Jervis Bay Road Intersection Upgrade

Review of Environmental Factors

Transport for NSW | June 2021

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Prepared by Arcadis Australia Pacific Pty Ltd (Arcadis) and Transport for NSW

TfNSW: 21.106

ISBN: 978-1-922549-02-0

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Document controls

Approval and authorisation

Title	Jervis Bay Road Intersection Upgrade Review of Environmental Factors
Accepted on behalf of Transport for NSW by:	Nicole Moore Project Development Manager Project Development South Regional Infrastructure Development Infrastructure & Place Transport for NSW
Signed:	
Dated:	June 2021

Document status

Document status	Date	Prepared by	Reviewed by
Final for public display	June 2021	Rachel Perry	Javier Valderrama

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Executive summary

The proposal

Transport for NSW proposes to upgrade the Jervis Bay Road and Princes Highway intersection at Falls Creek (the proposal). Key features of the proposal include:

- A new intersection between Jervis Bay Road and the Princes Highway, incorporating:
    - Realignment of the existing Princes Highway, including widening from two lanes to a four-lane divided highway (two lanes in each direction), with median separation using flexible safety barriers, providing an uninterrupted through alignment for the Princes Highway
    - An overpass bridge over Jervis Bay Road
    - An unsignalised single-lane at-grade double roundabout interchange providing:
        - Direct access from Jervis Bay Road and Old Princes Highway to the Princes Highway
        - Direct access from the Princes Highway to Jervis Bay Road and Old Princes Highway
    - Direct connection to existing properties and businesses at the Old Princes Highway
    - A connection from Willowgreen Road to Old Princes Highway
    - Tie-ins with the Old Princes Highway and with Jervis Bay Road
- Access road to service Princes Highway properties south east of the intersection
- Shared user paths along Jervis Bay Road, connecting to the new bus bay and Jervis Bay Road and Old Princes Highway road shoulders
- Adjustments of drainage infrastructure and provision of new drainage infrastructure such as pit and pipe networks, culverts, open channels and retention basins
- Permanent water quality measures such as vegetated swales, bioretention swales and bioretention basins
- Adjustment, protection and relocation of existing utilities
- Other roadside furniture including safety barriers, signage, line marking, lighting and fencing
- A bus bay adjacent to the interchange, including kiss and ride car spots
- Establishment and use of temporary ancillary facilities during construction
- Property works including acquisition, demolition and adjustments to accesses, and at property noise treatments (where applicable)
- Rehabilitation of disturbed areas and landscaping.

Construction is expected to commence in 2022 and would take around two years to complete.

Need for the proposal

Transport for NSW is planning an upgrade of the Princes Highway between Jervis Bay Road the Victorian border. The Princes Highway upgrade program would deliver a safer, more accessible, and resilient corridor and support the liveability and sustainable economic growth of the region. An upgrade of the Jervis Bay Road and Princes Highway intersection has been identified as a priority project under the Princes Highway upgrade program.

The Jervis Bay Road intersection is a key gateway along the Princes Highway corridor providing the main east-west link to the coastal villages of Huskisson, Vincentia, Hyams Beach and Jervis Bay.

The intersection has the highest volume of vehicle movements on the Princes Highway between Nowra in the north and the Victorian border in the south. Vehicle movements are about 23,070 vehicles per day on the Princes Highway and about 9,830 vehicles per day on Jervis Bay Road. This traffic volume results in significant delays and queuing on Jervis Bay Road, particularly during weekday and holiday peaks.

The existing intersection performs poorly in terms of road safety with 26 crashes recorded in the 10 years to March 2019 and a score of two out of five stars against the Australian Road Assessment Program road safety risk analysis.

Proposal objectives

The objectives of the proposal are to:

- Improve safety at the intersection
- Improve transport network efficiency and connectivity to support regional economic development, tourism and freight
- Improve transport network resilience
- Support an increase in active transport (walking and cycling) and use of public transport
- Respect our community and the environment
- Increase customer value.

Options considered

Alternatives and options were considered through a comprehensive and multi-staged identification and assessment process, including consideration of environmental impacts.

Strategic options considered for the proposal included traffic signals, roundabouts, grade separation and a “do nothing” scenario. The roundabout and grade separation strategic options were found to be the best alternatives for the intersection because of their safety, constructability, traffic efficiency and access benefits.

Based on the strategic alternatives, a total of 26 options were developed and evaluated from which four options were shortlisted and subject to multi-criteria analysis and a value management process:

- Option 1004 – Roundabout with right turn flyover
- Option 1005 – Roundabout with right turn underpass
- Option 2005 – Mainline grade separated over at-grade roundabout
- Option 2009 – Mainline grade separated over at-grade double roundabout.

At a value management workshop in September 2020, the at-grade double roundabout interchange (Option 2009) was selected as the preferred option, as it best satisfies the proposal objectives.

The preferred option was placed on public display in November and December 2020 to give the community and stakeholders an opportunity to review the preferred option and provide feedback. Transport for NSW has used this feedback to refine the proposal design and carry out the environmental assessment.

Statutory and planning framework

The proposal is for a road and is to be carried out by, or on behalf of, Transport for NSW, and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from council is not required. A referral under the *Environment Protection and Biodiversity Conservation Act 1999* is not required.

Community and stakeholder consultation

Consultation has been carried out with the local community and key stakeholders, including affected landowners, the Aboriginal community, Vincentia Matters community group, Shoalhaven City Council and emergency services.

Strong community support for the proposal was indicated in feedback from display of the preferred option. Of the 227 submissions received, more than 90 per cent agree the preferred option would improve safety, reliability and resilience of the transport network. More than 88 per cent agree the preferred option would improve freight access.

Key concerns raised through community and stakeholder consultation include the cost and environmental impact of the proposal, and traffic congestion and amenity impacts during construction. Incorporation of public and active transport into the proposal, as well as bushfire and incident resilience were also raised by the community and stakeholders.

This community and stakeholder consultation has informed further development of the proposal and the environmental assessment.

Resilience

The proposal would improve the resilience of the intersection and therefore increase the adaptive capacity and resilience of the local community. It would improve network reliability and safe access during emergencies including bushfire and flood. The proposal would cater to unexpected changes in traffic demand, evolving technologies and changes in climate.

The proposal would provide additional traffic capacity, including three-metre wide shoulders on the highway that could be used for emergency access and provide a buffer to adjacent vegetation in a bushfire scenario. The proposal would also enable movement in all directions between the highway and local roads, including turn-around capability during an incident or emergency. The proposal would provide flood immunity for the Princes Highway up to a climate change event of a one in five hundred year flood (0.2 per cent annual exceedance probability event).

Environmental impacts

Traffic and transport

During construction, there may be temporary increases in travel times due to speed limit restrictions, additional construction vehicle movements and temporary traffic diversions. Whilst there would be altered property arrangements and alternative public and active transport facilities, access would be maintained throughout construction.

When completed, the proposal would improve traffic efficiency and safety for road, public and active transport users. The reliability and efficiency of the Princes Highway and Jervis Bay Road as emergency evacuation routes for both emergency services and the general public would be enhanced.

Noise and vibration

The majority of construction work would be carried out during standard construction hours. During construction, exceedances of the noise management levels are predicted, particularly at residences located in close proximity to the construction footprint. Under the worst-case

scenario during standard construction hours, construction is predicted to exceed the highly noise affected level of 75 decibels (dBA) at up to 18 residential receivers and four non-residential receivers. Measures in the Transport for NSW Construction Noise and Vibration Guideline would be implemented to mitigate construction noise impacts.

When completed, the proposal would not substantially change traffic noise levels in most locations. Almost all (99 per cent) sensitive receivers are predicted to experience changes in operational road traffic noise levels of less than 2 dBA. Noise modelling indicates that eight receivers would be eligible for consideration of measures to manage noise impacts in accordance with the Transport for NSW Noise Mitigation Guidelines. Three of these receivers would experience an increase in operational noise of more than 2 dBA (up to 3 dBA). Six of the receivers would reach the cumulative limit by 2035 and three would be acutely affected by 2035. Mitigation is expected to comprise at-property treatment.

Property and land use

About 18 hectares of land outside the existing road corridor would be directly impacted by the proposal. This includes full acquisition of seven properties, partial acquisition of 18 properties and temporary lease of seven properties.

All acquisitions would be undertaken in consultation with landowners and in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the Transport for NSW Land Acquisition Information Guide.

Socio-economic

During construction, the proposal would positively contribute to the sustainability of the local economy through direct employment by on-site construction activities, increased expenditure at local and regional businesses and provision of construction goods and services.

When completed, potential adverse amenity impacts may result from changes in noise levels and visual impacts from cleared vegetation. The proposal is expected to provide a range of socio-economic benefits for both the local and broader community including improvements in road safety, traffic flow, freight transport and public and active transport reliability and accessibility.

Biodiversity

The proposal would result in clearing of up to 15.71 hectares of native vegetation, including:

- Up to 11.98 hectares of the ecological community Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- Up to 3.73 hectares of the ecological community Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion, listed as endangered under the *Biodiversity Conservation Act 2016*. Of this vegetation, 2.64 hectares comprises the Illawarra and south coast lowland forest and woodland critically endangered ecologically community listed under the *Environment Protection and Biodiversity Conservation Act 1999*
- Up to 10.51 hectares of suitable habitat for the threatened flora species *Hibbertia puberula subsp. puberula*, listed as endangered under the *Biodiversity Conservation Act 2016,* as well as the direct removal of 55 individuals of this flora species
- Up to 15.71 hectares of potential habitat for threatened fauna species, including bird species, grey headed flying fox and microbats.

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats within the meaning of the *Biodiversity Conservation Act 2016* or the *Environment Protection and Biodiversity Conservation Act 1999*. Biodiversity offsets required for the proposed impacts would be delivered in accordance with the Transport for NSW Biodiversity Offset Guidelines.

Flooding and surface water

Parts of the construction footprint are within the existing one per cent annual exceedance probability flood event. During construction impacts to hydrology may result from earthworks and positioning of ancillary facilities changing local topography and existing drainage patterns. Impacts to drainage patterns would be localised and temporary. If a major flood were to occur during construction, water quality impacts could occur due to erosion of disturbed areas and displacement of plant and equipment. Ancillary facility layout, stockpile locations and drainage works would be planned to minimise any potential flood impacts.

The proposal would provide flood immunity for the Princes Highway and Jervis Bay Road during a one per cent annual exceedance probability flood event. The culvert at the southern end of the proposal would be upgraded and more aligned with natural flow-paths. This would reduce an area of ponding near the existing intersection and help protect dwellings on the eastern side of the highway in large flood events.

Operational water quality controls, such as vegetated swales, bioretention swales and bioretention basins, would be implemented as part of the proposal. Modelling indicates these controls would surpass the proposal pollution retention objectives and provide an overall net benefit to water quality.

Aboriginal heritage

The proposal would impact one known Aboriginal heritage object of low significance. An Aboriginal heritage impact permit would be sought for the proposal construction footprint in accordance with Section 90 of the *National Parks and Wildlife Act 1974*.

Landscape character and visual impacts

The proposal would impact the surrounding bushland and rural residential landscape character and views due to vegetation clearing, earthworks and the introduction of new infrastructure.

The urban design and landscaping strategy for the proposal incorporates the use of materials that respond to the existing rural context and revegetation of disturbed areas with local native plant communities. Embankments would be integrated into the natural landform and setting, where practicable, with gentle slopes and consistent planting with the adjoining landscape.

How will the likely impacts be managed?

This review of environmental factors identifies comprehensive safeguards and management measures that would be implemented to avoid, manage, mitigate, offset and/or monitor impacts during construction and operation of the proposal. These include best practice environmental planning and management techniques, including (but not limited to) the implementation of a construction environmental management plan and a community and stakeholder engagement plan.

Justification and conclusion

The implementation of the proposal would improve safety for road, public and active transport users and reduce queuing and delay at the intersection. Though environmental impacts would occur, they would be effectively mitigated with the application of safeguards and management measures outlined within this review of environmental factors.

The benefits of the proposal are considered to outweigh the expected impacts on the environment. The environmental impacts for the proposal are not likely to be significant and therefore the preparation of an environmental impact statement and approval from the Minister for Planning under Division 5.2 of the *Environmental Planning and Assessment Act 1979* are not required. A referral under the *Environment Protection and Biodiversity Conservation Act 1999* is not required.

Display of the review of environmental factors

This review of environmental factors is on display for comment between 18 June and 18 July 2021. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Transport for NSW website at nswroads.work/jervisbayroad.

Printed copies

The documents can be viewed at the following locations:

- Nowra Library, Nowra
- Sanctuary Point Library, Sanctuary Point
- Services NSW, South Nowra
- Council Office, Nowra
- Visitors Information Centre, Maritime Museum, Huskisson.

Copies by request

Printed and electronic copies are available by contacting the project team via phone 1800 570 562 or email jervisbayroad@transport.nsw.gov.au, noting that there may be a charge for hard copies, CD or USB.

Staffed displays

Staffed displays will be held at the following locations:

- Tuesday 6 July, 2pm to 6pm at the Huskisson Community Centre, Huskisson
- Thursday 8 July, 9am to 12pm, Vincentia Public Hall, Wood Road, Vincentia
- Saturday 10 July, 8am to 12pm, Falls Creek Public School.

Bookings are essential. Visit nswroads.work/jervisbayroad for session and booking details.

Transport for NSW will also be available at the Huskisson Markets, Huskisson sports ground, on Sunday 11 July, 8am to 1pm.

How can I make a submission

To make a submission about this proposal, please send your written comments to:

- PO Box 477, Wollongong NSW 2500
- jervisbayroad@transport.nsw.gov.au
- Visit nswroads.work/jervisbayroad to fill out an online survey.

Submissions must be received by 18 July 2021. Submissions will be managed in accordance with the Transport for NSW Privacy Statement which can be found here https://www.transport.nsw.gov.au/privacy-statement or by contacting 1800 570 562 for a copy.

What happens next

Transport for NSW will collate and consider the submissions received during public display of the review of environmental factors. A submission report will be released, responding to feedback raised during this period.

After this, Transport for NSW will determine whether or not the proposal should proceed as proposed and will inform the community and stakeholders of this decision.

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

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Contents

Figures

Tables

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1 Introduction

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

1.1 Proposal identification

Transport for NSW proposes to upgrade the intersection of Jervis Bay Road and the Princes Highway in the vicinity of Falls Creek, NSW, located about 12 kilometres south of Nowra (the proposal) within the Shoalhaven local government area.

Jervis Bay Road provides the main east-west link to the coastal villages of Huskisson, Vincentia, Hyams Beach and Jervis Bay. The intersection of Jervis Bay Road and the Princes Highway therefore provides the main access to these areas and forms a key part of the transport network within changing residential, tourism, defence and industrial areas within the Shoalhaven.

The existing Jervis Bay Road and the Princes Highway seagull intersection performs poorly in terms of traffic efficiency and safety. The intersection has the highest volume of vehicle movements on the Princes Highway between Nowra in the north and the Victorian border in the south. Vehicle movements are about 23,070 vehicles per day on the Princes Highway and about 9,830 vehicles per day on Jervis Bay Road. This traffic volume results in significant delays and queuing on Jervis Bay Road, particularly during weekday and holiday peaks. There have been 26 crashes at the intersection in the 10 year period ending 31 March 2019 resulting in seven serious injuries. The intersection scored of two out of five stars against the Australian Road Assessment Program (AusRAP) road safety risk analysis.

There are no formalised pedestrian or bicycle paths at the intersection, and three existing bus stops at the intersection service regional bus routes. The bus stops have no formal access and no lighting, shelter or signposts. In addition, a school bus stop is located on Willowgreen Road and has a shelter and informal pull over area for buses.

There is flood prone land around the intersection, and an undersized culvert could lead to overtopping of both Jervis Bay Road and the Princes Highway in a one per cent annual exceedance probability (AEP) (ie a one in one hundred year) flood event.

The purpose of the proposal is to improve safety, reduce queuing and delay at the intersection, and facilitate multi-modal trips now and into the future.

The proposal is part of a program to upgrade the Princes Highway, a vital transport corridor that provides community connection between towns, regional centres and attractions, linking Sydney and the Illawarra region with the NSW South Coast and beyond into Victoria. The Princes Highway is an important freight link, connects with key east-west transport corridors like the Kings Highway and Snowy Mountains Highway, and is a significant route for inter-regional business, tourism and leisure travel.

Key features of the proposal would include:

- A new intersection between Jervis Bay Road and the Princes Highway, incorporating:
    - Realignment of the existing Princes Highway, including widening from two lanes to a four-lane divided highway (two lanes in each direction), with median separation using flexible safety barriers, providing an uninterrupted through alignment for the Princes Highway
    - An overpass bridge over Jervis Bay Road
    - An unsignalised single-lane at-grade double roundabout interchange providing:

        - Direct access from Jervis Bay Road and Old Princes Highway to the Princes Highway
        - Direct access from the Princes Highway to Jervis Bay Road and Old Princes Highway.
    - Direct connection to existing properties and businesses at the Old Princes Highway
    - A connection from Willowgreen Road to Old Princes Highway
    - Tie-ins with the Old Princes Highway and with Jervis Bay Road
- Access road to service Princes Highway properties south east of the intersection
- Shared user paths along Jervis Bay Road, connecting to the new bus bay and Jervis Bay Road and the Old Princes Highway road shoulders
- Adjustments to drainage infrastructure and provision of new drainage infrastructure such as pit and pipe networks, culverts, open channels and retention basins
- Permanent water quality measures such as vegetated swales, bioretention swales and bioretention basins
- Adjustment, protection and relocation of existing utilities
- Other roadside furniture including safety barriers, signage, line marking, lighting and fencing
- A bus bay adjacent to the interchange, including kiss and ride car spots
- Establishment and use of temporary ancillary facilities during construction
- Property works including acquisition, demolition and adjustments to accesses, and at-property noise treatments
- Rehabilitation of disturbed areas and landscaping.

The location of the proposal is shown in Figure 1-1 and an overview of the proposal is provided in Figure 1-2. Section 3 describes the proposal in more detail, including the proposed construction methodology and ancillary facilities.

1.2 Purpose of the report

This review of environmental factors has been prepared by Arcadis Australia Pacific Pty Ltd (Arcadis) on behalf of Transport for NSW. For the purposes of this proposal, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979.*

The purpose of the review of environmental factors is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be carried out.

The description of the proposal and assessment of associated environmental impacts has been carried out in the context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (DUAP, 1995/1996), *Roads and Related Facilities EIS Guideline* (DUAP 1996), the *Biodiversity Conservation Act 2016*, the *Fisheries Management Act 1994*, and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999*.

In doing so, the review of environmental factors helps to fulfil the requirements of Section 5.5 of the *Environmental Planning and Assessment Act 1979* including that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the review of environmental factors will be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the *Environmental Planning and Assessment Act 1979*
- The significance of any impact on threatened species as defined by the *Biodiversity Conservation Act 2016* and/or *Fisheries Management Act 1994*, in Section 1.7 of the *Environmental Planning and Assessment Act 1979* and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The significance of any impact on nationally listed biodiversity matters under the *Environment Protection and Biodiversity Conservation Act 1999*, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- The potential for the proposal to significantly impact any other matters of national environmental significance or the environment of Commonwealth land and the need, subject to the *Environment Protection and Biodiversity Conservation Act 1999* strategic assessment approval, to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the *Environment Protection and Biodiversity Conservation Act 1999*.

Figure 1-1 Location of the proposal

Figure 1-2 Overview of the proposal operational features

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2 Need and options considered

This section describes the need for the proposal in terms of its strategic setting and operational need. It presents the objectives of the proposal and assesses alternatives to the proposal and intersection options in accordance with these objectives.

2.1 Strategic need for the proposal

Transport for NSW is planning an upgrade of the Princes Highway between Jervis Bay Road the Victorian border. The Princes Highway upgrade program would deliver a safer, more accessible, and resilient corridor and support the liveability and sustainable economic growth of the region.

An upgrade of the Jervis Bay Road and Princes Highway intersection has been identified as a priority project under the Princes Highway upgrade program.

Jervis Bay Road provides the main east-west link to the coastal villages of Huskisson, Vincentia, Hyams Beach and Jervis Bay. The intersection of Jervis Bay Road and the Princes Highway therefore provides the main access to these areas and forms a key part of the transport network within changing residential, tourism, defence and industrial areas within the Shoalhaven.

The purpose of the proposal is to improve safety, reduce queuing and delay at the intersection, and facilitate multi-modal trips now and into the future.

2.1.1 Future Transport Strategy 2056

The *Future Transport Strategy 2056* (NSW Government, 2018a) outlines a 40 year vision to create and maintain a world class, safe, efficient and reliable transport system across NSW. There are a series of infrastructure and services plans that underpin the delivery of the strategic directions and customer outcomes.

The proposal contributes to achieving several of the key objectives including:

- Supporting the hub and spoke transport network that connects regional cities (Wollongong) to outlying towns and centres (including Nowra, Vincentia, Ulladulla and Batemans Bay)
- Adopting a Safe System approach to the delivery of road safety improvements to contribute to achieving the ‘Towards Zero’ target.

2.1.2 Connecting to the future – Our 10 Year Blueprint

Connecting to the future – Our 10 Year Blueprint (Transport for NSW, 2018) lays out Transport for NSW’s desired outcomes, ambitions and strategic priorities over a 10 year period. It sets out where Transport for NSW need to focus their efforts in the near term to move towards the long term vision outlined in *Future Transport 2056*. It is structured around four primary outcomes that focus on connecting customers and communities and contributing to a strong economy and quality of life.

The proposal contributes to achieving several of the key outcomes including:

- Safe, seamless journeys for people and goods
- Transport Investments and solutions that service the people of NSW
- Quality assets and efficient networks managed at the right price.

2.1.3 Regional NSW Services and Infrastructure Plan

For Regional NSW, the *Future Transport Strategy 2056* is supplemented by the *Regional NSW Services and Infrastructure Plan* (NSW Government, 2018b) which identifies initiatives required in the short, medium and long term to meet customer needs now and into the future.

The proposal contributes to the commitment to investigate duplication of the Princes Highway between Jervis Bay Road and Moruya.

2.1.4 Tourism and Transport Plan

The NSW *Tourism and Transport Plan* (NSW Government, 2018c) is a key supporting plan to the *Future Transport Strategy 2056*. The plan provides a framework of customer outcomes and initiatives that are designed to harness emerging technology and service models as well as visitor trends.

The proposal supports the following customer outcomes and initiatives:

- Enhancing the visitor experience
    - Improved travel experiences to and from destinations
- Greater access to more of NSW
    - Connecting visitors to the regions
    - Improved services
- A seamless experience
    - Servicing events, festivals and peak holiday times
    - Integrating tourism into transport planning.

2.1.5 NSW Road Safety Strategy 2021

The *NSW Road Safety Strategy 2021* (NSW Government, 2018d) outlines how Transport for NSW will work towards the State Priority Target of reducing fatalities by 30 per cent by 2021[1]. The Plan also aligns the Towards Zero vision within the Future *Transport Strategy 2056*, which aims to have a NSW transport network with zero trauma by 2056.

The proposal contributes to the commitment to reduce fatal and serious injury crashes on rural roads by targeting an identified crash cluster and applying a Safe System approach to intersection design.

2.1.6 NSW Freight and Ports Plan 2018 – 2023

The *NSW Freight and Ports Plan 2018 – 2023* (NSW Government, 2018e) details how the NSW Government will provide an efficient freight network for the public and private sectors to sustain the local economies across NSW. It supports the *Future Transport Strategy 2056* and provides direction to business and industry for managing and investing in freight. It is a call to action for industry and government to collaborate on clear initiatives and targets to make the NSW freight task more efficient and safe so NSW can continue to move and grow. The plan includes an implementation plan of over 70 initiatives, with emphasis on regional corridors.

[1] compared to average annual fatalities over 2008–2010

The proposal supports the plan by:

- Enhancing productivity
- Increasing use of safer and more productive vehicles
- Enabling regional growth
- Reducing fatalities and serious injuries from crashes involving heavy vehicles or light trucks.

2.1.7 NSW South Coast Marine Tourism Strategy 2019

The *NSW South Coast Marine Tourism Strategy 2019* (NSW Government, 2018f) provides guidance for local, regional, State and Commonwealth governments to fulfill the potential of the region's marine environment over a 20 year period. It provides a framework to improve connectivity between marine tourism assets, visitor experiences and infrastructure to facilitate sustainable tourism growth.

The proposal aligns with Strategic Direction 4: Tourism Activation of the Marine Environment by improving accessibility to the South Coast from Sydney.

2.1.8 Draft Illawarra Shoalhaven Regional Plan 2041

The draft *Illawarra Shoalhaven Regional Plan 2041* (DPIE, 2020a) provides the strategic policy, planning and decision-making framework to guide the region to sustainable growth over a 20 year period. It integrates economic, social and environmental considerations in the interests of achieving ecologically sustainable development for the region.

The proposal is consistent with the plan by supporting the integration of transport and land use planning to maximise the benefits of investments in the region, thereby supporting the NSW Government's approach to creating a connected, sustainable, innovative and vibrant region. The Princes Highway plays an important role in achieving this goal by connecting regional towns to larger centres like Nowra, Ulladulla and Sydney.

Jervis Bay is a key area for tourism in close proximity to the proposal area, highlighting the importance of ensuring that the road network servicing this sector can cater for increased vehicular movement. Upgrading the Jervis Bay Road and Princes Highway intersection to improve safety, reducing queuing and delays, and facilitating multi-modal trips is an important step in achieving the goals of the regional plan.

2.1.9 Princes Highway corridor strategy

The *Princes Highway Corridor Strategy* (Department of Infrastructure, Transport, Cities and Regional Development, 2019) provides a whole of corridor perspective of the current and future role of the Princes Highway as a transport route.

The vision for the strategy is to enhance the Princes Highway Corridor as a corridor of national significance and economic importance, achieving improved safety and efficiency, and maximising access and connectivity for local communities and broader user groups.

The proposal would facilitate the achievement of the strategy vision by improving the existing Princes Highway and Jervis Bay Road intersection safety and efficiency, and maximising access and connectivity for the local community and beyond.

2.1.10 Princes Highway upgrade roadmap

Transport for NSW has developed a strategic roadmap for the Princes Highway upgrade. It is Transport's plan for the highway over the next 20 years and identifies what needs to be

done in the short, medium and long term to deliver a vision for the Princes Highway as a safe, reliable, efficient and connected network.

It would be a highway that enables the movement of people and goods and supports sustainable growth of the local economy, employment opportunities and population.

It would contribute to the character of the places it serves and be resilient to adapt to natural hazards and climate change, respond to changing land use, and support new technologies, industries and economic trends.

The roadmap is built on five goals:

- **Safety**: A safer corridor for all customers and communities including local traffic, freight, tourists, and public and active transport users.
- **Resilience**: A corridor that can be efficiently managed and maintained while adapting to changing social, environmental and economic factors including the ability to quickly recover from natural disasters and respond to changing land use and technologies.
- **Liveability**: A corridor that supports communities by connecting and contributing to providing attractive and healthy places to live, work and play.
- **Sustainability**: A corridor that is socially, environmentally and economically sustainable and unlocks a wide range benefits for communities and other customers.
- **Connectivity and Accessibility**: A corridor that has good physical and digital connectivity and accessibility, for access to opportunity and services.

The proposal is part of the Princes Highway upgrade road map short term needs.

2.2 Limitations of existing infrastructure

The existing Princes Highway and Jervis Bay Road intersection experiences some of the highest vehicle movements on the NSW south coast, with about 23,070 vehicles using the Princes Highway at this location and about 9,830 vehicles using Jervis Bay Road on an average day.

The intersection performs poorly during weekday and holiday peaks, with delays and queuing experienced on Jervis Bay Road.

The intersection and approaches also perform poorly when considered against the AusRAP road safety analysis, scoring two out of a possible five stars. There have been 26 crashes at the intersection in the 10 year period ending 31 March 2019, resulting in seven serious and 12 minor or moderate injuries. These crashes were mainly related to vehicles exiting Jervis Bay Road being struck by vehicles travelling on the Princes Highway.

There are no formalised pedestrian or bicycle paths at the intersection.

There are three existing bus stops located at the intersection serviced by regional bus services, however they have no formal access and none are signposted or have lighting or shelters. One school bus stop with a bus shelter is located on Willowgreen Road near the Princes Highway.

The area to the west of the intersection is identified as flood prone. There are six locations along the intersection with culvert drainage structures. The existing culvert located about 450 metres south of the intersection is undersized and could lead to overtopping of both the Princes Highway and Jervis Bay Road in a one per cent AEP flood event.

2.3 Proposal objectives

The proposal objectives are presented in Table 2-1.

Table 2-1 Proposal objectives

Objective	Description
1. Improve safety at the intersection	Provide an intersection that allows for safe access to and from Jervis Bay Road for all transport users. Provide an intersection that reduces the incidence of fatal and serious injury crashes on the network.
2. Improve transport network efficiency and connectivity to support regional economic development, tourism and freight	Provide an intersection that caters for short, local trips and regional, long distance trips, improving efficiency and connectivity that supports a range of transport options for all transport users including public transport, motorists and freight.
3. Improve transport network resilience	Improve network reliability and safe access during emergencies including bushfire and flood. Deliver a futureproofed interchange that responds to unexpected changes in traffic demand, evolving technologies and changes in climate.
4. Support an increase in active transport (walking and cycling) and use of public transport	Provide integrated active transport options such as pedestrian paths and cycleways, as well as the accommodation of safe and efficient public transport access that enables integration with a potential future multi modal interchange at the intersection.
5.Respect our community and the environment	Minimise impacts to areas of environmental sensitivity, as well as to the existing communities surrounding the proposed intersection.
6. Increase customer value	Provide the best value for money across the life of the proposal with consideration of the other proposal objectives and wider economic benefits.

2.3.1 Urban design objectives and principles

Urban design objectives and principles for the proposal are presented in Table 2-2.

Table 2-2 urban design objectives and principles

Objective	Principles
1. Achieve a proposal that fits sensitively within the existing environment as well as other Princes Highway upgrades	• Maintain and reinforce the existing landscape character including existing land uses, views and spatial character • Maximise local native vegetation, through minimising the proposal footprint and maximising revegetation, to maintain ecological values and assist in biodiversity protection and recovery • Use distinct vegetation to mark the approach to and arrival at the intersection • Respond to other Princes Highway upgrades in terms of planting and materials • Consider the selection of materials including their form, texture and colour, in the design process to achieve an integrated structure that is complementary to the setting and minimises visual impact • Planting and material selection to be low maintenance, and be easily accessible for maintenance purposes.

Objective	
2. To ensure the proposal is integrated and responsive with the surrounding landform	• Design major proposal elements and earthworks to integrate into the existing natural topography • Design structures as a simple and elegant, which avoid unnecessary bulk and clutter.
4. Minimise impacts on the public realm and surrounding land uses	• Use screen planting to provide visual privacy and reduce the scale of infrastructure for residential properties • Ensure all lighting and signage is unobtrusive in the landscape, including at night • Planting to consider bushfire resilience strategies in terms of species selection, location and density.

2.3.2 Safe System approach

The proposal adopts the Safe System approach (Austroads, 2016), which aims to improve road safety using a holistic view of the road transport system and the interactions among roads and roadsides, travel speeds, vehicles and road users. It is an inclusive approach that caters for all groups using the road system, including drivers, motorcyclists, passengers, pedestrians, cyclists, and commercial and heavy vehicle drivers. It recognises that people will always make mistakes and may have road crashes, but the system should be forgiving, and those crashes should not result in death or serious injury.

The Safe System approach therefore favours certain treatments that significantly reduce the exposure, likelihood or severity of crashes. The main treatments considered for the proposal are:

- Flexible roadside and median barriers
- One-way traffic/divided carriageway on the Princes Highway
- Grade separation to remove conflict points between through traffic and intersection traffic and reduce the amount of traffic using the intersection
- Roundabouts that cause lower crash severity due to the flatter impact angles
- Separation of pedestrians and cyclists from vehicular traffic through the intersection
- Lower speed environment at crossing points.

2.4 Alternatives and options considered

This section presents a summary of the alternatives and options considered. It presents the preferred option and the design refinements made to the preferred option.

2.4.1 Strategic alternatives considered

Strategic alternatives were identified and assessed by Transport for NSW in early 2020. The approach for assessing strategic options is documented in the *Princes Highway Upgrade Jervis Bay Road Intersection Strategic Options Report* (Transport for NSW, 2020a) available on the project's website nswroads.work/jervisbayroad. These alternatives were presented to the public to provide comment and assist Transport for NSW in understanding the community's priorities and values. The following alternatives were considered:

- Traffic signals
- Roundabout
- Grade separation.

A “do nothing” alternative has also been considered as part of this review of environmental factors.

The strategic alternatives were comparatively assessed against priority values identified by Transport for NSW. The priority values focussed on safety of transport users and workers, easing congestion, timing and ease of build, management of existing road and property access, and environmental impacts. This evaluation process enabled a relative ranking of each intersection treatment.

These alternatives are described and evaluated below.

The “do nothing” alternative

Transport for NSW considered a theoretical “do nothing” alternative. Under this alternative, there would be no upgrades to Jervis Bay Road and the Princes Highway intersection. This alternative would avoid any capital works expenditure but it would not meet the proposal objectives as it would not provide a safe and efficient intersection that supports an increase in active and public transport use.

Under this alternative, the intersection would continue to experience delays and queuing on Jervis Bay Road during weekday and holiday peaks. This congestion would increase as the level of traffic and congestion grows on the existing road network in the future. The growth in traffic would also likely result in an increase in the total number of crashes occurring.

For these reasons, the “do nothing” alternative was not considered further.

Traffic signals

Under the Safe System approach, traffic signals are not recommended on rural roads, such as the Princes Highway, when the posted speed limit is 90 kilometres per hour or higher. As such traffic signals would require a posted speed limit of 80 kilometres per hour or less on the Princes Highway if it were selected as the preferred treatment option.

The traffic signals alternative was ranked the poorest option comparatively overall. While construction would be simpler, require less time and would incur minimum impact to the surrounding environment and road users, this treatment option would not meet the proposal objectives as traffic efficiency and safety issues would remain. Traffic signals are not compliant with the Safe System approach, as a conflicting right turn movement would remain. Therefore, this option was not progressed further.

Roundabout

A roundabout intersection treatment on the Princes Highway that connects to Jervis Bay Road and potentially to other nearby local road roads such as the Old Princes Highway was considered. Roundabouts slow vehicles and reduce the angle of impact if a crash were to occur, reducing the crash severity.

Roundabouts rank third on the hierarchy of intersection treatments under the Safe System approach for high speed (greater than 80 kilometres per hour) rural roads behind closing an intersection and grade separated treatments, which are ranked first and second, respectively.

Roundabouts offer flexibility in design and managing local road, property and emergency access. A roundabout would provide a safe system design approach that reduces the likelihood and severity of all crash types and would provide better traffic efficiency than the

traffic signals and business as usual options. Roundabout options, however, would require some level of grade separation to provide the traffic performance required for the proposal.

When considering all criteria, this option ranked equally with grade separation and therefore a series of roundabout options were developed for consideration during the preferred option selection.

Grade separation

The option of a grade separated interchange at or near the existing intersection was considered.

Grade separated options rank second on the hierarchy of intersection treatments under the Safe System approach for high speed rural roads behind the option of closing the intersection.

There are two grade separated intersection treatment options that were considered:

- Full grade separated interchange
    - This option would provide a two lane bridge over the Princes Highway to eliminate the conflict points associated with vehicles turning right into and out of Jervis Bay Road. This would have the lowest number of conflict points by eliminating conflicts between vehicles travelling on the highway and vehicles entering or leaving Jervis Bay Road
- Grade separation of right hand turn out of Jervis Bay Road
    - This option would provide a single lane bridge over the Princes Highway for vehicles turning right out of Jervis Bay Road, eliminating one of the right turn conflicts. This option has a lower ranking under the Safe System approach due to the at-grade right turn into Jervis Bay Road remaining and the number of southbound though lanes on the Princes Highway increasing to two.

Grade separation, while incurring longer construction time, would result in optimal safety and efficiency. Similar to the roundabout option, grade separation would provide a safe system design approach that reduces the likelihood and severity of all crash types, and would provide better traffic efficiency than the traffic signals and ”do nothing” options.

This option ranked equally overall with roundabouts and therefore a series of grade separated options were developed for consideration during the preferred option selection.

2.4.2 Methodology for selection of the preferred option

The approach for the selection of the preferred option is documented in the *Jervis Bay Road Intersection Upgrade Preferred Strategic Options Report* (Transport for NSW, 2020b) available on the project’s website nswroads.work/jervisbayroad. Below is a summary of this process and its outcomes. The steps taken to identify the preferred option for the proposal (Figure 2-1) were:

- **Identification of key constraints.** Identify physical, environmental and social constraints associated with the investigation area, through review of existing technical reports and preliminary environmental investigations, to allow a comparative analysis of a long list of options and to short list potential options for further assessment
- **Identification of a long list of options.** Investigate various configurations of roundabout intersections and interchanges to identify potential solutions, while taking into consideration the key constraints. The longlisted options were evaluated using a comparative analysis at two Transport for NSW workshops. Criteria for evaluation of

the long list of options were developed by the project team are aligned to the proposal objectives

- **Identification of a short list of options.** The evaluation of the long list of options resulted in four shortlisted options that progressed to further design development
- **Development of the shortlisted options.** Investigations on the short list of options included constructability, health and safety in design, traffic and transport, flooding, landscape character and visual amenity, biodiversity and noise. A value management workshop was carried out in October 2020 and included the project team and State and local government representatives. A multi-criteria and sensitivity analysis of each of the four shortlisted options was carried out to recommend a preferred option for the proposal. A series of scenarios were tested where proposal objectives were assigned different weightings to determine the ranking of the options based on adjusted priorities and further inform the workshop attendees' recommendation of a preferred option
- **Identification of preferred option.** After completion of the multi-criteria assessment, sensitivity analysis and discussion amongst workshop attendees, workshop attendees recommended which option best satisfied the proposal objectives and the purpose of the proposal.

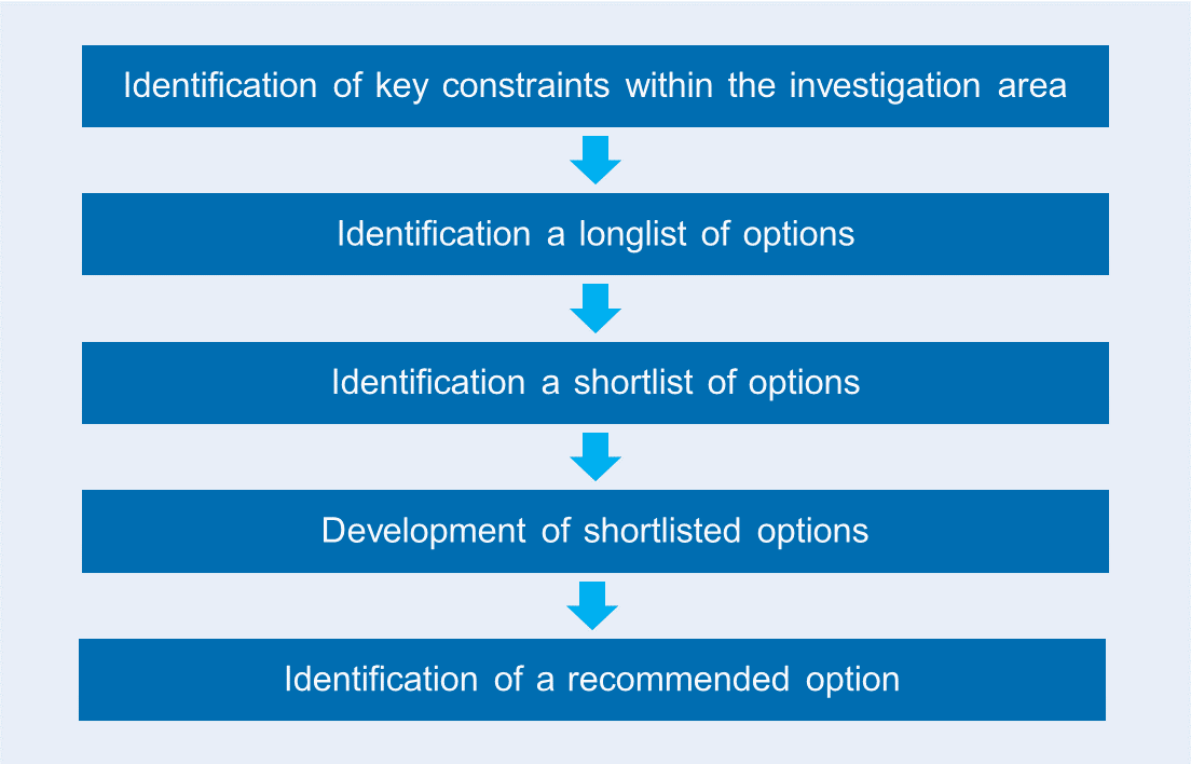

Figure 2-1 Steps to determining the preferred option

2.4.3 Identified options – long list

A long list of 26 options was identified for assessment. These options were grouped as either "roundabout" or "grade separated", as described in Table 2-3.

Table 2-3 Longlisted options

Option	Description
Roundabout options	
At grade	A series of at-grade options involving no elements of grade separation were investigated. Options generally took the form of a roundabout incorporating all movements at a single interchange. This would minimise the footprint and achieve all movements with an improved safety outcome. Traffic modelling highlighted that an at-grade roundabout would not meet the traffic demands in 2039, leading to unacceptable queue lengths on the Jervis Bay Road approach. For this reason, at-grade options involving no elements of grade separation were not further considered.
Right turn grade separation	These options include an at-grade roundabout which separate the right turn movement from Jervis Bay Road to the Princes Highway northbound from the intersection. This is in the form of both a flyover and an underpass. Grade separation of these movements alleviates the major traffic conflict at the intersection between the Jervis Bay Road right turn and Princes Highway southbound through traffic.
Roundabout with alternative single movement grade separation	These options included: • The northbound or southbound Princes Highway traffic crossing over the roundabout • The northbound and southbound traffic offset to cross over the connecting approaches. The separation of only Princes Highway southbound or northbound through traffic from the intersection did not meet traffic performance requirements and introduced large diversions for safe cyclist movements around the intersection.
Grade separated options	
Traditional diamond interchange	The diamond interchange options provide full grade separation, thereby removing conflicting movements at Jervis Bay Road and Old Princes Highway for all through traffic on the Princes Highway. All traditional diamond interchange options were satisfactory for traffic performance. A spread diamond approach was initially considered but not progressed due to its larger footprint. A closed diamond was also investigated as both an overpass and an underpass. These options provide a compact footprint, however they result in conflicting right turn movements where entry and exit ramps join Jervis Bay Road, which are not aligned with the Safe System approach.
Double roundabout interchange	These interchanges are named as such as they consist of two roundabouts either side of the highway with a connection between the two. Some options had large footprints with high impact to ecology and residential property. One option minimised the footprint by having the roundabouts closer together, maximising re-use of existing road corridor while maintaining the operational benefits. Maintaining the roundabouts at grade with the highway on an overpass was adopted for its constructability benefits and minimisation of impacts to environmentally sensitive areas and residential properties. This is based on surrounding landform and topography with the Princes Highway already being elevated above the adjacent landform through the study area.

Option	Description
	All double roundabout options provide full grade separation of the Princes Highway and would result in satisfactory traffic performance at the intersection.
Large roundabout with grade separation	Interchange options consisting of a single large roundabout with the Princes Highway through traffic separated were considered. These options would require larger bridge structures when compared to other options, however, like the double roundabout and diamond options, the grade separation means there is no impact to through traffic resulting in satisfactory traffic performance at the intersection.
Alternative grade separations	Alternative grade separation options were investigated to determine if there were any other potential solutions to accommodate all turning movements or safety improvements, such as the incorporation of loops to minimise right turn movements at the intersection or multiple levels of grade separation. These options would require additional infrastructure and associated impacts with negligible performance benefit.

After the options evaluation, four grade separated options remained. Five roundabout options were also retained, however the decision was made to combine three options due to their similarity and optimise one roundabout with right turn flyover option. Therefore, a total of seven options were retained (four grade separated and three roundabout options).

These options were comparatively assessed to confirm whether one option provided the same function with less impact and/or complexity than another option.

The at grade roundabout with right turn flyover and underpass options were both taken forward for further design development and investigation. While the flyover option would be more visually intrusive and involve a potentially long, complex structure, there would likely be less constructability issues to overcome than the underpass option. Alternatively, the underpass would be relatively more visually concealed however could result in constructability and flood immunity difficulties.

The option of an at grade roundabout with Princes Highway grade separation in both directions performed comparatively well against the northbound only grade separation option as it would result in less safety issues for vehicles, pedestrians and cyclists. It is also preferred over the diamond interchange options as there would be less safety issues, less constructability issues through design optimisation and the potential opportunity for future provision of multi-modal interchange facilities.

One double roundabout option remained after the comparative assessment. This option is similar in functionality and safety to the at grade roundabout with Princes Highway grade separation both directions option, however would have less constructability challenges and a simpler bridge structure.

Based on the above, a short list of four options was determined and progressed to further design development and evaluation.

2.4.4 Identified options – short list

The shortlist of options that progressed to further design development and investigation for evaluation at the value management workshop are identified in Table 2-4.

2.4.5 Analysis of shortlisted options

An analysis of the shortlisted options and their performance against the proposal objectives is presented in Table 2-5.

