HEREFORD STREET

MOVEMENT SUMMARY

▽ Site: I-03 [I-03 Enabling and Construction PM]

Enterprise Drive/Hereford Street
2018 Enabling and Construction PM
Giveaway/Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
NorthEast: Enterprise Drive (NE)												
5	T1	338	7.8	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	60.0	
6	R2	80	21.1	0.189	13.5	LOS A	0.7	5.6	0.72	0.88	44.2	
Approach		418	10.3	0.189	2.6	NA	0.7	5.6	0.14	0.17	56.1	
NorthWest: Hereford Street (NW)												
7	L2	221	5.7	0.474	14.9	LOS B	2.2	16.2	0.77	1.01	43.4	
9	R2	36	20.6	0.346	48.3	LOS D	1.1	9.5	0.93	1.01	32.6	
Approach		257	7.8	0.474	19.6	LOS B	2.2	16.2	0.79	1.01	40.9	
SouthWest: Enterprise Drive (SW)												
10	L2	13	58.3	0.010	6.2	LOS A	0.0	0.0	0.00	0.57	51.2	
11	T1	766	3.6	0.402	0.1	LOS A	0.0	0.0	0.00	0.00	59.9	
Approach		779	4.5	0.402	0.2	NA	0.0	0.0	0.00	0.01	59.7	
All Vehicles		1454	6.7	0.474	4.3	NA	2.2	16.2	0.18	0.23	54.2	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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APPENDIX E

FLOODING, DRAINAGE AND WATER
QUALITY TECHNICAL ASSESSMENT





MEMO

TO: Transport for NSW
FROM: Sarah Redfern
SUBJECT: **New Intercity Fleet Maintenance Facility RFI – Flooding, drainage and water quality technical assessment**
OUR REF: PS108239-ENV-MEM-001_RevC (Final)
DATE: **8 June 2018**

1. INTRODUCTION

WSP was engaged by Transport for NSW to undertake a flooding, drainage and water quality assessment of a proposed modification to the New Intercity Fleet Maintenance Facility (NIF MF) at Kangy Angy (the approved project). The proposed modification includes works associated with an alternate access road for construction of the approved project. This assessment supplements the REF prepared for the NIF MF (*New Intercity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP | Parsons Brinkerhoff, 2016).

The intent of the assessment is to provide a summary of the surface water environment and impacts that the proposed alternate access road would have and identify potential mitigation measures to reduce the impacts. This Flooding, Drainage and Water Quality Assessment will form a section of the Addendum REF.

1.1 PROPOSED MODIFICATION

The proposed modification includes upgrade of existing roads surrounding the approved project and an access road within the rail corridor to provide temporary access for construction vehicles associated with the approved project.

Access for heavy vehicles would be via Enterprise Drive, Hereford Street, Chittaway Road and a service road within the western portion of the rail corridor (rail service road).

Access for light vehicles would be via Turpentine Road and Ourimbah Road, with no upgrades to the existing roads required for access.

The proposed modification includes:

- Widening of a small section of Hereford Street and Chittaway Road around the existing rail underpass to provide sufficient turning room for longer vehicles, including a turning area on the western side
- Upgrade of the existing rail service road, including widening to create bi-directional road sections

- Upgrade of an existing track next to the rail corridor to provide connection to the rail service road with construction of a temporary drainage line crossing for access to the rail service road.

Further details regarding the proposed scope of works associated with the proposed modification is provided in Chapter 3 of the addendum REF.

1.2 BACKGROUND

The approved project is located adjacent to the Main North Line near Kangy Angy and is located on the Ourimbah Creek floodplain within the Tuggerah Lake Catchment. The *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP | Parsons Brinkerhoff, 2016) was prepared for the approved project and can be summarised as follows:

- The site lies within the wider catchments of Lake Macquarie and Tuggerah Lakes. These catchments are susceptible to pollution due to surrounding urban development which is an issue, as the lakes are popular with recreational water activities. Development within this catchment must ensure there is negligible impact to water quality.
- The flood extent for the 1 per cent Annual Exceedance Probability (AEP) storm event with a 10 per cent increase in rainfall for climate change used in the assessment is shown in Figure 1, Appendix A (AECOM 2016a). The flood envelope was extracted from a regional model for Ourimbah Creek. It shows that infrastructure, including existing roads and sidings from the Main North Line is likely impacted during the modelled storm event.
- Previously, it was identified that the immunity at Chittaway Creek rail over road crossing along Turpentine Road is less than 20 per cent AEP event.