Table 2-4 Shortlisted options

Option	Description	
Option 1004 – Roundabout with right turn flyover	This option provides a grade separated flyover right hand turn movement from Jervis Bay Road to the Princes Highway northbound. Major traffic conflict between Jervis Bay Road right turn and the Princes Highway southbound through traffic would be alleviated. This option would achieve one per cent AEP flood immunity and minimise the impact on property, Aboriginal heritage, and landscape character and visual amenity. This option could be staged with the roundabout constructed first.	
Option 1005 – Roundabout with right turn underpass	This option provides similar traffic functionality and performance to Option 1004 with an underpass in place of a grade separated flyover. The visual and noise impact of this option would be lower compared with Option 1004. This option would also require more earthworks and would present potential flooding issues.	

Option	Description	
Option 2005 – Mainline grade separated over at-grade roundabout	This option has the Princes Highway grade separated over an at grade roundabout configuration carrying turning movements. This option would require a long bridge structure, would incur significantly higher capital costs than other options and would result in substantial disruption to the community through the construction phase compared to other options.	
Option 2009 – Mainline grade separated over at-grade double roundabout	This option includes raising the Princes Highway over the local road connections and implementing a double roundabout configuration. The double roundabout interchange would be located at ground level and would maximise use of existing road corridor where possible. The western roundabout is located at the existing intersection between Jervis Bay Road and the Princes Highway to minimise impacts to properties along Old Princes Highway. The option includes a single, short bridge over the local road. The Princes Highway is offset from the existing highway to facilitate constructability. The option has a large footprint as it provides roundabouts at ramp terminals, which are preferable to unsignalised intersections from a Safe System approach.	

Table 2-5 Analysis of shortlisted options

Objective	Option evaluation	Option ranking			
		1004	1005	2005	2009
1. Improve safety at the intersection	Option 2009 performs best against these objectives, followed by Option 2005 and then Options 1004 and 1005. • Options 1004 and 1005 provided the least effective solutions to improving safety, efficiency and connectivity at the intersection. Both options would result in through traffic on the Princes Highway needing to slow down on approach to the roundabouts. This would be exacerbated during weekday and holiday peak periods, and would be disadvantageous to freight movements • Options 2005 and 2009 separate through traffic from the roundabout via grade separation and therefore no decrease in speed is required • From a Safe System approach, Option 2009 performs best.	3	3	2	1
2. Improve transport network efficiency and connectivity to support regional economic development, tourism and freight		3	3	2	1
3. Improve transport network resilience	Options 2005 and 2009 perform best against this objective, followed by Options 1004 and 1005. • Options 1004 and 1005 were the least effective in improving transport network resilience. These options saw a rapid deterioration in intersection performance with only a minor increase in traffic in the 2039 scenario • Options 2005 and 2009 have more than 20 per cent spare capacity in the 2039 scenario • Options 2005 and 2009 have the ability to maintain Princes Highway through traffic during incidents by redirecting traffic via the ramps and roundabouts • Option 1005 is the only option that would not achieve flood immunity in a one per cent AEP event.	2	2	1	1
4. Support an increase in walking, cycling and use of public transport	All options support an increase in active transport use via provision of shoulders and shared paths. Safety was a large factor noting the majority of pedestrian traffic is school children taking the bus from this intersection.	3	4	2	1

Objective	Option evaluation	Option ranking			
		1004	1005	2005	2009
	• Options 2005 and 2009 preformed best due to lower traffic volumes in the intersection compared to Options 1004 and 1005 and the requirement to only cross one lane instead of two • Option 2009 is preferred due to the smaller roundabout size and related lower speeds • All options provide the opportunity to reinstate existing bus stops at a higher standard with bus bays, shared path connectivity and room for shelters if required. • Similar to above, the difference in traffic volumes was considered for each option, with Option 2005 and 2009 performing better due to lower traffic volumes and therefore increase safety and accessibility.				
5.Respect our community and the environment	• Option 2009 would result in the least disruption to the community during construction, followed by Option 1004 and then Options 1005 and 2005 • Option 2009 would result in the lowest impact on threatened ecological communities compared to other options • Option 1004 would result in the least impact on property, followed by Options 1005 and 2009 and then Option 2005 • Options 2005 and 2009 would result in impacts to Aboriginal heritage and substantial visual impacts for residents and road users due to their larger footprint and large embankments and overpass structures.	1	2	4	3
6. Increase customer value	Based on their benefit-cost ratio and strategic capital cost, Options 1004 and 1005 provided the best value for money. Option 2005 performed poorly due to its significantly higher capital cost compared to other options.	1	2	4	3

2.5 Preferred option

After completion of the multi-criteria assessment, sensitivity analysis and discussion amongst workshop attendees, the at-grade double roundabout interchange (Option 4) was selected as the preferred option for the proposal. This option best satisfies the proposal objectives as follows:

- Improve safety at the intersection
    - The preferred option performs best from a Safe System approach
    - The preferred option would be the safest to maintain, with no piers in the centre of roundabouts
- Improve transport network efficiency and connectivity to support regional economic development, tourism and freight
    - The preferred option would allow for uninterrupted through movements for northbound and southbound Princes Highway traffic
    - The preferred option would minimise delays and queuing experienced on Jervis Bay Road during weekday and holiday peaks
    - The preferred option would provide improved safety for property access to the Princes Highway through a connection road to Jervis Bay Road and lower traffic volumes from the Princes Highway separation
- Improve transport network resilience
    - The preferred option would have more than 20 per cent spare network capacity when considering 2039 traffic projections
    - The preferred option would have little impact on flood behaviour and would allow continued operation in the one per cent AEP flood event
    - The preferred option would have the ability to maintain Princes Highway through traffic by redirecting traffic via the ramps and roundabouts in the event of an incident on the Princes Highway
- Support an increase in walking, cycling and use of public transport
    - The preferred option would result in lower traffic volumes at slower speeds at grade, therefore providing a safer environment for active and public transport users
    - Active transport would be supported through inclusion of shoulders and shared paths
    - Existing bus stops would be reinstated at a higher standard, including a bus bay and shared path connectivity
- Respect our community and the environment
    - The proposed Princes Highway would be offset from the existing Princes Highway to minimise impacts to the community during construction
    - The preferred option would maximise use of existing road corridor where possible to minimise impacts to properties and biodiversity
    - The preferred option would have the lowest impact on threatened ecological communities compared to other options
    - Adverse environmental impacts of the preferred option would be managed through the implementation of appropriate safeguards and management measures as detailed in Section 7
- Increase customer value

- The preferred option would use the existing road reserve where possible and therefore minimise the construction footprint and the amount of property acquisition required.

The preferred option was placed on public display from 25 November 2020 to 20 December 2020 to provide the community and stakeholders an opportunity to review the preferred option and provide feedback. Consideration of community and stakeholder feedback is discussed in Section 5.

2.6 Design refinements

The following refinements have been made to the preferred option design since being placed on public display:

- Addition of a new access road to service Princes Highway properties south east of the intersection
- Addition of cyclist and pedestrian access
- Addition of a bus bay adjacent to the interchange, including kiss and ride car spots
- Addition of a new property access road north east of the intersection
- Jervis Bay Road wide vegetated median has been removed and replaced with a kerbed median.

The description of the proposal incorporating the above refinements is presented in Section 3.

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3 Description of the proposal

This section describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

Transport for NSW proposes to upgrade the intersection of Jervis Bay Road and the Princes Highway in the vicinity of Falls Creek, NSW, located about 12 kilometres south of Nowra within the City of Shoalhaven local government area. The proposal would provide a grade separated through alignment for the Princes Highway with network access to Jervis Bay Road and Old Princes Highway provided via dual at grade roundabouts serviced by on and off ramps.

Key features of the proposal are shown in Figure 3-1 and would include:

- A new intersection between Jervis Bay Road and the Princes Highway, incorporating:
    - Realignment of the existing Princes Highway, including widening from two lanes to a four-lane divided highway (two lanes in each direction), with median separation using flexible safety barriers, providing an uninterrupted through alignment for the Princes Highway
    - An overpass bridge over Jervis Bay Road
    - An unsignalised single-lane at-grade double roundabout interchange providing:
        - Direct access from Jervis Bay Road and Old Princes Highway to the Princes Highway
        - Direct access from the Princes Highway to Jervis Bay Road and Old Princes Highway
    - Direct connection to existing properties and businesses at the Old Princes Highway
    - A connection from Willowgreen Road to Old Princes Highway
    - Tie-ins with the Old Princes Highway and with Jervis Bay Road
- Access road to service Princes Highway properties south east of the intersection
- Shared user paths along Jervis Bay Road, connecting to the new bus bay and the Jervis Bay Road and Old Princes Highway road shoulders
- Adjustments of drainage infrastructure and provision of new drainage infrastructure such as pit and pipe networks, culverts, open channels and retention basins
- Permanent water quality measures such as vegetated swales, bioretention swales and bioretention basins
- Adjustment, protection and relocation of existing utilities
- Other roadside furniture including safety barriers, signage, line marking, lighting and fencing
- A bus bay adjacent to the interchange, including kiss and ride car spots
- Establishment and use of temporary ancillary facilities during construction
- Property works including acquisition, demolition and adjustments to accesses, and at-property noise treatments
- Rehabilitation of disturbed areas and landscaping.

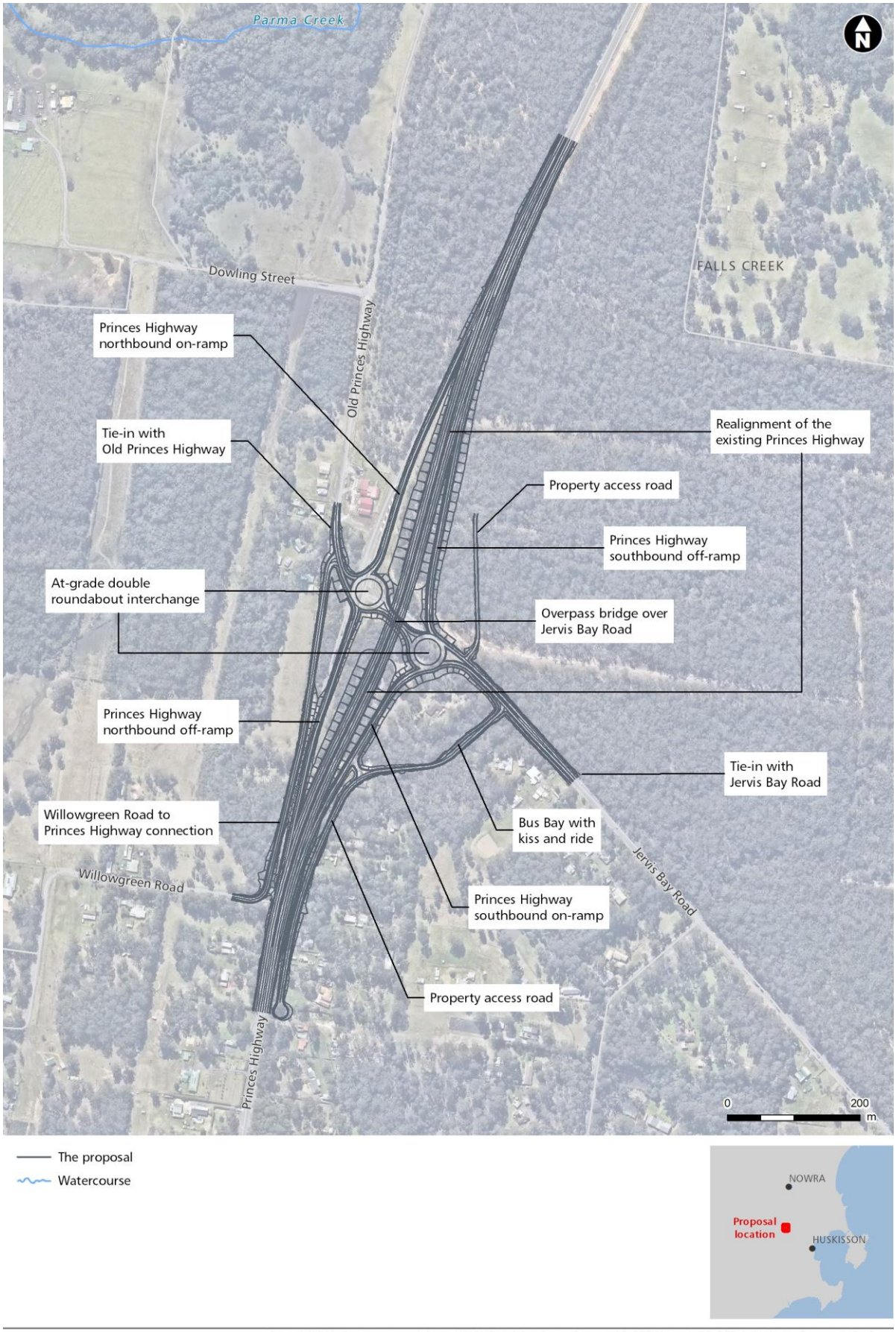

Figure 3-1 Key features of the proposal – operational

3.2 Design

The design is being prepared in accordance with Transport for NSW project specifications and design standards and guidelines as follows:

- Austroads Guides
- Australian Standards
- Transport for NSW supplements to Austroads Guides and Australian Standards
- Technical directions and quality alerts
- Other current Transport for NSW publications.

The main standards and guidelines used include:

- Guide to Road Design (Austroads, 2017), including Transport for NSW supplements
- Design Vehicles and Turning Path Templates (Austroads, 2013)
- Safe System Assessment Framework (Austroads, 2016)
- Cycling Aspects of Austroads Guides (Austroads, 2017)
- Beyond the Pavement, urban design approach and procedures for road and maritime infrastructure planning, design and construction (Transport for NSW, 2020c)
- Guide to Pavement Design Part 2: Pavement Structural Design (Austroads, 2017) including Transport for NSW supplement
- R0600 – Street Lighting Series (Roads and Maritime Services, 2017).

Table 3-1 presents key design criteria for the proposal. While the design criteria presented in Table 3-1 are indicative and may be further refined, this information represents the standard to which the proposal would be designed and constructed.

Typical cross sections of the proposal are presented in Figure 3-2, Figure 3-3 and Figure 3-4.

Table 3-1 Design criteria

Criteria	Requirement	Reference
Minimum grade	• 0.5 per cent	Austroads
Maximum grade	• 6 per cent	Austroads

Design speed	• Princes Highway:
	  ○ Horizontal: 110 kilometres per hour
	  ○ Vertical: 100 kilometres per hour
	• Jervis Bay Road:
	  ○ 80 kilometres per hour at the proposal
	  ○ 90 kilometres per hour on approach to the proposal
	• Old Princes Highway, Willowgreen Road and access roads:
	  ○ 60 kilometres per hour
		Project Specification

Design vehicle	• Princes Highway: Performance based standard Level 2 (B) – 30 metre combination with Higher Mass Limit • Jervis Bay Road: Performance based standard Level 2 (B) – 30 metre combination with Higher Mass Limit • Old Princes Highway: 12.5 single unit truck. Checking vehicle 19 metre semi-trailer	Project Specification

Criteria	Requirement	Reference
	• Willowgreen Road: 8.8 metre service vehicle. Checking vehicle 19 metre semi-trailer • Access Road: 12.5 metre single unit truck. Checking vehicle 19 metre semi-trailer	
Posted speed limit	• Princes Highway: 100 kilometres per hour • Jervis Bay Road: 80 kilometres per hour • Old Princes Highway, Willowgreen Road and Access Road: 60 kilometres per hour	Project Specification
Minimum lane width	• Princes Highway, Jervis Bay Road and Old Princes Highway: 3.5 metres • Willowgreen Road and Access Road: 3.1 metres	Project Specification
Minimum auxiliary lane width	• 3.5 metres	Project Specification

Minimum shoulder width	• Princes Highway:
	  ○ Nearside (outside): three metres
	  ○ Offside (median): 1.5 metres (inclusive of median)
	• Jervis Bay Road: two metres
	• Old Princes Highway: 1.5 metres
	• Willowgreen Road: 0.5 metres (unsealed)
	• Access Road: 0.5 metres
		Project Specification

Cut batter slope	• 2:1 ratio	Project Specification
Fill batter slope	• Maximum: 2:1 ratio	Project Specification
Vertical clearance to overpass	• 5.4 metres	Project Specification
Flood immunity	• Princes Highway and Jervis Bay Road: one per cent AEP flood event • Local roads: 10 per cent AEP flood event	Project Specification
Shared user path width	• 3 metres	Austroads

Minimal horizontal curve radius	• Princes Highway:
	  ○ 529 metres at six per cent crossfall
	  ○ 2,000 metres at three per cent adverse crossfall
		Austroads

Pavement design life	• 40 years	Project Specification
Design life of major structures	• 100 years	Project Specification
Drainage design life	• Accessible for refurbishment: 40 years • Inaccessible: 100 years	Project Specification

Figure 3-2 Typical cross section of Princes Highway

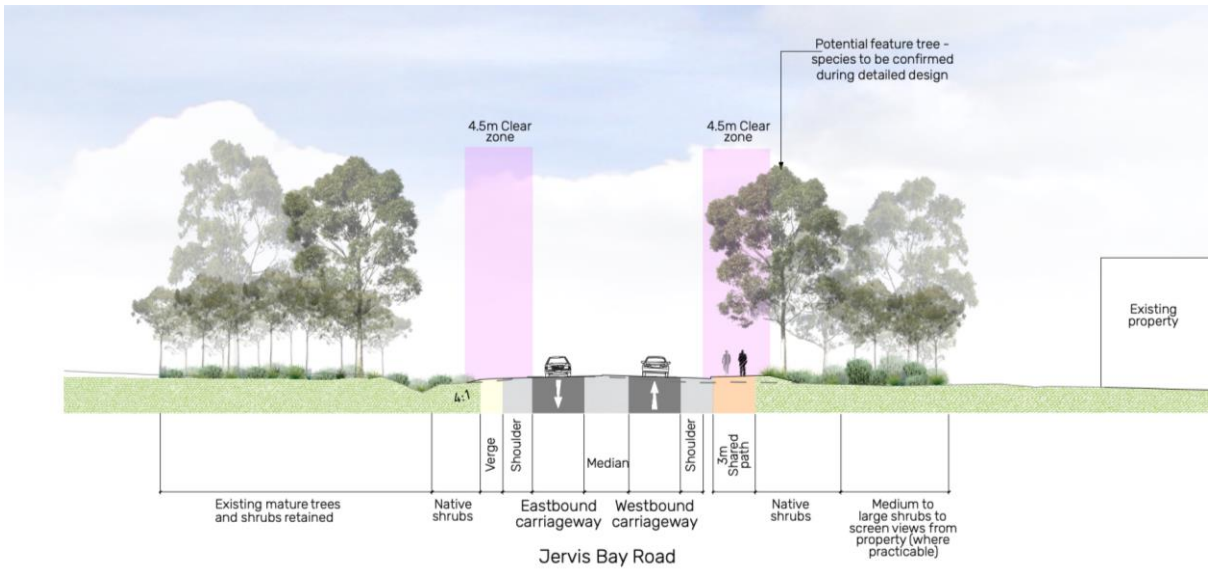

Figure 3-3 Typical cross-section of Jervis Bay Road

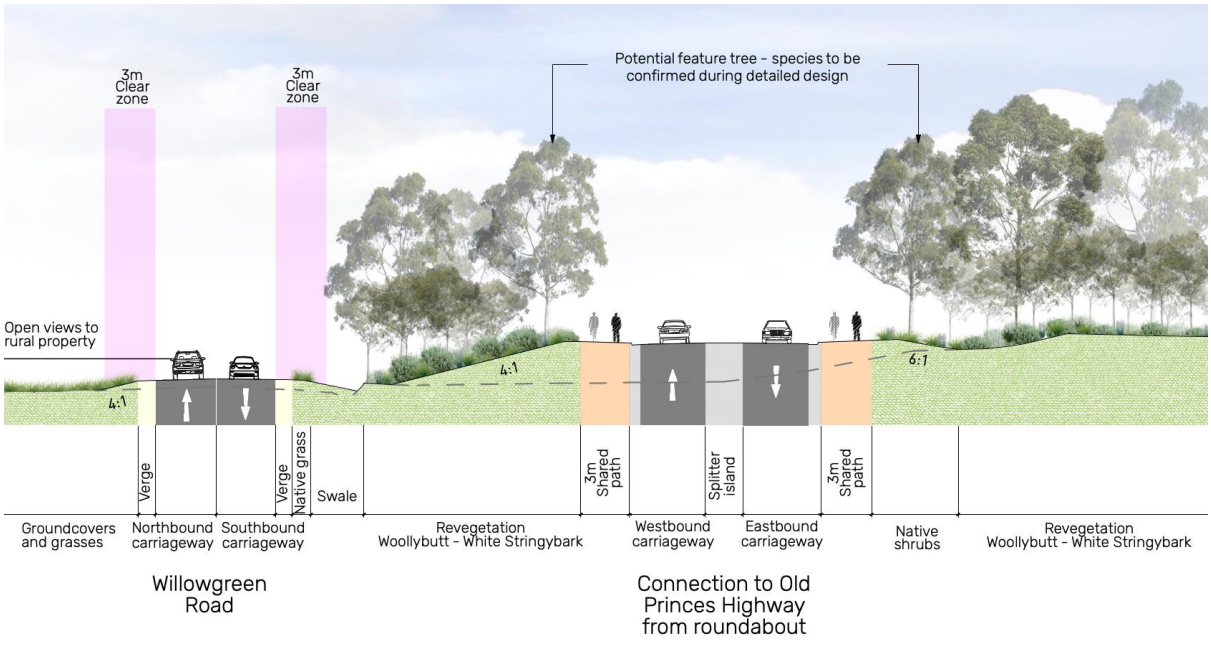

Figure 3-4 Typical cross-section of Old Princes Highway

3.2.1 Engineering constraints

Engineering constraints considered in the design of the proposal include drainage and flooding, topography, utilities and availability of construction ancillary facility sites, as discussed below.

Drainage and flooding

The proposal site is primarily drained by two relatively small watercourses which are conveyed under the existing Princes Highway at the southern end of the proposal via a triple cell box transverse culvert before discharging to the floodplain via Parma Creek. There are three smaller transverse pipe culverts that also provide drainage relief for local sub-catchment depressions to the north of Jervis Bay Road.

The main flood behaviour constraints are:

- The floodplain area immediately to the west of Jervis Bay Road and the Princes Highway intersection is influenced by backwater flooding from Parma Creek
- The existing triple cell box transverse culvert under the Princes Highway at the southern end of the proposal is under capacity in the one per cent AEP flood event and requires upgrading as part of the proposal
- Floodwaters surcharging from the existing triple cell box transverse culvert overtop the Princes Highway and also continue to flow north alongside the embankment towards Jervis Bay Road, resulting in a large area of ponding at the south eastern corner of the existing intersection.

Topography

The existing Princes Highway carriageway is located on an embankment, placing it about three to four metres above the ground surface that surrounds it. As a result, the construction of the proposal would require fill to be imported to further elevate the proposed Princes Highway realignment.

Section 3.4 provides details on the quantity of fill material required for the proposal.

Utilities

Construction of the proposal would require the protection or relocation of utilities within the proposal construction footprint, including:

- Ausgrid 11kV overhead power line
- Telstra Yatte Yattah major optic fibre line
- Other Telstra/Optus communications lines
- Shoalhaven Water residential and trunk water mains
- Street lighting.

Section 3.6 describes how the utilities affected would be adjusted or relocated.
Any protection or relocation activities would be carried out in consultation with the relevant utilities authorities.

Availability of construction ancillary facility sites

Cleared land available for construction ancillary facilities near the proposal location is limited. Section 3.5 describes the ancillary facilities that would be required for construction of the proposal.

3.2.2 Major design features

Princes Highway realignment

The proposal includes an upgrade of the Princes Highway from two lanes to a four lane divided carriageway that is grade separated from Jervis Bay Road intersection. To facilitate this arrangement, the Princes Highway would be elevated to cross over Jervis Bay Road and realigned to the east for a length of about one kilometre to enable offline construction.

The fill embankments for the new Princes Highway alignment would mainly be constructed with the use of imported fill given the existing topography. Retaining walls and 2:1 batter slopes are proposed along the mainline to reduce the amount of fill required and to keep the realignment closer to the existing carriageway to reduce the proposal construction footprint.

This realignment would also allow the northbound on and off ramps to be placed mainly on the existing Princes Highway embankment to minimise impacts to the western side of the intersection.

The southern tie-in would accommodate the future planned road upgrade of the Princes Highway to four lanes further south. A two lane, two way connection to the existing Princes Highway will be provided in the interim until the future upgrade is completed.

Overpass bridge over Jervis Bay Road

The proposal would include a single span concrete overpass bridge about 32 metres long over Jervis Bay Road (Figure 3-5).

The overpass bridge would allow all northbound and southbound vehicles on the Princes Highway to continue unimpeded. The overpass bridge would be a four-lane carriageway consisting of two lanes in both the northbound and southbound directions with a continuation of the median barrier on the bridge structure. The overpass bridge approaches would be in the form of a walled embankment and walled abutments, minimising the structure length.

At-grade double roundabout interchange

The proposal would include an at grade interchange at the intersection of Jervis Bay Road and the Princes Highway to allow road users to enter and exit the Princes Highway (Figure 3-5). The interchange would include:

- Two unsignalised single lane roundabouts of about 50 metres diameter measured from the outer edge of the road with a two-lane, two-way connection between the two. This connection would travel underneath the overpass bridge.
- On and off ramps connecting the Princes Highway to Jervis Bay Road and the Old Princes Highway via the roundabouts.

All road movements involving the Princes Highway, Old Princes Highway and Jervis Bay Road would be possible via the proposed interchange. Road users wishing to exit the Princes Highway to Jervis Bay Road or Old Princes Highway would be able to do so by taking the off ramp in either direction and then travelling through the interchange to the relevant roundabout exit. Road users exiting Jervis Bay Road or Old Princes Highway would be able to enter the Princes Highway via the on ramps in either the northbound or southbound direction. A secondary exit from the southbound on-ramp would be provided to access the bus bay and an access road connecting properties to the southeast of the intersection.

Bus bay

The bus bay would provide adequate space for two buses and two vehicle kiss and ride (ie drop off) spots. From the southbound on-ramp exit, a one way road would connect to the bus

bay and turn onto Jervis Bay Road. In connection with the double roundabout, this arrangement would provide full connectivity between the interchange and the bus bay, while locating the bay adjacent to a low volume, low speed road with kiss and ride and shared path connection.

Willowgreen Road to Princes Highway connection

The Willowgreen Road access to the Princes Highway would be relocated to the proposed at grade interchange.

Willowgreen Road would connect to Old Princes Highway via a connection parallel to the Princes Highway near the eastern roundabout. This connection would be designed for light vehicles and service vehicles. This would provide a safe connection to the Princes Highway without movement restrictions. Heavy vehicle access to and from Willowgreen Road would be maintained via Patterson Road and Watt Road to the south.

Property access

Access to properties would be maintained. However, the method of access may be altered under the proposal.

Property access to the north west of the Jervis Bay Road and Princes Highway intersection would continue to be via the Old Princes Highway which would connect to the proposed at-grade double roundabout interchange.

Access to the rural properties north east of the Jervis Bay Road and Princes Highway intersection would continue to be via Jervis Bay Road.

Residential properties south of the Jervis Bay Road and Princes Highway intersection currently have driveways connecting directly to the Princes Highway. As the proposal would install flexible safety barriers through the median and along both shoulders of the Princes Highway to improve safety, these direct driveway connections would no longer be possible.

Property access to the south east of the intersection would be provided via a new access road that can be accessed via an exit from the roundabout interchange southbound on-ramp. At the end of the access road, a cul-de-sac would provide for turning movements by light vehicles. Egress would be provided via a one way connection to Jervis Bay Road westbound.

Property access to the south west of the Jervis Bay Road and Princes Highway intersection connecting to the Princes Highway south of Willowgreen Road would be maintained as they are located clear of the northbound off-ramp diverge.

Shared user paths

A shared user path network is proposed to separate pedestrians and cyclists from the vehicle movements along Jervis Bay Road and at the roundabouts.

These paths would cater for all pedestrian movements between the Old Princes Highway, Jervis Bay Road and the proposed bus bay. Cyclists would also use the shared user paths for movements at the intersection with a connections to an in-shoulder cycle lane treatment along the Princes Highway mainline and ramps. At the eastern and western end of the proposed shared path, pedestrians and cyclists would continue travelling via existing verge, shoulders or road surface.

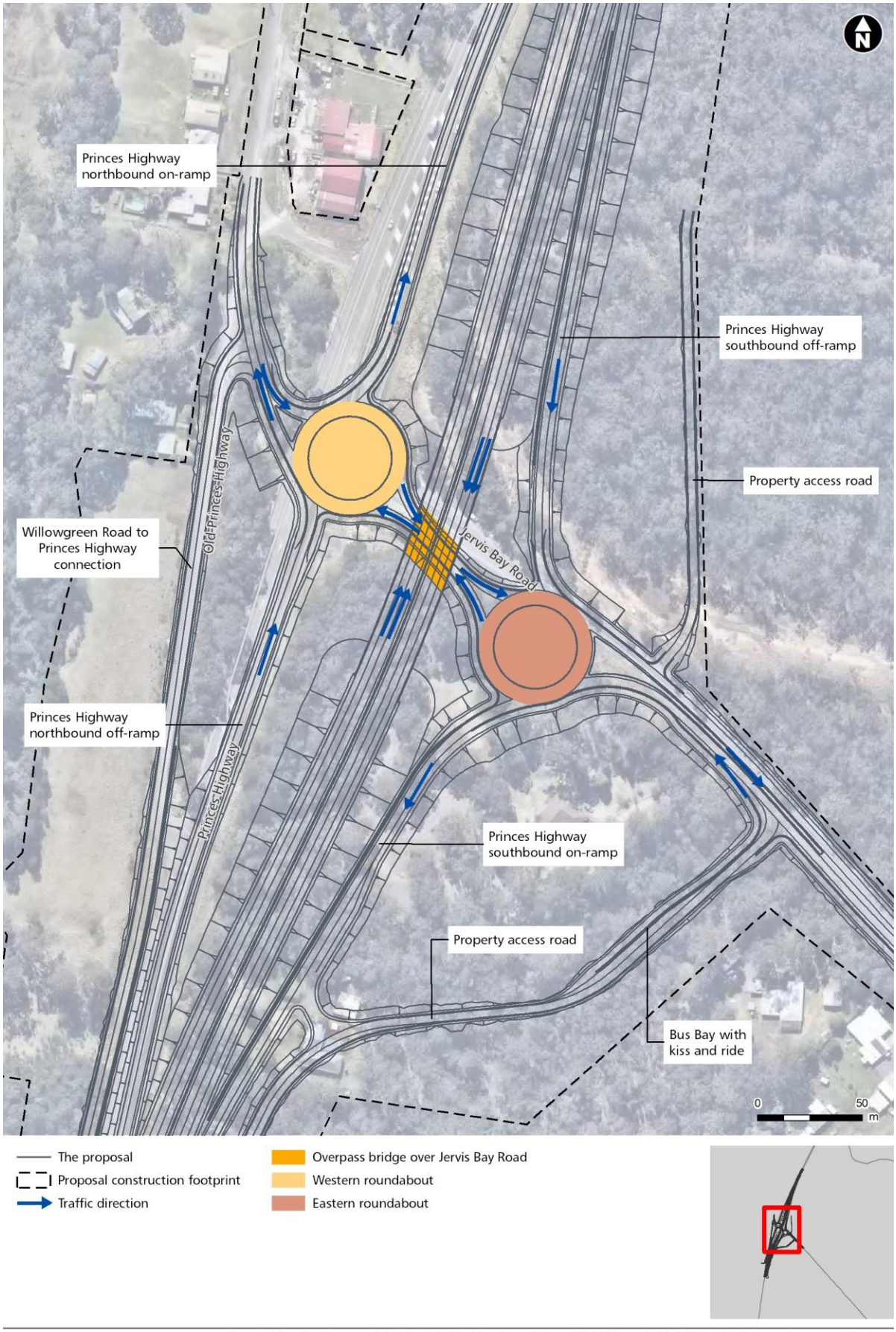

Figure 3-5 Overpass bridge over Jervis Bay Road and at-grade double roundabout interchange

Drainage structures and permanent water quality measures

Drainage infrastructure to be constructed as part of the proposal would include pit and pipe networks through the intersection and along the extent of the shared user path, culverts and permanent water quality control measures.

Surface flows on the overpass bridge would be captured by scuppers in the toe of the bridge barrier and connected to the piped network. New drainage networks would be provided at the following locations:

- Throughout the at grade interchange, including the double roundabout
- The kerbed section of Jervis Bay Road and the bus bay access road
- On the Princes Highway along the overbridge and retaining walls
- Along the south facing ramps adjacent to the mainline
- Along Willowgreen Road adjacent to the Princes Highway ramp.

Open channels would generally be provided at the toe of batters. Permanent water quality measures, such as vegetated swales, bioretention swales and bioretention basins, would be provided as required to achieve the water quality targets discussed in Section 6.7.

New culverts would be provided under the northbound on ramp and off ramp to discharge into the open channels between the Old Princes Highway and the proposed on and off ramps. Scour protection would be provided at the upstream and downstream ends of the culverts. Existing culverts would be extended or replaced to accommodate the new footprint of the intersection.

The existing triple cell box culvert located under the existing Princes Highway embankment at the southern end of the proposal would be upgraded to improve the flood immunity of the Princes Highway and the proposed at grade interchange during a one per cent annual exceedance probability flood event.

Roadside furniture

Indicative details of roadside furniture that would be included as part of the proposal design are provided in Table 3-2. The location and design of the roadside furniture would be refined during further design development.

Table 3-2 Indicative roadside furniture

Roadside furniture	Description
Lighting	Lighting would be provided throughout the intersection on the Jervis Bay Road and Old Princes Highway approaches, the on and off ramps, and roundabouts. Lighting would be provided at the new bus bay.
Safety barriers	Flexible safety barriers would be provided on medians to separate the opposing carriageways and alongside the Princes Highway mainline and on and off ramps. Concrete barriers would be provided on the bridge and retaining walls.
Line marking	Line marking would be provided in accordance with *Australian Standard – AS1742 Manual of Uniform Traffic Control Devices* and Transport for NSW *Road Design Guidelines*. Line marking would include reflective lines and raised pavement markers.
Traffic signs	Traffic signs would be provided and would be legible at the posted speed limits. The signs would be consistent and compatible with the State road network and the rest of the Princes Highway. The signs would state direction,

Roadside furniture	Description
	speed, place names, height clearances, feature names and include symbols as appropriate.
Bus shelters	A bus shelter would be provided at the new bus bay.
Fencing	Fencing would be provided along the boundary of the road reserve and private land to demarcate land ownership.
Head light screens	Headlight screens would be required between the Princes Highway, Access Road and Willowgreen Road connection due to the proximity and similar elevation of these local roads and the Princes Highway.

3.3 Construction footprint

Figure 3-6 shows the area required to construct the proposal. The areas highlighted in orange would be used as ancillary facilities to support construction of the proposal.

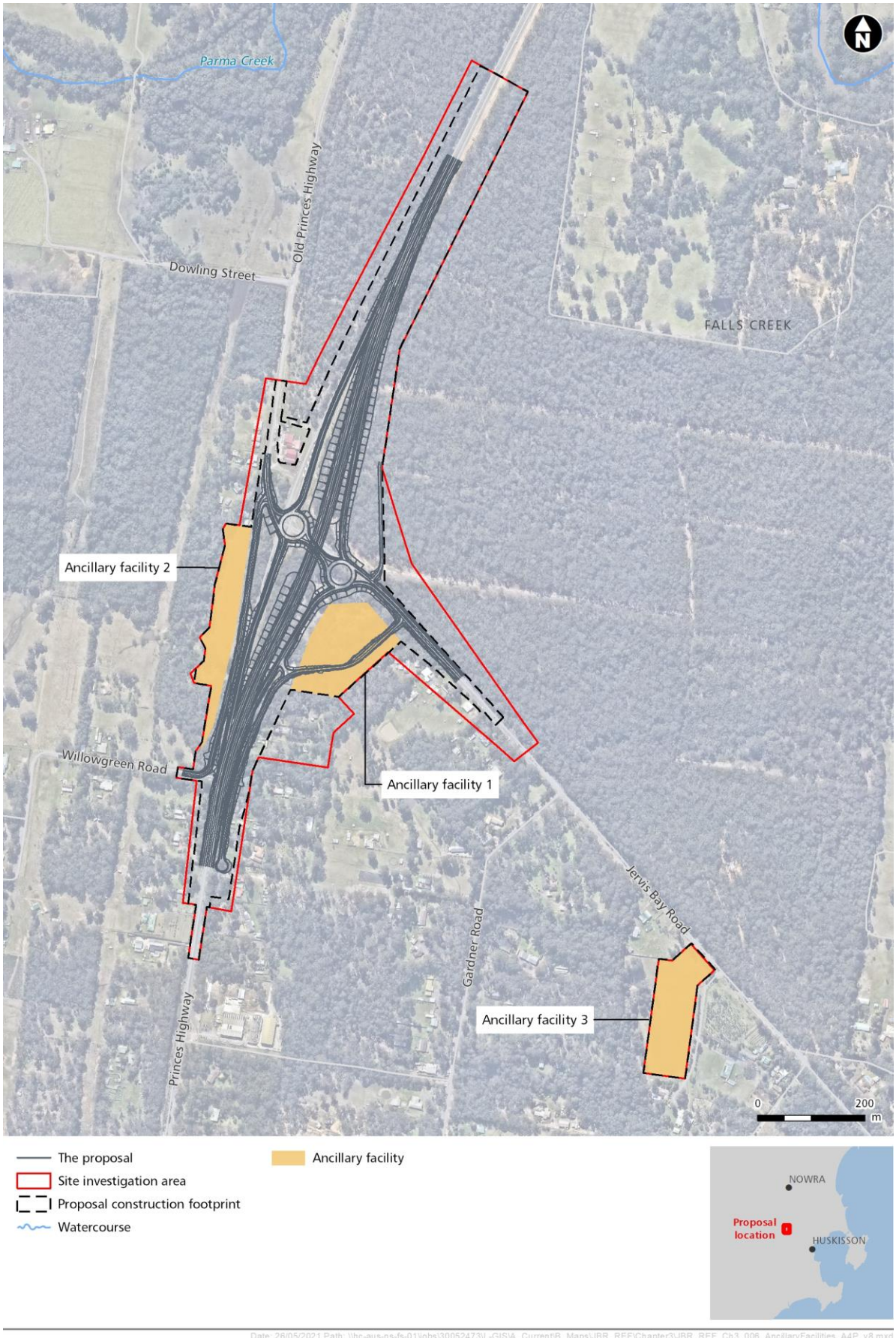

Figure 3-6 Proposal construction footprint and ancillary facilities

3.4 Construction activities

This section describes how the proposal would be constructed. The methodology presented in this section would be refined during further design development.

3.4.1 Work methodology

Construction activities would be carried out in accordance with a construction environmental management plan to ensure work complies with Transport for NSW's commitments and legislative requirements. The indicative construction work methodology is described in Table 3-3. Detailed construction work methodologies would be developed by the construction contractor.

Table 3-3 Indicative construction activities

Component	Typical activities
Pre-construction and early works	• Demarcation of the proposal construction footprint and installation of temporary safety barriers where required • Installation of erosion and sediment controls • Set up of temporary traffic management arrangements
Site establishment	• Site survey, geotechnical and other investigations • Pre-clearing biodiversity surveys • Vegetation clearing and grubbing Mobilisation and establishment of ancillary facilities as described in Section 3.5 and shown in Figure 3-6
Intersection construction	• Utilities relocation or protection including overhead power lines • Construct temporary Jervis Bay Road alignment • Construct access road for south eastern properties • Construct Old Princes Highway connection • Construct eastern and western ramps and associated fill embankment • Construct bridge, bridge abutments and retaining walls • Construct roundabouts and connecting roads • Tie-in works • Construction of new drainage structures and extension or replacements of existing drainage structures • Construction of pavement layers including selected material, sub-surface drainage, subbase and base layers and surfacing • Construction of permanent water quality control measures such as vegetated swales, bioretention swales and bioretention basins • Installation of lighting, safety barriers, traffic signs and bus shelter • Line marking and raised pavement markers • Fencing • Property accesses adjustments
Finishing work	• Rehabilitation of disturbed areas and landscaping in accordance with the urban design and landscape plan • Installation of safety barriers, street lighting, fencing and roadside furniture • Decommission and rehabilitation of ancillary facilities.

3.4.2 Construction workforce

The indicative construction workforce that would be required at each stage is described in Table 3-4.

Table 3-4 Construction workforce

Construction phase	Indicative maximum workforce required (number of full time equivalents)
Pre-construction and early works	10
Site establishment	20
Intersection construction	60
Finishing work	20

3.4.3 Construction duration and hours

Subject to planning approval, construction of the proposal is planned to commence in 2022 and would take about two years.

Most construction would be carried out within the standard construction hours as defined in the *Interim Construction Noise Guidelines* (DECCW, 2009):

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturday
- No work on Sundays and public holidays.

Work outside standard construction hours would be required at times, including for safety and traffic management purposes. Any work outside of standard construction hours would be carried out in accordance with the *Construction Noise and Vibration Guidelines* (Roads and Maritime, 2016), any road occupancy licence requirements and the environmental management measures listed in Section 7.

Potential construction work that would be carried out outside of standard construction hours is described in Table 3-5. Some of these activities may take place within the construction ancillary facilities described in Section 3.5.

Table 3-5 Potential work outside of standard construction hours

Activity	Justification
Installation of temporary traffic barriers along Princes Highway and Jervis Bay Road	Restriction of lanes would be required during temporary barrier installation and this work would need to be completed outside of standard construction hours to minimise traffic performance and safety issues for Princes Highway and Jervis Bay Road.
Utility adjustments	Some utility relocations would require work near the carriageways and crossing the carriageways. This work would need to be completed outside of standard construction hours to minimise disruption to road users and maintain the safety of construction personnel.
Delivery and placement of large precast concrete components	The delivery and placement of large precast concrete components (eg bridge girders) would take place outside of standard construction hours to minimise disruptions to highway and local traffic flows and maintain the safety of construction personnel.

Activity	Justification
Installation of large precast concrete components	Due to the potential safety risks to road users and construction personnel associated with operating over the existing alignment, these works would need to be carried out at night when there are lower traffic flows. Avoiding peak periods would also minimise the disruption to traffic.
Construction of major drainage structures	Work to major drainage structures located beneath or near the carriageways would typically need to be carried out during out of hours work to minimise the impact on road users and ensure the safety of workers involved.
Completion of tie-ins to the Princes Highway and temporary traffic facilities, and completion of temporary diversions and traffic switches	Large parts of the proposal would be built offline. The tie-ins to the existing Princes Highway would require some level adjustments and new pavement construction which would need to be built outside of standard construction hours to minimise performance and safety impacts for Princes Highway traffic.

3.4.4 Construction plant and equipment

The plant and equipment listed in Table 3-6 are likely to be used during construction of the proposal. The final list of plant and equipment required for each construction activity, and the duration of each activity, would depend on the final construction methodology developed by the construction contractor.

Table 3-6 Indicative construction plant and equipment required for the proposal

Construction activity	Plant required	Equipment required
Site establishment	Small cranes and lifting equipment, excavators, front end loaders, road trucks, light vehicles	Fences, portable sheds, portable ablutions, fuel storage, generators, waste tanks
Utilities relocation and protection	Small cranes, elevated work platforms, excavators, backhoes, front end loaders, trenching machines, dump trucks, road trucks, light vehicles, agitator trucks	Jack hammers, concrete saws and other small handheld equipment
Vegetation clearing and grubbing and topsoil stripping	Excavators, bulldozers, graders, water carts, front end loaders, dump trucks, fuel trucks, road trucks, scrapers, light vehicles	Not required
Bulk earthworks and materials haulage including water quality structures	Excavators, bulldozers, graders, water carts, front end loaders, vibratory rollers, dump trucks, road trucks, scrapers, fuel trucks, light vehicles	Hand-held compactors
Road surface construction	Excavators, bulldozers, graders, water carts, front end loaders, compactors, road sweepers, fuel trucks, asphalt pavers, bituminous spray sealing trucks, vibratory rollers, rubber-tyre rollers, road trucks, line marking machines, light vehicles	Hand-held compactors, jack hammers, concrete saws and other small handheld equipment

Construction activity	Plant required	Equipment required
Drainage structures construction	Underborers, excavators, mobile cranes, front end loaders, agitator trucks, concrete pumps, vibratory rollers, road trucks, light vehicles	Hand-held compactors and other small tooling
Overpass bridge construction including heavy vehicle deliveries of over-size loads	Excavators, elevated work platforms, mobile cranes, agitator trucks, piling rigs, concrete pumps, vibratory rollers, road trucks, light vehicles	Hand-held compactors and other small tooling
Signposting	Excavators, elevated work platforms, mobile cranes, agitator trucks, road trucks, light vehicles	Hand-held compactors, jack hammers and other small tooling
Lighting and roadside furniture installation	Excavators, elevated work platforms, mobile cranes, agitator trucks, road trucks, light vehicles	Hand-held compactors and other small tooling
Landscaping, waste disposal and rehabilitation of disturbed areas	Excavators, bulldozers, water carts, front end loaders, graders, road trucks, light vehicles	Small tooling

3.4.5 Earthworks

The total raw fill volume required for the proposal is estimated to be 204,000 cubic metres while total raw cut volume is estimated to be 34,000 cubic metres.

The proposal would relocate the Princes Highway alignment offline to the east of the existing and onto a high embankment to cross over the Jervis Bay Road connection via a single span concrete bridge. The southbound on and off ramps would also be located on an embankment. Shallow cuts would be required where the alignment ties back into the existing Princes Highway. Material excavated from shallow cuts would be considered for reuse on site subject to the quality of material. The majority of the fill material required would be imported to site.

Material to be excavated from the proposed drainage channels would be considered for re-use for the proposal, such as for on and off ramp embankments. A Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the *Protection of the Environment Operations (Waste) Regulation 2014* for excavated natural material would be required to meet the conditions for excavated natural material that is, or is intended to be, for use in earthworks for the proposal.

3.4.6 Source and quantity of construction materials

Construction would require various resources and materials. Typical materials that would be used for the construction of the proposal and estimated quantities are presented in Table 3-7.

Construction materials would generally be sourced from off-site suppliers. Where feasible and reasonable, local sources of construction materials would be used to minimise haulage distances and support the local economy.

Table 3-7 Typical construction materials and approximate quantities

Material	Approximate quantity
Imported fill material	180,000 cubic metres
Imported select material	15,000 cubic metres
Asphalt	62,500 square metres
Topsoil	30,000 cubic metres
Concrete	6,500 cubic metres
Steel	620 tonnes

Earthworks materials

Imported earthworks material would be required. At the time of writing, there were no known proposals planned in close proximity to the proposal that could cater as alternative source for fill material. Potential locations to source earthworks materials are presented in Table 3-8.

Table 3-8 Potential locations for earthwork material sources

Location	Distance from the proposal (kilometres)
Hanson Bass Point Quarry	70
Cleary Brothers Albion Park	75
Boral Concrete Dunmore	70
South Coast Concrete Crushing and Recycling Nowra	10
Schmidt Quarries Nerriga	60

Asphalt pavement materials

Asphalt pavement materials would be sourced from existing batch plants operating within the Shoalhaven local government area and beyond. The nearest existing batch plant facility is located in Nowra about 12 kilometres from the proposal.

Reinforced steel

Reinforcing steel for structures would be sourced from suppliers throughout Australia. The construction contractor would select a source that conforms to the quality and performance requirements of the proposal.

Concrete

A number of concrete batching plants are located near the proposal, the closest being about 10 to 15 kilometres from the proposal site.

Concrete for the bridge, pavement sub-bases and other proposal elements would be sourced from batch plant facilities selected by the construction contractor with agitator trucks delivering to the work fronts via the haulage routes presented in Section 3.4.7.

3.4.7 Traffic management and access

Temporary traffic management arrangements

The construction of the proposal would be subject to comprehensive traffic management measures to ensure the ongoing functionality of the Princes Highway, Jervis Bay Road, Old Princes Highway and Willowgreen Road, and the safety of the public, motorists and construction workers.

Temporary traffic management arrangements likely to be required by the proposal are presented in Table 3-9. These arrangements would be refined during further design development and further development of the construction methodology with consideration of the construction contractor's requirements.

Table 3-9 Temporary traffic management arrangements during construction

Construction stage	Temporary traffic management arrangements
Site establishment	• Jervis Bay Road traffic would be diverted onto a temporary alignment built during this stage • The intersection with Princes Highway would be a signalised T intersection • All existing turning movements would remain.
Intersection construction	• Jervis Bay Road traffic would be diverted onto the final alignment, utilising temporary pavement through the eastern roundabout • The intersection with Princes Highway would remain as a signalised T-intersection during this stage.
Finishing work	• Mainline traffic would be diverted onto the new mainline and new southbound on and off ramps • Northbound ramp traffic would use the existing Princes Highway carriageways under traffic control while the proposed northbound on and off ramps would be constructed along with the completion of the western roundabout • Minor tie-in works on the mainline and on and off ramps would be completed under traffic control.

Construction vehicle movements

It is estimated that the proposal would generate up to 140 heavy vehicle movements per day and 50 light vehicle movements per day.

Haulage routes

Mass haulage of materials would be carried out primarily using the Princes Highway. Some haulage would take place on Jervis Bay Road between the ancillary facilities and the proposal construction footprint.

Internal haul roads would provide vehicle access between work sites and ancillary facilities. Figure 3-7 shows the indicative location of construction entry and exit to the ancillary facilities. The final location of internal haul roads and entry and exit points would be confirmed during further development of the construction methodology with consideration of the construction contractor's requirements.

Controlled construction traffic entry and exit points would be minimised and the use of the existing highway would be restricted at peak hours, especially during holiday periods. This may require the introduction of temporary traffic management measures, which would be determined in the construction traffic management plan for the proposal (refer to Section 6.1).

Public and active transport arrangements

The existing bus stops located at the intersection would need to be relocated during construction. Alternative temporary locations for bus stops would be determined as the proposal progresses and advanced notification would be provided to affected bus customers.

There are currently no formal pedestrian and cycling facilities within the proposal construction footprint. The proposal construction traffic management plan would include measures to manage active transport movements throughout construction.

Property access arrangements

Access to residences, businesses and roads would be provided during construction as described in Table 3-10.

Table 3-10 Proposed access arrangements during construction

Location	Proposed access arrangements
Residences along south eastern extent of the proposal	An Access Road would be constructed as part of the proposal to provide access to Princes Highway via Jervis Bay Road. Access to the properties would be maintained throughout the construction of the proposal.
Residences and businesses along Old Princes Highway	Access would be maintained via the current intersection and then the new intersection of Old Princes Highway with Princes Highway.
Willowgreen Road residences	The existing Willowgreen Road and Princes Highway intersection would be for periods of time during construction. Under these closures, traffic would be diverted via Watt Road and Peterson Road until the proposed Willowgreen Road and Old Princes Highway connection is constructed.
Jervis Bay Road residences	Access to Jervis Bay Road would be maintained throughout the construction phase.

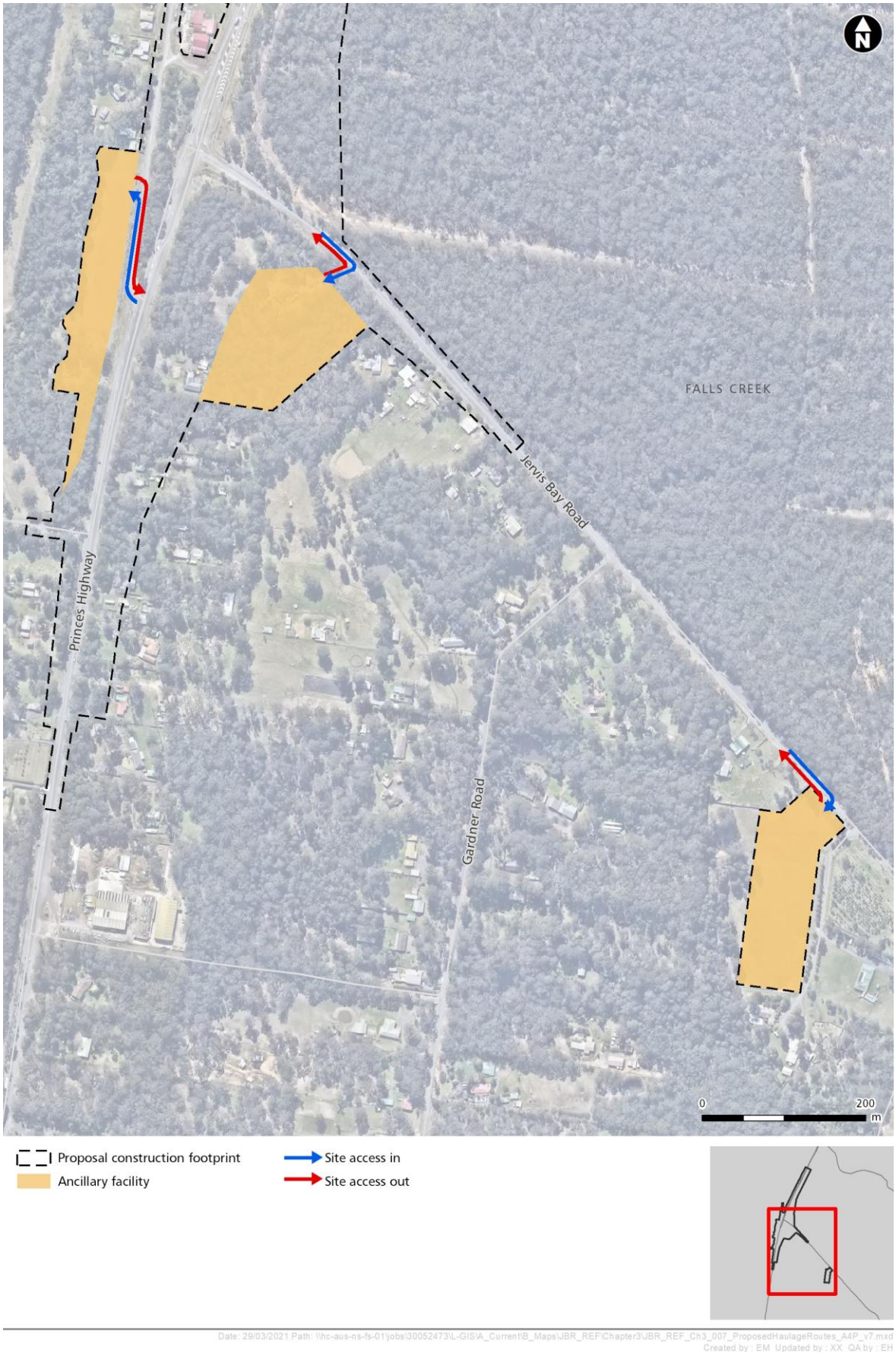

Figure 3-7 Indicative construction ancillary facility entry and exit points

3.5 Ancillary facilities

A number of ancillary facilities would be required to support the proposal construction, including for:

- Site compounds
- Stockpile sites for materials, spoil and cleared vegetation
- Laydown areas.

Three locations have been identified for ancillary facilities. These facilities are described in Table 3-11 and shown in Figure 3-6.

Table 3-11 Ancillary facilities

Facility	Location (refer to Figure 3-6)	Approximate size (hectares)	Indicative purpose
Ancillary Facility 1	24 Jervis Bay Rd, Lot 7 DP1093336 921 Princes Highway, Lot 59 DP15507.	1.0	• Offices • Amenities • Workshops • Stockpile and laydown areas • Car park • Storage areas.
Ancillary Facility 2	24 Willowgreen Rd, Lot 1 DP871596.	1.5	• Stockpile and laydown area • Car park.
Ancillary Facility 3	132 Jervis Bay Rd, Lot 4 DP773881.	1.9	• Stockpile and laydown area.

The initial selection criteria used to identify ancillary facility locations included, in order of priority:

- Sites located within or directly adjacent to the proposal construction footprint
- Sites located on land owned or to be acquired by Transport for NSW
- Sites that can be leased from Shoalhaven City Council
- Sites that can be leased from private property owners.

Then, the selection of ancillary facility locations was based on the criteria presented in Table 3-12. The potential environmental impacts associated with the facilities are assessed in detail in Section 6.

Table 3-12 Ancillary facility site criteria

Consideration	Ancillary Facility 1	Ancillary Facility 2	Ancillary Facility 3
Located more than 40 metres from a waterway	Yes	Yes	Yes
Located within or next to land where the proposal is being carried out	Yes	Yes	No Located about 700 metres from the proposal

Consideration	Ancillary Facility 1	Ancillary Facility 2	Ancillary Facility 3
Ready access to the road network	Yes	Yes	Yes
Located to minimise the need for heavy vehicles to travel through residential areas	Yes	Yes	Yes
Sited on relatively level land	Yes	Yes	Yes
Separated from nearest residences by at least 100 metres	No Located about 60 metres from nearest residence	No Located about 30 metres from nearest residence	No Located about 80 metres from nearest residence
Not requiring vegetation clearing beyond that already required by the proposal	No Additional clearing required	Yes	Yes
Avoiding and minimising impact on heritage items (including areas of archaeological sensitivity)	Yes	Yes	Yes
Not unreasonably affecting the land use of nearby properties	Yes	Yes	Yes
Above the 10 per cent AEP flood level unless a contingency plan to manage flooding is prepared and implemented	Yes	Yes	Yes

3.6 Public utility adjustment

The major public utilities located within the proposal construction footprint, and requirements for potential protection or relocation, are presented in Table 3-13 and shown in Figure 3-8. For any utilities where potential for relocation has been identified, further consultation with utility asset owners would be carried out to determine opportunities for protection, rather than relocation, of utility assets.

Table 3-13 Major public utilities

Asset owner	Asset type	Location	Relocation required?[1]
Shoalhaven Water	150 millimetre PVC council water main and 35 millimetre PVC water property connections	West of Jervis Bay Road, in between the Old Princes Highway and Princes Highway	Yes
Shoalhaven Water	150mm PVC council water main	Runs from east to west from Jervis Bay Road to the Old Princes Highway	Yes
Shoalhaven Water	100 millimetre asbestos council water main	Runs from south to north on the eastern side up to the Jervis Bay Road Intersection	Yes

Asset owner	Asset type	Location	Relocation required?[1]
Telstra	Three copper communications cables	Eastern section of the Princes Highway, north of the intersection at Jervis Bay Road	Yes
Telstra	Nowra to Yatte Yattah high integrity optic fibre cable	Eastern section of the Princes Highway, north of the intersection at Jervis Bay Road and runs down Jervis Bay Road	Yes
Telstra	One P100 Telstra Optic and copper communications cable	Crossing at Jervis Bay Road at the Princes Highway intersection	Yes
Telstra	One P100 Telstra copper communications cable	Runs from the Old Princes Highway through to Jervis Bay Road	Yes
Telstra	One P100 copper communications cable	Runs south to north up to the Jervis Bay Road Intersection	Yes
Telstra	Direct buried copper communications cable	Runs east to west across the Princes Highway, north of the Jervis Bay Road Intersection	No – not active
Telstra	Direct buried copper communications cable	Runs east to west across the Princes Highway, north of the Jervis Bay Road Intersection	No – not active
Optus	One P50 optic fibre cable	Runs from Princes Highway to Jervis Bay Road	Yes
Endeavour Energy	Low voltage overhead electricity	Princes Highway	Yes
Endeavour Energy	11kV overhead electricity	Princes Highway	Yes
Endeavour Energy	11kV overhead electricity	Old Princes Highway	Yes

Note:

[1] For any utilities where potential for relocation has been identified, further consultation with utility asset owners would be carried out to determine opportunities for protection, rather than relocation, of utility assets.

3.7 Property acquisition

The proposal has been designed and developed to minimise property acquisitions and has prioritised the use of Transport for NSW land. Notwithstanding this, some temporary use and permanent acquisition of properties would be required. All property acquisitions required for the proposal would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.

The proposal would impact 32 properties, of which seven would be directly impacted in their entirety and would require full acquisition. Twenty-four of the impacted properties are privately owned, three are owned by Shoalhaven City Council and two are Crown land.

About 17.87 hectares of land that is outside of the existing road corridor would be directly impacted by the proposal. This includes 12.32 hectares to be permanently acquired and 5.55 hectares to be temporarily leased. Refer to Section 6.3 for further details on properties to be acquired or leased.

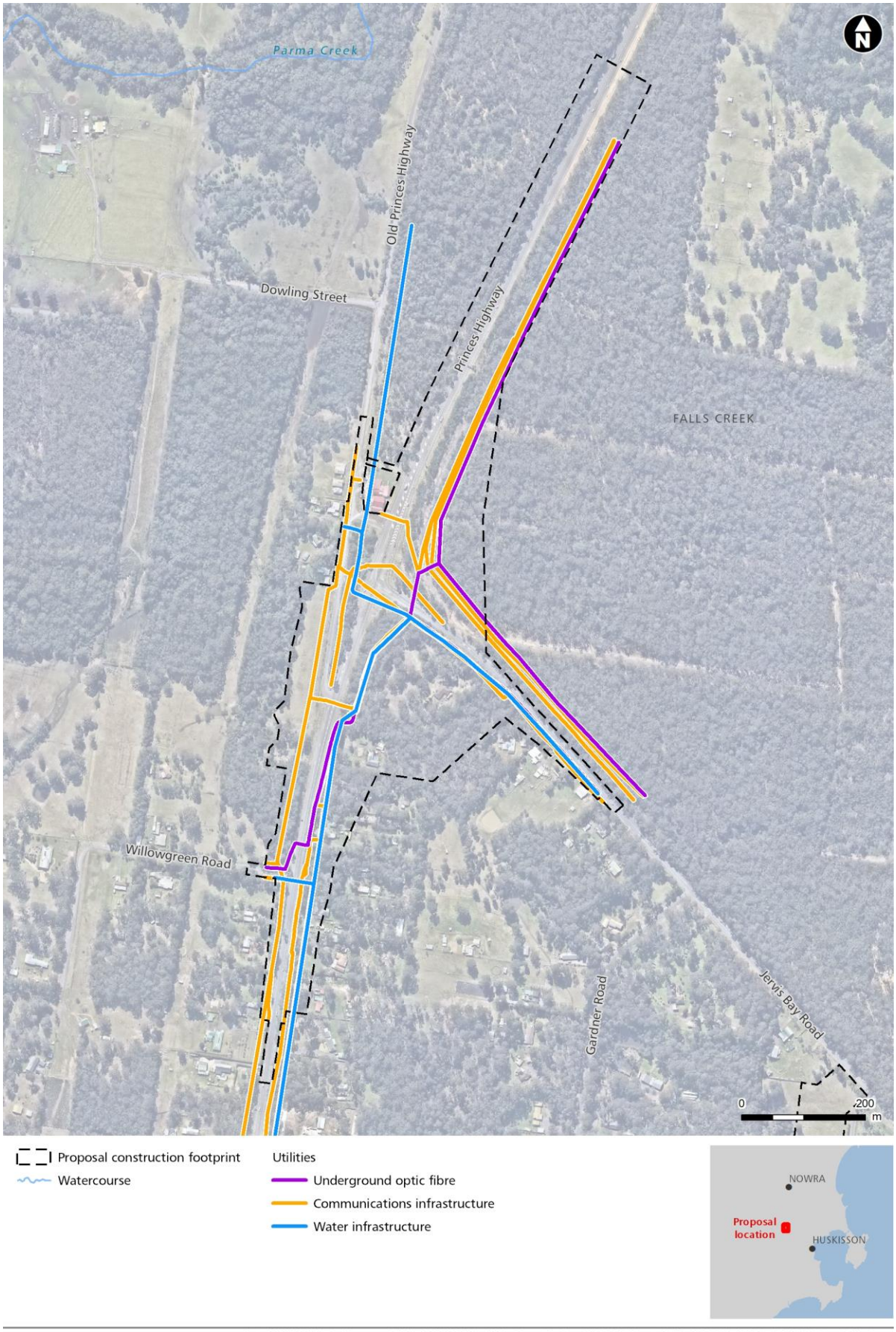

Figure 3-8 Existing major public utilities

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4 Statutory planning framework

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

4.1 Environmental Planning and Assessment Act 1979

The objects of the *Environmental Planning and Assessment Act 1979* are:

a) to encourage:
   i. the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,
   ii. the promotion and co-ordination of the orderly and economic use and development of land,
   iii. the protection, provision and co-ordination of communication and utility services,
   iv. the provision of land for public purposes,
   v. the provision and co-ordination of community services and facilities, and
   vi. the protection of the environment, including the protection and conservation of native animals and plants, including threatened species and ecological communities, and their habitats, and
   vii. ecologically sustainable development, and
   viii. the provision and maintenance of affordable housing, and
b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and
c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

In accordance with Part 5, Subdivision 2, Section 5.5, for the purpose of attaining the objects of the *Environmental Planning and Assessment Act 1979* relating to the protection and enhancement of the environment, a determining authority (ie Transport for NSW) in its consideration of an activity (ie construction and operation of the proposal) shall, notwithstanding any other provisions of this Act or the provisions of any other Act or of any instrument made under this or any other Act, examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity.

4.2 State Environmental Planning Policies

4.2.1 State Environmental Planning Policy (Infrastructure) 2007

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

Clause 94 of the *State Environmental Planning Policy (Infrastructure) 2007* permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road intersection and is to be carried out by or on behalf of Transport for NSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from Shoalhaven City Council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not require development consent or approval under *State Environmental Planning Policy (Coastal Management) 2018*, *State Environmental Planning Policy (State and Regional Development) 2011* or *State Environmental Planning Policy (State Significant Precincts) 2005*.

Part 2 of the *State Environmental Planning Policy (Infrastructure) 2007* contains provisions for public authorities to consult with local councils and other public authorities prior to starting certain types of development. Consultation, including consultation as required by the *State Environmental Planning Policy (Infrastructure) 2007* (where applicable), is discussed in Section 5.

4.2.2 State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

The site investigation area does not include any land identified as coastal wetlands, coastal wetland proximity, coastal use or coastal environment areas identified under the *State Environmental Planning Policy (Coastal Management) 2018*. The nearest mapped *State Environmental Planning Policy (Coastal Management) 2018* coastal use and coastal environment zones are within Currambene Creek and located about 300 metres and 40 metres northeast of the proposal, respectively.

4.2.3 State Environmental Planning Policy (Koala Habitat Protection) 2021

The *State Environmental Planning Policy (Koala Habitat Protection) 2021* aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline. The policy applies to the Shoalhaven local government area, which is part of the Central and Southern Tablelands South Coast koala management area.

As the proposal does not require development consent in accordance with *State Environmental Planning Policy (Infrastructure) 2007*, the *State Environmental Planning Policy (Koala Habitat Protection) 2021* does not apply to the proposal. Regardless, this document has been considered when assessing potential impacts on koalas and koala habitat, as part of the biodiversity assessment documented in Section 6.5 and Appendix A.

A review of koala tree use across New South Wales (OEH, 2018a) indicates that the Shoalhaven region (South Coast Koala Management Area) contains relatively low Koala numbers and low numbers of tree species with evidence of Koala use. As such, Koala populations within the South Coast Koala Management Area are sparse and localised. A total of 27 Koala feed trees have been identified within the South Coast Koala Management Area (DPIE, 2020b). While the site investigation area contains marginal potential Koala habitat, no Koalas are present and no Koalas have been recorded up to 2.5 kilometres from the site investigation area within the past 18 years (two records, the most recent from 1995, occur within the study area). As such, the site investigation area does not contain core Koala habitat.

4.3 Shoalhaven Local Environmental Plan 2014

The proposal is located within the Shoalhaven Local Government Area which is subject to the *Shoalhaven Local Environmental Plan 2014*. Under this local environmental plan, the land occupied by the proposal site is zoned as (Figure 4-1):

- SP2 Infrastructure
- RU2 Rural landscape
- R5 Large lot residential.

As described in Section 4.2.1, Clause 94 of the *State Environmental Planning Policy (Infrastructure) 2007* permits Transport for NSW to carry out development for the purpose of a road and/or road infrastructure facilities on any land without consent. As a result, while development for roads would be permissible in all three land zones, consent from Shoalhaven City Council under the local environmental plan is not required for the proposal.

Table 4-1 describes the objectives of these land use zones and describes the proposal's consistency with these objectives.

Table 4-1 Shoalhaven Local Environmental Plan 2014 land use zone objectives and consistency with the proposal

Land use zone	Land use zone objectives	Consistency of proposal with land use zone objectives
SP2 Infrastructure	• To provide for infrastructure and related uses • To prevent development that is not compatible with or that may detract from the provision of infrastructure.	The proposal would provide infrastructure in the form of a road intersection
RU2 Rural landscape	• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base • To maintain the rural landscape character of the land • To provide for a range of compatible land uses, including extensive agriculture.	Transport benefits associated with the proposal would support local and regional primary industries without reducing the natural resource base. The rural landscape character of the land would be retained by landscaping and preservation of land wherever possible. About 4.24 hectares of land occupied by the proposal and zoned RU2 Rural landscape would be acquired.
R5 Large lot residential	• To provide residential housing in a rural setting while preserving, and minimising impacts on, environmentally sensitive locations and scenic quality • To ensure that large residential lots do not hinder the proper and orderly development of urban areas in the future • To ensure that development in the area does not unreasonably increase the demand for public services or public facilities • To minimise conflict between land uses within this zone and land uses within adjoining zones.	The proposal would provide safe access to adjacent residential development by maintaining and improving property access to the road network. About 7.64 hectares of land occupied by the proposal and zoned R5 Large lot residential would be acquired.

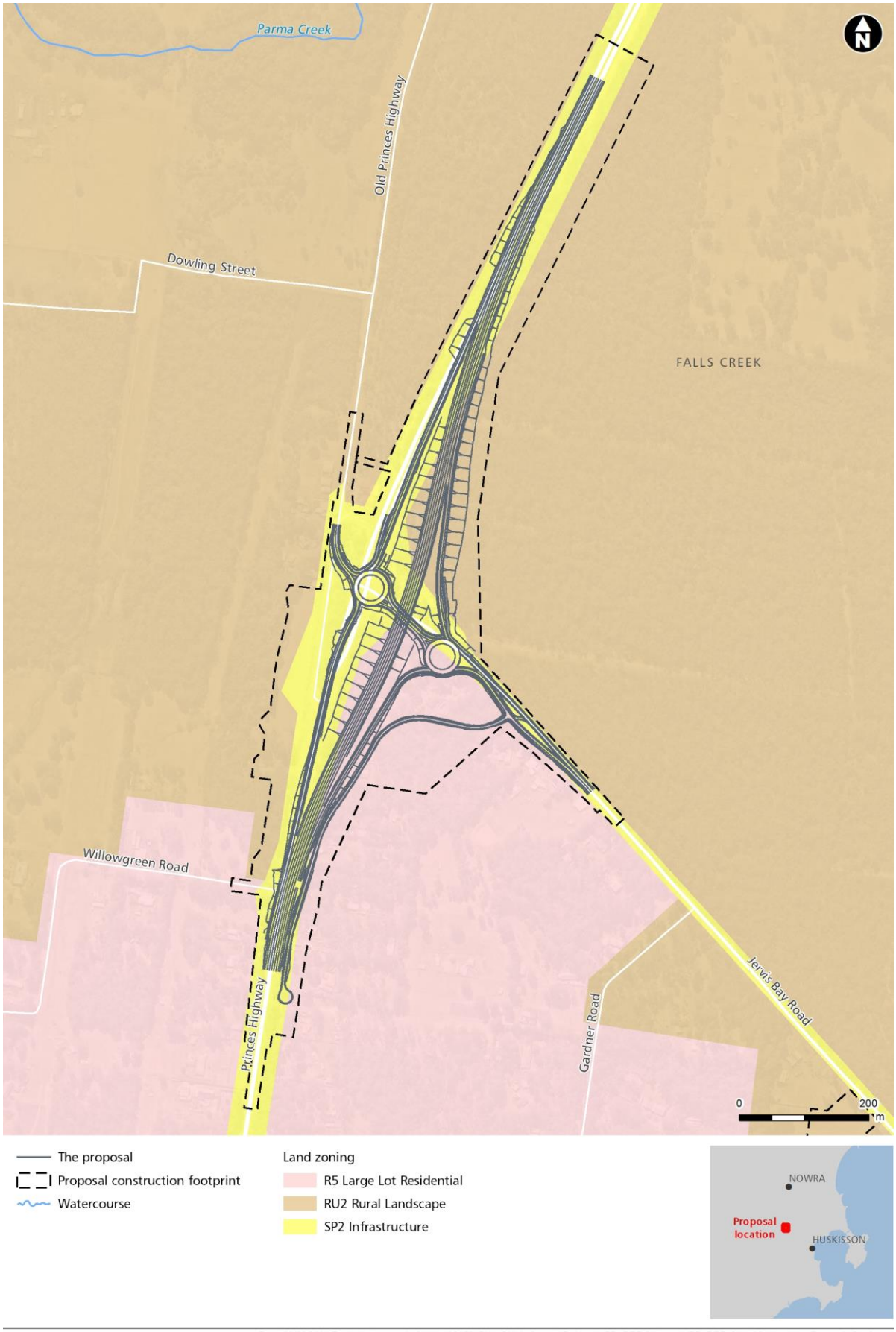

Figure 4-1 Land use zones as per Shoalhaven Local Environmental Plan 2014

4.4 Other relevant NSW legislation

Other NSW legislation that is relevant to the proposal include:

- *Roads Act 1993*
- *Protection of the Environment Operations Act 1997* and *Regulation 2014*
- *Biodiversity Conservation Act 2016*
- *Biosecurity Act 2015*
- *National Parks and Wildlife Act 1974*
- *Heritage Act 1977*
- *Crown Lands Management Act 2016*
- *Aboriginal Land Rights Act 1983*
- *Land Acquisition (Just Terms Compensation) Act 1991*
- *Water Management Act 2000*
- *Contaminated Land Management Act 1997*
- *Waste Avoidance and Resource Recovery Act 2001.*

These are discussed below.

4.4.1 Roads Act 1993

Section 138 of the *Roads Act 1993* requires consent from the relevant roads authority (Transport for NSW or Shoalhaven City Council) for the erection of a structure, or the carrying out of work in, on or over a public road, or the digging up or disturbance of the surface of a road.

The Princes Highway and Jervis Bay Road are classified roads. Transport for NSW would obtain a road occupancy licence from the NSW Traffic Management Centre for work on these roads, the closure of traffic lanes and the movement of over-sized vehicles during the construction. The Old Princes Highway is a non-classified road. Shoalhaven City Council approval would be sought for a road occupancy licence for work on this road.

4.4.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* establishes a regulatory framework for the protection and restoration of the environment.

The *Protection of the Environment Operations Act 1997*:

- Specifies requirements for licences and the regulation of various activities that have the potential to pollute or harm the environment
- Integrates NSW Environment Protection Authority licensing with the development approval procedures under the *Environmental Planning and Assessment Act 1979*
- Provides for the issuing of clean-up notices, prevention notices and environment protection notices
- Classifies environment protection offences and penalties
- Allows for mandatory audits and provides authorised officers with the power to carry out investigations.

Section 120 of the *Protection of the Environment Operations Act 1997* prohibits the pollution of waters. Potential water quality impacts are discussed in Section 6.7 and Section 6.8.

Air pollution-related Sections 124 to 126 of the *Protection of the Environment Operations Act 1997* require activities to be conducted in a proper and efficient manner, while Section 128 requires that all necessary practicable means are used to prevent or minimise air pollution. Potential air quality impacts are discussed in Section 6.12.

Pollution of land and waste is covered by Part 5.6 of the *Protection of the Environment Operations Act 1997*. It makes it an offence to unlawfully transport waste material (Section 143); to use the premises as a waste facility without the authority to do so (Section 144); or provide misleading information about waste storage, transport and disposal (Section 144AA). Potential impacts of the proposal on waste management are assessed in Section 6.14 .

Section 35 of Schedule 1 of the *Protection of the Environment Operations Act 1997* prescribes the thresholds for a road construction activity to be declared a scheduled activity under the Act. An environment protection licence is required for scheduled activities where they include:

- Extraction or processing of more than 150,000 tonnes of material over the life of the project
- The construction of roads with four or more traffic lanes (other than bicycle lanes or lanes used for entry or exit) for a continuous length of five kilometres.

The proposal would not result in extraction of more than 150,000 tonnes of material or result in the construction of four or more traffic lanes for a continuous length of five kilometres. As a result, the proposal would not meet the criteria to be deemed a scheduled activity under the *Protection of the Environment Operations Act 1997* and would not require an environment protection licence for construction works associated with the proposal.

4.4.3 Protection of the Environment Operations (Waste) Regulation 2014

The *Protection of the Environment Operations (Waste) Regulation 2014* sets out the provisions around the way waste is managed in terms of storage and transportation as well as reporting and record keeping requirements for waste facilities. Material that requires removal from the proposal and which is deemed to be of unsuitable condition for use would be disposed of offsite as per the requirements set out in this regulation. Any such material would first be sorted and classified according to the NSW *Waste Classification Guidelines* (EPA, 2014a) before it is removed off-site.

Where it can be demonstrated that a specific type of waste can safely be used for another purpose, rather than being disposed of in accordance with the waste regulations, the Environment Protection Authority (EPA) may grant permission for that waste to be used for the specified purpose, subject to strict conditions. These permissions are known as ‘resource recovery exemptions’ (clause 93 of the *Protection of the Environment Operations (Waste) Regulation 2014*).

Resource recovery exemptions may be used by Transport for NSW, without seeking approval from the EPA, provided the generators, processors and consumers fully comply with the conditions of the exemption. The general exemptions currently in force that are relevant to the proposal are:

- Excavated natural material exemption
- Excavated public road material exemption
- Mulch exemption
- Reclaimed asphalt pavement exemption
- Recovered aggregate
- Stormwater.

If approved, the construction and operational stages of the proposal would need to comply with the *Protection of the Environment Operations Act 1997* provisions related to prevention of pollution and waste classification, management and disposal.

4.4.4 Biodiversity Conservation Act 2016

The purpose of the *Biodiversity Conservation Act 2016* is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development.

The NSW Biodiversity Offsets Scheme is established under Part 6 of the *Biodiversity Conservation Act 2016* and the Biodiversity Assessment Method is established under section 6.7 of the *Biodiversity Conservation Act 2016*. The purpose of the Biodiversity Assessment Method is to prescribe requirements for the assessment of certain impacts on listed threatened species, populations and ecological communities, areas of outstanding biodiversity value, and key threatening processes

Section 7.3 of the *Biodiversity Conservation Act 2016* provides a test for determining whether proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. Where a significant impact is likely, a Species Impact Statement must be prepared.

The significant impact test applied to threatened species and ecological communities relevant to the proposal is presented in Section 6.5 and . The proposal is unlikely to have a significant impact on any *Biodiversity Conservation Act 2016* listed species, populations or ecological communities.

4.4.5 Biosecurity Act 2015

The primary objective of the *Biosecurity Act 2015* is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers. Division 2 of the Act defines local control authorities for priority weeds and Schedule 1 outlines special provisions relating to weeds, including the duty of land occupiers to control and manage weeds.

Four exotic species identified within the site investigation area are listed as Priority Weeds and Weeds of National Significance.

Environmental safeguards and management measures to control weeds are presented in Section 7.

4.4.6 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* provides for the conservation and management of nature and objects, places and features of cultural value. It is the primary legislation for the protection of Aboriginal cultural heritage in NSW. Part 6 of the *National Parks and Wildlife Act 1974* provides protection for all Aboriginal objects and Aboriginal places in NSW. Under Section 90 of the Act, where harm to an Aboriginal object or Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit is required before the disturbance of Aboriginal objects or places.

The assessment of the proposal's impact on Aboriginal heritage determined that an Aboriginal Heritage Impact Permit would be required for the proposal. This assessment is presented in Section 6.9 and Appendix I.

4.4.7 Heritage Act 1977

The *Heritage Act 1977* provides a mechanism for the protection of items of both local and state non-Aboriginal heritage significance in NSW and establishes the State Heritage Council. Approval from the Heritage Council is required before the potential disturbance or excavation of items, relics and artefacts with historic heritage significance.

There are no listed heritage items within or near the site investigation area.

Further information on non-Aboriginal heritage is presented in Section 6.10.

4.4.8 Crown Lands Management Act 2016

The *Crown Lands Management Act 2016* ensures that Crown land is managed for the benefit of the people of New South Wales and set up requirements for granting a relevant interest over a Crown Reserve including licences, permits, easements or rights of way.

Ministerial approval is required to grant a 'lease, licence, permit, easement or right of way over a Crown Reserve'.

There are no Crown Reserves within the site investigation area, however there are parcels of Crown land that would be impacted by the proposal. The impact of the proposal on Crown lands is assessed in Section 6.3.

4.4.9 Aboriginal Land Rights Act 1983

The *Aboriginal Land Rights Act 1983* recognises the traditional ownership and occupation of the land by Aboriginal peoples and the importance of their connection to land. The Act enables Aboriginal Land Councils in NSW to claim land as compensation for historic dispossession of land and to support Aboriginal communities' social and economic development.

There is one lot of land within the site investigation area on which an Aboriginal land claim has been granted and two lots of Crown land that are subject to Aboriginal land claims under the *Aboriginal Land Rights Act 1983.* Land acquisition requirements for the proposal are discussed in Section 6.3.

4.4.10 Land Acquisition (Just Terms Compensation) Act 1991

The *Land Acquisitions (Just Terms Compensation) Act 1991* applies to the acquisition of land (by agreement or compulsory process) by a public authority authorised to acquire the land by compulsory process. It provides a guarantee that, when a public authority requires the acquisition of land, the amount of compensation will not be less than the market value of the land.

The proposal would require the full acquisition of seven properties and the partial acquisition of 19 properties. Land acquisition requirements for the proposal are discussed in Section 6.3.

4.4.11 Water Management Act 2000

General water management principles are listed under Part 1, Division 1, Section 5 of the *Water Management Act 2000*. Of relevance to the proposal, water sources, floodplains and dependent ecosystems (including groundwater and wetlands) should be protected and restored and, where possible, land should not be degraded. Assessment of the proposal's impact on flooding, surface water and groundwater are presented in Section 6.7 and Section 6.8.

The *Water Sharing Plan for the Clyde River Unregulated and Alluvial Water Sources 2016* applies to the proposal prepared in accordance with Part 3 Division 2 of the Act.

Section 56 of the *Water Management Act 2000* establishes access licences for the taking of water within a particular water management area within a water sharing plan. Under section 18(1) of the *Water Management (General) Regulation 2011*, Transport for NSW, as a roads authority, is exempt from the need to obtain an access licence in relation to water required for road construction and road maintenance.

Under Section 91E of the *Water Management Act 2000* it is an offense to carry out a controlled activity on waterfront land. However, Section 38 of the *Water Management (General) Regulation 2011* deems a public authority exempt from the conditions of Section 91E.

4.4.12 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* establishes a process for investigating, managing and remediating contaminated land and outlines the circumstances in which notification to the Environment Protection Authority is required, such as certain levels of soil contamination, potential to contaminate neighbouring land, presence of friable asbestos and potential surface and groundwater contamination.

There are no registered contaminated sites within the site investigation area. Management of potential unregistered contaminated land that would be impacted by the proposal is discussed in Section 6.6.

4.4.13 Waste Avoidance and Resource Recovery Act 2001

Waste management for the proposal would be carried out in accordance with the *Waste Avoidance and Resource Recovery Act 2001*. This Act establishes a waste hierarchy, which requires that resource management options are considered against a hierarchy of the following order:

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

Other principles and objectives of the *Waste Avoidance and Resource Recovery Act 2001* to be followed by the proposal are to:

- Encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development
- Provide for the continual reduction in waste generation
- Minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste
- Ensure that industry shares with the community the responsibility for reducing and dealing with waste
- Ensure the efficient funding of waste and resource management planning, programs and service delivery
- Achieve integrated waste and resource management planning, programs and service delivery on a State-wide basis
- Assist in the achievement of the objectives of the *Protection of the Environment Operations Act 1997*.

In addition, the *Waste Avoidance and Resource Recovery Strategy 2014-21* (EPA, 2014b) and the NSW Government's Waste Reduction and Purchasing Policy provide guidance on waste management priorities. Transport for NSW's contractors are required to propose recycled-content materials where they are cost and performance competitive and are at least the environmental equivalent of the non-recycled alternatives.

4.5 Commonwealth legislation

4.5.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999*, a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land.

A referral is not required for proposed road activities that may affect nationally listed threatened species, endangered ecological communities and migratory species as the requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the *Environment Protection and Biodiversity Conservation Act 1999* by the Australian Government in September 2015.

The aspects of the proposal relevant to the *Environment Protection and Biodiversity Conservation Act 1999* are considered in Section 6.5 and Appendix F.

Findings – matters of national environmental significance

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Agriculture, Water and Environment under the *Environment Protection and Biodiversity Conservation Act 1999*.

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

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

4.5.2 Native Title Act 1993

The *Native Title Act 1993* recognises and protects native title. This Act covers actions affecting native title and the processes for determining whether native title exists and compensation for actions affective native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register. Under the *Native Title Act 1993*, a future act includes proposed public infrastructure on land or waters that affects native title rights or interest.

A search of the following was carried out on 20 April 2020 for the Shoalhaven local government area:

- Register of Native Title Claims
- Native Title Register
- Register of Indigenous Land Use Agreements

- Native Title applications and determinations database.

The results indicated that the Native Title Claim NC2017/003 - South Coast People (decision date 31/1/2018) is located across the site investigation area. This claim extends from Sydney, following the coastline south to Eden.

4.6 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road intersection upgrade and is being carried out by Transport for NSW. Under clause 94 of *State Environmental Planning Policy (Infrastructure) 2007*, the proposal is permissible without consent.
The proposal is not State significant infrastructure or State significant development.
The proposal can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*.

Transport for NSW is the determining authority for the proposal. This review of environmental factors fulfils Transport for NSW's obligation under section 5.5 of the *Environmental Planning and Assessment Act 1979* including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

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5 Consultation

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

5.1 Consultation strategy

The *Communications and Stakeholder Engagement Plan* (Transport for NSW, 2020d) for the proposal was developed in alignment with the *Future Transport Strategy 2056* (NSW Government, 2018a), which aims to deliver projects that are convenient and responsive to the needs of customers.

Two community consultation activities have been carried out on the proposal including on the strategic options assessment and the preferred corridor.

The purpose of the consultation of the strategic options report was to:

- Understand what the community values most when it comes to an upgraded intersection
- Inform local communities and stakeholders of potential upgrade options and benefits
- Inform local communities and stakeholders of the next steps and timeframes of the project
- Obtain feedback and understand initial concerns of adjacent and nearby property owners and transport users
- Build a database of interested community members and groups
- Acknowledge and be sensitive to potential hardships concerning the personal and economic effects of drought, bushfires and the COVID-19 outbreak
- Consult with emergency services and associated agencies
- Provide feedback to the community on how their input will be considered during the development of the proposal.

The purpose of the consultation of the preferred option report was to:

- Inform the wider community of the preferred option, its benefits, and the reasons it was identified
- Inform the community of how the project aligns with the Princes Highway upgrade
- Enable community and stakeholders to easily have their say
- Adapt to COVID-19 restrictions, providing a range of digital and traditional ways for the community to engage with the project team
- Gather quality feedback to help inform the design of the project
- Gain more insight into identified and potential community issues
- Acknowledge nearby residents and businesses, by contacting nearby properties immediately after the announcement informing them of the preferred option and what it means to be near a project study area.

During public display of this review of environmental factors, members of the public and stakeholders will have further opportunities to provide feedback on the proposal as described in Section 5.6.

5.2 Community involvement

Due to social distancing requirements as a result of the COVID-19 outbreak, consultation was carried out online or at a distance where possible. A summary of submissions received from the community is presented in Table 5-1.

5.2.1 Strategic option assessment consultation

Consultation on the strategic option assessment included:

- A web portal with interactive maps and up to date information on the Princes Highway upgrade, located at http://princeshighway.nsw.gov.au/
- A website with targeted information on the intersection upgrade and potential options nswroads.work/jervisbayroad
- Briefings with Shoalhaven City Council, government agencies (refer to Section 5.5) and community groups in March and April 2020
- A dedicated email address and information phone line for the project, which enabled community members to contact Transport for NSW with feedback or questions
- Printed reply-paid surveys were distributed in March 2020
- Postcards were sent to all households in the Jervis Bay area in March 2020 to inform community members that project feedback was being invited
- A media release was issued and media event was held on 16 March 2020 to update the community on the progress of the project and to seek feedback
- Print and digital advertising was used to inform the community of the project and encourage feedback
- A frequently asked questions information sheet published in March 2021 on the project website listed above
- Four separate social media posts targeted towards the Jervis Bay community, published throughout March and April 2020
- Three emails to stakeholders and subscribed community members were sent throughout March and April 2020
- A Facebook Livestream Q&A event held on 6 April 2020. This event was previously planned as a community drop-in session, but was moved online due to the COVID-19 pandemic.

A community consultation summary was released to the community, explaining how their feedback was considered in identifying the strategic option. Responses to community feedback on the strategic options can be found in *Jervis Bay Road and Princes Highway Intersection Upgrade Strategic Intersection Treatment Options Community Consultation Report* available at nswroads.work/jervisbayroad.