1.3 PREVIOUS STUDIES AND REPORTS

In addition to the *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP | Parsons Brinkerhoff, 2016), a desktop review of previous studies was again undertaken to inform this assessment:

- New Intercity Fleet Maintenance Facility Draft Pre-Concept Report, AECOM 2016a
- Ourimbah Creek Catchment Flood Study, Catchment Simulation Solutions, October 2013
- Water and Catchment Management, State of Environment Report, Wyong Council, 2003–2004 (Chapter 5)
- Draft Constructability Report, AECOM 2016b
- Practical Consideration of Climate Change in Floodplain Risk Management, Department of Environment and Climate Change (DECC), 2007.

It is noted that Central Coast Council held a public meeting on 14 March 2017 to discuss Ourimbah Creek Flood Risk Plan at The University of Newcastle, Ourimbah Campus, New South Wales. However, additional information is yet to be released by the Central Coast Council. No additional studies were identified in a desktop review.

2. METHODOLOGY

The flooding, drainage and water quality assessment is a desktop assessment of existing studies and reports. A qualitative assessment of the proposed modification has been undertaken. The impact assessment has focused on:

- Construction phase
- Regional flooding impacts
- Local drainage and overland flow impacts
- Water quality.

The study area is shown in Figure 1.

3. EXISTING SURFACE WATER ENVIRONMENT

3.1 REGIONAL FLOODING

The proposed modification is bounded by Ourimbah Creek and its flood plains to the north and east, Bangalow Creek and Chittaway Creek in the west and the Main North Line in the south. The topography typically falls south to north from the Main North Line into the Ourimbah Creek catchment which is part of the Tuggerah Lake catchment. Ourimbah Creek flows from Kulnura, through the State forest and rural bushland before passing beneath the Sydney–Newcastle M1 Pacific Motorway and Pacific Highway near Palmdale. It continues to flow in a northern and then easterly direction before passing beneath the Main North Line and Wyong Road and eventually discharging into Tuggerah Lake at Chittaway Point (Ourimbah Creek Catchment Flood Study, 2013).

The Ourimbah Creek catchment also incorporates a number of substantial tributaries including Bangalow Creek, Cut Rock Creek, Chittaway Creek, Dog Trap Gully, Canada Drop Down Creek and Kangy Angy Creek. Typically, the upper reaches of these catchments are covered by natural bushland, while the lower reaches comprise of low density urbanised areas. For further information on regional flooding refer to *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP| Parsons Brinkerhoff, 2016).

For the purposes of this assessment, the proposed access route and turning circle lie within the Ourimbah Creek catchment. As per the existing flood mapping (refer to Figure 1, Appendix A), this infrastructure will likely be impacted during storm events. In particular, Hereford Street is likely to be affected by overbank flooding from Ourimbah Creek and it is understood that the residential areas of Kangy Angy are isolated during flood events. In its current condition, the Turpentine Road railway underpass at Chittaway Creek is predicted to be completely inundated during the 20 per cent AEP event, with predicted flow depths of around three metres (Catchment Simulation Solutions, 2013). Therefore, during flood events it is likely access via Hereford Street, Chittaway Road and Turpentine Road would be temporarily impacted.

There is an existing cess drain within the project boundary which lies parallel to the Main North Line. The catchment associated with the cess drain is not a major influence on the Ourimbah Creek floodplain due to relatively small size and minor levels of discharge. It is therefore not expected, that drainage from the cess drain would have any significant regional flooding impact.

3.2 LOCAL DRAINAGE

Existing local drainage features are likely to include cross drainage culverts. There are no formal kerbs and gutters on the existing local roads. Rainfall runoff from the road surface would fall to the outer edge of the road and flow to the nearest cross drainage structure and drain to Ourimbah Creek via Chittaway Creek and other minor channels. Detailed survey should be collected to confirm culvert locations and sizes, and local overland flow paths.

An existing cess drain is located parallel to the Main North Line and the rail access track. Whilst no information on this drainage was available, it's inferred that stormwater drains northwest under Orchard Road and discharges to Ourimbah Creek.

3.3 WATER QUALITY

The study area is located on the Ourimbah Creek catchment and is part of the larger Lake Macquarie and Tuggerah Lake catchment. Water quality studies for the Ourimbah Creek catchment were reviewed as part of the *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP | Parsons Brinkerhoff, 2016), and are summarised below:

- Wyong Council State of Environment Report (2003–2004) found that:
 - Ourimbah Creek and Wyong River total nitrogen and ammonia levels regularly exceed Australian and New Zealand Environment Conservation Council (ANZECC) guidelines
 - Ourimbah Creek was unsuitable for recreational swimming because of high faecal coliforms and enterococci levels that exceeded ANZECC guidelines for recreational swimming
 - Ourimbah Creek is under stress as a result of clearing of vegetation on land and creek banks, urban development, water extraction and stock access to creeks which have resulted in erosion, bank collapse and weed invasion
 - Tuggerah Lakes drains a large catchment (670 square kilometres) and is prone to the build-up of nutrients and sediment as result of vegetation clearing and agricultural practices. The Lakes also collect bacteria such as enterococci and faecal coliforms because of sewage and stormwater runoff. Tuggerah Lakes is estuarine and the balance of salt and fresh water is important for marine and bird life
 - High turbidity levels were noted in Tuggerah Lake and may be due to wind mixing fine silt from the lake bed (Wyong Shire Council, 2004).
- Tuggerah Lakes Catchment Monitoring Program:
 - Concluded after seven years of collecting baseline data the Lakes' health is defined as medium
 - Nitrogen levels are regularly above ANZECC guidelines for estuaries.

No water quality sampling or assessment has been undertaken as part of this assessment. According to the Wyong Council Tuggerah Lake Estuary report cards for 2012, 2013 and 2014 (Wyong Shire Council), the estuary health grading is fair (C) suggesting that the water quality has not changed notably in recent years of data. Fair (C) is determined where indicators meet some benchmarks for part of the year; equal to the middle 30% of scores in NSW (Wyong Shire Council, 2015). The three important indicators, as defined by NSW Office of Environment and Heritage (OEH), are: chlorophyll-a (nutrient and microalgae indicator), turbidity and seagrass depth; where growth rate depends on access to sunlight, water clarity and nutrient concentrations (Wyong Shire Council, 2015).

4. APPLICABLE POLICIES AND GUIDELINES

The following policies and guidelines are applicable to the management of the surface water in and around the proposed modifications:

- *Australian and New Zealand guidelines for fresh and marine water quality Guidelines*, Australian and New Zealand Environment Conservation Council (ANZECC) 2000
- *Australian Rainfall and Runoff a Guide to Flood Estimation: Chapter 6 Climate Change Considerations*, Engineers Australia 2016
- *'Blue Book' Soils and Construction – Managing Urban Stormwater*, Landcom, 2004
- *Climate Change 2014 Mitigation of Climate Change: Summary for Policymaker Technical Summary*, IPCC, 2015
- *Floodplain Development Manual*, NSW Government, 2005
- *Wyong Shire Council Development Control Plan*, Wyong Shire Council 2013
- *Volume 1 – Civil Works Design Guideline: Revision 1*, Wyong Shire Council, 6/8/2013
- *Volume 2 – Civil Works Construction Specification: Revision 1*, Wyong Shire Council, 6/8/2013.

5. CONSTRUCTION IMPACT ASSESSMENT

5.1 REGIONAL AND LOCAL FLOOD IMPACTS

It is not anticipated that the proposed modification will have regional or local flood impacts during construction. Existing road conditions are to be retained along Hereford Street and therefore there will be no change to regional flood behaviour at this location. Notably, the road immunity of Hereford Street is not known, however existing flood modelling (refer to Figure 1, Appendix A) indicates that Hereford Street is impacted by the 1:100 AEP climate change event, with predicted flow depths of up to four metres. Whilst, the turning circle on Chittaway Road is located outside the flood extent modelled, it is in-cut (refer to Appendix A Figure 2 for approximate impacted area), and any overbank flooding at this location may change. This is likely to result in a reduction in flood levels external to the proposed modification due to the increase in floodplain storage within the cut. Changes to local overland flow paths would be minor in and around the cutting and continue to drain to Ourimbah Creek. The existing cess drain capacity is to be maintained during use of the temporary crossing for access.

5.2 WATER QUALITY IMPACTS

Stormwater runoff from both the cess drainage line crossing and turning circle cutting has potential to increase sediment mobilisation and nutrient flow into Ourimbah Creek. Consequently, the proposed modification works have potential to adversely impact water quality within the Ourimbah Creek catchment and floodplain if activities are not appropriately managed.