5.2.2 Preferred option assessment consultation

Consultation on the preferred option assessment included:

- Update of the web portal and interactive maps and up to date information on the preferred option, located at http://princeshighway.nsw.gov.au/
- Update of the website with targeted information on preferred option nswroads.work/jervisbayroad
- Briefings with Shoalhaven City Council, government agencies (refer to Section 5.5) and community groups in November and December 2020

- A dedicated email address and information phone line for the project, which enabled community members to contact Transport for NSW with feedback or questions
- Display of the preferred options report at Nowra Library and Sanctuary Point Library
- Posters and have-your-say forms at Nowra Library and Sanctuary Point Library
- Postcards were sent to all households in the Jervis Bay area in November 2020 to inform community members that project feedback was being invited
- A media release was issued and media event was held on 25 November 2020 to update the community on the progress of the project and to seek feedback
- Print and digital advertising was used to inform the community of the project and encourage feedback
- A four page community update, summarising the preferred option report including benefits and features, was published on the project website and placed at local libraries
- A frequently asked questions information sheet published on the project website and placed at local libraries in November 2020
- Four separate social media posts targeted towards the Jervis Bay community, published throughout November and December 2020
- A Facebook Livestream Q&A event held on 4 December 2020. This event was previously planned as a community drop-in session, but was moved online due to the COVID-19 pandemic
- Three emails to stakeholders and subscribed community members were sent throughout November and December 2020.
- A community consultation summary has been released to the community, explaining how their feedback of the preferred option was considered in finalising the environmental assessment and concept design. Responses to community feedback on the strategic options can be found in *Jervis Bay Road and Princes Highway Intersection Upgrade Preferred Option Community Consultation Report* available at nswroads.work/jervisbayroad*.*

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

Issue raised	Response/where addressed in the review of environmental factors
General feedback expressing support for the proposal	Transport for NSW has noted this feedback.
Concern relating to the ability of Transport for NSW to complete the proposal	In March 2019, the Australian and NSW Governments committed to upgrading the Princes Highway between Nowra and the Victorian Border. The upgrade of Jervis Bay Road intersection was announced as a priority project and Transport for NSW is committed to developing the proposal. Proposal duration is discussed in Section 3.4.
Comments about option selection and strategic alternatives	Transport for NSW have considered a range of factors during the planning phase to assess and identify a preferred option including safety, functionality, environmental impact, future growth, future transport use and cost. Strategic alternatives (Transport for NSW, 2020a) and preferred options (Transport for NSW, 2020b) were identified and assessed in 2020 to better understand the factors that may influence the feasibility of different intersection options. This process is described in Section 2.
Queries about the need and benefit of roundabouts included in the proposal concept design	Roundabouts are proposed on either side of the intersection to further reduce the likelihood of accidents and provide safer connectivity for all transport users with local roads and the highway entry and exit lanes. Traffic modelling carried out for the proposal shows that road users would experience reliable and uncongested movement at the roundabouts. The roundabouts would also improve the transport network's resilience during emergency events. The *Preferred Options Report* (Transport for NSW, 2020b) details the analysis carried out for the inclusion of roundabouts in the preferred option design. Alternatives considered for the proposal including roundabouts are discussed in Section 2.4.
Support for traffic signals as an alternative preferred option	Transport for NSW assessed a range of alternative options, including traffic signals. Traffic signals did not progress as the preferred option as they would not achieve the safety and traffic efficiency objectives of the proposal. Consideration of alternative options is provided in the *Preferred Options Report* (Transport for NSW, 2020b). Alternatives considered for the proposal including traffic signals are discussed in Section 2.4.
Comments about the cost and effectiveness of the proposal	Transport considers a range of factors during the planning phase to identify and assess alternative options. This includes a cost analysis and assessments into safety, functionality, environmental impact, future growth and future land and transport use. This has been considered in the selection of the preferred option (Transport for NSW, 2020b), development of the concept design and assessment of environmental impacts.

Issue raised	Response/where addressed in the review of environmental factors
Comments about the consistency of the proposal with the Princes Highway corridor strategy	The *Princes Highway Corridor Strategy* (Australian Government, 2019) provides a 'whole-of-corridor' perspective of the current and future role of the Princes Highway Corridor (the Corridor), underpinned by economic, social and environmental factors as well as the principle of Movement and Place. The proposal would support the vision of the strategy by improving the intersection safety and providing efficient driving conditions and promoting better access and road connectivity. Consistency of the proposal with the *Princes Highway Corridor Strategy* vision is discussed in Section 2.1.
Comments about the proposal need and justification	The strategic need for the proposal is described in Section 2.1.
Queries about the construction elements of the proposal and construction timeframes	A description of the proposal construction is provided in Section 3.
Comments on the consultation process	The consultation process is described within this section.
Comments on placemaking and urban renewal	A key objective of the Princes Highway upgrade is to grow regional economies through improved access and connectivity between regional centres. To achieve this, Transport for NSW has worked and will continue working with key stakeholders to understand placemaking opportunities for town centres connected to the Princes Highway as we develop the highway upgrade.
Comments that environmental impacts should be reduced where practicable and appropriately mitigated	Minimise impacts to areas of environmental sensitivity is a key objective of the proposal. The environmental impacts of the proposal, including safeguards and management measures to reduce these impacts, are discussed in Section 6 and Section 7.
Comments that the intersection upgrade is crucial for sustained growth of the Shoalhaven, and will serve the growing community and tourist demand in the region	A key objective of the proposal is to improve transport network efficiency and connectivity to support regional economic development, tourism and freight. This was a key consideration when selecting the preferred option as discussed in Section 2. This review of environmental factors further assesses the socio-economic impacts and benefits of the proposal, as provided in Section 6.4 and Appendix E.
Comments that existing traffic and transport conditions at the intersection should be improved.	Improving existing conditions is a key priority for the proposal.

Issue raised	Response/where addressed in the review of environmental factors
Comments regarding importance of the intersection upgrade in improving freight access and transportation	The traffic and transport assessment carried out for the proposal is detailed in Section 6.1 and Appendix Cand demonstrates how the proposal would improve the performance of the intersection.
Comments regarding importance of improving safety performance of the intersection	Transport for NSW has noted the concerns and suggestions relating to the safety of the intersection, local roads and driveways and have considered these through design development and assessment of traffic and transport impacts. Transport is developing a whole-of-transport design to ensure all transport users are considered during the development of the proposal. User groups include drivers of various vehicle classes, cyclists, pedestrians, public and private transport users and ride share users. Further detail is provided in the traffic and transport assessment in Section 6.1 and Appendix C.
Request for further information about property access	Access to all properties would be maintained throughout construction. Changes to property access during operation are discussed in Section 6.1 and Appendix C.
Concern that travel time and congestion would significantly increase during construction	Temporary traffic signals are expected to be used during construction for Jervis Bay Road east approach traffic, southbound Princes Highway traffic and northbound traffic turning right into Jervis Bay Road. This would allow priority movement to right turning Jervis Bay Road east approach traffic and reduce substantial delays. Construction traffic and transport impacts are discussed in Section 6.1 and Appendix C.
Comments and suggestions about incorporating public and active transport into design	Shared user paths, cycle lanes and a new bus bay (including kiss and ride spots) have been incorporated into design, as shown in Figure 3-2, Figure 3-3 and Figure 3-4. During development of the proposal, consideration was given to the potential future need for a multi-modal interchange at the new bus bay location, dependant on future customer service needs and travel patterns. A space-proofing assessment was completed to ensure a multi-modal interchange could be provided in the future should the need be identified. Transport for NSW is currently developing a Public Transport Services Plan for the Princes Highway Upgrade Program and will continue to consult with transport operators and active transport users as the proposal design is progressed.
Comments about importance of the intersection upgrade in improving freight access and transportation	Enabling more efficient movement of freight is a key objective of the proposal and Transport for NSW notes this feedback. Transport for NSW will continue to work with key stakeholder groups to understand the needs of heavy vehicles and freight and ensure these concerns are considered in the development of the proposal design.

Issue raised	Response/where addressed in the review of environmental factors
	Heavy vehicle movements have been considered in the traffic and transport assessment (Section 6.1 and Appendix C). A socio-economic assessment has been prepared (Section 6.4 and Appendix E) that considers the proposal's impacts and benefits to the regional economy, including higher productivity freight transport.
Concern about biodiversity impacts of the proposal	The proposal has been designed to minimise the clearance of native vegetation by maximising the use of the existing road corridor and cleared land. A biodiversity assessment has been carried out (Section 6.5 and Appendix F) to identify biodiversity impacts for the proposal. Mitigation and management measures would be carried out during design, construction and operation of the proposal to manage biodiversity impacts.
Comments about the importance of Aboriginal cultural heritage in the region and the need for consultation with the Aboriginal community	Transport for NSW acknowledges the importance of Aboriginal cultural heritage in the Shoalhaven and the wider Princes Highway corridor. An Aboriginal cultural heritage assessment has been carried out for the proposal (refer to Section 6.9 and Appendix I). The Aboriginal community consultation process carried out for this cultural heritage assessment is detailed in Section 5.3.
Concern about water quality impacts downstream of the proposal	Water quality impacts as a result of construction and operation of the proposal have been assessed and environmental management measures have been developed to manage identified impacts. Refer to Section 6.7 and Appendix H.
Concern about bushfire and incident resilience	Improved resilience is one of five key goals identified in the 20 year roadmap for the Princes Highway upgrade program. This would deliver a highway corridor that can be efficiently managed and maintained while adapting to changing social, environmental and economic factors including the ability to quickly recover from natural disasters and respond to changing land use and technologies. Consultation with Emergency Services have been carried out and will continue during the development of the proposal to identify opportunities to improve the management of the transport network during emergencies or major incidents.
Queries about how impacts to amenity would be managed for nearby residents	Minimising impacts to the community is a key objective of the proposal. Potential noise and vibration, visual amenity and air quality impacts are presented in Section 0, Section 6.11, Section 6.12, Appendix D and Appendix J. Environmental management measures have been developed to manage impacts during construction and operation.

Issue raised	Response/where addressed in the review of environmental factors
Comments about impacts to businesses and local property owners	Nearby businesses and owners and tenants of potentially directly affected properties were informed of the preferred option after the announcement in November 2020. Potentially directly affected properties are discussed in Section 6.3. Property owners or tenants impacted by the proposal have been contacted directly and Transport for NSW will continue working closely with these people to support them throughout the proposal development. Transport for NSW will also continue to consult with nearby business owners to provide support throughout the proposal development. A socio-economic assessment has been prepared (Section 6.4 and Appendix E) that considers the proposal's impacts and benefits to nearby businesses.
Comments or requests for upgrades or improvements that are outside the scope of the proposal	Transport for NSW notes this feedback is outside the scope of the proposal. Where relevant, feedback has been shared with the agency responsible for the work.

5.3 Aboriginal community involvement

Consultation with Aboriginal stakeholders for the proposal has been carried out in accordance with the *Procedure for Aboriginal Cultural Heritage Consultation and Investigations* (PACHCI) (Roads and Maritime Services, 2011) and the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (the Consultation Requirements) (DECCW, 2010).

In August 2020, representatives of the Jerrinja and Nowra local Aboriginal land councils, as well as a South Coast Native Title claimant representative, participated in an archaeological survey as part of the PACHCI Stage 2 Aboriginal heritage assessment for the proposal. The representatives were also given the opportunity to provide input on cultural significance of the area.

As the survey identified potential for impacts on Aboriginal heritage values, Transport for NSW commenced consultation requirements in accordance with PACHCI Stage 3 and the Consultation Requirements. This process included the following:

- Transport for NSW contacted relevant organisations on 24 July 2020 requesting the details of Aboriginal people who may hold cultural knowledge relevant to determining the Aboriginal significance of Aboriginal objects and/or places within the proposal construction footprint
- Letters were sent by Transport for NSW on 11 August 2020 to all parties identified in the above step inviting them to participate in the assessment of the proposal
- Nine newspaper advertisements were placed by Transport for NSW on 28 to 31 July 2020 inviting participation of Aboriginal people who may hold cultural knowledge relevant to determining the Aboriginal significance of Aboriginal objects and places within the local area
- In response to the letters and advertisements, a total of 53 Aboriginal parties registered for consultation on the proposal
- An invitation to attend an Aboriginal focus group meeting was sent on 11 November 2020 to all registered Aboriginal parties. At the same time, a copy of the draft test excavation methodology was sent, requesting comments to be submitted by 9 December 2020. At the end of the review period, no registered Aboriginal parties had provided comment on the draft test excavation methodology
- An Aboriginal focus group meeting was held on 1 December 2020 to present the proposal, the details of the previously completed archaeological assessment (PACHCI Stage 2 report) and to discuss the test excavation methodology. The six attendees at the meeting indicated that they had no comment on the proposed approach. A representative from Heritage NSW in attendance provided comment on the test excavation methodology
- A copy of the Aboriginal focus group meeting PowerPoint presentation and minutes were issued to all registered Aboriginal parties on 4 December 2020
- Following completion of the review period on 9 December 2020, the test excavation methodology was finalised. A copy of the archaeological methodology was provided to Heritage NSW for their review on 30 November 2020
- Heritage NSW was notified of the start date of the archaeological test excavation on 30 November 2020
- All registered Aboriginal parties were notified of the start date for test excavations on 1 December 2020. Nine groups expressed interest in participating in the test excavation programme

- Archaeological test excavation was carried out on 15 and 16 December 2020. Representatives from three registered Aboriginal parties participated in the test excavation program
- A copy of the draft archaeological test excavation report and the draft Aboriginal cultural heritage assessment report, as well as an invitation to attend an Aboriginal focus group meeting, were sent to registered Aboriginal parties on 25 February 2021, with comments requested by 1 April 2021
- An Aboriginal focus group meeting was held on 19 March 2021 to present the proposal, the details of the previously completed test excavation and to discuss the draft Aboriginal cultural heritage assessment report (PACHCI Stage 3 report). Feedback on the draft Aboriginal cultural heritage assessment report from the five attendees at the meeting included showing Local Aboriginal Land Council boundaries on figures, describing artefact storage processes and including site officer reports. A representative from Heritage NSW was also in attendance
- A copy of the Aboriginal focus group meeting PowerPoint presentation and minutes were issued to all attendees and registered Aboriginal parties on 29 March 2021.

Registered Aboriginal parties' feedback on the draft archaeological test excavation report and the draft Aboriginal cultural heritage assessment report have been taken into account for the completion of these reports which are presented in Appendix I.

Consultation with the Aboriginal community will be ongoing as the proposal progresses.

5.4 State Environmental Planning Policy (Infrastructure) 2007 consultation

Under clauses 13 to 16 of the *State Environmental Planning Policy (Infrastructure) 2007*, Transport for NSW may be required to consult with the local council about potential impacts on council-related infrastructure or services, local heritage or flood liable land, or with other specified public authorities for particular development types, for a consultation period of 21 days.

5.4.1 Shoalhaven City Council

The proposal would require works that involves more than minor or inconsequential excavation of the surface of a road for which Shoalhaven City Council is the roads authority under the *Roads Act 1993* (ie works at Willowgreen Road, Jervis Bay Road and Old Princes Highway). Transport for NSW has consulted with Shoalhaven City Council in accordance with clause 13(1)(f) of the *State Environmental Planning Policy (Infrastructure) 2007* via a letter dated 26 April 2021.

A summary of issues raised is outlined in Table 5-2.

Table 5-2 Summary of issues raised through Shoalhaven City Council *State Environmental Planning Policy (Infrastructure) 2007* consultation

Issue raised	Response/where addressed in the review of environmental factors
Council noted its support of the proposal	Council support is acknowledged.
Request for 'works as executed' plans to be completed to Council's engineering specifications	'Works as executed' plans will be completed to Transport for NSW specifications. Transport for NSW would continue consultation with Council throughout the proposal lifecycle, as discussed in Section 5.6 below.

Request for information on the lifecycle of the asset	As provided in Section 3.2, the proposal design life would be as follows:
	• Pavement design life – 40 years
	• Design life of major structures – 100 years
	• Drainage design life
	  ○ Accessible for refurbishment – 40 years
	  ○ Inaccessible – 100 years
	Further information in relation to asset quantities can be provided to Council as the proposal progresses.

Request to delineate maintenance responsibility	Responsibility of road maintenance would remain unchanged, with Transport for NSW responsible for the Princes Highway, and Council responsible for local roads and Jervis Bay Road. Transport for NSW would continue to consult with Council to define exact limits as the proposal progresses.
Request for involvement during design, construction and operation of the proposal	Transport for NSW would continue consultation with Council throughout the proposal lifecycle, as discussed in Section 5.6 below.
Request for information regarding proposed stormwater infrastructure and any interaction with threatened species habitat	Section 3.2.2 provides a description of proposal drainage structures and permanent water quality measures. Section 6.7 and Appendix H discusses flood impacts of the proposal. Section 6.5 and Appendix F discusses biodiversity impacts of the proposal.
Request for environmental assessment details to be provided when available	As discussed in Section 5.6, Council is invited to make written submissions on the proposal during the public display of this review of environmental factors.
Shared path or cyclist facilities along the highway and connection	As described in Section 3.2.2, a shared user path network is proposed to separate active transport users (pedestrians and cyclists) from the vehicle movements along Jervis Bay Road and at the roundabouts. Additionally, the proposal includes three metre wide shoulders along the Princes Highway on and off-ramps for cyclist use.

Issue raised	Response/where addressed in the review of environmental factors
of this infrastructure to the proposed Jervis Bay Road	
Concern about the Nowra Bombaderry congestion and the Princes Highway from South Nowra to Jervis Bay Road, and suggestion to extent the proposal to include this section of road	Transport for NSW notes this feedback is outside the scope of the proposal.
Concern about the need for entering northbound traffic to merge onto the Princes Highway, and suggestion to provide a dedicated lane for entering traffic	Traffic modelling confirms that the northbound carriageway of the Princes Highway has a low degree of saturation, indicating that merging vehicles can find a gap in traffic. Section 6.1 and Appendix C discuss the traffic and transport impacts of the proposal Mutual sight distance is provided as required by Austroads.
Concern about the merge lane length and consideration of high volume of traffic and high speed environment	The merge lane has been designed as a simple merge to comply with *Austroads Guide to Road Design Part 4C* (Austroads, 2015). Design refinements to the entry ramp may be considered at detailed design.
Concern about property access on Jervis Bay Road between the intersection and Gardner Road and request for the proposal to extend further along Jervis Bay Road	The existing Jervis Bay Road between the limit of works and Gardner Road right turn lane is built to a similar standard that matches the proposed Jervis Bay Road cross section closely. The standard of access of the driveways within the proposal construction footprint would be reconnected to the proposed new alignment, at the same standard as the existing driveways in this area. Impacts to property access has been considered in the traffic and transport assessment (Section 6.1.3 and Appendix C).
Concern the intersection of Willowgreen Road and the Old Princes Highway has not adequately considered sight distances and large vehicles (such as buses) that use this road	The intersection of Willowgreen Road and the Old Princes Highway has been designed for an 8.8 metre service (checking vehicle: 19 metre semi-trailer) Refer to Section 3.2. Sight distances have been checked during design development. Transport for NSW will continue to refine the design as the proposal progresses.
Request for the Willowgreen Road bus stop to be relocated	The proposal provides a bus bay adjacent to the interchange, as described in Section 3. Consultation with bus service providers would be undertaken as the proposal progresses.

Issue raised	Response/where addressed in the review of environmental factors
Clarification of the Lot 2 and 3 DP244495 property access road configuration	The northeastern property access would be via a left in left out treatment onto Jervis Bay Rad. To access the Princes Highway from the property access, vehicles would continue on Jervis Bay Road eastbound, then turn right into Gardner Road and loop back to the Princes Highway via Mortimer Road.
Clarification of the bus bay access road configuration, and request for sight distances to be addressed to ensure safety of the proposed bus bay access road and Jervis Bay Road intersection	As described in Section 3.2.2, the proposed bus bay would be accessed via a one way road connected from the southbound on-ramp and exit to Jervis Bay Road. The access road connection at Jervis Bay Road would be left turn on, with traffic continuing to the double roundabout interchange for full connectivity. Sight distances have been checked during design development. The proposed two metre shoulder and three metre shared path along Jervis Bay Road westbound ensures clear sight lines for exiting traffic.
Suggestion to expand the bus bay to cater for general park and ride	As described in Section 3.2.2, the proposed bus bay would include adequate space for two buses and two vehicle kiss and ride spots. A park and ride facility is not part of the proposal, however a space-proofing assessment has been completed to ensure the area can cater for future expansion.
Lighting needs to be provided at the bus bay	With reference to Table 3-2, lighting would be provided at the new bus bay and along shared paths leading to the bus bay.
Council noted its support of the inclusion of shared user paths and highlighted a need cyclist safety to be addressed as part of the proposal	Council support is acknowledged. Shared user paths and active transport impacts are discussed in this review of environmental factors in Section 3.2.2 and Section 6.1.
Council noted the opportunity to provide an eye-catching and landscaped entry treatment given the significance of the intersection to the entrance of the Jervis Bay territory	Entranceway signage will be considered as the design progresses. Transport for NSW would consult with Council during this process.

5.4.2 State Emergency Service

The proposal would also require development on land that is susceptible to flooding by the probable maximum flood event. Accordingly, Transport for NSW has consulted with the State Emergency Service in accordance with clause 15AA of the *State Environmental Planning Policy (Infrastructure) 2007* via a letter dated 26 April 2021.

In their response, the State Emergency Service noted the proposed works would have minimal risk to their response operations and did not request further consultation or information.

5.5 Government agency and stakeholder involvement

Transport for NSW held briefings and provided notification to the following government agencies and stakeholder groups to inform them of the proposal and seek feedback on the preferred option:

- Department of Planning, Industry and Environment
  - Engagement during the proposal value management workshop in September 2020
  - Notification of the selection of the preferred option for the proposal on 25 November 2020
  - Consultation meeting on the flood modelling approach and potential impacts on flooding and flood liable land on 10 December 2020
- Shoalhaven City Council
  - Engagement during the proposal value management workshop in September 2020
  - Notification of the selection of the preferred option for the proposal on 25 November 2020
  - Consultation meeting on the proposal impacts on flooding and flood liable land on 10 December 2020
  - Project update meeting on 30 April 2021.
- Utility providers – Telstra, Optus, Endeavour Energy and Shoalhaven Water
  - Various meetings and correspondence related to utility protection and relocation
- NSW Police
  - Engagement during the proposal value management workshop in September 2020
- Vincentia Matters, an association of residents from Vincentia and surrounding townships committed to advocating for improvements to their community
  - Consultation meeting on 8 December 2020 to address questions about the preferred option.

A summary of issues that have been raised as a result of consultation with these agencies and stakeholders are outlined in Table 5-3.

Table 5-3 Summary of issues raised through government agency and stakeholder consultation

Agency / stakeholder	Issue raised	Response/where addressed in the review of environmental factors
Department of Planning, Industry and Environment	Requested further opportunity to discuss biodiversity considerations of the proposal	Further consultation with agencies would be carried out during the public display period as discussed in Section 5.6 below.

Agency / stakeholder	Issue raised	Response/where addressed in the review of environmental factors
	The proposal will need to address the "avoid, minimise and offset" framework of the NSW *Biodiversity Conservation Act 2016*	The "avoid, minimise and offset" framework has been considered throughout development of the proposal, as discussed in the Biodiversity Assessment Report (Appendix F).
	Recommendation that Transport for NSW opt in to use of the biodiversity offset scheme under the *Biodiversity Conservation Act 2016* (s7.11 and 7.15) and prepare a Biodiversity Development Assessment Report to assess impacts on biodiversity	A Biodiversity Assessment Report has been prepared for this proposal to assess impacts on biodiversity. As the proposal is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994,* a Biodiversity Development Assessment Report is not required. Offsetting required as a result of the proposal is discussed in Section 6.5 of this review of environmental factors and the Biodiversity Assessment Report (Appendix F).
	Further consideration of ecological constraints is required to better achieve the "avoid, minimise and offset" framework of the *Biodiversity Conservation Act 2016*, including consideration of: • High environmental value vegetation and biodiversity corridors • Threatened ecological communities and threatened species listed under NSW and Commonwealth legislation • Serious and Irreversible Impact (SAII) entities • Areas important for wildlife connectivity • Hollow-bearing trees.	A Biodiversity Assessment Report has been completed for the proposal that considers key ecological constraints and impacts of the proposal (Section 6.5 and Appendix F).
	Request for further information about flood modelling and reporting carried out for the proposal to shape an informed view on its reliability and robustness	Further information about flood modelling and reporting was provided to the Department of Planning, Industry and Environment and discussed during a meeting on 10 December 2020. Section 6.7 and Appendix H of this review of environmental factors discusses flood impacts of the proposal.
Shoalhaven City Council	Council enquired whether onsite detention basins would be required, and noted the requirements of	Current flood investigations (Section 6.7 and Appendix H) have determined that onside detention basins would not be

Agency / stakeholder	Issue raised	Response/where addressed in the review of environmental factors
	Chapter G2 of the *Shoalhaven Development Control Plan 2014* and Section 73 of the *Shoalhaven Local Environmental Plan 2014* would apply if required.	required for the proposal. This would be confirmed during detailed design development and Council would be consulted as required.
	Council supports the current proposed concept design, in particular: - The priority given to the Princes Highway as the pre-eminent carriageway proving access to/from the South Coast - The design addresses the needs of all user groups, especially freight vehicles, employees commuting to/from employment, residents and holiday visitors	Council support is acknowledged.
	Ensure cyclists are catered for in the design, including safe access through the proposed upgraded intersection traversing in all directions of travel	Providing integrated active transport options is a key objective of the proposal. The proposal includes shared user paths and cycle lanes, as shown in Figure 3-2, Figure 3-3 and Figure 3-4. Active transport has been considered in the traffic and transport assessment (Section 6.1 and Appendix C).
	Suggestion to address the High Mass Limit restriction on the existing Currambene Creek northbound bridge as part of this proposal. Suggestion of a need to alleviate congestion associated with other locations along the Princes Highway, including: - The signalised Princes Highway and Bolong Road intersection - Suggestion to plan and construct six continuous lanes from Bomaderry to South Nowra	Transport for NSW notes these suggestions are outside the scope of the proposal.
	Suggestion of further investigation into a “park and ride” facility adjacent to this intersection	Investigations into the provision of park and ride facilities at the intersection are ongoing, however these facilities do not form part of the proposal. A space-proofing assessment was completed to ensure park and ride facilities could be provided in the future should the need be identified.

Agency / stakeholder	Issue raised	Response/where addressed in the review of environmental factors
	Suggestion that any changes to design plans, (eg landscape plans) after the display of a review of environmental factors should be better communicated with Council and the community	Council suggestion is acknowledged and would be actioned as required.
	Council noted that the most demand for the bus bay is from vehicles travelling south, and therefore access arrangements should cater for this	Vehicles travelling in any direction would be able to access the new bus bay and kiss and ride facilities via an exit from the roundabout interchange southbound on-ramp, as discussed in Section 3.2.2.
	Concern regarding transfer of congestion from Jervis Bay Road to the Princes Highway	Congestion associated with Jervis Bay Road is due to the continuous oncoming southbound Princes Highway traffic not allowing safe right hand turn movements from Jervis Bay Road onto the Princes Highway northbound. The proposed double roundabout interchange eliminates this conflict point.
Utility providers	Endeavour Energy noted the impacts of the proposal on existing infrastructure and the preference for infrastructure to be relocated underground, as overhead assets are not preferable in bushfire prone areas or where there are property constraints.	The proposal concept design specifies underground relocation of Endeavour Energy assets. Transport for NSW would continue consultation with Endeavour Energy throughout detailed design of the proposal.
	Optus noted the impacts of the proposal on existing infrastructure and provided comments for consideration during the detailed design phase, including preferred construction techniques.	Transport for NSW would continue consultation with Optus throughout detailed design of the proposal and development of the construction methodology.
	Telstra noted there may be third party services (such as NBN) that use their pits and pipes. Telstra are carrying out a utilities impact identification study to confirm direct proposal impacts.	The results of Telstra's utilities impact identification study would be considered during detailed design. Transport for NSW would continue consultation with Telstra, and other identified third party services providers (as required), throughout detailed design of the proposal and development of the construction methodology.
	Shoalhaven Water has reviewed the concept design, providing comments for consideration during the detailed design phase. Shoalhaven Water noted the importance of ensuring any temporary service connections are carried out	Transport for NSW would continue consultation with Shoalhaven Water throughout detailed design of the proposal and development of the construction methodology.

Agency / stakeholder	Issue raised	Response/where addressed in the review of environmental factors
	after appropriate customer notification time.	
NSW Police	NSW Police were supportive of the proposed intersection upgrade and noted the importance of upgrading the intersection to improve emergency resilience and safety for road, active and public transport users.	NSW Police support is acknowledged. Increased resilience and improved safety at the intersection are two of the key objectives of the proposal.
Vincentia Matters	A petition from Vincentia Matters including over 14,000 signatures was presented to NSW Parliament in September 2020. The petition requested that a flyover option be built at the Jervis Bay Road and Princes Highway intersection. After release of the preferred option in November 2020, Vincentia Matters was generally supportive of the preferred option.	Vincentia Matters support is acknowledged. The proposed grade separation of the Princes Highway provides uninterrupted through movements for the Princes Highway. This allows for safe and efficient movement to and from Jervis Bay Road and Old Princes Highway via the at-grade double roundabout interchange.

5.6 Ongoing or future consultation

Transport for NSW would continue to consult with the community, Shoalhaven City Council and relevant stakeholders during detailed design and construction of the proposal.

5.6.1 Consultation during public display of the review of environmental factors

This review of environmental factors will be advertised and placed on public display for a period of not less than four weeks at the following locations:

- Digital version available on the Transport for NSW website at nswroads.work/jervisbayroad
- Printed version available at:
  - Nowra Library, Nowra
  - Sanctuary Point Library, Sanctuary Point
  - Services NSW, South Nowra
  - Council Office, Nowra
  - Visitors Information Centre, Maritime Museum, Huskisson
- Staffed displays held at (Note: Bookings are essential. Visit website above for session and booking details):
  - Tuesday 6 July, 2pm to 6pm at the Huskisson Community Centre, Huskisson
  - Thursday 8 July, 9am to 12pm, Vincentia Public Hall, Wood Road, Vincentia
  - Saturday 10 July, 8am to 12pm, Falls Creek Public School
  - Sunday 11 July, 8am to 1pm, Huskisson Markets, Huskisson sports ground.

During the display of this review of environmental factors, the community, government agencies and other interested parties are invited to make written submissions on the proposal to Transport for NSW.

A range of consultation activities would be carried out in accordance with the *Communications and Stakeholder Engagement Plan* (Transport for NSW, 2020d) and would include:

- Stakeholder and government agencies briefings
- Meetings with directly affected property owners
- Community information sessions
- Letter box drops
- Website updates.

After the display of the review of environmental factors, Transport for NSW will prepare a submissions report to summarise and respond to the issues raised and detail any design changes deemed necessary to properly address issues raised. The submissions report will be published on the project website. All submissions will be formally considered and responses provided in the submissions report.

5.6.2 Consultation during detailed design and construction

After the review of environmental factors display period and continuing into the detailed design and construction phase of proposal, Transport for NSW would continue to identify and manage issues of interest or concern to the community and other stakeholders. The aims of ongoing communications and consultation are to provide the community with:

- Accurate and accessible information about the processes and activities associated with the proposal
- Information in a timely manner
- Appropriate avenues for providing comment or raising concerns, and to ensure they are aware of the avenues
- A high level of responsiveness to their issues and concerns throughout development and delivery of the proposal.

After determination, the community would continue to be updated about the progress of construction and provided notification of any road closures or night works in advance of the works occurring. A Community and Stakeholder Engagement Plan would be developed and implemented by the construction contractor, as detailed in Section 7, to effectively manage consultation during the construction stage of the proposal.

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6 Environmental assessment

This section of the review of environmental factors provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal.

All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999*
- The factors specified in the guidelines *Is an EIS required?* (DUAP 1995/1996) as required under clause 228(1) of the *Environmental Planning and Assessment Regulation 2000* and the *Roads and Related Facilities EIS Guideline* (DUAP 1996). The factors specified in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000* are also considered in Appendix A.

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

6.1 Traffic and transport

This section provides an assessment of the potential impacts of the proposal on traffic and transport and identifies safeguards and management measures to avoid or minimise these impacts. A detailed assessment of traffic and transport impacts is presented in Appendix C.

6.1.1 Methodology

The traffic and transport impact assessment included the following:

- Collection and analysis of traffic data
    - Traffic surveys were carried out in January 2019, June 2019, December 2019[2], January 2020[2] and January 2021[3] to inform holiday peak period demand and typical morning and afternoon peak period demand
    - Three types of data were used, including:
        - Midblock traffic counts, collected using Automatic Tube Counters
        - Intersection classified turning movement counts (including light and heavy vehicles, cyclists and pedestrians)
        - Intersection queue length surveys
- Develop a base case strategic traffic model
    - The existing conditions base case SIDRA models were developed for both typical commuter conditions and holiday peak conditions with 2019 as the base year
- Characterise existing traffic and transport conditions
    - Identify existing road infrastructure and heavy vehicle routes within the study area
    - Describe and analyse road safety and crash history based on crash data collected over the last ten years
    - Characterise commuter mode share based on information from the Australian Bureau of Statistics
    - Model year 2019 level of service at key intersections within the study area under typical morning (AM) peak period, afternoon (PM) peak period and holiday peak period traffic conditions
    - The AM peak period is from 7.30am to 8.30am; the PM peak period is from 3.30pm to 4.30pm; and the holiday peak period is from 3.00pm to 4.00pm for 2019 data and from 10.45am to 11.45am for 2021 data
    - Characterise existing active transport (pedestrian and cyclists) and public transport conditions
- Traffic forecasting
    - Forecast traffic volumes on key roads were prepared for 2029 and 2039

[2] While this time period represents the holiday period during which Jervis Bay typically sees high volumes of tourism, note that the NSW South Coast was ravaged by bushfires during the 2019/20 New Year period which affected vehicle movements and may not be representative of the typical holiday season

[3] Due to the increased detection of COVID-19 in the lead-up to the 2020/21 holiday season, these traffic surveys may not not be representative of the typical holiday season

    - A peak period traffic growth between 2019 and 2039 was assumed to be 1.7 per cent per annum on the Princes Highway and 2.5 per cent per annum on Jervis Bay Road
- Assessment of construction impacts
    - Assesses the impact of construction vehicles and road closures on property access, road users and active transport users
    - The construction assessment assumes no changes to traffic volumes on the intersection, given the relatively short time frame of proposal construction, and was carried out using the SIDRA calibrated and validated base model
    - Construction traffic was added to the background traffic based on the proposed location of the ancillary facilities, haulage routes and projected number of construction vehicles
    - Qualitative assessment of the construction impact on existing active and public transport networks around the study area
- Future traffic conditions without and with the proposal
    - Preparation of 2029 and 2039 models without and with the proposal
- Assessment of operational impacts
    - Queue lengths – used to compare road improvement based on the reduction of queue lengths on critical movements (ie better improvements will likely result in lower queues)
    - Degree of saturation – also known as the volume to capacity ratio, this is used to determine if the proposal provides acceptable capacity for predicted demand. The acceptable levels of degree of saturation as defined in the *Traffic Modelling Guidelines* (Roads and Maritime Services, 2013) and are shown in Table 6-1
    - Average delays and level of service – used to determine the effectiveness of intersection operation, most commonly used to analyse intersections by categorising traffic flow conditions
    - Table 6-2 shows the Transport for NSW standard level of service criteria for intersection operation. The target performance for SIDRA models for the proposal is level of service D or better in 2039
    - Qualitative assessment of impacts on active and public transport networks around the study area.
- Identification of safeguards and management measures to mitigate potential traffic and transport impacts.

Table 6-1 Maximum practical degree of saturation (Roads and Maritime Services, 2013)

Intersection type	Maximum practical degree of saturation
Signals	0.90
Roundabouts	0.85
Sign-controlled	0.80
Continuous lanes	0.98

Table 6-2 Level of service criteria for intersections (RTA, 2002)

Level of service	Average delay per vehicle (seconds)	Description
A	<14	Considered to represent good to acceptable levels of service. Traffic is still within the limits of stable flow with most vehicles being able to travel at the desired speed.
B	15 to 28	
C	29 to 42	
D	43 to 56	Still within capacity. Close to the limit of stable flow with the desired speed and manoeuvring of vehicles is restricted.
E	57 to 70	Traffic volumes are close to capacity. Delays at the intersection can be considered significant.
F	>70	Traffic volumes have reached the capacity for the intersection. Significant delays and queuing can be expected.

Relevant legislation, plans and policies

The impact assessment of the proposal on traffic and transport has been prepared with consideration of:

- *Heavy Vehicle (Mass, Dimension and Loading) National Regulation* (National Heavy Vehicle Regulator, 2018)
- *Traffic Modelling Guidelines* (Roads and Maritime Services, 2013)
- *Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals Appendix B Austroads Vehicle Classification* (Austroads, 2019)
- *Interim Construction Noise Guidelines* (DECC, 2009).

Study area

The traffic and transport study area focuses on the section of the Princes Highway from Jervis Bay Road south to Mortimer Road (Figure 6-1).

For the operational traffic and transport assessment, the study area excludes the ancillary facility on Jervis Bay Road as well as some sections of the proposal construction footprint to the north and east, focusing primarily on the intersection of Jervis Bay Road and the Princes Highway. While modelling work is centred on the intersection location, the proposal would change access arrangements to some properties and therefore redistribute local traffic extending to Mortimer Road, therefore this has been included in the study area.

For the construction traffic and transport assessment, the study area includes the study area shown in Figure 6-1 as well as the proposal construction footprint.

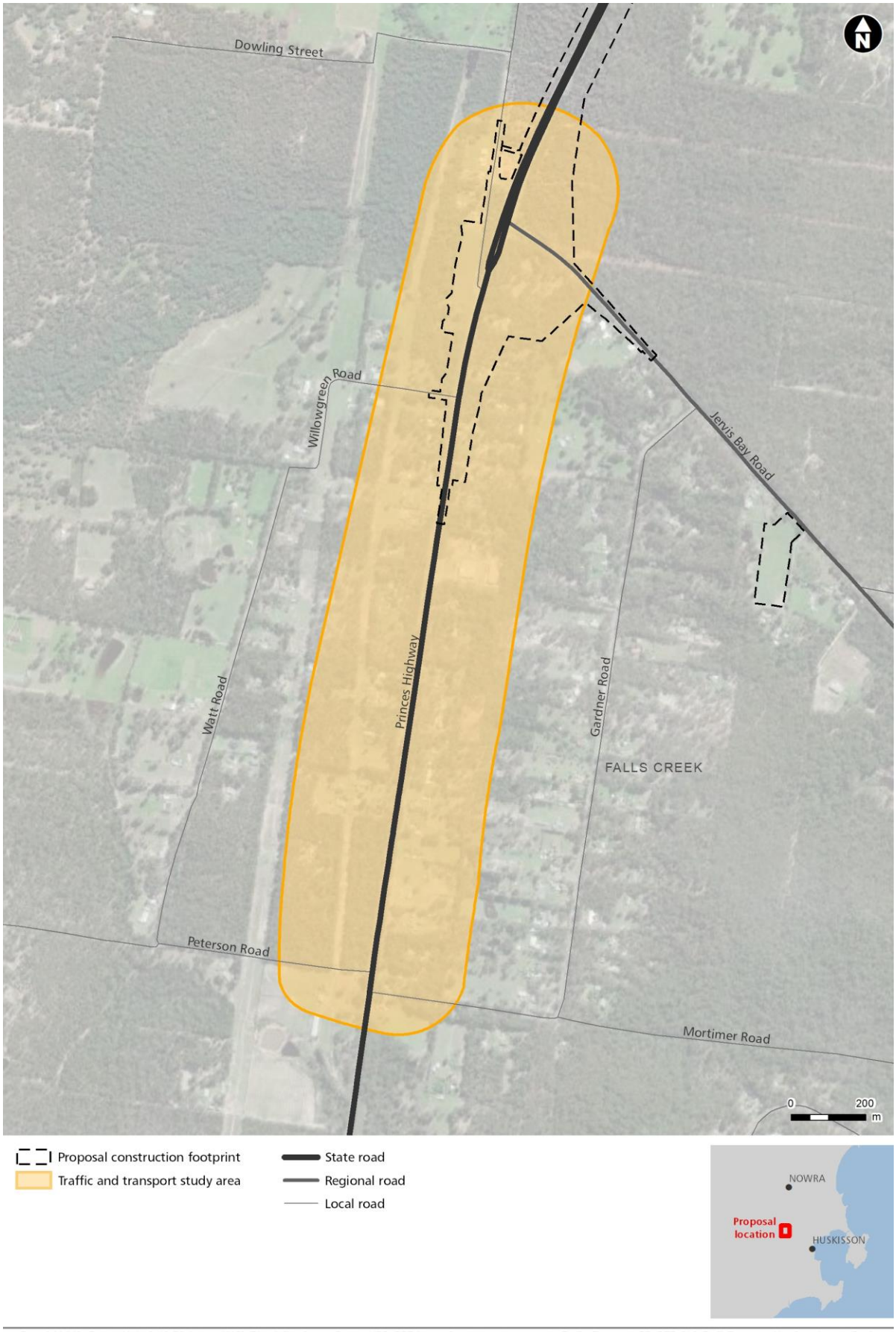

Figure 6-1 Traffic and transport study area

6.1.2 Existing environment

Existing road infrastructure

The Princes Highway

The Princes Highway is the main north-south regional road corridor between Sydney, the Illawarra and through the NSW South Coast to Victoria. The highway serves as a:

- Commuter route between Sydney, Wollongong, Nowra and other NSW South Coast towns
- Local route for residents of surrounding smaller towns and rural residences
- Major tourist route for key destinations, including Jervis Bay
- Important freight and bus route, particularly for the south coast and far south coast where there are no rail services.

North of the Jervis Bay Road and Princes Highway intersection, the Princes Highway is a four-lane divided highway (two lanes in each direction) with median separation using wire rope. South of the intersection, the highway is a two-lane undivided highway (one lane in each direction).

When travelling southbound, the left lane becomes a left-turn lane into Jervis Bay Road, restricting southbound highway traffic to a single lane. When travelling northbound, a right-turn lane into Jervis Bay Road is introduced, allowing single lane northbound movements. North of the intersection, the Princes Highway is two lanes in each direction.

The posted speed limit on the Princes Highway is 100 kilometres per hour.

The Old Princes Highway

The Princes Highway also provides access to the Old Princes Highway, a two lane unmarked local road that services residential properties and businesses. Access to the Old Princes Highway is via a dedicated left-hand turn lane from the Princes Highway northbound lane or dedicated right-hand turn lane from the Princes Highway southbound lane, located about 190 metres south of the Jervis Bay Road and Princes Highway intersection.

The posted speed limit on the Old Princes Highway is 50 kilometres per hour.

Jervis Bay Road

Jervis Bay Road is a regional road that provides the main east-west link to the coastal villages of Huskisson, Vincentia, Hyams Beach and Jervis Bay. The Jervis Bay Road and the Princes Highway intersection provides the main access to these areas and forms a key part of the transport network within changing residential, tourism, defence and industrial areas within the Shoalhaven.

Jervis Bay Road is a two-way undivided carriageway providing one lane in each direction with no specified turning lanes.

The posted speed limit on Jervis Bay Road is 90 kilometres per hour.

Heavy vehicle routes

Any single motor vehicle or combination which alone or together with its load exceeds the general access overall dimensions as defined in the *Heavy Vehicle (Mass, Dimension and Loading) National Regulation* (National Heavy Vehicle Regulator, 2018) is considered to be a Restricted Access Vehicle. The routes these vehicles can access, known as heavy vehicle routes, are restricted due to the road network or infrastructure access capable of accommodating these vehicles.

The Princes Highway is an approved heavy vehicle route for vehicles up to 4.6 metre high and 23 metres long. Figure 6-2 shows the heavy vehicle routes within and surrounding the study area.

Existing traffic volumes

Average daily movements

The average weekday volume of traffic is about 23,070 vehicles per day on the Princes Highway at Jervis Bay Road. On the weekend, the Princes Highway typically records traffic volumes about nine per cent lower than the weekday average. The highest traffic activity across the week is typically recorded on Fridays, with volumes of about 27,920 vehicles per day, about 21 per cent higher than the weekly average.

Holiday period movements

During the 2019/20 holiday period, the average volume of traffic is about 26,470 vehicles per day on the Princes Highway and about 9,830 vehicles per day on Jervis Bay Road.

During the 2020/21 holiday period the highest average traffic recorded in any week during that period showed about 30,820 vehicles per day on the Princes Highway and 12,340 vehicles per day on Jervis Bay Road.

Heavy vehicle movements

During surveys carried out, there was an average of about 3,090 heavy vehicles recorded per day, which made up 12 per cent of all traffic. Of these movements, the number and percentage of daily heavy vehicle volumes is shown in Table 6-3.

Table 6-3 Average daily heavy vehicle volumes by vehicle type

Vehicle type	Number of vehicles	Percentage of total heavy vehicles
Rigid	2,650	86
Single articulated	390	13
B-double	50	2

Existing intersection performance

The level of service, degree of saturation and queue lengths for the existing intersection is shown in Table 6-4.

It is noted that while there are no capacity issues under typical weekday peak operations, the intersection operates at a level of service F with lengthy delays of more than eight minutes during the holiday peak period (3.00pm to 4.00pm). Queues on Jervis Bay Road have been surveyed to extend to about 630 metres from the Princes Highway intersection during the holiday peak period due to the high volumes of through traffic on the Princes Highway.

The traffic modelling has been based on traffic surveys carried out in June 2019. During this survey, the observed queue length during the morning peak was 110 metres and would clear within 25 seconds. This queuing pattern does not appear to align with the traffic patterns that are experienced by transport users on a daily basis and the queue lengths observed during site visits. The traffic volumes align with a traffic survey carried out in November 2018, however, no queue lengths were surveyed at that time.

Due to the limitations of the data available, an alternative modelling scenario was carried out that used the traffic volumes obtained during the traffic survey and assumed a gap acceptance of seven seconds to better align with observed queue lengths. This modelling

scenario indicates a queue length of 235 metres on Jervis Bay Road due to the increased gap acceptance parameters, reflecting more cautious right-turn movements.