The construction activities with the highest potential for water quality impacts are:

- General earthworks, including stripping of topsoil, excavation or placement of fill
- Construction of drainage infrastructure
- Works in low lying areas or wet weather
- Leaks or spills from chemicals or fuels used.

The impacts from these activities could include:

- Sedimentation within the waterways
- Increased levels of nutrient, metals and other pollutants transported downstream
- Chemical, oil and grease and petroleum hydrocarbons in waterways from spills.

5.3 CLIMATE CHANGE

Due to the short-term nature of the proposed modification works it is anticipated these works will not be impacted by climate change (Australian Rainfall & Runoff (AR&R), 2016).

6. PERMANENT WORKS AND CLIMATE CHANGE IMPACTS

6.1 REGIONAL FLOODING AND LOCAL DRAINAGE IMPACTS

The proposed modification involves only minor changes to existing conditions and therefore it is anticipated that the proposed alternate access will have little to no impact on regional or local flooding during operation. Existing road conditions are to be retained along Hereford Street and therefore there will be no change to regional flood behaviour at this location.

The proposed turning circle on Chittaway Road is in-cut, and may have minor impacts to flood behaviour at the cutting and across the adjacent floodplain. These impacts may include a redistribution of over bank flooding due to the increase in flood storage area at the cutting, resulting in increased flood depths in the cutting and reduced flood extent on areas away from the cutting. The significance of this change cannot be determined due to lack of flood data for the site. Local drainage would be affected by the cutting, however the impact is not anticipated to be significant due to the localised nature of the works.

The existing cess drain capacity is to be maintained during use of the temporary access track and therefore there will be no impact to regional or local flooding.

6.2 WATER QUALITY

Water quality impacts during operation are similar to those listed in 5.2 for construction impacts.

6.3 OPERATION AND CLIMATE CHANGE

With respect to predicted climate change, the predicted change in rainfall intensity may increase the peak flows in the local drainage. However due to the short-term nature of the proposed modification works it is predicted there will be no adverse effects due to climate change (AR&R, 2016). Once the proposed modification works are constructed, there will be minimal impacts to local drainage since existing culverts will be retained.

7. MANAGEMENT AND MITIGATION MEASURES DURING CONSTRUCTION

7.1 GENERAL

All drainage would be designed to meet:

- Transport for NSW standards
- Engineers Australia's Australian Rainfall and Runoff (2016)
- 'Blue Book' Soils and Construction – Managing Urban Stormwater, Landcom (2004).

7.2 CONSTRUCTION

The following management and mitigation measures would be implemented to minimise impacts on flooding, drainage and water quality during construction:

- The Construction Environmental Management Plan (CEMP) for the approved project should be updated to include the alternate access road.
- Relevant management and mitigation measures for construction approved project, as detailed in the *InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment memo* (WSP | Parsons Brinkerhoff, 2016), would be implemented for the proposed modification.
- Any temporary flood diversion works should be adequately sized for a 2 year Average Recurrence Interval storm event, as recommended in the Blue Book (Landcom, 2004).
- The CEMP, and associated flood evacuation plan, should be updated to include the alternate access route prior to any work commencing on-site. It is known that part of the area is isolated during flood events as low as the 20% AEP. Contractors would be responsible for implementing their own flood emergency management plan.
- To reduce the potential impacts to surface water systems, no stockpiles should be located within high/medium flood risk areas or adjacent to culverts.
- The Chittaway Road turning circle should be stabilised to minimise erosion and scour which contribute to higher sediment and nutrient runoff.
- The banks and riparian vegetation of Ourimbah Creek (adjacent to the turning circle) should be protected during construction.

7.3 OPERATION

If any areas remain unsealed during the use of the alternate access road it is expected all controls and mitigation measures (such as erosion and sediment controls) would be maintained.

8. SUMMARY AND CONCLUSIONS

The assessment identified that management of impacts to water quality should be the focus of mitigation works for the proposed modification due to the current pressures on water quality in Ourimbah Creek and the wider Tuggerah Lakes catchment.

Regional and local flooding and drainage are not likely to be impacted significantly by the proposed works due to the minor changes proposed from existing conditions.

In summary, the environmental risk during construction and operation is not considered to be significant, provided appropriate environmental controls are implemented. Mitigation and management measures have been recommended and should be implemented during construction and operation to minimise impacts to flooding, and water quality within the Ourimbah Creek catchment.



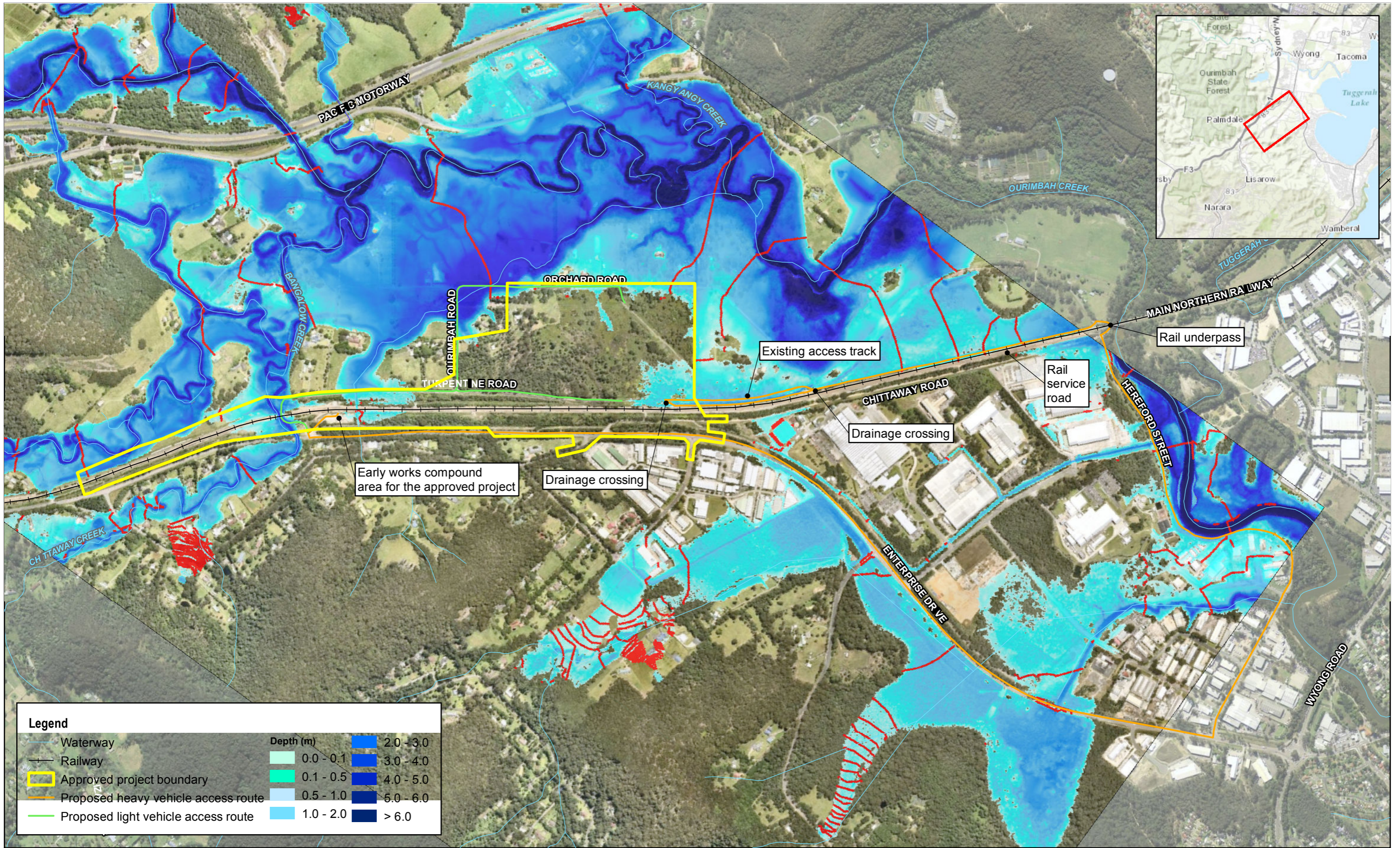
Yours sincerely,
Sarah Redfern
Water Resources Engineer