Table 6-4 2019 intersection performance

Peak period	Approach	Degree of saturation	Delay (seconds)	Level of service	95th percentile queue lengths (metres)
AM peak period (2019) **(7.30am to 8.30am)**	North – Princes Highway	0.208	9	A	5
	East – Jervis Bay Road	0.896	25	B	90
	South – Princes Highway	0.594	10	A	0
	Overall	0.896	25	B	90
AM peak period (seven second gap (7.30am to 8.30am)	North – Princes Highway	0.208	9	A	5
	East – Jervis Bay Road	≥ 1.0	68	E	230
	South – Princes Highway	0.594	10	A	0
	Overall	≥ 1.0	68	E	230
PM peak period (2019) **(3.30pm to 4.30pm)**	North – Princes Highway	0.606	9	A	10
	East – Jervis Bay Road	0.813	30	C	30
	South – Princes Highway	0.280	22	B	0
	Overall	0.813	30	C	30
Holiday peak period (2021) **(10.45am to 11.45am)**	North – Princes Highway	0.612	8	A	30
	East – Jervis Bay Road	≥ 1.0	597	F	670
	South – Princes Highway	0.464	16	B	0
	Overall	≥ 1.0	597	F	670
Holiday peak period (2019) **(3.00pm to 4.00pm)**	North – Princes Highway	0.674	9	A	20
	East – Jervis Bay Road	≥ 1.0	472	F	340
	South – Princes Highway	0.589	25	B	0
	Overall	≥ 1.0	472	F	340

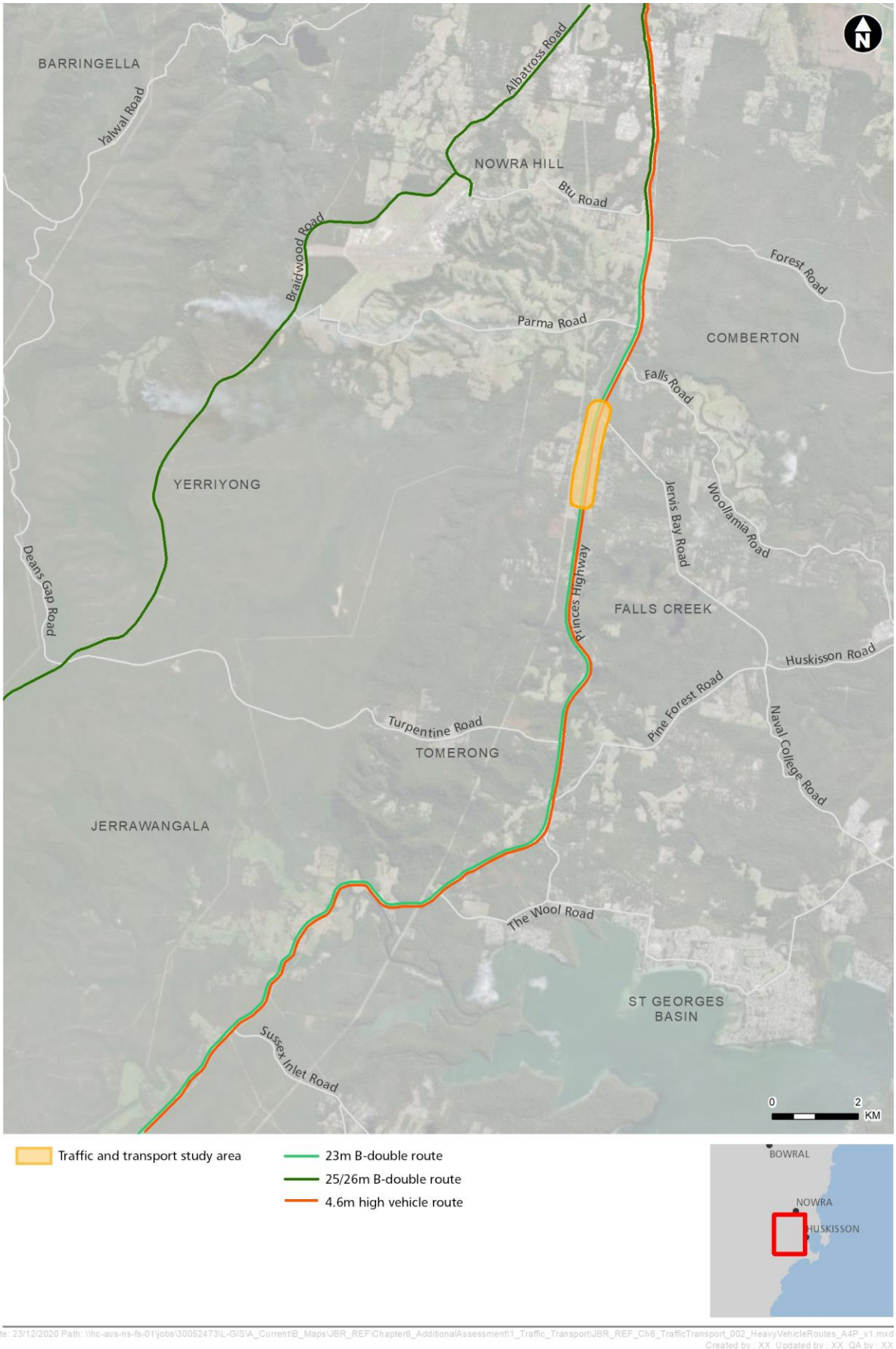

Figure 6-2 Heavy vehicle routes

Road safety

Crash data for a 10 year period from 1 April 2009 to 31 March 2019, including fatal, injury or vehicle damage accidents, was supplied by Transport for NSW (2019).

During this period, 26 crashes were recorded within the study area. Of these:

- 73 per cent of crashes involved at least one person being injured
- 27 per cent of crashes were non-casualty crashes that involved tow-aways
- Seven crashes causing serious injury were recorded
- A total of 38 people were injured within the study area
- No fatal crashes were reported.

The type of crashes recorded during this period are summarised in Table 6-5. Most crashes at the intersection are associated with vehicles travelling southbound on Princes Highway colliding with right turning vehicles exiting Jervis Bay Road (cross traffic) and vehicles turning right from Princes Highway northbound into Jervis Bay Road.

Table 6-5 Crashes by road user movement (Transport for NSW, 2019)

Road user movement	Count	Percentage
Right through	7	27
Cross traffic	5	19
Right near	5	19
Rear end	4	15
Head on (not overtaking)	1	4
Lane sideswipe	1	4
Other same direction	1	4
Right off carriageway into object	1	4
Off carriageway right on left bend into object	1	4
Total	26	100

Commuter mode share

The Australian Bureau of Statistics provides journey to work journey to work data including mode of transport which were collected during the 2016 Census. For all work trips from Jervis Bay, Huskisson, Vincentia, and Falls Creek that use the intersection, 98 per cent use private vehicles as the main journey to work mode of transport, with the remaining two per cent completed using active and public transport.

Public transport

Public transport in and near the study area is provided by buses and coaches. There are three existing bus stops located at the intersection of the Princes Highway and Jervis Bay Road. These bus stops have no formal access areas, are not formally signposted and are not accessible via footpaths. Further, there are no provisions such as benches or bus shelters. The bus stops are serviced by three bus routes, as described in Table 6-6 and shown in Figure 6-3.

School buses also use these three bus stops and an additional bus stop within the proposal construction footprint on Willowgreen Road near the Princes Highway. School bus services

in the region are provided by Shoal Bus. Students often catch these buses in combination with other school buses to access schools in Bomaderry, Nowra, Milton and Ulladulla. The bus stop on Willowgreen Road has an informal pull over area and a bus shelter. Buses also pull over informally on the Princes Highway at this location.

The study area has no direct rail service, with the nearest railway station located in Bomaderry, about 16 kilometres to the north.

Table 6-6 Bus routes servicing bus stops within the study area

Route	Description	Number of services
102	Bomaderry to Vincentia via Nowra and St Georges Basin	Monday to Friday: five services each way Saturday: two services southbound, three services northbound Sunday: one service southbound, two services northbound
103	Nowra to Hyams Beach via Erowal Bay	Monday to Friday (school terms): one service southbound, two services northbound Monday to Friday (school holidays): one service each way
135	Bomaderry Station to Berrara via Nowra, Tomerong and Sussex Inlet	Monday to Friday: three services each way Saturday: one service southbound, two services northbound

Active transport

There are currently no formal shared paths for pedestrians or cyclists along either the Princes Highway or Jervis Bay Road, however an informal unsealed path along the southern side of Jervis Bay Road connects to the southbound bus stop on the Princes Highway. There is no formal access for pedestrians to the northbound bus stop on the Princes Highway and no formalised provisions for pedestrians to cross the Princes Highway.

There are no bicycle paths within the study area. Cyclists use the paved shoulder of the Princes Highway and the carriageways of Jervis Bay Road. The existing Princes Highway shoulder width varies from three metres to one metre within the study area which is not suitable for cyclist use. Acceptable shoulder widths of two metres and greater for cyclist use along the Princes Highway are available north of the Parma Road intersection, 2.5 kilometres north of Jervis Bay Road.

A review of Strava data (2020) suggests that pedestrian and cycling activity is confined to the main residential and commercial areas away from the Jervis Bay Road and Princes Highway intersection, and within the neighbouring national parks. There is some localised active transport to the east and south of the intersection, suggesting that the area can be accessed on foot and by bike.

Emergency evacuation routes

The Princes Highway and Jervis Bay Road are key evacuation routes for the South Coast and Jervis Bay communities during natural disasters, such as bushfires.

The 2019/2020 bushfires saw substantial delays and queues of over one kilometre along Jervis Bay Road due to high traffic volumes along the Princes Highway and right turning northbound vehicles on Jervis Bay Road who were evacuating the South Coast area.

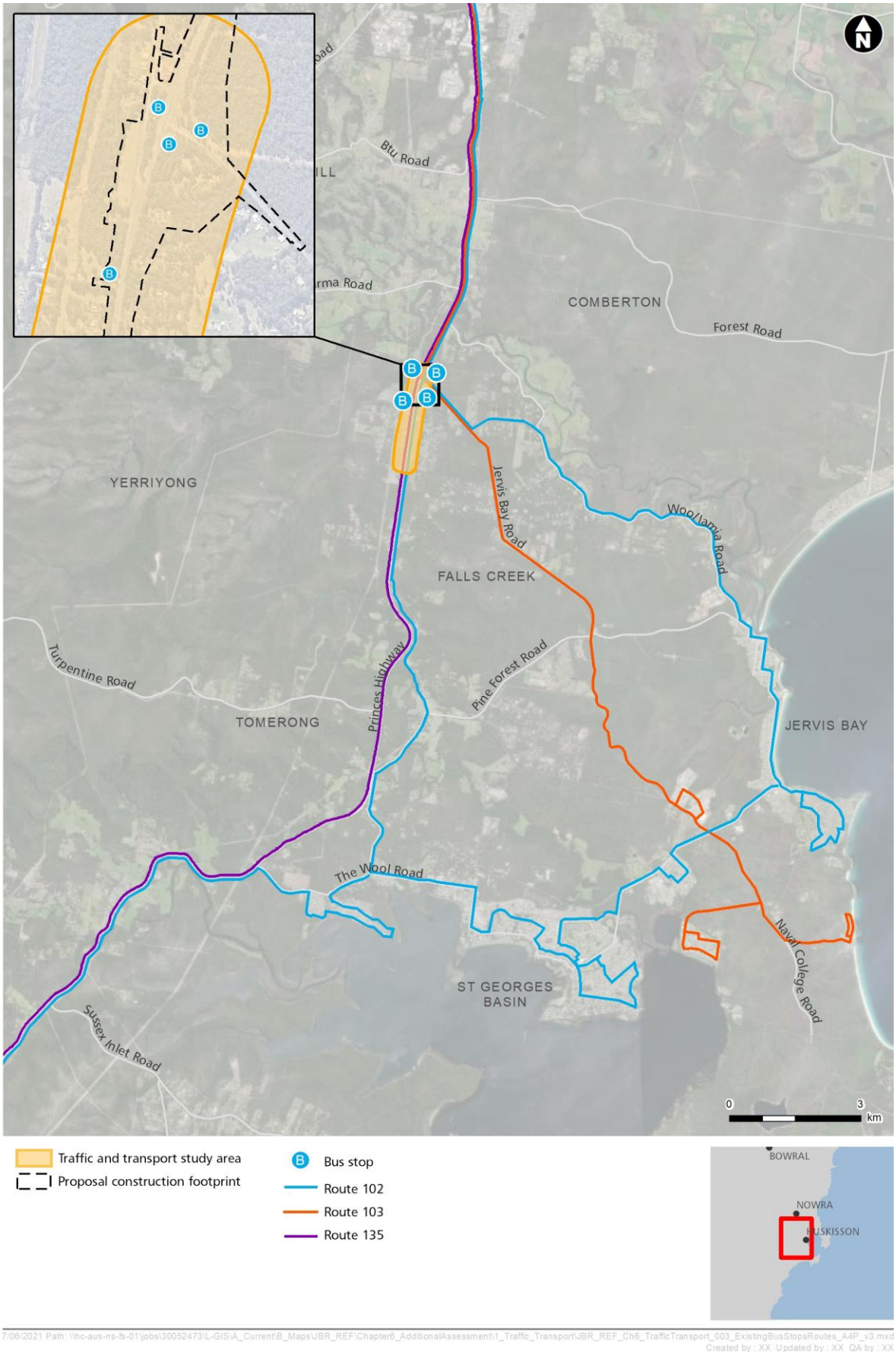

Figure 6-3 Existing bus stops and bus routes within the study area

6.1.3 Potential impacts

Construction

Construction of the proposal is expected to commence in 2022 and would take about two years. Construction of the proposal would generate both light and heavy vehicle movements. It is estimated that construction would generate up to 140 heavy vehicle movements per day and 50 light vehicle movements per day, which equates to under one per cent of average daily traffic movements.

Potential construction impacts on traffic and transport would include:

- Temporary increases to travel times due to speed limit restrictions on existing roads within and surrounding the proposal construction footprint
- Increased traffic as a result of:
    - Construction vehicles hauling material to and from site
    - Additional vehicle movements around ancillary facilities and work areas associated with deliveries and workforce movements
    - Temporary traffic diversions for the northbound/southbound movements on Princes Highway
    - Changes to the safe operating profile of the road network given traffic associated with construction
- Installation of temporary traffic signals during construction
- Altered property access arrangements for properties located south of the intersection
- Altered access for Old Princes Highway and Willowgreen Road connections
- Potential changes to stopping patterns at bus stops
- Safety issues that may arise due to the placement of temporary work areas.

Temporary traffic management arrangements during construction are discussed in Section 3.4. Access to the ancillary facilities for construction vehicles would be via Jervis Bay Road and the Old Princes Highway.

Intersection performance impacts

The impact of construction traffic on intersection operation is described below and shown in Table 6-7.

During construction, in the AM and PM peak, the Jervis Bay Road east approach level of service would slightly deteriorate with an increase in average vehicle delay as a result of proposal construction traffic. During the holiday peak, this potential delay time is more than double the existing conditions. Increased average vehicle delay would also be experienced at the Princes Highway south approach during the PM peak.

To alleviate these delays, temporary traffic signals may be used during construction for Jervis Bay Road east approach traffic, southbound Princes Highway traffic and northbound traffic right turning into Jervis Bay Road.

The AM, PM and holiday peak periods were modelled to assess the performance of the signalised intersection during construction, with gap acceptance parameters calibrated to reflect the queueing conditions observed on the date the surveys were conducted.
An additional sensitivity analysis was performed for the AM peak period, where gap acceptance was increased from six seconds to seven seconds for the right turn movement from Jervis Bay Road. This test was carried out as the higher gap acceptance allows for a more accurate reflection of typical queue lengths observed at the intersection, which are greater than the queues recorded on the survey date.

As the signalisation of the intersection would involve a dedicated phase for traffic movements out of Jervis Bay Road, gap acceptance for right turning vehicles would not be a variable taken into account by the model, and only one AM peak period scenario was modelled.

Traffic management, including the use and layout of traffic signals, would be refined during detailed design and further development of the construction methodology with consideration of the construction contractor's requirements. Intersection performance impacts would be managed via the safeguards and management measures outlined in Section 6.1.4.

Public transport impacts

It is likely that the bus stops located at the intersection would need to be relocated during the construction phase. Alternative temporary locations for bus stops would be determined as the proposal progresses and advanced notification would be provided to affected bus customers. Disruption to bus customers would be minimised by relocating the bus stops to the closest practical alternative.

It is expected that the services would be able to adapt to the temporary relocation of the bus stops without adversely affecting public transport users.

Active transport impacts

As highlighted in Section 6.1.2, there are currently no formal pedestrian and cycling facilities within the study area. Traffic survey data further shows very low volumes of pedestrian and cyclist activity at the intersection during a typical weekday, likely attributable to the high-speed vehicle environment, lack of formal active transport facilities and distance from active transport generators. The construction Traffic Management Plan for the proposal would include measures to manage active transport movements throughout construction. It is unlikely that there would be a significant impact on active transport users during construction of the proposal.

Property access impacts

Access to properties and businesses would be maintained for the full construction duration. Alternative access arrangements would be provided where the proposal would impact access. This would include slight alteration of driveway accesses as required for most impacted properties. Properties on the eastern side of the Princes Highway south of the intersection would be serviced by a temporary access road to allow for construction of the formalised property access road.

Traffic management controls would be in place to allow for safe access to properties throughout construction (Section 6.1.4).

Emergency evacuation route

The Princes Highway and Jervis Bay Road would remain operational throughout construction of the proposal. Consultation would be carried out with local emergency services during the development of the Traffic Management Plan to provide procedures to maintain an unrestricted and safe environment for emergency service vehicles to pass through the proposal construction footprint.

Table 6-7 Construction traffic impact on intersection operation

Peak period	Approach	Existing condition		With construction traffic and no temporary traffic signals		With construction traffic and temporary traffic signals	
		Delay (seconds)	Level of service	Delay (seconds)	Level of service	Delay (seconds)	Level of service
AM peak period (7.30am to 8.30am)	North – Princes Highway	9	A	9	A	-	-
	East – Jervis Bay Road	25	B	32	C	-	-
	South – Princes Highway	10	A	10	A	-	-
	Overall	25	B	32	C	-	-
AM peak period (7 second gap) (7.30am to 8.30am)	North – Princes Highway	9	A	9	A	15	B
	East – Jervis Bay Road	68	E	105	F	18	B
	South – Princes Highway	10	A	10	A	0.3	A
	Overall	68	E	105	F	8.5	A
PM peak period (3.30pm to 4.30pm)	North – Princes Highway	9	A	9	A	19	B
	East – Jervis Bay Road	30	C	36	C	52	D
	South – Princes Highway	22	B	43	D	4	A
	Overall	30	C	43	D	19	D
Holiday peak period (3.00pm to 4.00pm)	North – Princes Highway	9	A	9	A	15	B
	East – Jervis Bay Road	472	F	1002	F	75	F
	South – Princes Highway	25	B	25	B	1	A
	Overall	472	F	1002	F	14	A

Operation

Intersection performance impacts

The grade separation of through movements on the Princes Highway would reduce the queuing at the intersection substantially compared to intersection performance if the proposal is not built. In 2039, the longest queues in the weekday morning peak period would be expected to be about 20 metres on Jervis Bay Road, and in the weekday afternoon and holiday peak periods about 20 metres on the northern approach to the roundabout for southbound vehicles turning off the Princes Highway. The degree of saturation is within the acceptable practical degree of saturation for roundabout intersections. The proposal would result in all intersection approaches having a level of service A at all times (Table 6-8).

Table 6-8 2039 proposal intersection performance

Peak period	Approach	Degree of saturation	Delay (seconds)	Level of service	95th percentile queue length (metres)[1]
2039 without the proposal					
AM peak period (7.30 am to 8.30 am)	North – Princes Highway	0.292	9	A	10
	East – Jervis Bay Road	≥ 1.0	496	F	1170
	South – Princes Highway	0.833	11	A	0
	Overall	≥ 1.0	496	F	1170
PM peak period (3.30 pm to 4.30 pm)	North – Princes Highway	0.849	9	A	39
	East – Jervis Bay Road	≥ 1.0	>500	F	1300
	South – Princes Highway	0.773	296	F	20
	Overall	≥ 1.0	>500	F	1300
Holiday peak period (3 pm to 4 pm)	North – Princes Highway	0.729	9	A	20
	East – Jervis Bay Road	≥ 1.0	>500	F	1870
	South – Princes Highway	0.880	35	C	0
	Overall	≥ 1.0	>500	F	1870
2039 with the proposal					
AM peak period (7.30 am to 8.30 am)	North – Princes Highway	0.241	10	A	0
	East – Jervis Bay Road	0.533	4	A	20

Peak period	Approach	Degree of saturation	Delay (seconds)	Level of service	95th percentile queue length (metres)[1]
	South – Princes Highway	0.044	13	A	0
	West – Old Princes Highway	0.068	10	A	0
	Northbound ramp to Princes Highway	0.439	4	A	0
	Southbound ramp to Princes Highway	0.014	4	A	0
	Overall	0.533	13	A	20
PM peak period (3.30 pm to 4.30 pm)	North – Princes Highway	0.551	10	A	20
	East – Jervis Bay Road	0.320	4	A	10
	South – Princes Highway	0.047	13	A	0
	West – Old Princes Highway	0.051	7	A	0
	Northbound ramp to Princes Highway	0.247	4	A	0
	Southbound ramp to Princes Highway	0.022	4	A	0
	Overall	0.551	13	A	20
Holiday peak period (3 pm to 4 pm)	North – Princes Highway	0.655	11	A	20
	East – Jervis Bay Road	0.260	4	A	10
	South – Princes Highway	0.044	12	A	0
	West – Old Princes Highway	0.068	6	A	0
	Northbound ramp to Princes Highway	0.204	4	A	0
	Southbound ramp to Princes Highway	0.014	4	A	0
	Overall	0.655	12	A	20

Note:

[1] 95th percentile means 95 per cent of the time the queue length would be less than the value shown on the table.

Public transport impacts

The proposal would result in minor relocation of three bus stops servicing bus routes in the area and one dedicated school bus stop. A consolidated bus bay would be provided on the access road, south-east of the intersection. The new bus bay would include lighting, a bus shelter and formalised shared path access. This would provide an improved safety environment for commuters.

Bus routes that travel through the intersection would benefit from the improved safety and traffic performance, including lower delays and shorter queues, particularly regular and school bus services operating during the weekday morning and afternoon peak periods.

Active transport impacts

A shared user path would be provided along both sides of the road at all approaches to the at-grade double roundabout intersection and would connect directly to the road shoulder on the Princes Highway where cyclists would be expected to ride (Figure 3-2, Figure 3-3 and Figure 3-4).

Active transport users intending to cross the at-grade double roundabout would use the refuge islands separating opposing vehicle movements in the roundabout, and a storage width of two metres would be provided at each island. Ramps connecting to the road level from the kerb would be provided near the refuges to indicate crossing locations.

The proposal separates the high volumes of through vehicles on the Princes Highway from the movements between Jervis Bay Road and the Old Princes Highway, which are more likely to service pedestrian and cyclist movements than the mainline. The separation of movements on the minor roads from the highway provides for safer active transport links between Jervis Bay Road and the Old Princes Highway. While acceptable shoulder widths (two metres or greater) for cyclist use are not currently available northbound on the Princes Highway to the Parma Road intersection, the proposal would support future provision of a link for cyclists through this area. Compared to the existing condition where there are no formal provisions for pedestrians or cyclists, the proposed shared user paths and refuge islands would substantially improve the road safety environment for active transport users.

Property access impacts

Permanent alteration of some property access would be required for operation of the proposal.

Princes Highway

The Princes Highway would be upgraded to a dual carriageway with median barrier and continuous barriers along the verge, therefore a proposed access road along the eastern side of the Princes Highway would connect the adjacent properties to the Princes Highway via Jervis Bay Road.

Jervis Bay Road

Access arrangements to properties along Jervis Bay Road would generally be maintained, with minor works required to re-connect the existing driveways. The access to privately owned bushland properties north of Jervis Bay Road would also be reinstated.

Old Princes Highway

Most properties along the Old Princes Highway would retain their driveway connection with minor adjustments to tie-ins. Properties affected by the intersection upgrade would be connected to the Old Princes Highway via the proposed Willowgreen Road connection.

Willowgreen Road

The current direct connection between Willowgreen Road and the Princes Highway would be removed and replaced with a connection to the Old Princes Highway near the proposed

western roundabout. This would impact properties with driveway access to Willowgreen Road and properties on the Old Princes Highway south of the proposed western roundabout.

Emergency evacuation route

The proposal would result in improvements to safety and transport network efficiency, allowing for uninterrupted through movements for northbound and southbound Princes Highway traffic and significantly improve intersection performance for both Princes Highway and Jervis Bay Road traffic. This would improve the efficiency and reliability of the Princes Highway and Jervis Bay Road as emergency evacuation routes for both emergency services and general public traffic.

6.1.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
TR01 Traffic management during construction	A Traffic Management Plan (TMP) will be prepared and implemented in accordance with *Transport for NSW Specification D&C G10 Traffic Management* and *Traffic Control at Worksites Technical Manua*l (Roads and Maritime Services, 2018). The Traffic Management Plan will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Identification and management of any haulage vehicle marshalling areas • Site-specific traffic control measures, including signage and reduced speed zones, to manage and regulate traffic movement • Signage targeting critical access points to businesses and residences located along the Princes Highway, Old Princes Highway, Jervis Bay Road and properties in the vicinity of the intersection, as required • Measures to manage active transport movements throughout construction • Safe access to ancillary facilities including entry and exit locations and measures to prevent	Contractor	Pre-construction	Section 4.8 of QA G36 Environmental Protection G10 Traffic Management Traffic Control at Worksites Technical Manual (Roads and Maritime Services, 2018)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	queuing of construction vehicles • A response procedure for any construction road traffic incident.			
TR02 Public transport impacts	Consultation will be carried out with local and regional bus services that operate in the area before and during construction to confirm any bus stop relocations during construction, and any operational road network changes. Advanced notification will be provided to affected bus customers of bus stops changes. Disruption to bus customers will be minimised by relocating the bus stops to the closest practical alternative.	Transport for NSW Contractor	Detailed design Pre-construction Construction	
TR03 Consultation with emergency services	Consultation will be carried out with local emergency services during the development of the Traffic Management Plan ensure an unrestricted and safe environment for emergency service vehicles to pass through the proposal construction footprint. Updates will be provided on the staging and progress of construction.	Contractor	Pre-construction	
TR04 Road closures during construction	Partial road closures or any short-term full road closures will be avoided along the Princes Highway and Jervis Bay Road during peak periods when vehicle traffic volumes are high.	Transport for NSW Contractor	Construction	
TR05 Changes to local roads and property access during construction	Regular communication and consultation will be carried out with affected landowners and residents where temporary property access changes are required. Landowners and residents will be provided with advance notification of construction schedules and any changes to	Transport for NSW Contractor	Pre-construction Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	local roads and property access.			
TR06 Changes to property access during operation	Property access that is impacted by the proposal will be reinstated or relocated before the end of construction in consultation with affected landowners.	Transport for NSW Contractor	Detailed design Construction	

6.2 Noise and vibration

This section provides an assessment of the potential noise and vibration impacts from the proposal and identifies safeguards and management measures to avoid or minimise these impacts. A detailed assessment of noise and vibration impacts is presented in Appendix D.

6.2.1 Methodology

Existing noise environment

Nearby sensitive receivers were identified using desktop analysis. Noise monitoring was carried out to determine the existing noise environment within the study area, including:

- L_{Aeq} traffic noise levels for day (7 am – 10 pm) and night (10 pm – 7 am)
- The highest one-hour L_{Aeq} noise level during the daytime and night-time period
- L_{A90} traffic noise levels for day (7 am – 10 pm) and night (10 pm – 7 am)
- L_{Amax} noise levels to inform the maximum noise level assessment.

Unattended noise monitoring was carried out from 21 August 2020 to 11 September 2020 at three locations within the site investigation area (Figure 6-4). Attended noise monitoring was carried out at six locations (Figure 6-4) on 11 September 2020 to confirm the key contributing noise sources at each location and verify the validity of the noise logger data.

Construction noise and vibration assessment

Relevant construction noise and vibration criteria for sensitive receivers were established based on the *Interim Construction Noise Guideline* (DECC, 2009) and Transport for NSW's *Construction Noise and Vibration Guideline* (Transport for NSW, 2016).

The likely construction equipment and activities, and the sound power and noise emission levels for each of these activities, were predicted to determine:

- Construction noise predictions based on 3D noise modelling techniques
- Locations at which the noise management levels are predicted to be exceeded, and to what extent during standard construction hours and out of hours work
- Construction vibration levels in accordance with relevant standards for building damage and human comfort levels.

Based on the results of the above, safeguards and management measures were identified to manage potential construction noise and vibration impacts.

Construction noise management levels

The rating background level (RBL) was used to determine the construction noise management levels (NMLs) for the noise catchment area in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) and the *Noise Policy for Industry* (EPA, 2017). The NMLs for residential receivers are presented in Table 6-9. Refer to Section 6.2.2 for a discussion on the methodology used to determine construction NMLs.

Construction noise sources and activities

Sources of construction noise and vibration would comprise a range of heavy vehicles, plant and equipment and hand tools, with the noisiest activities expected to be related to bulk earthworks and road surface construction.

Construction noise source levels for typical road construction plant and equipment expected to be used as part of the proposal, and the total sound power levels (SWLs, L_w) for stages of construction

works, are presented in Table 6-10. The likely plant and equipment, and overall sound power level, required at each ancillary facility is presented in Table 6-11.

Table 6-9 Construction Noise Management Levels (NMLs) for residential receivers

Time	
Day Out of hours works (1 pm to 6 pm Saturday, 7 am to 6 pm Sunday and public holiday)	55
Night Out of hours works (10 pm to 7 am)	35

Table 6-10 Indicative plant and equipment and total Sound Power Level (SWL) for construction activities

Activity			
	Mobile crane	98	
	Excavator	110	
	Ute/crew truck	103	
	Total Activity L_w	113	
	Concrete agitator	109	
	Excavator	110	
Utility adjustments	Ute/crew truck	103	**2 to 3**
	Trenching machine	97	
	Hand tools	94	
	Excavator	110	
	Grader	113	

Activity	Plant and equipment	L_w, dB(A)	Indicative duration (months)
	Water cart	107	
	Front end loader	112	
	Roller (vibratory)	109	
	Dump truck	110	
	Road truck 39t	108	
	Ute/crew truck	103	
	Excavator	110	
	Total Activity L_w	119	
Bulk earthworks and materials haulage including sediment basins and diversion drains	Excavator	110	**12 to 14**
	Bulldozer D9	116	
	Grader	113	
	Water cart	107	
	Front end loader	112	
	Roller (vibratory)	109	
	Dump truck	110	
	Road truck 39t	108	
	Ute/crew truck	103	
	Excavator	110	
	Jackhammer	121	
	Total Activity L_w	121	
Road surface construction	Excavator	110	**4 to 6**
	Bulldozer D9	116	
	Grader	113	
	Water cart	107	
	Front end loader	112	
	Roller (vibratory)	109	
	Dump truck	110	
	Road truck 39t	108	
	Ute/crew truck	103	
	Line-marking machine	108	
	Street sweeper	108	

Activity	Plant and equipment	L_w, dB(A)	Indicative duration (months)
	Jackhammer	121	
	Asphalt paver	112	
	Total Activity L_w	121	
Drainage structures construction	Excavator with auger	112	3
	Excavator	110	
	Crane (mobile)	113	
	Front end loader	112	
	Roller (vibratory)	109	
	Road truck 39t	108	
	Ute/crew truck	103	
	Total Activity L_w	117	
Overpass construction works including heavy vehicle deliverables of over-size loads	Excavator	110	**7 to 9**
	Franna crane	98	
	Crane (mobile)	113	
	Concrete agitator	109	
	Excavator with hammer	122	
	Concrete pump truck	109	
	Roller (vibratory)	109	
	Road truck 39t	108	
	Ute/crew truck	103	
	Total Activity L_w	120	
Signposting	Excavator	110	**1 to 2**
	Franna crane	98	
	Crane (mobile)	113	
	Concrete agitator	109	
	Road truck 39t	108	
	Ute/crew truck	103	
	Jackhammer	121	
	Hand tools	94	
	Total Activity L_w	119	
	Excavator	110	**1 to 2**

Activity	Plant and equipment	L_w, dB(A)	Indicative duration (months)
Lighting and roadside furniture installation	Franna crane	98	
	Crane (mobile)	113	
	Concrete agitator	109	
	Road truck 39t	108	
	Ute/crew truck	103	
	Hand tools	94	
	Total Activity L_w	115	
Landscaping, waste disposal and rehabilitation of disturbed areas with no future use	Excavator	110	**2 to 3**
	Bulldozer D9	116	
	Water cart	107	
	Front end loader	112	
	Grader	113	
	Road truck 39t	108	
	Ute/crew truck	103	
	Hand tools	94	
	Total Activity L_w	**117**	

Table 6-11 Indicative plant and equipment and total Sound Power Level (SWL) at ancillary facilities

Activity	Plant and equipment	L_w, dB(A)
Ancillary facility 1	Generator	**103**
	Ute/crew truck	**103**
	Excavator	**110**
	Dump truck	**110**
	Total Activity L_w	**111**
Ancillary Facility 2	Excavator	**110**
	Dump truck	**110**
	Light Vehicles	**103**
	Total Activity L_w	**109**
Ancillary Facility 3	Excavator	**110**
	Dump truck	**110**
	Total Activity L_w	**108**

Operational road noise assessment

Operational road traffic noise modelling and assessment

A 3D noise model was produced using SoundPLAN v8.1, based on the existing road layout, and validated with reference to the measured road traffic noise levels in accordance with Transport for NSW's *Noise Model Validation Guideline* (Roads and Maritime Services, 2016). The validated noise model was then augmented to produce models for the following scenarios

- 'No build scenario': Assumed year that project commences operations (2025) and 10 years after opening (2035) incorporating future predicted traffic flows
- 'Build scenario': Assumed year that project commences operations (2025) and 10 years after opening (2035) incorporating road alignment and future predicted traffic flows.

The road traffic noise emissions were predicted for each of the above scenarios for both daytime and night-time period. The predictions determined whether noise levels increase by more than 2 dBA by comparing 'Build' scenario noise level predictions with that of the 'No-Build' scenario for year of opening. Where noise levels are predicted to increase by more than 2 dBA, consideration for noise mitigation was given where predicted noise levels are higher than existing road criteria (Roads and Maritime Services, 2015b).

Maximum noise level assessment

The maximum noise level refers to the loudest individual noise measurement within a given period of time. In relation to road traffic noise, maximum noise levels are often associated with loud trucks or motorcycles passing by or screeching breaks which cause annoyance to sensitive receivers. These are singular occurrences and do not represent a continuous high noise level environment. A maximum noise level assessment was carried out based upon the measured road traffic noise levels assessment of potential for change in road traffic related maximum noise level events during the night-time period.

Safeguards and management measures

Based on the results of the above, design considerations and safeguards and management measures were identified to manage potential road noise impacts in accordance with Transport for NSW's *Noise Mitigation Guideline* (Roads and Maritime Services, 2015b).

Relevant legislation, plans and policies

The impact assessment of the proposal on noise and vibration has been prepared in accordance with:

- *Interim Construction Noise Guideline* (DECC, 2009)
- *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016a)
- *Noise Model Validation Guideline* (Roads and Maritime Services, 2016b)
- *Noise Policy for Industry* (EPA, 2017)
- *NSW Road Noise Policy* (DECCW, 2011)
- *Noise Criteria Guideline* (Roads and Maritime Services, 2015a)
- *Noise Mitigation Guideline* (Roads and Maritime Services, 2015b)
- *Assessing Vibration – a technical guideline* (DEC, 2006)
- DIN 4150-3 *Structural vibration – Effects of vibration on structures* (Deutsches Institute fur Normung, 2016)
- BS 7385-2 *Evaluation and Measurement for Vibration in Buildings* (BSI, 1993)

- *Environmental Noise Management Manual* (RTA, 2001)
- Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime Services, 2016c)
- *At-Receiver Noise Treatment Guideline* (Roads and Maritime Services, 2017).

Noise and vibration study area

The noise and vibration study area includes a 4.3 by 3.6 kilometre area centred on the proposal construction footprint (Figure 6-4). The study area is equivalent to the noise catchment area discussed in Section 6.2.4.

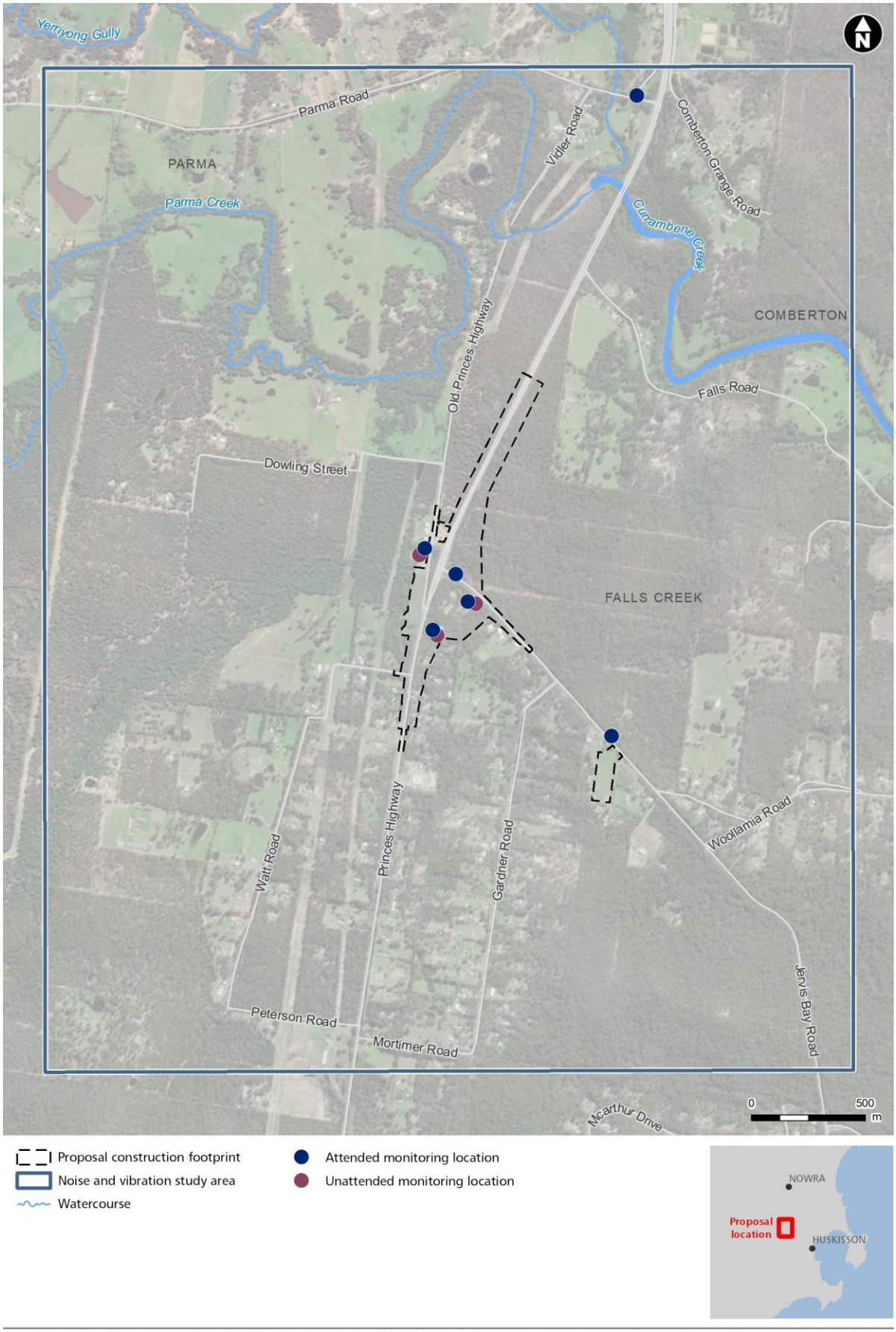

Figure 6-4 Noise and vibration study area and noise monitoring locations

6.2.2 Noise and vibration criteria

The construction noise and vibration criteria and the operational road traffic noise criteria used in the assessment is presented below.

Construction noise criteria

Construction hours

The *Interim Construction Noise Guideline* (DECC, 2009) defines working hours for which different construction noise assessment procedures apply. Standard working hours, during which the majority of construction work would occur, are:

- 7 am to 6 pm, Monday to Friday
- 8 am to 1 pm Saturday
- No work on Sundays or public holidays.

Any works outside of these hours would be classified as out of hours works.

The *Construction Noise and Vibration Guideline* (Transport for NSW, 2016) defines time periods when certain construction activity should be limited, where practicable, as described in Table 6-12.

Table 6-12 *Construction Noise and Vibration Guideline* (Transport for NSW, 2016) construction hours

Activity	Working hours		
	Monday to Friday	Saturday	Sunday and public holiday
Standard construction	7 am to 6 pm	8 am to 1 pm	No work
Construction activities with impulsive or tonal noise emissions	8 am to 5 pm	9 am to 1 pm	No work
Blasting	9 am to 5 pm	9 am to 1 pm	No blasting

Construction noise management levels

The *Interim Construction Noise Guideline* (DECC, 2009) contains procedures for determining proposal specific Noise Management Levels (NML) for sensitive receivers based on the existing background noise in the area.

The NML for residential receivers set in accordance with the *Construction Noise and Vibration Guideline* (Transport for NSW, 2016) are provided in Table 6-13. NMLs are set with reference to time of day and the background noise, known as the Rated Background Level (RBL). The RBL for each monitoring location is presented in Table 6-22 and has been determined based on the quietest period of the day, evening or night assessment period in accordance with the *Noise Policy for Industry* (EPA, 2017), above which reasonable and feasible noise mitigation needs to be considered. The NMLs apply at the property boundary most exposed to construction noise.

The NML for non-residential receivers are provided in Table 6-14. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is 10dB(A), which provides a conservative assumption that windows are open. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 6-13 Noise Management Levels at residential receivers (DECC, 2009)

Time of day	Noise Management Level, $L_{Aeq\ (15\ minute)}$
Recommended standard construction hours: • **Monday to Friday 7am to 6pm** • **Saturday 8am to 1pm** • **No work on Sundays or public holidays**	Noise affected RBL + 10dB(A)
	Highly noise affected 75dB(A)
Outside recommended standard construction hours	Noise affected RBL + 5dB (A)

Table 6-14 Noise Management Levels for other sensitive land uses (DECC, 2009)

Land use	Noise Management Level, $L_{Aeq(15\text{-}minute)}$
Classrooms at schools and other educational institutions	Internal noise level – 45 dB(A)
Places of worship	Internal noise level – 45 dB(A)
Active recreation areas (characterised by sporting activities and activities that generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level – 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (ie reading and meditation)	External noise level – 60 dB(A)
Community centres	Dependent on the intended use. Refer to the recommended 'maximum' internal levels in AS/NZS 2107 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.
Industrial premises	External noise level – 75 dB(A)
Commercial premises	External noise level – 70 dB(A)

Sleep disturbance

The *Construction Noise and Vibration Guideline* (Transport for NSW, 2016) considers night works exceeding an external L_{Amax} sound pressure level at a receiver of 65 dB to impact upon occupant sleep amenity.

Ground-borne noise

Ground-borne noise would not be a controlling factor with respect to construction noise impacts. No underground works would occur, and therefore air-borne noise levels would exceed the ground-borne noise levels. As such, a detailed ground-borne noise assessment is not required for the proposal.

Triggers for additional mitigation measures – airborne noise

The *Construction Noise and Vibration Guideline* (Transport for NSW, 2016) provides triggers for additional measures to be considered for sensitive receivers based on how far above the background noise level or NML the construction noise is. These triggers are provided in Table 6-15.

Table 6-15 Triggers for additional mitigation measures - airborne noise (Transport for NSW, 2016)

Predicted airborne $L_{Aeq(15\text{-}minute)}$ noise at receiver			Additional mitigation measures type[1]	Mitigation levels[2]
Perception	**dB(A) above RBL**	**dB(A) above NML**		
All hours				
75dBA or greater	-	-	N, V, PC, RO	HA
Standard hours: Monday to Friday 7am to 6pm, Saturday 8am to 1pm, Sunday and Public holiday Nil				
Noticeable	5 to 10	0	-	NML
Clearly audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML + 10
Highly intrusive	> 30	> 20	N, V	NML + 20
Out of hours works Period 1: Monday to Friday 6pm to 10pm, Saturday 7am to 8am and 1pm to 10pm, Sunday and Public holiday 8am to 6pm				
Noticeable	5 to 10	< 5	-	NML
Clearly audible	10 to 20	5 to 15	N, R1, DR	NML + 5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML + 15
Highly intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN	NML + 25
Out of hours works Period 2: Monday to Friday 10pm to 7am, Saturday 10pm to 8am, Sunday and Public holiday 6pm to 7am				
Noticeable	5 to 10	< 5	N	NML
Clearly audible	10 to 20	5 to 15	V, N, R2, DR	NML + 5
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML + 15
Highly intrusive	> 30	> 25	AA, V, IB, N, PC, SN, R2, DR	NML + 25

Notes:

[1] AA = Alternative Accommodation
V = Verification
IB = Individual briefings
N = Notification
R1 = Respite Period 1
PC = Phone calls
SN = Specific notifications
Perception = relates to level above RBL
R2 = Respite Period 2
DR = Duration Respite

[2] NML = Noise Management Level
HA = Highly Affected (> 75 dB(A) - applies to residences only)

Construction vibration criteria

Ground vibration generated by construction can have a range of effects on buildings and building occupants, with the main effects generally classified as:

- Human disturbance – disturbance to building occupants: vibration which inconveniences or interferes with the activities of the occupants or users of the building
- Effects on building structures – vibration that may compromise the condition of the building structure itself.

In general, vibration criteria for human disturbance are more stringent than vibration criteria for effects on building contents and structural damage. Building occupants will normally feel vibration readily at levels well below those that may cause a risk of cosmetic or structural damage to a structure. However, it may not always be practical to achieve the human comfort criteria. Furthermore, unnecessary restriction of construction activities can prolong construction works longer than necessary, potentially resulting in other undesirable effects for the local community.

Construction vibration screening criteria have been adopted from the following sources:

- Minimum working distances: *Construction Noise and Vibration Guideline* (Transport for NSW, 2016)
- Human comfort: *Assessing Vibration – a technical guideline* (DEC, 2006)
- Cosmetic and structural damage to buildings: As outlined in the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016a), guidance for cosmetic damage of structures is provided in the *British Standard 7385: Part 2*; while the *German Standard DIN 4150-3 Structural Vibration – Part 3: Effects of vibration on structures* has criteria of particular reference for heritage structures.

Minimum working distances

The *Construction Noise and Vibration Guideline* (Transport for NSW, 2016) provides guidelines for minimum working distances for vibration-intensive activities with respect to the stated standards and guidelines. The minimum working distances apply to addressing the risk of cosmetic (minor, easily reparable) damage of typical buildings under typical geotechnical conditions.

In relation to human comfort, the minimum working distances relate to continuous vibration. For most construction activities, vibration emissions would be intermittent in nature and for this reason, higher vibration levels occurring over shorter periods may be allowed.

The recommended minimum working distances for vibration intensive plant are presented in Table 6-16.

Table 6-16 Recommended safe working distances for vibration intensive plant

Plant item	Rating/Description	Minimum working distance – cosmetic damage (BS 7385) (metres)	Minimum working distance – human response (DEC, 2006) (metres)
Vibratory roller	< 50 kN (typically 1-2 tonnes)	5	15 to 20
	< 100 kN (typically 2-4 tonnes)	6	20

Plant item	Rating/Description	Minimum working distance – cosmetic damage (BS 7385) (metres)	Minimum working distance – human response (DEC, 2006) (metres)
	< 200 kN (typically 4-6 tonnes)	12	40
	< 300 kN (typically 7-13 tonnes)	15	100
	> 300 kN (typically 13-18 tonnes)	20	100
	> 300 kN (> 18 tonnes)	25	100
Small hydraulic hammer	300 kilograms – 5 to 12 tonne excavator	2	7
Medium hydraulic hammer	900 kilograms – 12 to 18 tonne excavator	7	23
Large hydraulic hammer	1600 kilograms – 18 to 24 tonne excavator	22	73
Vibratory pile driver	Sheet piles	2 to 20	20
Pile boring	≤ 800 millimetres	2 (nominal)	4
Jackhammer	Handheld	1 (nominal)	2

Human comfort

The vibration assessment criteria in *Assessing Vibration – a technical guideline* (DEC, 2006) are for human comfort and represent goals that, where predicted or measured to be exceeded, require the application of all feasible and reasonable mitigation measures. Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value as it accounts for the duration of the source, which will occur intermittently over the assessment period. Acceptable levels of vibration dose are presented in Table 6-17 for sensitive receivers.

Table 6-17 Human comfort level intermittent vibration limits

Receiver	Intermittent vibration dose value ($m/s^{1.75}$)	
	Preferred	Maximum
Residences – daytime	0.2	0.4
Residences – night-time	0.13	0.26
Offices, schools, places of worship	0.4	0.8
Workshops	0.8	1.6

Cosmetic and structural damage

Table 6-18 presents the German Standard DIN 4150-3 minimum safe levels of vibration at different frequencies for commercial and residential buildings, and Table 6-19 presents the BS 7385-2 guideline values relating to cosmetic damage from transient vibration.

DIN 4150-3 and BS 7385-2 state that exceedances of the guidance values do not necessarily mean that damage will occur, but that more detailed analysis may be required in order to quantify the site-specific relationship between vibration levels, strain and the potential for damage.

Table 6-18 Vibration cosmetic and structural damage criteria (DIN 4150-3)

Structure type	Peak particle velocity (millimetres per second)			
	Foundation of structure			Vibration at horizontal plane of highest floor at all frequencies
	<10 Hz	10 to 50 Hz	50 to 100 Hz	
Buildings used for commercial, industrial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwelling and buildings of similar design and/or use	5	5 to 15	15 to 20	18
Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in rows 1 and 2, and are of great intrinsic value (eg heritage-listed buildings)	3	3 to 8	8 to 10	8

Table 6-19 Transient vibration guide values for cosmetic damage (BS 7385-2)

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		Frequency range	
		4-15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes:

1. Values referred to are at the base of the building.
2. For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 millimetres (zero to peak) should not be exceeded.

Operational road traffic noise criteria

Operational road traffic noise criteria are assigned to sensitive receivers using Transport for NSW's *Noise Criteria Guideline* (Roads and Maritime Services, 2015a). This guideline provides guidance on how to implement the NSW *Road Noise Policy* (DECCW, 2011).

Road traffic noise – residential receivers

Road traffic noise impacts on residential receivers are assessed using assessment criteria which are based on the type of road a residence is affected by the project. In some instances, residences may be exposed to noise from new and redeveloped roads or different functional classes of roads and the proportion of noise from each road is used to establish transition zone criteria.

In addition to road traffic noise which exceeds the assessment criteria, large increases in the level of noise can change the acoustic environment of a location, particularly for quieter areas. To address large increases in noise levels, relative increase criteria are used.

Where criteria for a particular road category are exceeded due to the proposal, reasonable and feasible mitigation is required.

A summary of the applicable road traffic noise criteria for residential receivers in accordance with the *Noise Criteria Guideline* (Roads and Maritime Services, 2015a) is presented in Table 6-20.

Table 6-20 Road traffic noise criteria for residential receivers

Road category	Type of proposal/land use	Assessment criteria, dB	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq(15hour)}$ 55 (external)	$L_{Aeq(9hour)}$ 50 (external)
	Existing residences affected by noise from redevelopment of existing freeway/ arterial/sub-arterial roads	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
	New road corridor/ redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq(15hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq(9hour)}$ + 12 dB (external)
Local roads	Existing residences affected by noise from new local road corridors	$L_{Aeq(15hour)}$ 55 (external)	$L_{Aeq(9hour)}$ 50 (external)
	Existing residences affected by noise from redevelopment of existing local roads		
	Existing residences affected by additional traffic on existing local roads generated by land use developments		

Road traffic noise – non-residential receivers

The *Noise Criteria Guideline* (Roads and Maritime Services, 2015b) also sets criteria for the assessment of road traffic noise on the internal and external areas of non-residential land uses, such as schools, hospitals, places of worship and recreation areas. For sensitive land uses, the criteria was applied to internal areas to provide a conservative assessment of impacts.

It is generally accepted that most buildings provide a noise reduction of at least 10 dB(A) when windows are left 20 per cent open, without providing additional treatment. Therefore, where the noise goals are internal, a 10 dB(A) reduction from external noise levels to internal noise levels was adopted to allow an external assessment. The applicable criteria are shown in Table 6-21.

Table 6-21 Road traffic noise criteria for non-residential receivers

Existing sensitive land use	Assessment criteria, dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
School classrooms	40 $L_{Aeq,1hour}$ (internal) when in use	-
Hospital wards	35 $L_{Aeq,1hour}$ (internal)	35 $L_{Aeq,1hour}$ (internal)
Places of worship	40 $L_{Aeq,1hour}$ (internal)	40 $L_{Aeq,1hour}$ (internal)
Open space (active use)	60 $L_{Aeq,15hour}$ (external) when in use	-
Open space (passive use)	55 $L_{Aeq,15hour}$ (external) when in use	-
Childcare facilities	Sleeping rooms 35 $L_{Aeq,1hour}$ (internal) Indoor play areas 40 $L_{Aeq,1hour}$ (internal) Outdoor play areas 55 $L_{Aeq,1hour}$ (external)	-
Aged care facilities	Residential land use noise assessment criteria apply	Residential land use noise assessment criteria apply

Operational road traffic noise mitigation

The *Noise Mitigation Guideline* (Roads and Maritime Services, 2015b) describes the principles to be applied when reviewing operational road traffic noise mitigation, recognising that the *Noise Criteria Guideline* (Roads and Maritime Services, 2015a) criteria are not always practicable and that it is not always feasible or reasonable to expect that they are achieved.

When evaluating if a receiver qualifies for consideration of additional noise mitigation, the *Noise Mitigation Guideline* (Roads and Maritime Services, 201ba) considers how far above the criterion the noise level is, and by how much the noise level has increased. These considerations provide a feasible and reasonable approach to identifying eligible receivers.

The *Noise Mitigation Guideline* (Roads and Maritime Services, 2015b) provides three triggers where a receiver may qualify for consideration of additional noise mitigation. These are:

- Trigger 1 – the predicted 'Build' noise level exceeds the *Noise Criteria Guideline* (Roads and Maritime Services, 2015a) controlling criterion and the noise level increase due to the proposal is greater than 2 dBA
- Trigger 2 – the predicted Build noise level is 5 dBA or more above the *Noise Criteria Guideline* (Roads and Maritime Services, 2015a) controlling criterion and the receiver is significantly influenced by proposal road noise, regardless of the incremental impact of the proposal
- Trigger 3 – the noise level contribution from the road project is acute (daytime $L_{Aeq(15hour)}$ 65 dBA or higher, or night-time $L_{Aeq(9hour)}$ 60 dBA or higher) even if noise levels are dominated by a non-proposal road.

6.2.3 Existing environment

Noise sensitive receivers

There are 173 noise sensitive receivers within the study area, mostly comprising residential dwellings and some non-residential buildings within the rural area of Falls Creek.

Noise monitoring was carried out for groups of receivers with a common exposure to the same construction works. Given the similar ambient noise environment measured at different locations (as discussed below), noise sensitive receivers within the study area have categorised into one noise catchment area. The minimum distance from the nearest road to the worst affected receiver is 10 metres.

The proposal construction footprint, noise catchment area and noise sensitive receiver locations are shown in Figure 6-5.

Existing noise environment

Rural areas surround the proposal and consist of agricultural properties and scattered rural residences. Existing ambient environment that surrounds the proposal is typically dominated by the road traffic noise generated from Princes Highway and Jervis Bay Road.
Noise generating sources include:

- Engine noise and tyre noise from vehicle passbys
- Acceleration and deceleration at the existing intersection.

The results of the noise monitoring carried out is provided in Table 6-22.

Table 6-22 Unattended noise monitoring results

ID	Rated background level, dB(A)						Ambient noise level, dB(A)	
	Day (7 am to 6 pm)		Evening (6 pm to 10 pm)		Night (10 pm to 7 am)		Day 15 hour (7am to 10pm)	Night 9 hour (10pm to 7am)
	RBL	L_{eq}	RBL	L_{eq}	RBL	L_{eq}	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$
NL1	51	58	44	54	30	53	57	53
NL2	50	59	40	56	30	53	59	54
NL3	51	63	39	58	30	57	62	57

Existing maximum noise levels

Maximum noise level events during the nine hour night-time period were measured at two unattended noise monitoring locations.

There were 11 maximum noise level events were recorded on the Old Princes Highway. The highest measured maximum noise level event was 73 dB(A), an exceedance of up to 5dB above the L_{aeq}+15 dB criteria.

There were 21 maximum noise level events were recorded on Jervis Bay Road. The highest measured maximum noise level event was 79 dB(A), an exceedance of up to 10dB above the L_{aeq}+15 dB criteria.

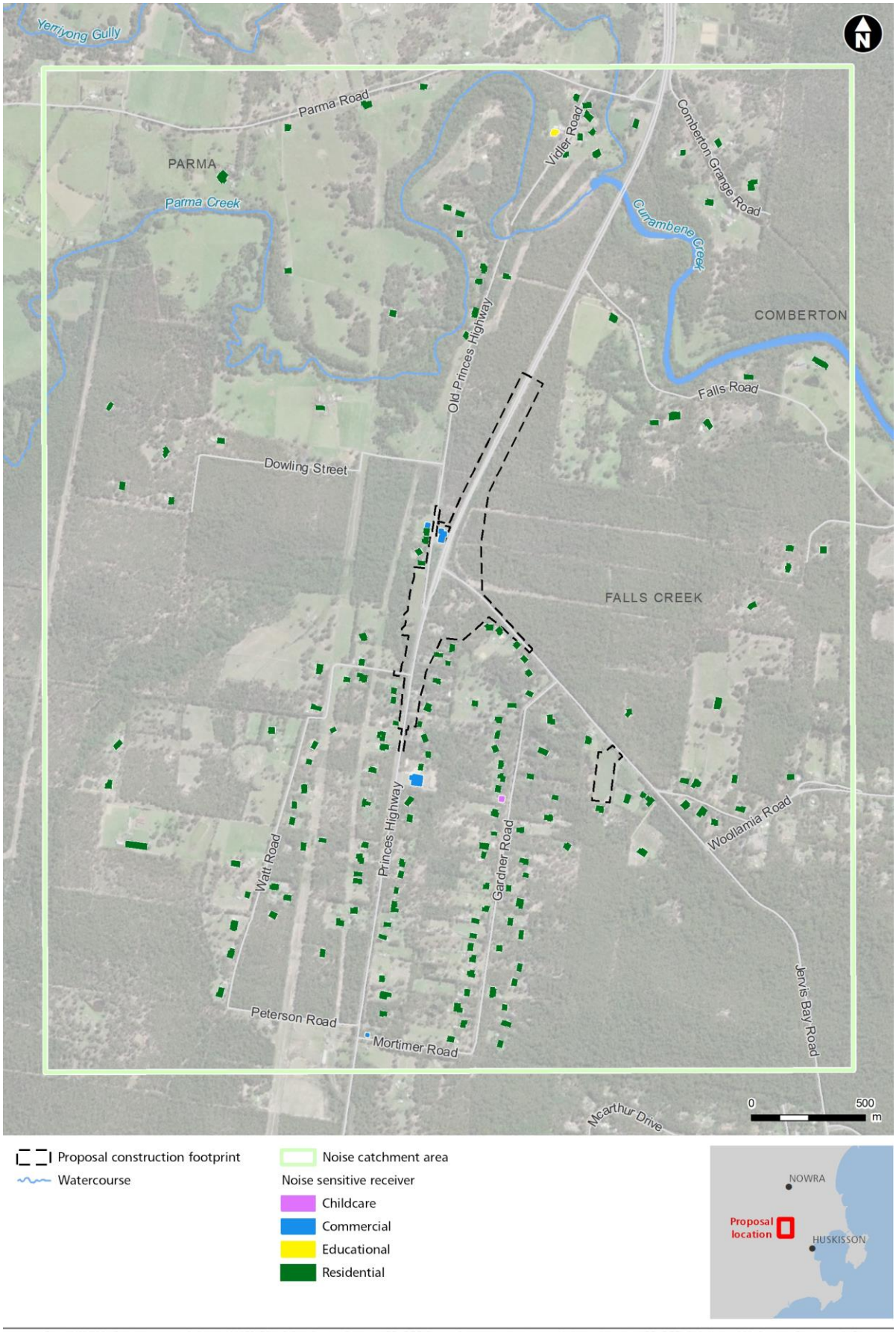

Figure 6-5 Noise sensitive receivers and noise catchment area

6.2.4 Potential impacts

Construction

Airborne construction noise - standard construction hours

Figure 6-6 presents noise levels likely to be experienced by sensitive receivers during a 'typical' construction noise day, that is, days where highly noise construction plant and equipment is not being used. Figure 6-7 presents noise levels likely to be experienced by sensitive receivers during a 'worst case' construction noise day, that is, days where highly noise construction plant and equipment is being constantly used resulting in noise levels of about 122 dB(A).

The majority of construction work would be carried out during standard construction hours. During construction, exceedances of the noise management levels are predicted, particularly at residences located in close proximity to the construction footprint. Under the worst-case scenario during standard construction hours, the proposal construction is predicted to exceed the highly noise affected level of 75 dB(A) at up to 18 residential receivers and four non-residential receivers. Table 6-23 provides the approximate offset distances in metres for noise impacts of each construction activity during standard construction hours.

Noise levels at residential receivers within 30 metres of the boundary of the construction footprint and within 20 metres of ancillary facilities are predicted to be in the highly noise affected category (noise levels greater than 75 dB(A)) depending on the stage of work in closest proximity to the receivers. These highly noise affected receivers are located adjacent to the existing Jervis Bay Road and Princes Highway intersection, along the Old Princes Highway and in close proximity to the ancillary facilities. High noise intensity plant items are planned for use in all stages of the proposal construction. Typical construction activities and associated plant items that are likely to result in the highest NML exceedances at sensitive receiver locations include:

- Demolition of existing road infrastructure including the use of concrete saws, excavators, dump trucks and jackhammers.
- Pavement construction including the use of asphalt profilers and street sweepers.

Standard construction hours NML exceedances (noise levels exceeding 60 dB(A)) are predicted at receiver locations up to about 370 metres from the proposal construction footprint for the noisiest construction stages. Predicted exceedances during standard construction hours would be managed via the safeguards and management measures discussed in Section 6.2.5.

At large offset distances (greater than 370 metres) from the construction works, the predicted construction noise levels are predicted to be between 35 dB(A) and 60 dB(A) dependent upon the construction works occurring.

The majority of work would be conducted linearly along the proposal construction footprint in gradual stages (ie work would not occur at the same location for the duration of the construction period). Work would generally be conducted progressively from one end of the proposal construction footprint to the other, however some work may occur in discrete locations within the proposal construction footprint as required. Exceedances are based on all assumed plant and equipment working continuously adjacent to a sensitive receiver and consequently are the maximum impact from that activity. In reality this would only occur for short periods of time, if at all, and actual noise levels would generally be lower.

Table 6-23 Approximate offset distances (metres) for noise impacts of each construction activity during standard construction hours (Monday to Friday – 7 am to 6pm, Saturday – 8 am to 1 pm, Sunday/Public Holiday – Nil)

Descriptor	Mobilisation and site establishment	Utility adjustments	Clearing, grubbing and topsoil stripping	Bulk earthworks and materials haulage including sediment basins and diversion drains	Road surface construction	Drainage structures construction	Overpass construction works including heavy vehicle deliverables of over-size loads	Signposting	Lighting and roadside furniture installation	Landscaping, waste disposal and rehabilitation of disturbed areas with no future use
Noticeable	150	260	290	360	370	230	310	290	180	240
Clearly audible	120	210	230	280	300	180	240	230	140	190
Moderately intrusive	40	70	80	100	110	60	90	80	50	70
Highly intrusive	10	20	30	30	30	20	30	30	20	20

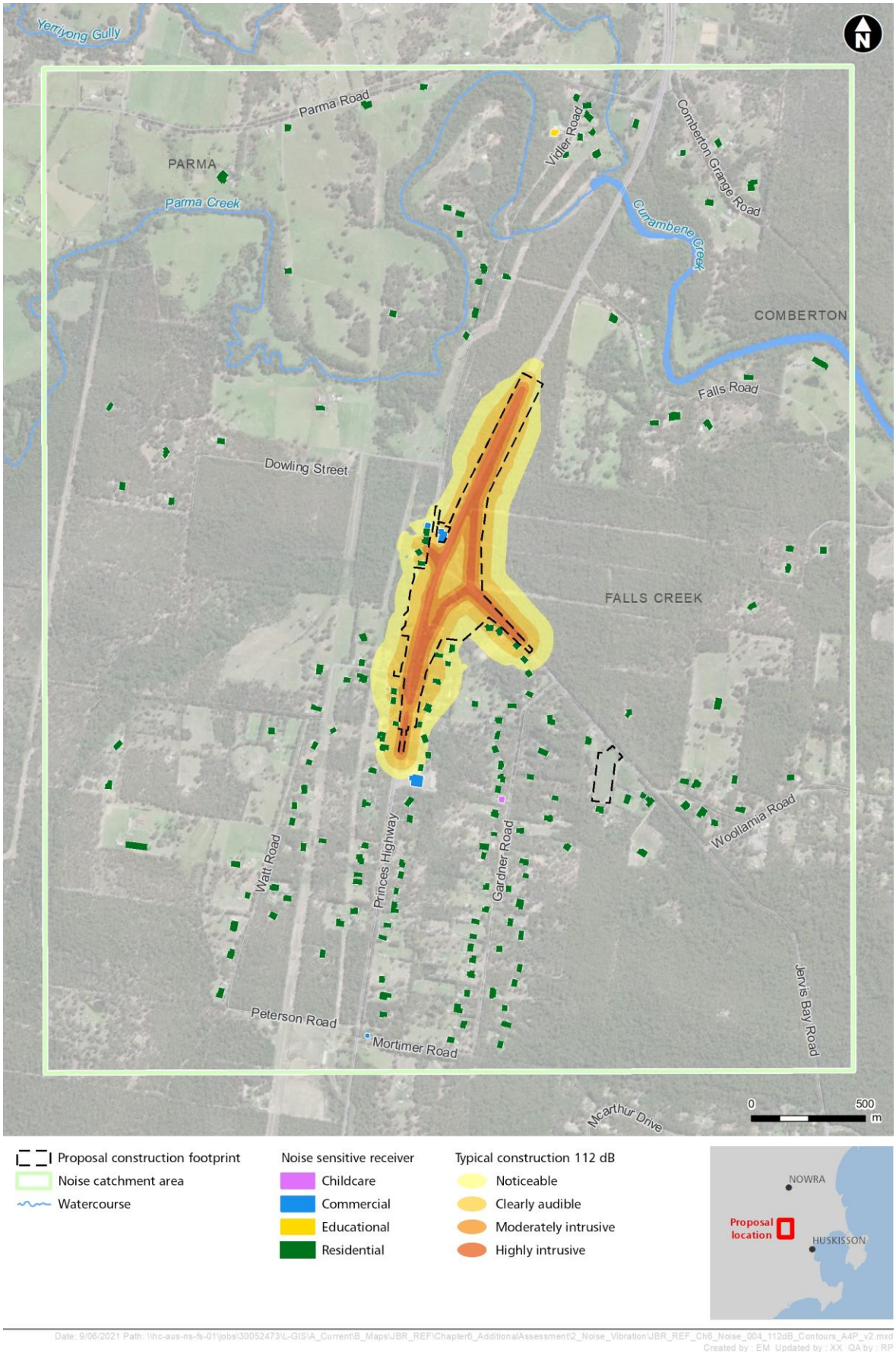

Figure 6-6 Indicative offset distances for typical noise construction activities (112 dB) during standard construction hours

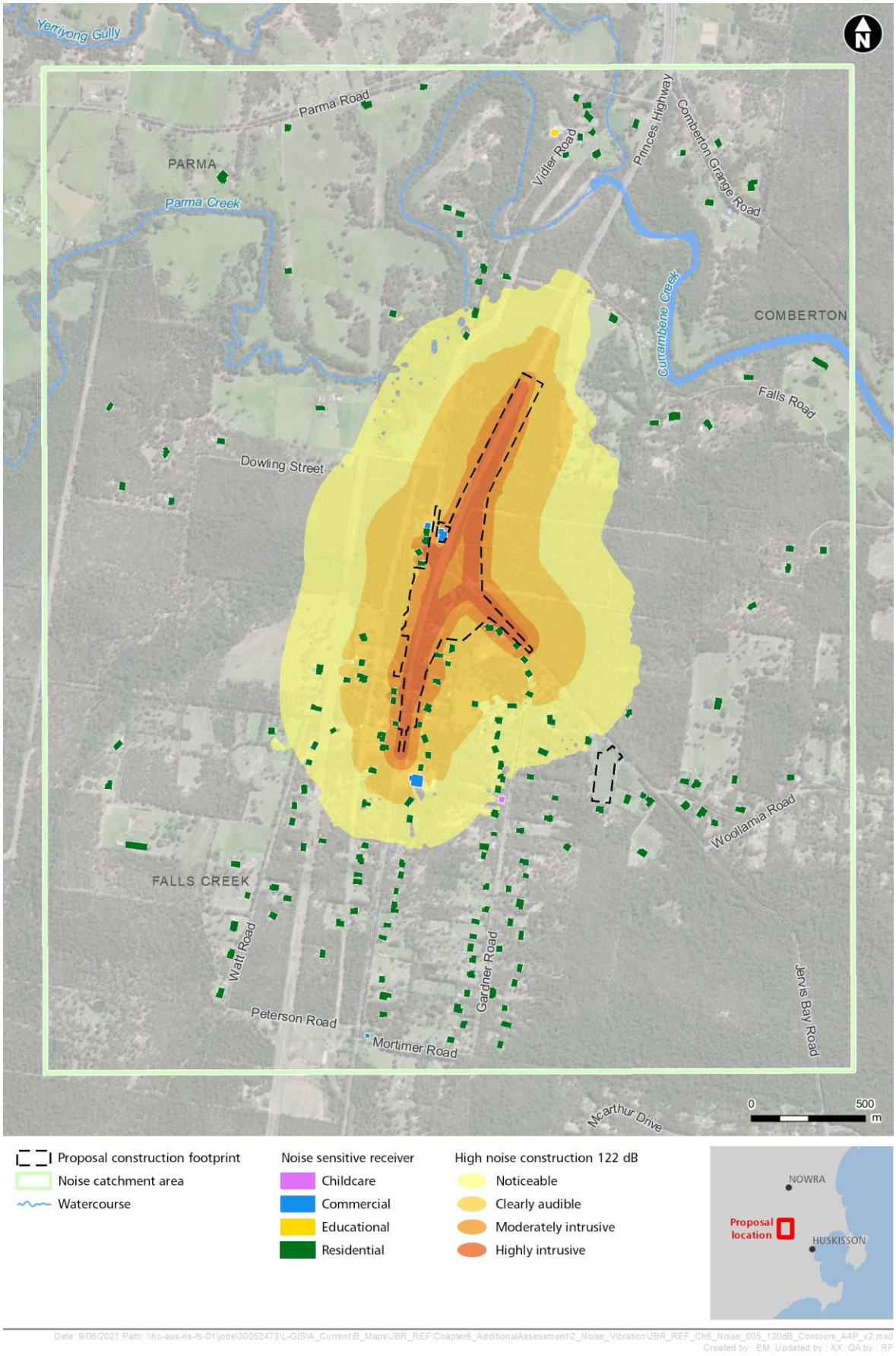

Figure 6-7 Indicative offset distances for high noise construction activities (122 dB) during standard construction hours

Airborne construction noise - out of hours work

Out of hours works would potentially be required for certain activities to minimise traffic impacts, road disruption and safety issues. These activities may include:

- Installation of temporary traffic barriers along Princes Highway and Jervis Bay Road
- Utility adjustments
- Delivery and installation of large precast concrete components
- Construction of major drainage structures
- Completion of tie-ins to the Princes Highway and temporary traffic facilities, and completion of temporary diversions and traffic switches.

When out of hours works are carried out, NML exceedances up to more than 45 dB are likely.

Table 6-24 provides the approximate offset distances in metres for out of hours work noise impacts for all construction activities. For completeness, all construction activities have been assessed for out of hours works, however not all construction activities would occur outside of standard construction hours.

Sleep disturbance

Exceedances of sleep disturbance criteria (ie external L_{Amax} sound pressure level at a receiver of 65 dB or greater) are predicted to occur across all stages of out of hours works at receivers within 190 metres of the proposal construction footprint. It should be noted that peak noise occurrences of about 65 dB are already occurring during the evening and night time, as recorded during attended noise monitoring.

Predicted exceedances during out of hours work and sleep disturbance exceedances would be managed via the environmental management measures discussed in Section 6.2.5.

Table 6-24 Approximate offset distances (metres) for noise impacts of each construction activity during out of hours works

Descriptor	Mobilisation and site establishment	Utility adjustments	Clearing, grubbing and topsoil stripping	Bulk earthworks and materials haulage including sediment basins and diversion drains	Road surface construction	Drainage structures construction	Overpass construction works including heavy vehicle deliverables of over-size loads	Signposting	Lighting and roadside furniture installation	Landscaping, waste disposal and rehabilitation of disturbed areas with no future use
Out of hours works, Period 1 (Monday to Friday – 6 pm to 10 pm, Saturday – 7 am to 8 am and 1 pm to 10 pm, Sunday/Public holiday – 8 am to 6 pm)[1]										
Noticeable	420	730	820	1000	1050	640	870	820	500	670
Clearly audible	290	520	580	710	740	450	610	580	350	470

Descriptor	Mobilisation and site establishment	Utility adjustments	Clearing, grubbing and topsoil stripping	Bulk earthworks and materials haulage including sediment basins and diversion drains	Road surface construction	Drainage structures construction	Overpass construction works including heavy vehicle deliverables of over-size loads	Signposting	Lighting and roadside furniture installation	Landscaping, waste disposal and rehabilitation of disturbed areas with no future use
Moderately intrusive	130	230	260	320	330	200	270	260	160	210
Highly intrusive	40	70	80	100	110	60	90	80	50	70
Out of hours works, Period 2 (Monday to Friday – 10 pm to 7 am, Saturday – 10 pm to 8 am, Sunday/Public holiday – 6 pm to 7 am)[1]										
Noticeable	1310	2320	2590	3170	3320	2030	2740	2610	1580	2110
Clearly audible	930	1640	1840	2240	2350	1440	1940	1850	1120	1500
Moderately intrusive	420	730	820	1000	1050	640	870	820	500	670
Highly intrusive	130	230	260	320	330	200	270	260	160	210

Note:

[1] For completeness, all construction activities have been assessed for out of hours works. Not all construction stages would occur outside of standard construction hours.

Construction vibration impacts

There is potential for vibration impacts from construction based upon the plant and equipment described in Table 6-10. The assumed construction staging indicates that excavator with hammer and vibratory rollers would be required for some of the construction activities. These plant items have minimum working distances of 23 metres and 40 metres, respectively. Vibration for receivers within these distances may be noticeable and would trigger consideration of the vibration safeguards and management measures as described in Section 6.2.5.

There are 22 buildings identified within the 40 metre minimum working distance for human response screening criteria, of which four buildings are commercial receivers and 18 are residential receivers. There are five buildings within the 12 metre minimum working distance for cosmetic damage screening criteria, of which three are commercial receivers and two are residential receivers. This typically encompasses the first row of buildings adjacent to the proposal construction footprint.

Generally, receivers beyond the first row of houses are sufficiently offset from the works to mitigate the potential vibration impacts. It is considered that structural or cosmetic damage impacts from vibration intensive works would be unlikely for the majority of buildings.

Where work is proposed to be carried out within the minimum working distances, the safeguards and management measures outlined in Section 6.2.5 would be implemented to reduce the impacts as far as practicable.

Operation

Operational road traffic noise

When completed, the proposal would not substantially change traffic noise levels in most locations. Almost all (99 per cent) sensitive receivers are predicted to experience changes in operational road traffic noise levels of less than 2 dB(A). Noise modelling indicates that eight receivers would be eligible for consideration of measures to manage noise impacts in accordance with the Transport for NSW Noise Mitigation Guidelines. Three of these receivers would experience an increase in operational noise of more than 2 dB(A) (up to 3 dB(A)) associated with the proposal. Six of the receivers would reach the cumulative limit by 2035 and three would be acutely affected by 2035. Mitigation is expected to comprise at-property treatment.

Operational road traffic noise mitigation options were investigated. These included:

- Quieter pavement surfaces
- Noise mounds and walls
- At-property treatments.

After an assessment of these mitigation options (Appendix D), at-property treatments were determined to be the only reasonable and feasible option for noise mitigation for the proposal. At-property treatment would be considered at the impacted receivers during detailed design.

After the commencement of the operation of the proposal, actual operational noise performance would be compared to predicted operational noise performance as reviewed during detailed design to analyse the effectiveness of the operational road traffic noise mitigation measures. Additional feasible and reasonable mitigation would also be considered where any additional receivers are identified as qualifying for consideration of noise mitigation under the *Noise Mitigation Guideline* (Roads and Maritime, 2015).

Maximum noise level

As the proposal would relocate traffic to be in closer proximity to nearby receivers, it is anticipated that the maximum noise level exceedance would increase. Additionally, the deceleration and acceleration of vehicles into and out of the proposed roundabouts is a contributing factor to increases in magnitude of maximum noise level events.

The proposal would bring Princes Highway traffic closer to receivers on the Old Princes Highway. It would also increase the noise exposure of receivers along the Old Princes Highway due to proximity to traffic travelling along the on and off ramps. The receivers located along Jervis Bay Road are also predicted to experience increased maximum noise levels due to the relocation of the road alignment and the inclusion of roundabouts.

6.2.5 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
NV01 Construction noise and vibration management	A construction Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the *Interim Construction Noise Guideline* (DECC, 2009) and the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016), and will: • Identify potential major noise and vibration generating activities associated with the proposal • Outline standard and additional mitigation measures from the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) and information about when and how each will be applied • Outline requirements for the development and implementation of an out of hours work protocol • Outline monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contactor	Pre-construction Construction	Section 4.6 of QA G36 Environment Protection Interim Construction Noise Guideline (DECC, 2009) Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016)
NV02 Construction noise from ancillary facilities	The layout and use of ancillary facilities will be planned to minimise noise and vibration impacts to sensitive receivers. Before	Contractor	Pre-construction Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	establishment of each ancillary facility, the noise and vibration impacts of these ancillary facilities will be confirmed. Standard safeguards and management measures (and additional site-specific measures, where required) will be implemented in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime 2016).			
NV03 Construction ground-borne vibration	Attended vibration measurements will be carried out at the commencement of works where predicted ground-borne vibration levels exceed the cosmetic damage screening criteria to verify ground-borne vibration predictions. Management of ground-borne vibration level exceedances will be detailed in the NVMP.	Contractor	Construction	
NV04 Operational road traffic noise impacts	Within 12 months of the commencement of the operation of the proposal, actual operational noise performance will be compared to predicted operational noise performance (as reviewed during detailed design) to analyse the effectiveness of the operational road traffic noise mitigation measures. Additional feasible and reasonable mitigation will be considered where any additional receivers are identified as qualifying for consideration of noise mitigation under the *Noise Mitigation Guideline* (Roads and Maritime, 2015).	Transport for NSW project manager	Operation	*Noise Mitigation Guideline* (Roads and Maritime, 2015)

6.3 Property and land use

This section provides an assessment of the potential impacts of the proposal on property and land use and identifies safeguards and management measures to avoid or minimise these impacts.

6.3.1 Methodology

The assessment methodology for impacts on land use and property included the following key tasks:

- A desktop assessment of property ownership and existing land uses in and around the proposal construction footprint was carried out, which included a review of available government sources and aerial photographs
- Identification of potential future uses of land required for construction but not required for operation
- Assessment of potential impacts on properties including those that would need to be acquired to construct and operate the proposal
- Assessment of the potential impacts on existing and likely future land uses during construction and operation of the proposal
- Identification measures to avoid, minimise and manage impacts on land use and property.

Relevant legislation, plans and policies

The impact assessment of the proposal on property and land use has been prepared in accordance with:

- *Land Acquisition (Just Terms Compensation) Act 1991*
- *Land Acquisition Information Guide* (Roads and Maritime Services, 2014).

Property and land use study area

The property and land use assessment study area is equivalent to the review of environmental factors site investigation area presented in Figure 3-6.

6.3.2 Existing environment

Land use zoning

The proposal is located in the vicinity of Falls Creek within the Shoalhaven local government area. Existing land use zones in and around the construction footprint (Figure 4-1), as defined by the *Shoalhaven Local Environment Plan 2014*, include:

- SP2 Infrastructure
- RU2 Rural Landscape
- R5 Large Lot Residential.

Existing land use

Existing land uses in and around the proposal construction footprint comprise the transport corridor, rural residential properties, bushland and limited commercial activities.
Rural properties have been subdivided with dwellings in closer densities on the western side of Old Princes Highway, southern side of Jervis Bay Road and eastern side of the Princes Highway.

Within the proposal construction footprint, two lots are Crown land and 35 are privately owned. The remaining lots within the proposal construction footprint are owned by Shoalhaven City Council or Transport for NSW.

Properties that would be impacted by the proposal and a description of their current use are identified in Table 6-25 and shown in Figure 6-8 and Figure 6-9.

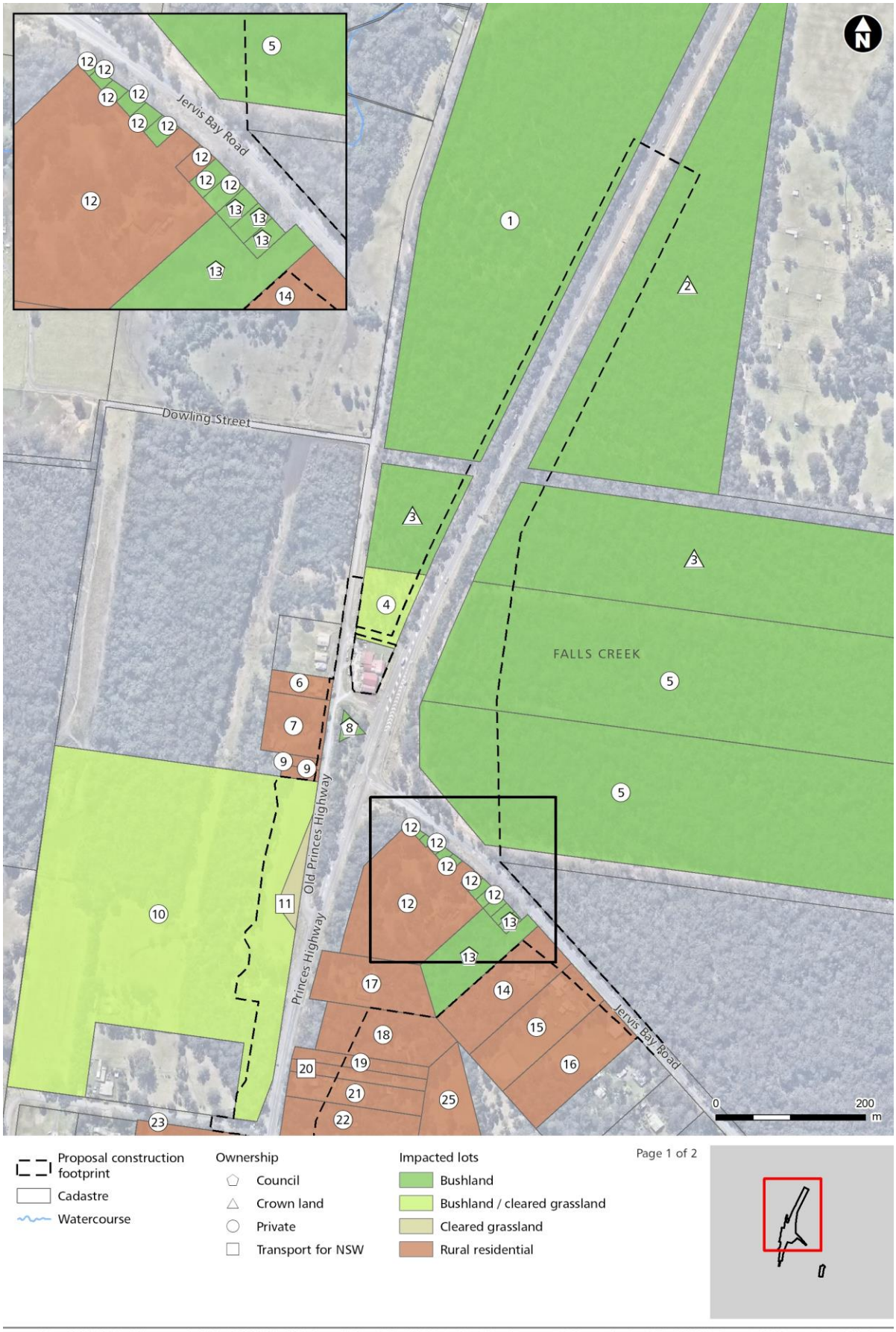

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Figure 6-8 Overview of land uses

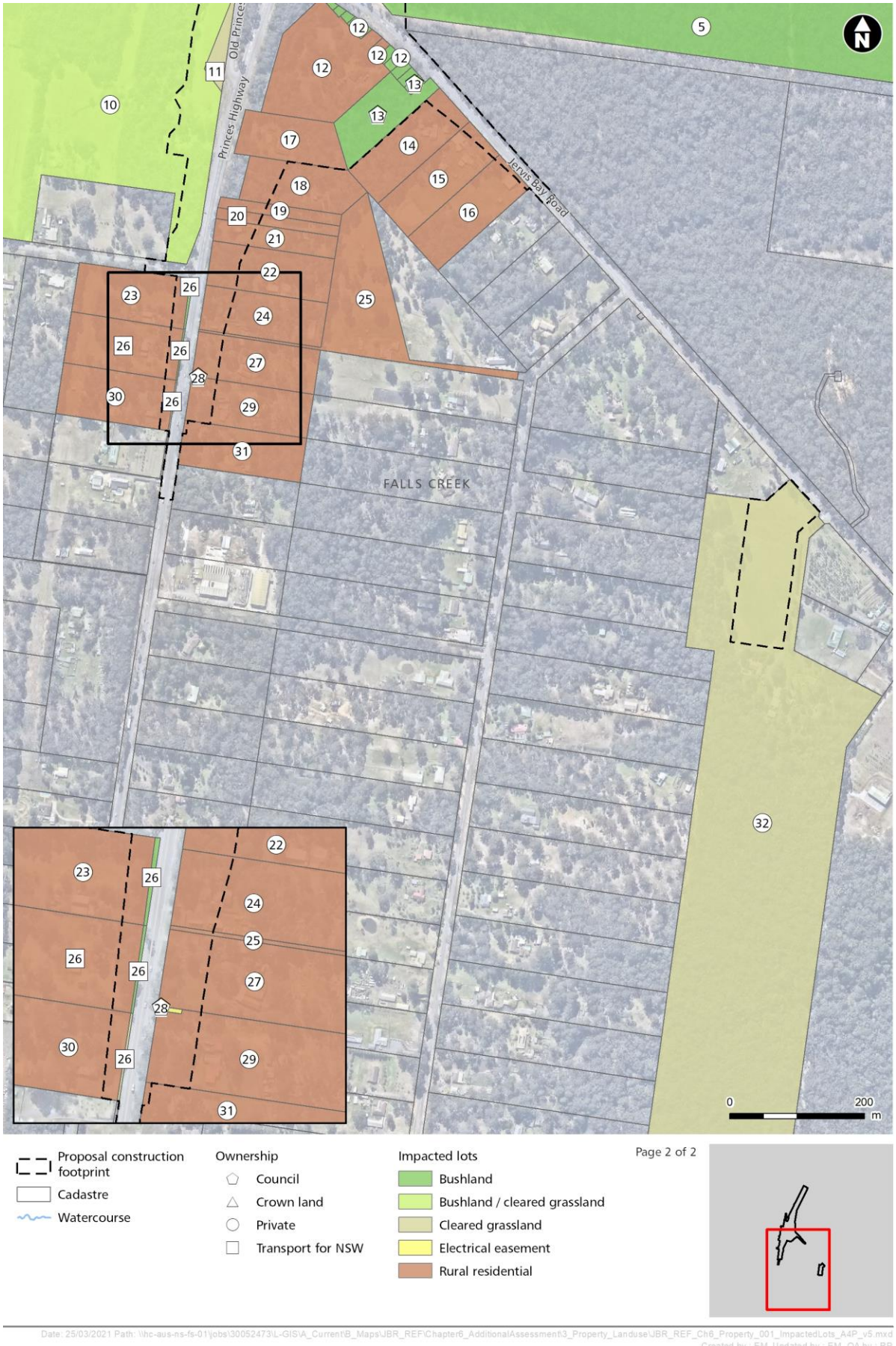


Figure 6-9 Overview of land uses

6.3.3 Potential impacts

Construction

Long term impacts on property and land use would occur from the commencement of construction. These impacts would generally be related to property acquisition, changes to land use, changes to local road connections to the Princes Highway and changes to property access. Although these impacts would be immediate, they are long term and permanent and have therefore been discussed below as operational impacts of the proposal.

Property impacts

Short term property impacts would potentially occur during construction as a result of leasing land for ancillary facilities and other construction activities, such as land use changes and changes to property access. Consultation with land owners would be held in relation to leasing these properties (see Section 5). Property impacts on leased sites would be temporary and limited to the construction phase only.

Land use impacts

During construction, potential impacts on existing land use within the proposal construction footprint would mainly relate to direct impacts from the siting of ancillary facilities. These ancillary facilities would include temporary construction support sites and stockpile areas, as described in Section 3.5. Two ancillary facilities are proposed on cleared grassland with limited biodiversity value. These areas would be managed in accordance with the construction environmental management plan and rehabilitated at the completion of construction, therefore the potential impacts are generally expected to be low.

Crown and Aboriginal land

There is one property within the proposal construction footprint on which an Aboriginal land claim has been granted (ID 1 in Table 6-25). It is proposed to lease part of this land for the duration of construction.

Two Crown land properties (ID 2 and 3 in Table 6-25) that are subject to Aboriginal land claims under the *Aboriginal Land Rights Act 1983* would be also be partially temporarily lease for the duration of construction.

Other land

Four private properties (ID 4, 10, 31 and 32 in Table 6-25) would be subject to partial temporary lease for the duration of construction.

Temporary changes to local roads and property accesses

As detailed in Section 6.1, temporary disruptions to local roads and property accesses would be expected during construction of the proposal. Local roads that would potentially experience some delays and changed traffic arrangements during construction include the Old Princes Highway, Jervis Bay Road and Willowgreen Road. These roads would be directly linked to, or serviced by, the proposal and would experience temporary diversions and traffic switches before traffic is shifted to the revised permanent intersection arrangement with the Princes Highway. These impacts would be minimised through the implementation of a Traffic Management Plan as discussed in Section 6.1.4.

Operation

Operational impacts on property and land use as a result of the proposal would commence during construction.

Property impacts

Details of direct property acquisition as a result of the proposal are provided in Table 6-25, with property reference numbers corresponding to Figure 6-8 and Figure 6-9. Of the 32 properties impacted, seven would be directly impacted in their entirety and would require full acquisition. Twenty-four of the impacted properties are privately owned, three are owned by Shoalhaven City Council and two are Crown land.