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APPENDIX A FIGURES



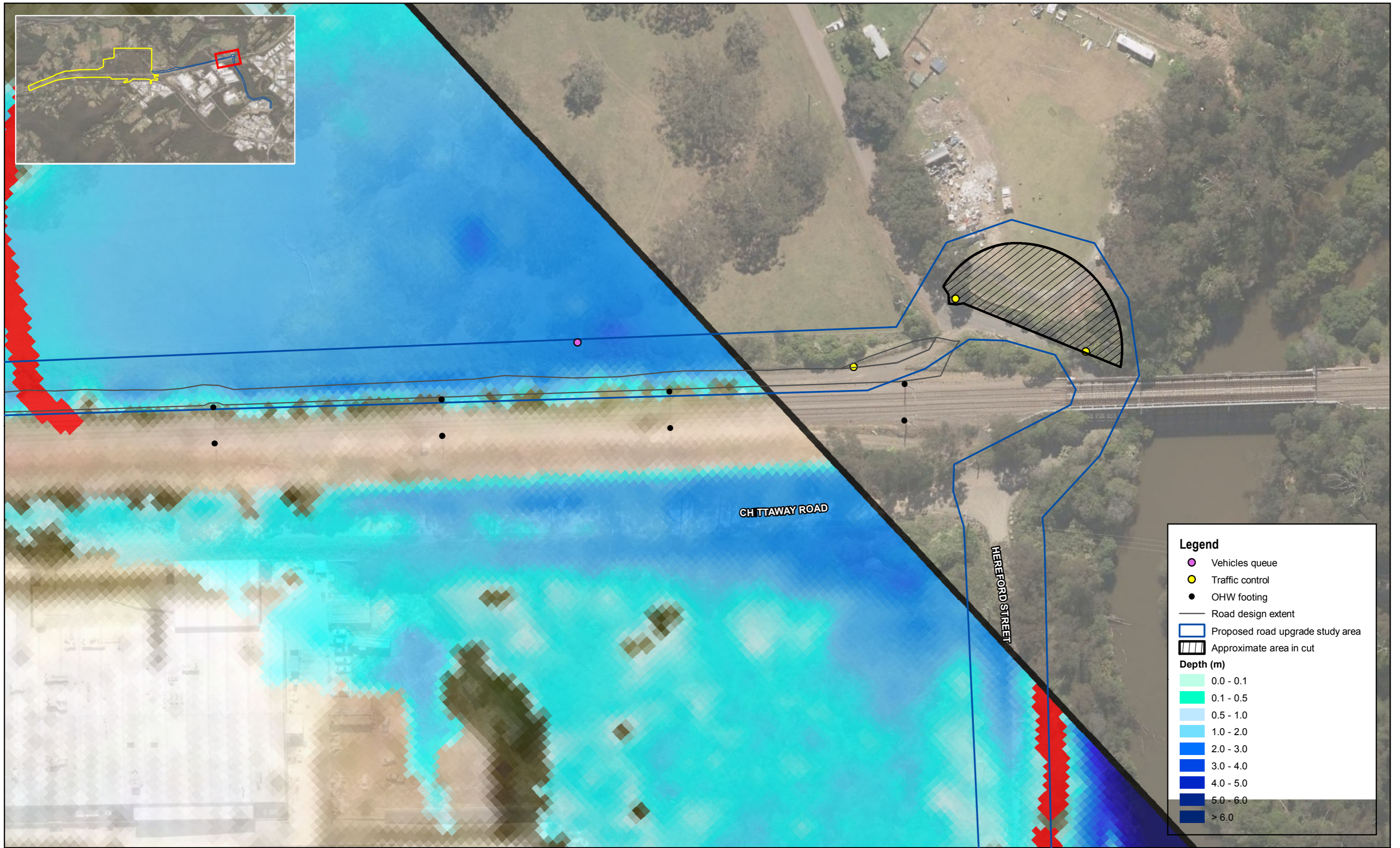
Legend	
	Waterway
	Railway
	Approved project boundary
	Proposed heavy vehicle access route
	Proposed light vehicle access route
Depth (m)	
	0.0 - 0.1
	0.1 - 0.5
	0.5 - 1.0
	1.0 - 2.0
	2.0 - 3.0
	3.0 - 4.0
	4.0 - 5.0
	5.0 - 6.0
	> 6.0

Map: 2202522A_GIS_F143_A1	Author: MitchellEm		
Date: 28/05/2018	Approved by: -		
<small>Data source: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community © Department of Finance, Services & Innovation 2017</small>		<small>Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3</small>	


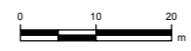


New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 1
1:100 year flood level with 10% rainfall increase



Map: 2202522A_GIS_F144_A1
 Author: MitchellEm
 Date: 28/05/2018
 Approved by: -



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

Data source: © Department of Finance, Services & Innovation 2017

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New Intercity Fleet Maintenance Facility Project - Addendum REF

Figure 2
Proposed road upgrades

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