About 17.87 hectares of land that is outside of the existing road corridor would be directly impacted by the proposal. This includes 12.32 hectares to be permanently acquired and 5.55 hectares to be temporarily leased.

Table 6-25 also shows three properties that are currently owned by Transport for NSW. These properties have been identified but have not been included in the property acquisition calculations required for the proposal.

The areas of direct impact to property have been calculated using the proposal construction footprint and cadastral overlay. This would be subject to ground survey and further refinement during the detailed design phase of the proposal, which may alter the final acquisition requirements and estimates. All acquisitions would be carried out in consultation with landowners and in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the Transport for NSW (formerly Roads and Maritime Services) *Land Acquisition Information Guide* (Roads and Maritime Services, 2014).

Land use impacts

Much of the proposal construction footprint is already used as transport (road) infrastructure, including the Princes Highway, Jervis Bay Road and surrounding local roads. This overall transport corridor land use would remain with the infrastructure upgraded.

Land classified as rural residential and bushland comprises about 95 per cent of directly impacted land to be acquired, with the remaining five per cent classified as cleared grassland or electrical easements.

Most properties would be only partially impacted, with 18 properties requiring partial acquisition where the proposal would have no substantial effect on the functionality or viability of the current or future use of the remainder of the property.

Partial or full rezoning from R5 Rural Residential or RU1 Rural Landscape to SP2 Infrastructure of at least 18 properties would be required as a result of the proposal, although some properties that would be acquired (or part thereof) are already zoned SP2 Infrastructure.

Crown and Aboriginal land

Two Crown land properties (ID 2 and 3 in Table 6-25) that are subject to Aboriginal land claims under the *Aboriginal Land Rights Act 1983* that would require partial acquisition.

Consultation would be undertaken by Transport for NSW with Aboriginal claimants and the relevant NSW Government departments to resolve the status and use of these properties.

Other land

Four properties (identified as ID 12, 17, 21 and 24 in Table 6-25) to be fully acquired would require demolition of dwellings and other buildings as a result of the proposal, resulting in permanent change in land use from rural residential to transport infrastructure. Similarly, three properties of bushland (with an area totalling less than 1.5 hectares) would permanently change and become transport infrastructure.

Changes in external property access

External property access refers to the connection of a property to the external road network. This may be a direct driveway connection at the property via a private road or by a right of way access through a neighbouring property.

Changes to external property access would be required for properties adjoining the Princes Highway, Jervis Bay Road, the Old Princes Highway and Willowgreen Road as a result of the proposal. These changes are discussed and assessed in Section 6.1.

Table 6-25 Impacted properties and proposed property acquisition

ID (Figure 6-8 and Figure 6-9)	Lot and DP	Ownership	Predominant land use	Acquisition required (Yes/No)	Total property area (hectares)	Area of land to be acquired (hectares) (percentage of total property in brackets)	Area of land subject to temporary lease (hectares) (percentage of total property in brackets)
1	Lot 179 DP1055671	Private	Bushland	No	19.86	-	0.48 (2.4)
2	Lot 7014 DP1064563	Crown Land	Bushland	Yes	9.83	0.25 (2.5)	1.11 (11.3)
3	Lot 127 DP755965	Crown Land	Bushland	Yes	14.52	0.53 (3.7)	0.15 (1)
4	Lot 1 DP244495	Private	Bushland / cleared grassland	No	0.68	-	0.15 (22.1)
5	Lot 2 DP244495	Private	Bushland	Yes	18.24	1.29 (7.1)	-
	Lot 3 DP244495	Private	Bushland	Yes	19.46	1.51 (7.8)	-
6	Lot 6 DP32247	Private	Rural residential	Yes	0.25	0.01 (4)	-
7	Lot 345 DP836413	Private	Rural residential	Yes	0.65	0.04 (6.2)	-
8	Lot 1 DP15507	Council	Bushland	Yes	0.07	0.07 (100)	-
9	Lot 1 DP32247	Private	Rural residential	Yes	0.08	0.01 (12.5)	-
	Lot 2 DP32247	Private	Rural residential	Yes	0.08	0.01 (12.5)	-
10	Lot 1 DP871596	Private	Bushland / cleared grassland	Yes	13.93	0.52 (3.7)	1.78 (12.8)
11	Lot 2 DP871596	Transport for NSW	Cleared grassland	No	0.24	-	-

ID (Figure 6-8 and Figure 6-9)	Lot and DP	Ownership	Predominant land use	Acquisition required (Yes/No)	Total property area (hectares)	Area of land to be acquired (hectares) (percentage of total property in brackets)	Area of land subject to temporary lease (hectares) (percentage of total property in brackets)
12	Lot 1 DP1093336	Private	Bushland	Yes	0.01	0.01 (100)	-
	Lot 2 DP1093336	Private	Bushland	Yes	0.01	0.01 (100)	-
	Lot 3 DP1093336	Private	Bushland	Yes	0.02	0.02 (100)	-
	Lot 4 DP1093336	Private	Bushland	Yes	0.02	0.02 (100)	-
	Lot 5 DP1093336	Private	Bushland	Yes	0.03	0.03 (100)	-
	Lot 6 DP1093336	Private	Bushland	Yes	0.03	0.03 (100)	-
	Lot 7 DP1093336	Private	Rural residential	Yes	2.14	2.14 (100)	-
	Lot 8 DP1093336	Private	Bushland	Yes	0.04	0.04 (100)	-
	Lot 9 DP1093336	Private	Bushland	Yes	0.04	0.04 (100)	-
	Lot 10 DP1093336	Private	Bushland	Yes	0.04	0.04 (100)	-
13	Lot 35 DP1088614	Council	Bushland	Yes	0.04	0.04 (100)	-
	Lot 36 DP1088614	Council	Bushland	Yes	0.04	0.04 (100)	-
	Lot 37 DP1088614	Council	Bushland	Yes	0.04	0.04 (100)	-
	Lot 38 DP24409	Council	Bushland	Yes	0.94	0.94 (100)	-
14	Lot 5 DP15507	Private	Rural residential	Yes	1.22	0.15 (12.3)	-

ID (Figure 6-8 and Figure 6-9)	Lot and DP	Ownership	Predominant land use	Acquisition required (Yes/No)	Total property area (hectares)	Area of land to be acquired (hectares) (percentage of total property in brackets)	Area of land subject to temporary lease (hectares) (percentage of total property in brackets)
15	Lot 6 DP15507	Private	Rural residential	Yes	1.22	0.09 (7.4)	-
16	Lot 7 DP15507	Private	Rural residential	Yes	1.22	0.04 (3.3)	-
17	Lot 59 DP15507	Private	Rural residential	Yes	1.01	1.01 (100)	-
18	Lot 60 DP15507	Private	Rural residential	Yes	1.11	0.33 (29.7)	-
19	Lot C DP397510	Private	Rural residential	Yes	0.3	0.11 (36.7)	-
20	Lot D DP397510	Transport for NSW	Rural residential	No	0.3	-	-
21	Lot B DP392033	Private	Rural residential	Yes	0.61	0.61 (100)	-
22	Lot 62 DP15507	Private	Rural residential	Yes	1.22	0.31 (25.4)	-
23	Lot 12 DP1042235	Private	Rural residential	Yes	1.25	0.15 (12)	-
24	Lot 63 DP15507	Private	Rural residential	Yes	1.22	1.22 (100)	-
25	Lot 571 DP748653	Private	Rural residential (area impacted by the proposal is an electrical easement)	Yes	2.16	0.01 (0.5)	-
26	Lot 11 DP1042235	Transport for NSW	Rural residential	No	1.28	-	-
	Lot 13 DP1042235	Transport for NSW	Cleared grassland	No	0.02	-	-

ID (Figure 6-8 and Figure 6-9)	Lot and DP	Ownership	Predominant land use	Acquisition required (Yes/No)	Total property area (hectares)	Area of land to be acquired (hectares) (percentage of total property in brackets)	Area of land subject to temporary lease (hectares) (percentage of total property in brackets)
	Lot 14 DP1042235	Transport for NSW	Bushland	No	0.02	-	-
	Lot 15 DP1042235	Transport for NSW	Bushland	No	0.03	-	-
27	Lot 64 DP15507	Private	Rural residential	Yes	1.22	0.25 (20.5)	-
28	Lot 1 DP578303	Council	Electrical easement	Yes	0.01	0.01 (100)	-
29	Lot 2 DP578303	Private	Rural residential	Yes	1.21	0.24 (19.8)	-
30	Lot 10 DP1042235	Private	Rural residential	Yes	1.29	0.11 (8.5)	-
31	Lot 66 DP15507	Private	Rural residential	Yes	1.22	-	0.01 (0.8)
32	Lot 4 DP773881	Private	Cleared grassland	No	28.56	-	1.87 (6.5)
TOTAL						12.32	5.55

6.3.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
PR01 Land acquisition	Land acquisition for the proposal will be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, the *Roads and Maritime Services Land Acquisition Information Guide* (Roads and Maritime Services, 2014) and in accordance with the land acquisition reforms announced by the NSW Government in 2016.	Transport for NSW	Pre-construction Construction	*Land Acquisition Information Guide* (Roads and Maritime Services, 2014)
PR02 Property acquisition	Consultation with affected landowners about property acquisition will be carried out throughout the proposal.	Transport for NSW	Detailed design Pre-construction Construction	
PR03 Temporary use of land	Land subject to temporary use will be restored as soon as practicable to an appropriate land use, taking into consideration the location, land use characteristics, area and adjacent land uses. This will be carried out in consultation with the landowner.	Contractor	Construction	

6.4 Socio-economic

This section provides an assessment of the potential socio-economic impacts of the proposal, and identifies safeguards and management measures to avoid or minimise these impacts. A detailed assessment of socio-economic impacts is presented in Appendix E.

6.4.1 Methodology

The socio-economic impact assessment was carried out in accordance with the Environmental impact assessment practice note: socio-economic assessment (EIA-N05) and included:

- Collection and review of existing socio-economic literature and other assessment inputs
- Development of a socio-economic profile of existing geographic areas, social infrastructure and businesses that may be influenced by the proposal, using:
    - 2016 Australian Census of Population and Housing (Australian Bureau of Statistics, 2018)
    - Semi-structured interview with a representative from Shoalhaven City Council
    - Business impact surveys
    - Local, regional and state strategic plans and policies
- Review and analysis of data and assessment of socio-economic impacts during construction and operation of the proposal
- Identification of socio-economic safeguards and management measures.

Relevant legislation, plans and policies

The impact assessment of the proposal on landscape character and visual amenity has been prepared in consideration of:

- Draft *Illawarra Shoalhaven Regional Plan 2041* (DPIE, 2020a)
- *Future Transport 2056 Strategy* (New South Wales Government, 2018a)
- *Connecting to the future – Our 10 Year Blueprint* (Transport for New South Wales, 2018)
- *Regional NSW Services and Infrastructure Plan* (NSW Government, 2018b)
- *NSW Tourism and Transport Plan* (NSW Government, 2018c)
- *NSW Road Safety Strategy 2021* (NSW Government, 2018d)
- *The NSW Freight and Ports Plan 2018 – 2023* (NSW Government, 2018e)
- *NSW South Coast Marine Tourism Strategy 2019* (NSW Government, 2018f)

Detail of these plans is provided in Section 2.

Socio-economic impact assessment study area

The socio-economic impact assessment study area is the Shoalhaven local government area, with a focus on the suburb of Falls Creek where the proposal is located (Figure 6-10).

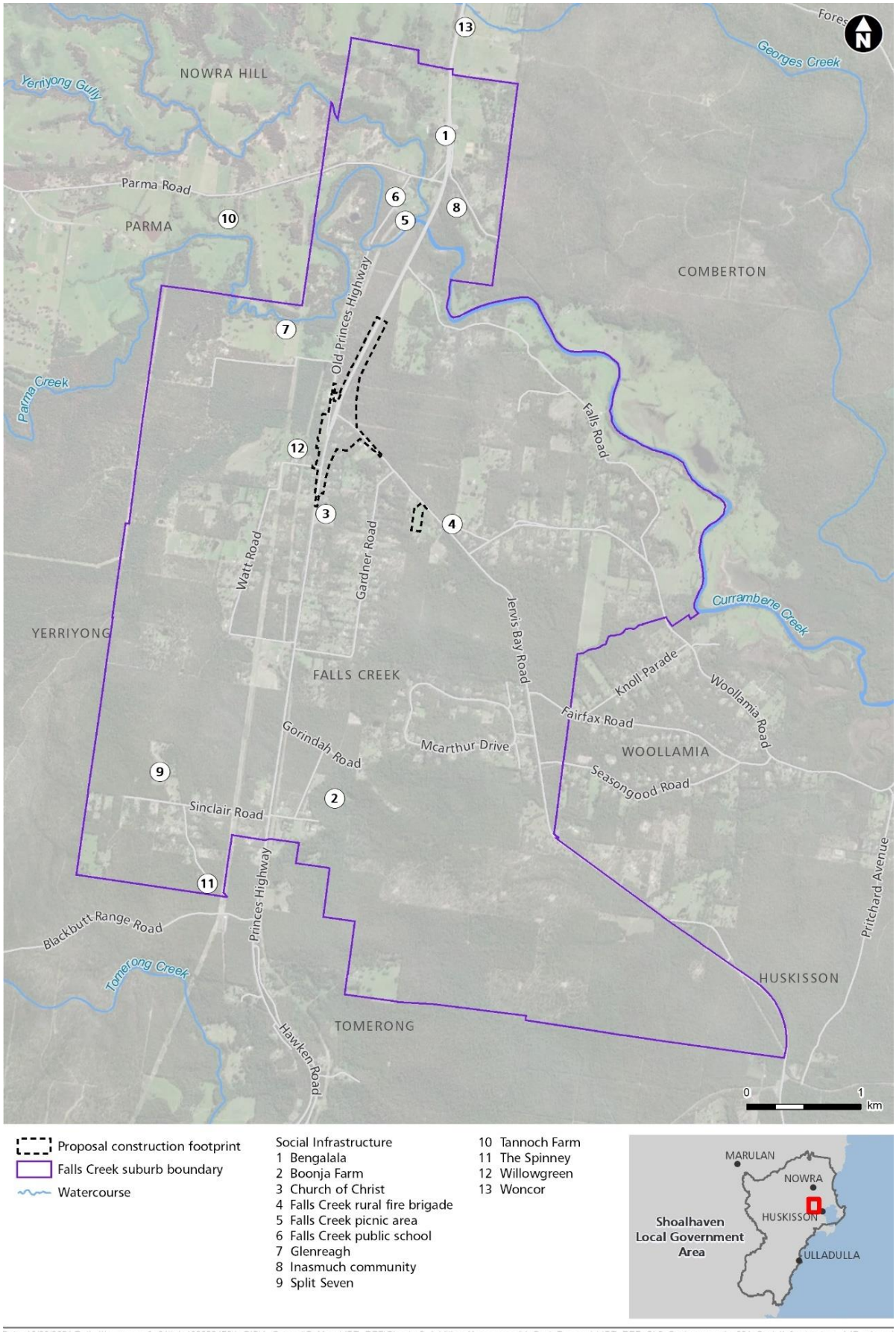


Figure 6-10 Socio-economic impact assessment study area

6.4.2 Existing environment

Population

At the time of the 2016 census, the Shoalhaven local government area (Shoalhaven Statistical Area Level 3, Australian Bureau of Statistics, 2018) had a population of 99,650. In 2018, it is estimated this population had grown by about 4.7 per cent to 104,371 (Australian Bureau of Statistics, 2019).

The Falls Creek population at the time of the 2016 census (NSW State Suburb, Australian Bureau of Statistics, 2018a) comprised 935 people. This population had remained stable from 2011 to 2016. The median age is 47, with more than 20 per cent of the population aged 65 years and older. Aboriginal and Torres Strait Islander people made up 4.7 per cent of the population, comparatively higher than NSW (2.9 per cent) and Australia (2.8 per cent).

The most common ancestries in Falls Creek comprise Australian (34.4 per cent), English (32.7 per cent), Irish (6.1 per cent), Scottish (5.8 per cent) and German (4.3 per cent). The most common ancestries generally correlate to those of NSW and Australia, however there is a larger representation of English and Australian ancestry in comparison to NSW and Australia. 89.7 per cent of the Falls Creek population speak English at home, comparatively higher than NSW (68.5 per cent) and Australia (72.7 per cent).

The main types of dwellings in Falls Creek are three bedroom (30.4 per cent) or four-or-more bedroom (58.5 per cent) houses. This composition is indicative of the low density and rural nature of the town, with individual homes situated on large parcels of land.

Labour force, income and employment

At the time of the census in 2016, 431 people in Falls Creek reported being in the labour force. Of these 54.8 per cent were employed full time, 34.3 per cent were employed part-time. This is generally comparable with NSW and Australia. The average personal weekly income for Falls Creek is $552. This is comparatively lower than the NSW and Australia scales of $664 and $662, respectively. The level of unemployment (3.9 per cent) is lower than NSW (6.3 per cent) and Australia (6.9 per cent).

The most common occupations in Falls Creek include technicians and trades workers (21.5 per cent), professionals (13.7 per cent), clerical and administrative workers (13.2 per cent), community and personal service workers (12.7 per cent), and labourers (12.7 per cent). Of the employed people in the study area, 6.6 per cent work in hospitals (except psychiatric hospitals). Other major industries of employment include aged care residential services (4.8 per cent), building and other industrial cleaning services (4.5 per cent), primary education (3.9 per cent) and local government administration (3.6 per cent).

Travel behaviour

At the time of the 2016 census, 75.4 per cent of the Falls Creek population used a vehicle, as the driver or passenger, to travel to work, contrasting both NSW (57.8 per cent) and Australia (61.5 per cent) with respect to the use of a private vehicle for travel to and from employment. 2.8 per cent of the population indicated that they worked from home and 2 per cent walked to work. No one indicated use of public transport as their method of travel to work.

The public transport network across Shoalhaven City is largely serviced by buses, with most services that interact with the study area originating or ending within Nowra. The Princes Highway is the main transport corridor for services south of Nowra, with three bus services accessing the Huskisson, Vincentia and Sanctuary Point areas, one of which travels via Jervis Bay Road. The frequency of services across the network is low, with one hour or greater between the most regular services.

The Bomaderry Rail Station, located about 16 kilometres north of the study area, provides the main rail service to Kiama, which then connects on to the South Coast Line services towards Sydney. Services operate every two hours, with supporting bus services between Bomaderry and Kiama operating between train services.

There are currently no formal shared paths for pedestrians or cyclists along either the Princes Highway or Jervis Bay Road in the vicinity of Falls Creek. Informal unsealed paths and narrow road shoulders are currently used. A review of Strava data (2020) suggests that pedestrian and cycling activity is generally confined to the main residential and commercial areas and within the neighbouring national parks.

Refer to Section 6.1 for further information about public and active transport.

Business and industry

The following information about business and industry is derived from the semi-structured interview conducted with a Council representative and the business impact surveys.

Local businesses in the Shoalhaven are dominated by individual trades and community members who travel to Nowra for work. The commuting workforce has contributed to congestion on the road network and prompted Council to encourage the setup of businesses and commercial activities closer to the proposal.

About 450,000 tourists visit the Jervis Bay area each year (Department of Infrastructure, Transport, Regional Development and Communications, 2020). Consequently, tourism has been identified in the *Illawarra Shoalhaven Regional Plan 2041* (Department of Planning and Environment, 2020) as an existing economic strength and an important future growth sector. The NSW Government has approved three aquaculture leases in Jervis Bay (Callala and Vincentia beaches), which will add to the need for strong freight and logistic services to transport products to distribution hubs like port facilities.

Supermarket chains have opened in the Jervis Bay territory alongside a developing industrial node immediately west of Huskisson. These operations require heavy vehicles for deliveries and product transport and contribute to traffic congestion.

Congestion along the roads have encouraged businesses to dispatch or receive materials outside of peak traffic periods.

Community values

The Shoalhaven City Council developed a vision (Shoalhaven City Council, 2020) for the region based on fostering a safe and attractive community pursuing sustainable development and environmental protection.

The Council representative interviewed also identified the following community values:

- Improved vehicular accessibility to townships
- Reduced congestion on highway and local road network
- Enjoying ‘lifestyle’ properties in the vicinity of the proposal, and the amenity of those properties.

Community values also emerged from the business survey results and included reduced traffic congestion, and improved travel times and road safety, specifically when entering or crossing the intersection.

6.4.3 Potential impacts

Construction

Traffic and access arrangements

Temporary speed limit reductions would be applied in the vicinity of the proposal construction footprint for the duration of construction. Traffic efficiencies would be reduced for local and regional commuters and there would be potential for delays due to changes to local roads, temporary traffic signals and potential local road closures and detours.

While the location and access to bus stops may be temporarily impacted, disruption to customers and service providers would be minimised by relocating the bus stops to the closest safe and practical alternative.

Impacts to property access points would occur as a result of the proposal. Access to properties and businesses would be maintained for the full construction duration. Alternative access arrangements would be provided where the proposal would impact access to residential and commercial properties.

As discussed in Section 6.1, construction traffic and access impacts would be managed through consultation and the implementation of a traffic management plan.

Local economy

The proposal construction would positively contribute to the local economy through:

- Direct employment through on-site construction activities (about 110 full time equivalent roles)
- Increased expenditure at local and regional businesses through purchases by the construction workforce
- Direct expenditure associated with on-site construction activities, such as procurement of materials
- Indirect employment and expenditure through the provision of goods and services required for construction, such as truck and dog operators and waste removal companies.

Property

Of the 32 properties that would be impacted by the proposal, seven would be directly impacted in their entirety and would require full acquisition. Twenty-four of the impacted properties are privately owned, three are owned by Shoalhaven City Council, two are Crown land and three are owned by Transport for NSW. There are also seven properties that would be subject to partial temporary lease for the duration of construction. Further detail about property acquisition is provided in Section 6.3.

Some property owners may see acquisition of their property as an opportunity to improve their social circumstances. This might apply to residents with no strong social connections to the local area, or to those residents who may be intending to relocate in the near future (eg retirees or ‘downsizers’). Some may accept financial compensation as a positive impact to their financial circumstances.

On the other hand, some property owners may experience adverse socio-economic impacts as a result of acquisition. This may take the form of financial pressure or social disruption as a result of forced relocation.

Amenity

Amenity impacts include any factors that affect the ability of a resident, visitor or business owner to enjoy their home and daily activities, for example, noise, vibration, changes to views or to air quality.

Predicted construction noise levels at residences would vary depending on the distance between the residence and the proposal construction footprint and on whether the work carried out at the time required the use of highly noise plant and equipment.

During the noisiest stages of construction, standard construction hours noise management level exceedances (noise levels exceeding 60 dB(A)) are predicted at receivers up to 370 metres from the proposal construction footprint, as shown in Figure 6-6 and Figure 6-7. The potential for construction noise to impact community members at work during business hours is low, but it is likely that a portion of the population will be at home during construction operations. These noise impacts will be exacerbated in the morning and afternoon when the majority of the community is still at home (for example, before leaving for or arriving home from work).

With regard to construction vibration, the operation of large vehicles, and vibration intensive plant and machinery within the minimum working distances, especially at the ancillary sites, has the potential to exceed the human response and structure cosmetic damage screening criteria.

Air quality impacts to residential receivers during construction may include:

- Annoyance due to dust deposition (eg settlement of surfaces at residences) and visible dust plumes
- Elevated PM_{10} concentrations due to on-site dust-generating activities
- Increased concentrations of airborne particulate matter and NO_2 due to exhaust emissions from on-site diesel-powered vehicles and construction equipment.

If unmanaged, the settlement of dust may impact upon human health and amenity at sensitive receivers located near the proposal, particularly from earthworks, intersection construction and track out activities.

Provided the implementation of standard safeguards and management measures typical of road infrastructure projects, the risk of dust and emissions impacts is expected to be low and would be limited to the construction phase only.

Further detail about amenity impacts during construction of the proposal are discussed in detail in Section 0, Section 6.11 and Section 6.12.

Operation

Traffic and access arrangements

Operation of the proposal would alleviate traffic congestion and improve safety for road users. This would have a positive impact on the local community, businesses and service providers, freight, tourists and commuters who move and operate around the Shoalhaven local government area.

While the proposal would result in a minor relocation of the bus stops servicing local routes and school buses, public transport users would benefit from the improved safety and traffic performance, including lower delays and shorter queues.

The proposal would provide a shared user path along the road at all approaches to the intersection. The proposal would also separate the high volumes of through vehicles on the Princes Highway from the movements between Jervis Bay Road and the Old Princes Highway, which are more likely to service pedestrian and cyclist movements than the

mainline. The separation of movements on the minor roads from the highway provides for safer road environment for active transport users.

Permanent alteration of external property access would be required during operation of the proposal for a number of properties on the Princes Highway, Jervis Bay Road, the Old Princes Highway and Willowgreen Road. All property access would be maintained. Refer to Section 6.1 for further details.

The proposal would result in improvements to safety and transport network efficiency, allowing for uninterrupted through movements for northbound and southbound Princes Highway traffic and significantly improve intersection performance for both Princes Highway and Jervis Bay Road traffic. This would improve the efficiency and reliability of the Princes Highway and Jervis Bay Road as emergency evacuation route for both emergency services and general public traffic.

Local economy

Construction jobs would no longer be required at the completion of construction, and many workers would relocate to their next project, resulting in a decrease in local expenditure. The local economy would, however, benefit from an improved and safer road network that promotes the efficient transport of goods and services in the region.

Community respondents to a Council survey (Shoalhaven City Council, 2020) and the interviewed Council representative note that reduced congestion would encourage business growth, particularly in relation to tourism activities and the transport of staff and materials for construction related businesses. For example, where the local earthworks business experienced added costs by delays at the congested intersection, an efficient road network would reduce these costs to the business and allow it to operate effectively during on-peak and off-peak periods.

Property

Where partial acquisitions are required, landowner's residences may become closer to the highway than before the upgrade. Therefore, there is the potential for increased noise impacts at these residences during operation. Mitigation of operational noise impacts are discussed in Section 0.

Amenity

Some residential receivers near the southern end of the proposal would be considered for operational noise mitigation due to the exceedance of the *Noise Criteria Guideline* (Roads and Maritime Services, 2015a).

Landscape character zones and viewpoints would be impacted due to vegetation clearing, the introduction of new infrastructure and associated earthworks.

While overall traffic growth would result in an increase of emissions, this would already occur without the proposal. The increase in efficiency at the intersection and reduced congestion as a result of the proposal would result in a reduction in emissions associated with wait times along Jervis Bay Road during peak periods.

Further detail about amenity impacts during operation of the proposal are discussed in detail in Section 0, Section 6.11 and Section 6.12.

6.4.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
SE01 Community engagement	A Community and Stakeholder Engagement Plan (CSEP) will be prepared and implemented. The CSEP will include: • Procedures and mechanisms implemented in response to the key social impacts identified for the proposal • Procedures and mechanisms used to engage with affected landowners, business owners and the wider community to identify potential access, parking, business visibility and other impacts and develop appropriate management measures • Procedures to keep the community informed about construction and any associated changes to conditions (eg detours or lane closures) such as through advertisements in local media and advisory notices or variable message signs • Procedures and mechanisms that will be used to engage with all sensitive receivers likely to be affected by construction noise and vibration before commencement of activities associated with noise and vibration impacts • Procedures to consult with affected landowners about property acquisition • Procedure for the management of complaints and enquiries, including a contact name and number for complaints.	Transport for NSW Contactor	Detailed design Pre-construction	

6.5 Biodiversity

This section provides an assessment of the potential impacts of the proposal on biodiversity and identifies safeguards and management measures to avoid or minimise these impacts. A detailed assessment of biodiversity impacts is presented in Appendix F.

6.5.1 Methodology

The methodology for the biodiversity assessment included a desktop assessment, habitat assessment, field surveys and the assessment of biodiversity impacts.

Desktop assessment

A desktop assessment was undertaken in August and September 2020 which included a review of the following relevant databases and previously undertaken assessments:

- The NSW BioNet Wildlife Atlas and Threatened Biodiversity data collection (DPIE, 2020a)
- The Protected Matters Search Tool (DAWE, 2020)
- The NSW BioNet Vegetation Classification data collection (DPIE, 2020b)
- The NSW DPI weeds database (DPIE, 2020c)
- Soils and geology database (eSPADE) (DPIE, 2020d)
- The Fisheries NSW Spatial Data Portal (DPI, 2020)
- The Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (BoM, 2020)
- Key Fish Habitat maps (DPI, n.d.)
- Compilation map: Biometric vegetation types of the Shoalhaven, Eurobodalla and Bega Valley local government areas. Version 2.1(OEH, 2013)
- Delineation and description of the Eastern Environmental Subregions (provinces) in New South Wales Study (Morgan, 2001)
- Descriptions for NSW (Mitchell) Landscapes Version 2 (NPWS, 2002)
- Princes Highway Upgrade, Jervis Bay Road to Sussex Inlet Road Preliminary Environment Investigation (Transport for NSW, 2020).

Habitat assessment

A list of threatened flora, fauna and ecological communities known or considered likely to occur within the study area was prepared and refined based on suitability habitat features present, including associated plant community types, soil and geological preferences. A habitat assessment was then undertaken to determine the likelihood for each of these threatened entities to occur and, as such, to be potentially impacted by the proposal.

Field surveys

Vegetation, flora and fauna field surveys were undertaken in 2020 and 2021 to target specific threatened species to validate the results of the desktop and habitat assessments. Survey effort is in accordance with current biodiversity assessment guidelines (OEH, 2017). A summary of the survey effort for the biodiversity assessment is shown in Table 6-26.

Table 6-26 Summary of biodiversity assessment survey effort

Date	Method
19 to 21 August 2020	Vegetation plots in areas of Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest (five plots) and Woollybutt - White Stringybark - Forest Red Gum grassy woodland (two plots). Fauna surveys including habitat assessment, stag watching and spotlighting. Habitat condition assessment and waterway classification of aquatic habitats.
24 September 2020	Vegetation surveys including EPBC TEC assessment and one vegetation plot in Woollybutt - White Stringybark - Forest Red Gum grassy woodland.
6 to 9 October 2020	Targeted surveys for non-seasonal threatened flora species and spring flowering species. Vegetation plots in areas of exotic grassland (one plot), Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest (one plot) and Woollybutt - White Stringybark - Forest Red Gum grassy woodland (one plot). Diurnal and nocturnal fauna surveys including camera traps, call playback, spotlighting and stag watching.
20 to 21 October 2020	Diurnal and nocturnal fauna surveys including camera traps, call playback, spotlighting and stag watching.
3 to 4 December 2020	Diurnal fauna surveys including baited camera and Anabat set up, and nocturnal fauna surveys including call playback, spotlighting and stag watching.
15 to 18 December 2020	Targeted searches for threatened flora species *Cryptostylis hunteriana.* Diurnal fauna surveys including Anabat and baited camera equipment collection, and nocturnal fauna surveys including call playback and spotlighting.
8 to 9 March 2021	Targeted searches for threatened flora species *Genoplesium baueri.*
13 to 14 April 2021 **20 April 2021**	Targeted searches for threatened flora species *Pterostylis ventricosa*. Vegetation plot in area of Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest.

Impact assessment

Potential impacts to biodiversity as a result of the proposal were identified and assessed. This included an assessment of direct and indirect construction and operational impacts. Mitigation measures for avoiding, managing or reducing impacts on biodiversity values during detailed design, construction and operation were identified. Offsetting requirements for any residual impacts that cannot be avoided, minimised or mitigated were outlined and discussed.

Relevant legislation, plans and policies

The impact assessment of the proposal on biodiversity has been prepared in accordance with, or with reference to:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Biodiversity Conservation Act 2016*
- *Biosecurity Act 2015*
- *Fisheries Management Act 2004*
- *State Environmental Planning Policy (Coastal Management) 2018*
- *State Environmental Planning Policy (Koala Habitat Protection) 2019*

- The Biodiversity Assessment Method (OEH, 2017)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities working draft (DEC, 2004)
- Threatened Species Assessment Guidelines: the assessment of significance (DECC, 2007)
- Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (DoE, 2013)
- Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method (DPIE, 2020e)
- 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method (OEH, 2018a)
- Survey guidelines for Australia's threatened mammals: guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (CoA, 2011)
- Survey guidelines for Australia's threatened birds: guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (CoA, 2010a)
- Survey guidelines for Australia's threatened bats: guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (CoA, 2010b)
- Survey guidelines for Australia's threatened orchids: guidelines for detecting orchids listed as 'threatened' under the Environment Protection and Biodiversity Conservation Act 1999 (CoA, 2013)
- *EPBC* Act referral guidelines for the vulnerable koala (CoA, 2014)
- Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013)
- Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003).

Biodiversity study area

The site investigation area for the biodiversity assessment is the area investigated during current site surveys, which includes the proposal construction footprint.

The study area for the biodiversity assessment refers to the broader area subject to desktop assessment, including database searches. The study area includes the site investigation area plus a 10 kilometre radius (Figure 6-11).

Figure 6-11 Biodiversity study area

6.5.2 Existing environment

Landscape features

Landscape context

The site investigation area is located within the *Jervis* sub-region of the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion. The *Jervis* sub-region is situated along the coastal area between Nowra and Durras.

The site investigation area is largely situated within the *Nowra-Durras Coastal Slopes* Mitchell Landscape, with an area of *Bherwerre Barrier* mapped at the centre of the site investigation area around the Jervis Bay Road and Princes Highway intersection by NPWS (2002).

Soils and geology

Two soil landscapes are mapped within the site investigation area: Nowra and Shoalhaven (DPIE, 2020d). Most of the site investigation area comprises the *Nowra* soil landscape, with an area in the central west of the site investigation area, surrounding the intersection, mapped as *Shoalhaven*. A small area of *Disturbed Terrain* has been mapped in the north-west of the site investigation area, near the proposal construction footprint boundary. Further details on soils and geology are provided in Section 6.6.

Rivers, streams and wetlands

The site investigation area is situated in the Southern Rivers catchment as defined by the NSW Department of Primary Industries. The site investigation area does not cross any major creeks, rivers or streams. Unnamed ephemeral watercourses that are tributaries of Parma Creek lie within the proposal construction footprint, intersecting north-west, central and southern areas.

Based on the Strahler method of stream ordering (Strahler, 1952) and using the *Water Management (General) Regulation 2018 Hydro Line spatial data* (DPI, 2018), Parma Creek (about 200 metres from the site investigation area) is classified as a second order stream. The unnamed ephemeral watercourses within the site investigation area are classified as first order streams.

Currambene Creek lies approximately 700 metres northeast of the site investigation area and is classified as a third order stream (DPI, 2018).

A coastal environment area[4] associated with Currambene Creek is mapped under the *State Environmental Planning Policy (Coastal Management) 2018* about 50 metres from the site investigation area.

Further details on rivers and streams are provided in Section 6.7.

Artificial wetlands (eg farm dams, detention basins, roadside drains, effluent treatment systems) are scattered throughout the site investigation area.

[4] Coastal management areas are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included.

Flora

Vegetation types

The native vegetation within the site investigation area is consistent with two plant community types (PCT):

- Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
- Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (PCT 1326).

Other vegetation types within the site investigation area include Exotic grassland and Planted native/exotic vegetation and remnant trees.

The key characteristics of the vegetation types within the site investigation area are presented below. Their area of coverage within the site investigation area is provided in Table 6-27 and their location is shown in Figure 6-12.

Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)

Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082) is recognised as an open forest or woodland with an understorey of sclerophyll shrubs and a groundcover of sedges. The community is associated with sandstone plateau in the lower Shoalhaven area and occurs in elevations of up to 700 metres (DPIE, 2020b).

Within the site investigation area, PCT 1082 is situated in the northern extent on both the east and west sides of the Princes Highway and in the eastern extent along Jervis Bay Road. This covers a total of 14.98 hectares. This area generally consists of the higher elevations across the site, between 30 and 40 metres above sea level, and the soil has a strong sandstone influence.

The areas of PCT 1082 within the site investigation area form three vegetation zones. Most areas of PCT 1082 within the site investigation area are in Good condition, while an area in the central section of the site investigation area is in Moderate Disturbed condition. There is also a small area to the south-east of the intersection is in Poor condition.

The areas of PCT 1082 in Good condition are dominated by native species in all strata with very few exotic species.

The area of PCT 1082 in Moderate Disturbed condition is also dominated by native species with an intact canopy of *Eucalyptus* and *Angophora* species. However, understory species are largely absent from this vegetation zone and are restricted to small patches of undisturbed vegetation. Surrounding these patches, the groundcover consists of a dense layer of mulch and is devoid of shrubs.

The area of PCT 1082 in Poor condition has been subject to historical disturbances such as clearing and grazing by horses, as well as ongoing disturbances including mowing. As a result, this area has a sparse canopy cover and the shrub layer is generally absent. Exotic species cover is also higher here, as a result of planted exotic trees and lawn grasses including *Stenotaphrum secundatum* (Buffalo Grass).

PCT 1082 in Good condition in the site investigation area covers an area of 10.64 hectares, while the area of Moderate Disturbed condition covers 2.50 hectares and the area of Poor condition covers 1.84 hectares.

PCT 1082 does not correspond to any threatened ecological communities listed under the *Biodiversity Conservation Act 2016* or *Environment Protection and Biodiversity Conservation Act 1999*.

Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (PCT 1326)

Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (PCT 1326) is recognised as a grassy woodland typically occurring between the Illawarra and Moruya. The community is associated with flats below 100 metres above sea level with sandy loam soils and partially impeded drainage (DPIE, 2020b).

The largest areas of PCT 1326 in the site investigation area occur in the central section between the Princes Highway and the Old Princes Highway. Smaller patches also occur along the Princes Highway south of the Jervis Bay Road intersection and in a small patch in the eastern extent of the site investigation area along Jervis Bay Road. Most patches of PCT 1326 are located on areas mapped as consisting of quaternary alluvial deposits (Department of Regional NSW, 2009) and with an elevation of below 30 metres above sea level. The patch in the southern extent occurs on a higher elevation of approximately 40 metres. PCT 1326 within the site investigation area covers 5.84 hectares.

PCT 1326 within the site investigation area forms three vegetation zones: 1326 – Moderate woodland, 1326 – Moderate garden and 1326 – Poor. 1326 – Moderate woodland generally has a dense shrub layer and high cover and diversity of native species within the ground layer. In comparison, areas of 1326 – Moderate garden are situated in the front and back yards of rural residential properties and are therefore subject to ongoing disturbances including mowing. As a result, they have a lower cover and diversity of native species and a sparse or absent shrub layer. However, areas of 1326 – Moderate garden have several remnant large Eucalypts, including hollow-bearing trees and as a result these areas are also considered to be in moderate condition. The vegetation zone 1326 – Poor is also subject to ongoing disturbances including mowing and historical clearing, as well as grazing from livestock. As a result, the shrub layer in these patches is often absent or sparsely present and the ground layer has a high cover of exotic species.

PCT 1326 within the site investigation area meets the criteria for threatened ecological communities listed under the *Biodiversity Conservation Act 2016* and *Environment Protection and Biodiversity Conservation Act 1999*, as discussed below.

Exotic grassland

Areas of exotic grassland are present to the west of the Old Princes Highway and within the proposed ancillary facility location along Jervis Bay Road to the south of Gardner Road. This vegetation type covers a total of 3.20 hectares. These areas are characterised by a groundcover dominated by exotic grasses, herbs and forbs and an absent canopy and shrub layer.

Historical aerial imagery shows these areas have been cleared from as early as 1949 and are not currently displaying signs of native regrowth. This is due to ongoing land use, grazing and maintenance activities, such as slashing and mowing, which prevent the regeneration of trees and shrubs in these cleared and disturbed areas.

This vegetation type is not representative of any plant community type known from the Jervis subregion, nor does it conform with the definition of any threatened ecological communities listed under the *Biodiversity Conservation Act 2016* or *Environment Protection and Biodiversity Conservation Act 1999*.

Planted native/exotic vegetation and remnant trees

Areas of planted native and exotic vegetation and remnant trees are scattered across the site investigation area in small patches, concentrated along Jervis Bay Road and the Princes Highway. This vegetation zone covers a total of 0.64 hectares in the site investigation area. As these patches are present in narrow strips and small patches which cross multiple properties, no plots were completed in this vegetation zone.

These patches are typically located in the front yards of properties and are characterised by the presence of a high number of planted exotic and non-locally native species. The ground cover in this vegetation zone is dominated by exotic lawn grasses. Native groundcover species are also present, with varying abundance across the patches.

While these patches contain some remnant native species characteristic of plant community types in the area, the vegetation has been subject to historical and ongoing disturbances, in particular clearing, edge effects and planting of exotic species, which has significantly altered the vegetation. As a result, the vegetation patches no longer reflect the floristic composition and structure of any plant community types known from the Jervis subregion. The patches also do not conform with the definition of any threatened ecological communities listed under the *Biodiversity Conservation Act 2016* or *Environment Protection and Biodiversity Conservation Act 1999*.

Threatened ecological communities

There are 5.84 hectares of PCT 1326 within the site investigation area that meets the description of the threatened ecological community Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion, listed as endangered under the *Biodiversity Conservation Act 2016*. There are 4.42 hectares of PCT 1326, which overlap with the *Biodiversity Conservation Act 2016* threatened ecological community, that also meet the size and condition threshold criteria for the threatened ecological community Illawarra and south coast lowland forest and woodland, listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999*.

The threatened ecological communities within the site investigation area are shown in Figure 6-13.

Table 6-27 Vegetation types within the site investigation area

PCT Name	PCT number	Structure/ condition class	Status		Extent within site investigation area (hectares)[1]
			BC Act	EPBC Act	
Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)	1082	Good	-	-	10.39
		Moderate Disturbed	-	-	2.75
		Poor	-	-	1.84
Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (PCT 1326)	1326	Moderate woodland	Endangered – Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	Critically Endangered – Illawarra and south coast lowland forest and woodland (patches that meet condition criteria)	2.54
		Moderate garden	Endangered – Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	Critically Endangered – Illawarra and south coast lowland forest and woodland	1.88
		Poor	Endangered – Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	-	1.42
Exotic grassland		N/A	-	-	3.20
Planted native/exotic vegetation and remnant trees		N/A	-	-	0.64
Total area native vegetation					20.82
Total area vegetation					24.66

Note:

[1] The site investigation area represents a larger area of vegetation than that to be removed from the proposal construction footprint. For vegetation removal impacts, refer to Section 6.5.3

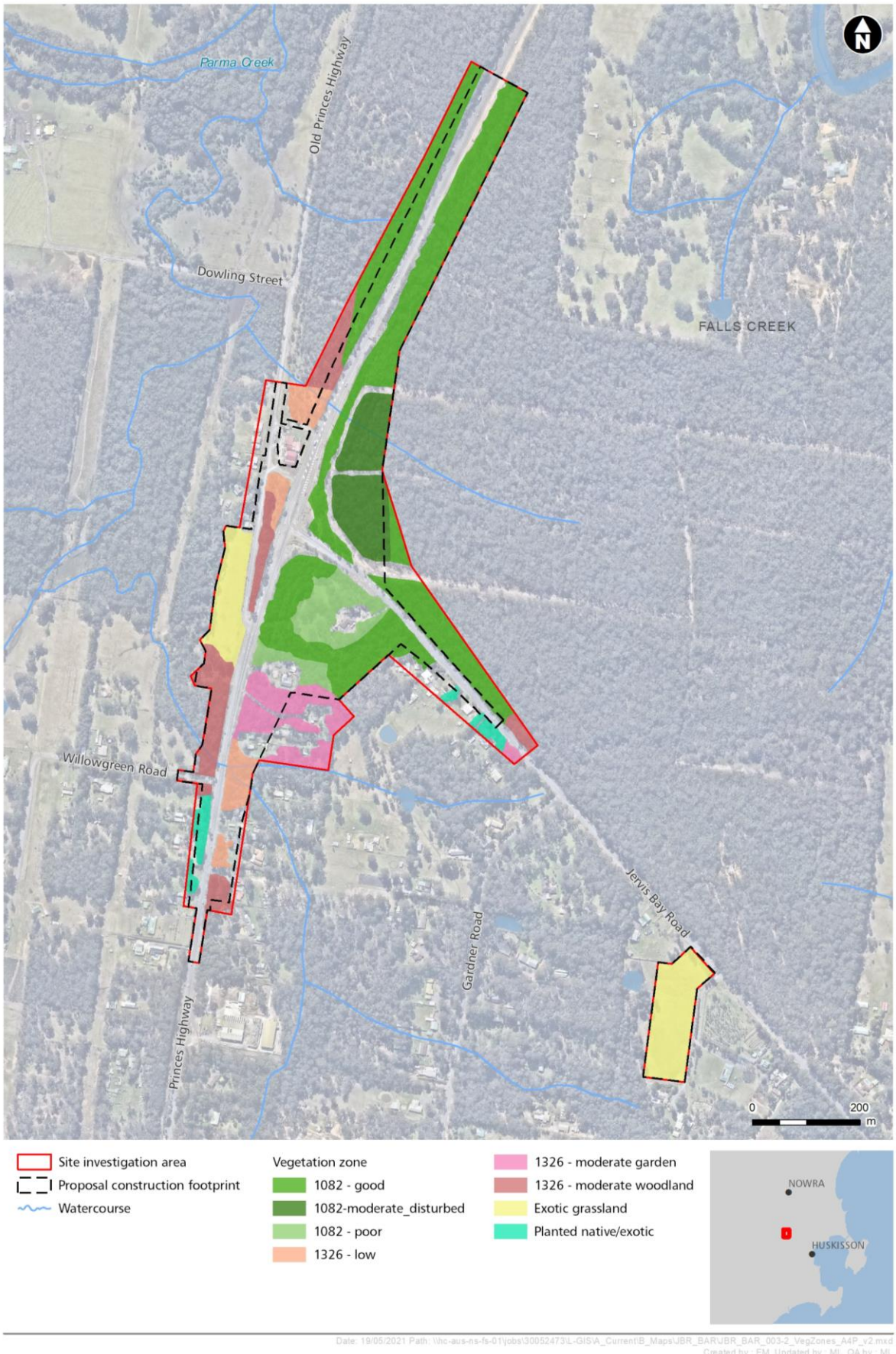


Figure 6-12 Vegetation types within the site investigation area

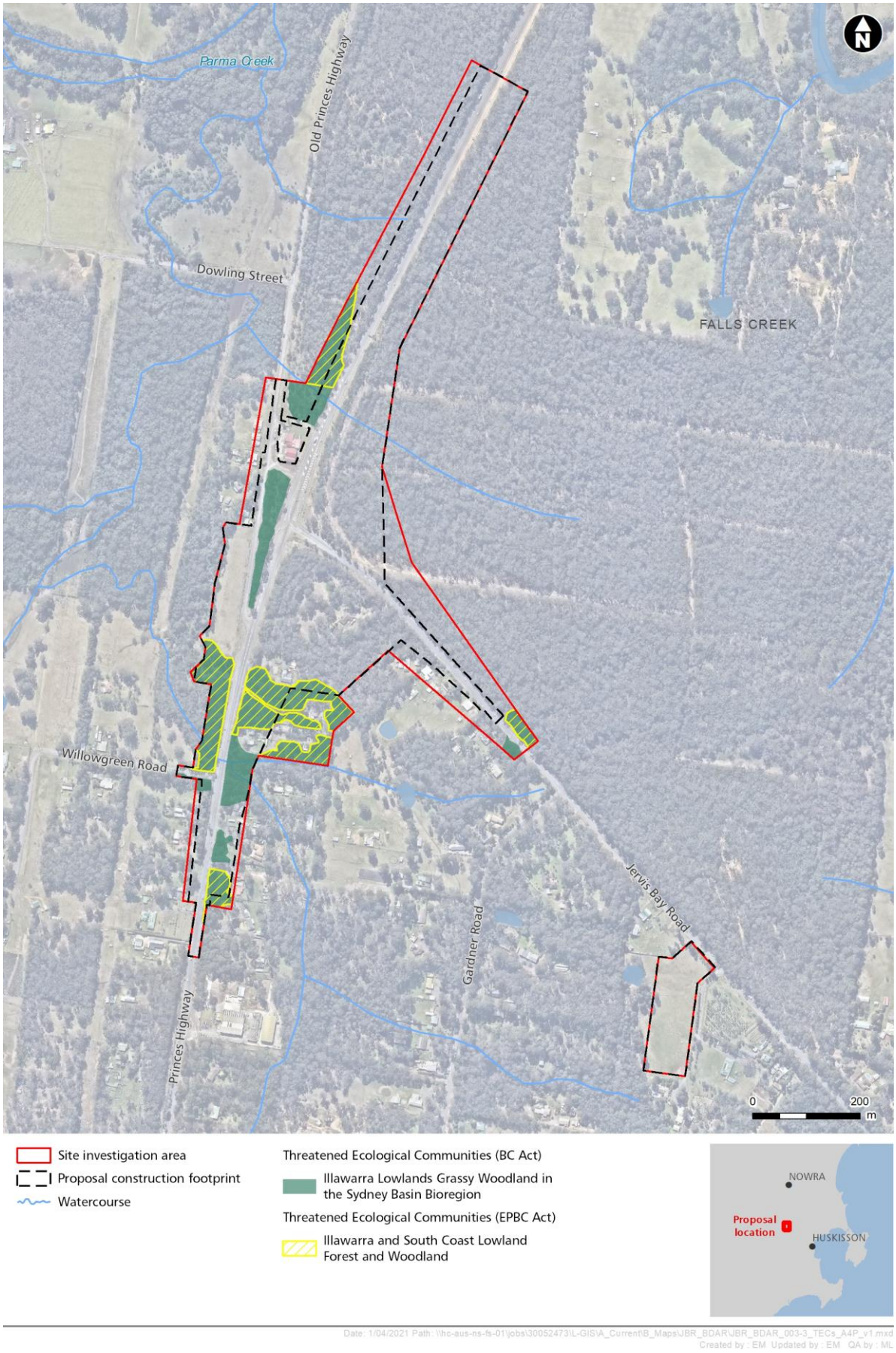


Figure 6-13 Threatened ecological communities within the site investigation area

Threatened flora species

One threatened flora species listed under the *Biodiversity Conservation Act 2016* was recorded within the site investigation during targeted surveys undertaken in 2020 and 2021: *Hibbertia puberula* subsp. *puberula*.

Hibbertia puberula subsp. *puberula* is listed as endangered under the *Biodiversity Conservation Act 2016*. Fifty-eight individuals of the species were recorded in four clusters across the site investigation area. Most individuals of *Hibbertia puberula* subsp. *puberula* across the site investigation area were in flower during surveys and appeared healthy. As records of *Hibbertia puberula* subsp. *puberula* were widespread across PCT 1082, a large area of this plant community type is deemed suitable habitat for the species. This includes the two properties to the east of the Princes Highway which were not surveyed due to access restrictions. Suitable habitat for *Hibbertia puberula* subsp. *puberula* within the site investigation area is 13.51 hectares (Figure 6-14).

No *Environment Protection and Biodiversity Conservation Act 1999* listed threatened flora species were recorded within the site investigation area.

Groundwater dependent ecosystems

Ecosystems with low to moderate potential to be interactive with groundwater have been recorded within the site investigation area. The vegetation associated with the areas of potential groundwater dependent ecosystems include PCT 1082 and PCT 1326. Figure 6-15 identifies groundwater dependent ecosystems within the site investigation area.

Weeds

The abundance of weeds is generally low across the site investigation area and concentrated in areas subject to high levels of disturbance including along the road verge, and within grazed areas and residential properties.

Surveys identified 35 exotic species within the site investigation area, of which four are listed as Priority Weeds for the South East region under the *Biosecurity Act 2015*. These four species are also included on the Commonwealth list of Weeds of National Significance. (WoNS).

Nine exotic species recorded within the site investigation area are considered to be high threat weeds (DPIE, 2020c). The names, classification and legal requirements for high threat weed species identified in the site investigation area are listed in Table 6-28.

Table 6-28 High threat weeds recorded in the site investigation area

High threat species	Common name	WoNS	Priority Weed and *Biosecurity Act 2015* status
Andropogon virginicus	Whisky grass	No	No
Asparagus aethiopicus	Asparagus fern	Yes	Yes Prohibition on dealings Must not be imported into the State or sold.
Bidens pilosa	Beggar's tick	No	No
Ehrharta erecta	Panic veldtgrass	No	No
Lonicera japonica	Japanese honeysuckle	No	No

High threat species	Common name	WoNS	Priority Weed and *Biosecurity Act 2015* status
Rubus fruticosus sp. agg.	Blackberry	Yes	Yes Prohibition on dealings Must not be imported into the State or sold.
Salix spp.	-	Yes	Yes Prohibition on dealings Must not be imported into the State or sold.
Senecio madagascariensis	Fireweed	Yes	Yes Prohibition on dealings Must not be imported into the State or sold. Regional Recommended Measure Exclusion zone: Whole of region except the core infestation area of Wollongong, Kiama, Shellharbour, Eurobodalla, Shoalhaven, Bega Valley and Wingecaribee councils. Whole region: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core area: Land managers reduce impacts from the plant on priority assets.
Stenotaphrum secundatum	Buffalo grass	No	No

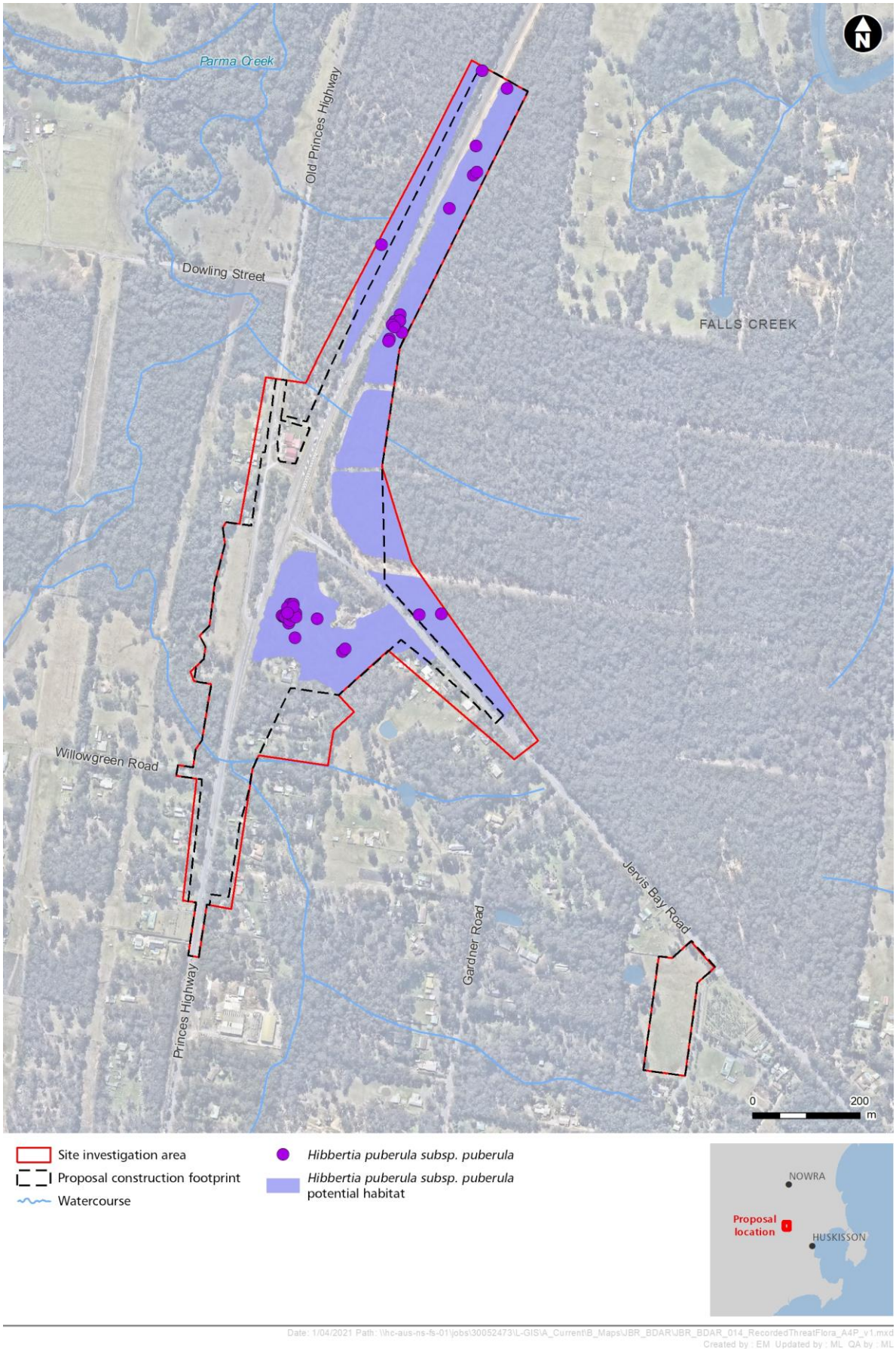


Figure 6-14 Recorded threatened flora species and habitat within the site investigation area

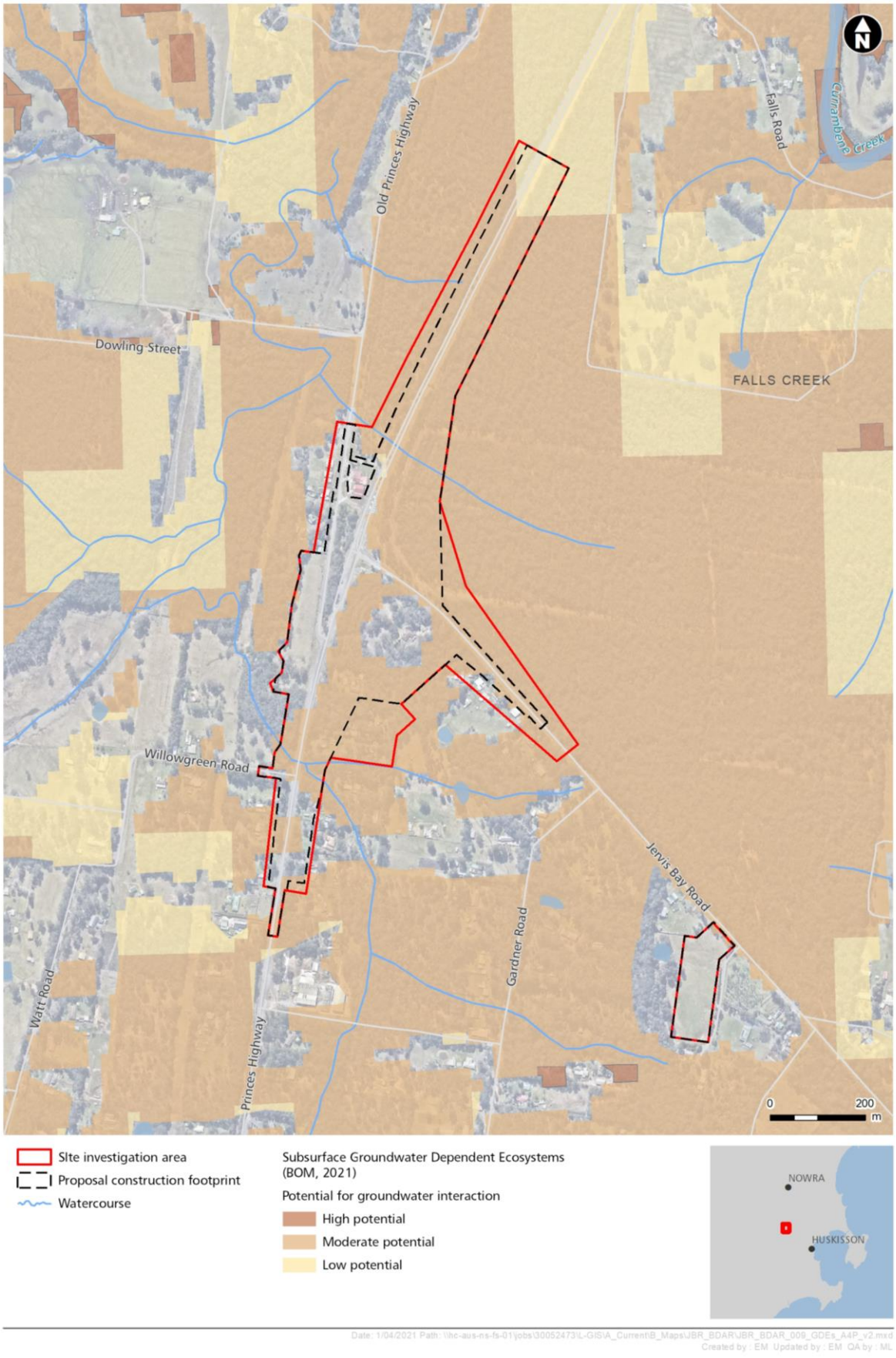


Figure 6-15 Groundwater dependent ecosystems

Fauna

Threatened fauna species

Threatened fauna species with a moderate or high likelihood of occurrence or that were recorded during surveys are outlined in Table 6-30. Species recorded within the site investigation area are discussed in further detail below. The location of threatened fauna species is shown in Figure 6-16. Potential impacts to threatened fauna species are detailed in Section6.5.3.

Glossy Black-Cockatoo

The Glossy Black-Cockatoo is listed as vulnerable under the *Biodiversity Conservation Act 2016*. A small flock (up to eight individuals mixed males, females and juveniles) were observed foraging in *Allocasuarina* along the Princes Highway and Jervis Bay Road during targeted surveys. In addition, this species was recorded by indirect evidence (chewed seed cones) present throughout the site investigation area.

The Glossy Black-Cockatoo is a dual credit species, meaning that both ecosystem credits and species credits may apply when calculating offset requirements using the Biodiversity Assessment Method calculator. Foraging habitat for the Glossy Black-Cockatoo is assumed as ecosystem credits. The species credit component is based on the presence of suitable breeding habitat (ie eucalypt tree species with hollows at least eight metres above the ground and fifteen centimetres diameter).

Allocasuarina and hollow-bearing trees within the site investigation area provide potential habitat for the species. While the site investigation area supports several large hollow-bearing trees, stag-watching surveys at all potential breeding nest sites did not detect any breeding Glossy Black-Cockatoo individuals during the breeding season specified in current best practice guidelines. As such, the species is unlikely to breed within the site investigation area and consequently no species credit habitat is present.

Little lorikeet

The Little Lorikeet is listed as vulnerable under the *Biodiversity Conservation Act 2016*. Two individual Little Lorikeet were recorded flying overhead the site investigation area during targeted surveys.

The Little Lorikeet is an ecosystem credit species as it is highly mobile, and the small hollows required for breeding are relatively common. Vegetation and hollow-bearing trees within the site investigation area provide potential habitat for the species. This habitat is assumed as ecosystem credits.

White-bellied Sea-Eagle

The White-bellied Sea-Eagle is listed as vulnerable under the *Biodiversity Conservation Act 2016*. One individual White-bellied Sea-Eagle was recorded flying overhead the site investigation area during targeted surveys.

The White-bellied Sea-Eagle is a dual credit species. Foraging habitat for the White-bellied Sea-Eagle is assumed as ecosystem credits. The species credit component is based on the presence of suitable breeding habitat (ie large, old trees within one kilometre of a waterbody with a large stick nest present).

Vegetation within the site investigation area provides potential habitat for the species. While the site investigation area supports several large trees that are required for breeding by the White-bellied Sea-Eagle, targeted surveys did not identify any large stick nests or detect any breeding individuals. In addition, the site investigation area is limited to small farm dams, drainage lines and creeks. As such, the species is unlikely to breed within the site investigation area and consequently no species credit habitat is present.

Powerful Owl

The Powerful Owl is listed as vulnerable under the *Biodiversity Conservation Act 2016*. One individual Powerful Owl was recorded foraging within the site investigation area during targeted nocturnal surveys.

The Powerful Owl is a dual credit species, meaning that both ecosystem credits and species credits may apply when calculating offset requirements using the Biodiversity Assessment Method calculator. Foraging habitat for the Powerful Owl is assumed as ecosystem credits. The species credit component is based on the presence of suitable breeding habitat (ie living or dead trees with hollows greater than 20 centimetres diameter).

Vegetation and hollow-bearing trees within the site investigation area provide potential habitat for the species. While the site investigation area supports several large hollow-bearing trees that are required for breeding by the Powerful Owl, stag-watching surveys at all potential breeding nest sites did not detect any breeding individuals during the breeding season specified in current best practice guidelines. As such, the species is unlikely to breed within the site investigation area and consequently no species credit habitat is present.

Grey-headed Flying-fox

The Grey-headed Flying-fox is listed as vulnerable under the *Biodiversity Conservation Act 2016* and *Environment Protection and Biodiversity Conservation Act 1999*. Two individual Grey-headed Flying-fox were recorded flying overhead the site investigation area during targeted surveys.

The Grey-headed Flying-fox is a dual credit species. Foraging habitat for the Grey-headed Flying-fox is assumed as ecosystem credits. The species credit component is based on localised breeding camps.

There are 145 records of the species within the study area, the most recent from 2019. Vegetation within the site investigation area provides potential foraging and dispersal habitat for the species. However, the site does not contain any camps required for roosting and/or breeding, with the nearest camps located at Bomaderry Creek (Camp ID 233 about 14 kilometres north of the site) and Bewong Creek (Camp ID 232 about 10 kilometres south-west of the site)). Consequently, no species credit habitat is present.

Southern Myotis

The Southern Myotis is listed as vulnerable under the *Biodiversity Conservation Act 2016*. The Southern Myotis was recorded as ‘Probable’ within the site investigation area using ultrasonic call detectors (Anabats).

The Southern Myotis is a species credit species as it is dependent on waterways with pools three metres wide or greater for foraging. In addition, habitat surrounding waterways is used for breeding and roosting. There are ten records of the species within the study area, the most recent from 2018. Habitat mapped within the site investigation area (species polygon in **Figure 6-14**) is within 200 metres of waterbodies greater than three metres wide, and within PCT 1326 (the plant community type that this species is associated with).

Other threatened microbats

The Eastern False Pipistrelle, Greater Broad-nosed Bat and Large Bent-winged Bat are all listed as vulnerable under the *Biodiversity Conservation Act 2016*. These species were recorded as ‘Possible’, ‘Possible’ and ‘Probable’ respectively within the site investigation area using Anabats.

Foraging habitat for these three threatened microbats is assumed as ecosystem credits. The Eastern False Pipistrelle and Greater Broad-nosed Bat are ecosystem credit species, of

which there are seven (most recent from 2018) and nine (most recent from 2016) records of each respective species within the study area.

The Large Bent-winged Bat is a dual credit species, with the species credit component based on highly specific breeding habitat (eg caves, tunnels, mines or other structures). There are 15 records of the species within the study area, the most recent from 2018. Vegetation within the site investigation area provides potential foraging and dispersal habitat for the species. However, the site does not contain any roosting and/or breeding habitat. Consequently, no species credit habitat is present.

Feral fauna and pests

Three introduced feral fauna species were recorded within the site investigation area:

- Feral Cat (*Felis catus*)
- European Rabbit (*Oryctolagus cuniculus*)
- European Red Fox (*Vulpes vulpes*).

In addition, eight other fauna species that are considered introduced pest species were recorded within the site investigation area:

- Common Blackbird (*Turdus merula*)
- Common Myna (Acridotheres tristis)
- Common Starling (*Sturnus vulgaris*)
- Black Rat (*Rattus rattus*)
- Cattle (*Bos taurus*)
- Horse (*Equus caballus*)
- Sheep (*Ovis aries*)
- Shetland Cattle (*Bos taurus taurus*).

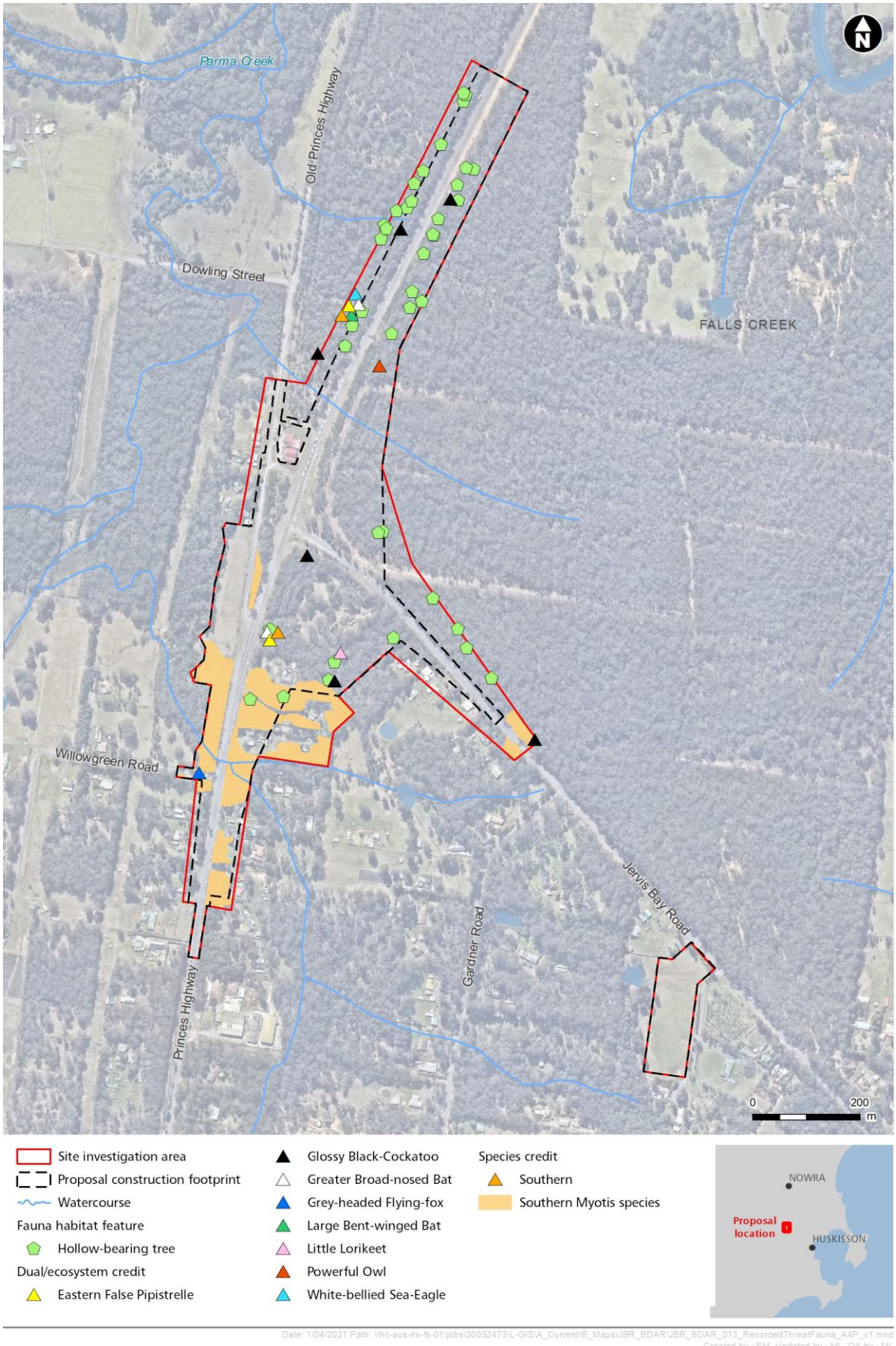


Figure 6-16 Recorded threatened fauna species and habitat within the site investigation area

Aquatic habitat and species

Most of the existing aquatic habitats within the site investigation area are minor and/or ephemeral (eg drainage lines and small, constructed farm dams). No important substrates, habitat features, or vegetation was recorded within any of the streams within the site investigation area. Water quality, based on visual observation, appeared poor (ie signs of pollutants, excess sediments and nutrients) and contained a high density of weeds. In addition, these watercourses are adjacent to the Princes Highway and are subject to edge effects and regular disturbance (ie vegetation trimming for powerlines, road works).

No threatened aquatic species were recorded within the site investigation area, and none are expected to occur. While Parma Creek is mapped as key fish habitat for the Shoalhaven area (DPI, n.d.), the unnamed ephemeral streams located within the site investigation area do not meet the definition of key fish habitat in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013) as they are all classified as first order streams. Similarly, any drainage lines and/or dams within the site investigation area are not considered key fish habitat.

6.5.3 Potential impacts

Avoidance and minimisation

To achieve the proposal objective of upgrading the Princes Highway and Jervis Bay Road intersection to improve its safety and reliability, impacts on ecological values could not be completely avoided.

The options assessment undertaken in November 2020 (Transport for NSW, 2020) and subsequent selection of the preferred option have considered biodiversity values which, as a result, has minimised impacts to high value biodiversity.

The proposal minimises vegetation clearing to the west of the Princes Highway, where the largest and highest condition patches of the *Biodiversity Conservation Act 2016* listed threatened ecological community Illawarra Lowlands Grassy Woodland is present. Direct impacts on clearing of native vegetation and habitat associated with the proposal have also been minimised by:

- Locating two large ancillary facilities in areas where there are low biodiversity values (ie within areas mapped as exotic grassland)
- Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat within the proposal construction footprint.

Construction

The construction of the proposal would result in both direct and indirect impacts to biodiversity, as discussed below.

Removal of native vegetation and threatened ecological communities

Construction of the proposal would require the removal of up to 15.71 hectares of native vegetation. Vegetation removal is summarised in Table 6-29.

Table 6-29 Removal of vegetation within the proposal construction footprint

PCT Name	PCT number	Structure/ condition class	Status		Extent within proposal construction footprint (hectares)
			BC Act	EPBC Act	
Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)	1082	Good	-	-	7.81
		Moderate Disturbed	-	-	2.33
		Poor	-	-	1.84
Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (PCT 1326)	1326	Moderate woodland	Endangered – Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	Critically Endangered – Illawarra and south coast lowland forest and woodland (patches that meet condition criteria)	1.78
		Moderate garden	Endangered – Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	Critically Endangered – Illawarra and south coast lowland forest and woodland	0.86
		Poor	Endangered – Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	-	1.09
Exotic grassland		N/A	-	-	3.20
Planted native/exotic vegetation and remnant trees		N/A	-	-	0.29
Total area native vegetation					15.71
Total area vegetation					19.20

Removal of threatened flora

One threatened flora species, *Hibbertia puberula* subsp*. puberula* listed as endangered under the *Biodiversity Conservation Act 2016*, has been identified in the site investigation area. The proposal would require removal of up to 55 individuals from the proposal construction footprint.

Vegetation removal would result in the loss of up to 10.51 hectares of suitable *Hibbertia puberula* subsp. *puberula* in the form of PCT 1082.

Removal of threatened fauna habitat

A summary of threatened fauna habitat impacts is provided in Table 6-30. Up to a total of 15.71 hectares of known or potential habitat for threatened fauna species would be cleared within the proposal construction footprint, comprising 11.98 hectares of PCT 1082 and 3.73 hectares of PCT 1326. Removal of native vegetation would reduce the availability of food resources for some threatened species, such as seeds, fruits and blossoms. The 3.49 hectares of Exotic grassland and Planted native/exotic vegetation and remnant trees is not considered to provide suitable habitat for any threatened fauna species.

Up to around 24 hollow-bearing trees would be cleared. This would impact a range of fauna, largely birds and arboreal mammals. There are hollow resources within the site investigation area and surrounding area that would provide habitat for impacted species. Additionally, a nest box strategy will be developed and implemented in accordance with Guide 8: Nest boxes of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).

As discussed above, stag-watching surveys at all potential breeding nest sites of the Glossy Black-Cockatoo and the Powerful Owl did not detect any breeding individuals during the breeding seasons specified in current best practice guidelines. As such, the Glossy Black-Cockatoo and Powerful Owl are unlikely to breed within the site investigation area and the removal of these hollows would not impact their capacity to breed.

Table 6-30 Threatened fauna habitat impacts

Scientific name	Common name	BC Act status	EPBC Act status	Potential occurrence (Moderate, High, Recorded)	Habitat within proposal construction footprint (hectares)	Likely significant impact?
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Recorded	15.71	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Recorded (possible)	15.71	No
Glossopsitta pusilla	Little Lorikeet	V	-	Recorded	15.71	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Recorded	3.73	No
Lophoictinia isura	Square-tailed Kite	V	-	Moderate	15.71	No
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Recorded (probable)	15.71	No
Myotis macropus	Southern Myotis	V	-	Recorded (probable)	2.92	No
Ninox strenua	Powerful Owl	V	-	Recorded	15.71	No
Petaurus australis	Yellow-bellied Glider	V	-	Moderate	15.71	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Recorded	15.71	No
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Recorded (possible)	15.71	No
Tyto novaehollandiae	Masked Owl	V	-	Moderate	15.71	No

Aquatic habitat impacts

Temporary crossings for watercourses have the potential to impact fish by temporarily altering the hydrological regimes, reducing stream width and reducing water quality from an increase in sedimentation and turbidity from the placement of material instream and vehicle/plant use of the crossing. Though fish passage may be altered, it would not impact upon any threatened species, or be blocked for the construction of the waterway crossings. Any temporary waterway crossings would take into consideration the requirements of the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).

Most watercourses within the site investigation area are ephemeral and therefore impacts would be confined to periods of higher rainfall when water is flowing. However, for permanent watercourses, particularly the unnamed tributary in the southern extent of the site investigation area, impacts to aquatic habitats would occur during construction from instream works, including culvert construction. Aquatic vegetation and snags would be removed from creek adjustments and culvert footprints. Removal of riparian vegetation would be minimised, and vegetation connectivity retained across the riparian zone where possible.

There is potential for sedimentation and spills to affect water quality in watercourses during the construction process which could also affect native fish and frogs, including downstream of the proposal construction footprint. Water quality management measures during construction would minimise the likelihood and extent of potential impacts to creeks (eg using appropriate sediment and erosion control procedures and keeping high risk activities such as concrete pouring and earthworks away from watercourses where practicable).

Fauna injury and mortality

The primary cause of increased fauna injury and mortality during the construction stage of the proposal would be as a result of vegetation clearing activities (particularly during the felling of hollow-bearing trees or trees containing undetected arboreal mammals (eg gliders, reptiles or active nests) or may result from collisions with work vehicles or plant, or accidental entrapment in plant, trenches or other works.

The removal of fauna habitat has inherent risks that can, in part, be mitigated through implementing appropriate clearing procedures. The majority of native and threatened fauna species that have habitat within the site investigation area are highly mobile and typically vacate the vegetation in which they reside at the commencement of vegetation clearing. Other, typically ground dwelling, species are less mobile and at higher risk of construction phase mortality. Measures to reduce accidental injury or mortality to fauna are proposed in Section6.5.5.

Invasion and spread of weeds

Four exotic species recorded in the site investigation area are listed as Priority Weeds in the South East region, which includes Shoalhaven local government area: *Asparagus aethiopicus*, *Rubus fruticosus* sp*. agg*., *Salix sp.* and *Senecio madagascariensis*. Invasive exotic grasses such as *Ehrharta erecta* also represent a threat to native vegetation.

An increase in the movement of people, vehicles, machinery, vegetation waste and soil during and following construction of the proposal may facilitate the introduction or spread of exotic weeds and grasses that currently occur within the site investigation area.

Disturbed areas, such as those in which earthworks are to be carried out, would be particularly susceptible to weed establishment. Management measures would be required to minimise the risk of introduction and spread of weeds.

Invasion and spread of pests

Activities such as vegetation clearing, habitat removal, increased noise and human presence as a result of the proposal have the potential to disperse pest species across the surrounding landscape and increase the ability of such species to utilise habitats during construction and operational phases. Vegetation clearing, and consequent fragmentation can result in the establishment of predator pest species such as the European Red Fox and Feral Cats, which pose a high risk to birds and small terrestrial fauna.

Within the site investigation area, most patches of vegetation are small and fragmented, and pest species are already well established. As such, many of the areas of vegetation and fauna habitat within and directly adjacent to the construction footprint are impacted by pest fauna. Consequently, while the pest species listed above are likely to capitalise on the disturbance associated with construction and development activities, the proposal is unlikely to significantly increase the overall impact of pest species within the site investigation area.

Invasion and spread of pathogens and disease

The proposal has the potential to increase the spread of pathogens that threaten native biodiversity values. Pathogens specific to the proposal are the soil-borne pathogen *Phytophthora cinnamomi* (Phytophthora), *Austropuccinia psidii* which causes the disease Myrtle rust and Psittacine beak and feather disease. These pathogens are listed as Key Threatening Processes under the *Biodiversity Conservation Act 2016*. While no indicators of Phytophthora, Myrtle Rust or Psittacine beak and feather disease were detected within the site investigation area during surveys, these pathogens are known to be highly invasive and have a wide distribution across eastern New South Wales and are therefore relevant to the proposal.

The proposal may increase the risk of dispersal of Phytophthora and Myrtle rust as a result of construction activities which involve the disturbance of soil and the movement of plant across the site investigation area.

Psittacine beak and feather disease is a highly infectious viral disease which affects parrots. Glossy Black-Cockatoo, a threatened species of parrot, have been recorded within the site investigation area. A large population of this species occurs within the Shoalhaven region. As such, Psittacine beak and feather disease is unlikely to have a major impact within the site investigation area.

To minimise the risk of these pathogens being spread as a result of the proposal, the Transport for NSW guideline would be followed as discussed in the management measures provided in Section 6.5.5.

Noise, light and vibration

While the construction phase of the proposal may cause temporary disturbance, the impact of noise on fauna would likely be localised to the proposal construction footprint and would be unlikely to have a significant, long-term impact on fauna. Within the site investigation area, some sensitive species (eg woodland birds) may avoid the noise and vibrations, while some more tolerant species (eg small mammals) are likely to habituate over the longer-term (Byrnes, Goosem and Turton, 2012).

While the proposal is likely to increase the amount of artificial lighting within the site investigation area and surrounds during the construction, roads within the locality already currently experience a high level of light exposure. These impacts are not

considered to have a significant, long-term impact on fauna, including threatened fauna, as fauna within the site investigation area would already be adapted to light pollution, and the increased artificial lighting associated with the proposal is unlikely to have a substantial effect.

Groundwater dependent ecosystems

A total of 18.59 hectares mapped by the Bureau of Meteorology (2020) as potential groundwater dependent ecosystems would be removed for the proposal.

The proposal does not require any deep cuts or excavations and therefore no dewatering of large amounts of groundwater, groundwater drawdown or changes to groundwater flows would occur. Impacts to potential groundwater dependent ecosystems as a result of the proposal are therefore unlikely. Effects of changes to groundwater flows and depth on potential groundwater dependent ecosystems have been assessed in accordance with the *Risk assessment guidelines for Groundwater Dependent Ecosystems* (DPI, 2012).

Operation

The operation of the proposal would have the potential to impact biodiversity, as discussed below.

Wildlife connectivity and habitat fragmentation

The site investigation area does not contain or encroach on any identified regional biodiversity corridors. However, small patches of good condition vegetation within the site provide habitat connectivity to large areas of adjacent vegetation in the surrounding Nature Reserves, Conservation Areas and National Parks to the east, south and west of the site investigation area. As such, fauna species are likely to use the site investigation area for habitat and dispersal, and the proposal has the potential to impact wildlife connectivity and habitat corridors by reducing the area of vegetation and width of habitat corridors, increasing the width of existing gaps and creating new gaps in habitat corridors and introducing or moving edge effects in habitat corridors.

While fauna species may use vegetation within the project footprint when moving to areas of higher quality habitat (eg Jerrawangala National Park, Booderee National Park), vegetation within the site investigation area is already substantially fragmented by roads, housing and other infrastructure which reduce habitat connectivity.

All threatened fauna recorded or assumed present (ie moderate or high likelihood of occurrence) within the site investigation area are highly mobile flying species. As such, the proposal is not anticipated to result in a barrier to connectivity for these fauna species. Further, given the existing barriers to impacts to habitat within the site investigation area, the proposal is not anticipated to result in impacts to movement and/or dispersal pathways for any threatened fauna species or population.

Edge effects on adjacent native vegetation and habitat

Vegetation occurring along the road verges of the Princes Highway, the Old Princes Highway and Jervis Bay Road is currently subject to edge effects. Residential and industrial development and agricultural activities including clearing have also created edge effects in adjacent areas of vegetation. All vegetation zones mapped within the site investigation area are subject to some level of edge effects. In particular, ground layer vegetation surrounding the road intersection has been degraded by the abundance of exotic species, run-off from the highway and dumping of rubbish.

The proposal could potentially result in expansion of some of the existing edge effects as a new edge is created along PCT 1082 to the east of the Princes Highway, and the edge along the west of the highway encroaches into PCT 1326 and the threatened

ecological community Illawarra Lowlands Grassy Woodland. Edge effects resulting from run-off may be reduced through capture and diversion of surface flows to water quality control measures, such as bioretention basins, as part of the proposal.

Aquatic impacts

The proposal would result in the upgrade of the existing culvert near the southern extent of the site investigation area. This would lead to a reduction in upstream flood levels but increased flow capacity and flood levels to a small, localised area immediately downstream. As a result, the proposal may lead to increased but localised areas of inundation. Such alterations to the local hydrology would have a negligible impact on aquatic species (eg fish), since this type of flow is ephemeral. However, it may change microhabitat features for common frog species. This potential impact is considered minor as these species are already adapted to a disturbed peri-urban environment.

Shading regimes may be altered as a result of culvert structures over small and limited areas of creeks within the proposal construction footprint. Due to the small areas to be impacted, and the absence of threatened fish within the site investigation area, fish movements are unlikely to be substantially impacted. Water temperature would be reduced in these areas compared with unshaded areas, however this reduction would be minor and form part of a mosaic of micro differences in water temperature along existing creek lines.

Fauna injury and mortality

The primary cause of increased fauna injury and mortality during the operational stage of the proposal is anticipated to be vehicle collisions. Existing cases of fauna injury and mortality primarily occur at the intersection of Jervis Bay Road and the Princes Highway, and are most likely to occur here after the upgrade. Key features of the intersection upgrade are unlikely to substantially increase the number of existing fauna injuries and mortalities resulting from vehicle strike.

The most susceptible species to vehicle strike are likely to be common, mobile and gregarious species, such as arboreal mammals (eg Common Brushtail Possum) or larger terrestrial mammals (eg Eastern Grey Kangaroo).

Conclusion on significance of impacts

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

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

6.5.4 Biodiversity offsets

Subject to vegetation clearing minimisation efforts, preparation of a biodiversity offset strategy would be required in accordance with the *Guideline for Biodiversity Offsets* (Roads and Maritime Services, 2016) for potential impacts to the *Biodiversity Conservation Act 2016* and *Environment Protection and Biodiversity Conservation Act 1999* listed threatened ecological community and threatened species habitat. Offsets may be delivered through a range of mechanisms, including securing offset properties under an appropriate legal instrument, purchasing and retiring biodiversity credits, paying into the Biodiversity Conservation Fund or progressing stewardship Site

Agreements on suitable properties in accordance with the *Guideline for Biodiversity Offsets* (Roads and Maritime, 2016)

To determine the likely biodiversity credit requirements for the impacts of the proposal, the data collected from the proposal construction footprint was entered into the Biodiversity Assessment Method (BAM) calculator. The biodiversity credit values of the native vegetation and threatened species habitat within the proposal construction footprint are presented in Table 6-31 and Table 6-32.

Table 6-31 Species credit values for the species identified in the proposal construction footprint

Scientific name	Vegetation zone	Area of potential habitat within proposal construction footprint (hectares)	Species credits
Hibbertia puberula subsp. puberula	1082 – Good	7.32	276
	1082 – Moderate Disturbed	2.33	56
	1082 – Poor	0.85	11
	Total	10.51	343
Southern Myotis	1326 – Low	0.70	11
	1326 – Moderate garden	0.86	22
	1326 – Moderate woodland	1.36	34
	Total	2.92	67
Total			410

Table 6-32 Ecosystem credit values for impacts in vegetation zones identified within the proposal construction footprint

PCT Name	Vegetation zone	Area within proposal construction footprint (hectares)	Total ecosystem credits required (including credits required to offset EPBC TEC impacts)	Ecosystem credits required to offset EPBC TEC impacts only
PCT 1082: Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	1082 – Good	7.81	221	N/A
	1082 – Moderate Disturbed	2.33	42	N/A
	1082 – Poor	1.84	18	N/A
PCT 1326: Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	1326 – Moderate woodland	1.78	44	32
	1326 – Moderate garden	0.86	22	22
	1326 – Poor	1.09	17	0
Total		15.71	364	

6.5.5 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Flora and fauna management	A Flora and Fauna Management Plan will be prepared and implemented as part of the CEMP. It will include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas, carried out in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) • Pre-clearing survey requirements, carried out in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) • Procedures for unexpected threatened species finds and fauna handling • Protocols to manage weeds and pathogens.	Contractor	Detailed design Pre-construction	Section 4.8 of QA G36 Environment Protection Protecting and managing biodiversity on RTA projects (RTA, 2011)
Removal of native vegetation, threatened species habitat and habitat features, and threatened plants	The detailed design and construction of the proposal will minimise native vegetation clearing and habitat removal, prioritising the avoidance of threatened ecological communities.	Transport for NSW Contractor	Detailed design Construction	
	Vegetation and habitat removal will be carried out in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: *Protecting and managing*	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	biodiversity on RTA projects (RTA, 2011).			
	Any revegetation will be carried out in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Post-construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
	The unexpected species find procedure under Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) is to be followed if threatened flora, fauna and/or ecological communities not assessed in the review of environmental factors are identified in the proposal construction footprint.	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
	Any fauna habitat replacement or reinstatement will be carried out in accordance with Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
	A nest box strategy will be developed and implemented in accordance with Guide 8: Nest boxes of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Transport for NSW Contractor	Detailed design Pre-construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011) Policy and guidelines for fish habitat conservation

Impact	Environmental safeguards	Responsibility	Timing	Reference
	measures of *the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI, 2013).			and management Update 2013 (DPI, 2013)
Injury and mortality of fauna	Fauna will be managed during construction in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
Invasion and spread of weeds	Weeds will be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
Noise, light and vibration	Lighting will only be used as necessary at night and will be turned off when not needed	Contractor	Construction	

6.6 Soils and contamination

This section provides an assessment of the potential impacts of the proposal on soils and contamination and identifies safeguards and management measures to avoid or minimise these impacts.

6.6.1 Methodology

Soils and geology

This assessment included the following:

- Desktop review of the relevant geological and soil landscape maps:
    - Wollongong 1:250,000 Geological Map (Rose, 1966)
    - Soil Landscapes of Central and Eastern NSW (DPIE, 2020f)
- Consideration of the contamination and geotechnical field work and investigations carried out for the proposal and documented in:
    - *Jervis Bay Rd to Sussex Inlet Rd Pavements and Geotechnical Desktop Study* (Transport for NSW, 2020f)
    - *Princes Highway Upgrade Program – Jervis Bay Road Intersection Upgrade Preliminary Site Investigation* (Arcadis, 2021a) (Appendix G)
    - *Geotechnical Interpretive Report for Concept Design – Jervis Bay Road Interchange Upgrade* (Arcadis, 2020)
    - Geologic logs (Transport for NSW, 2020g)
- Identification of potential geotechnical, soil and fill issues for the proposal and to assist in identifying appropriate safeguards and management measures for construction and operation
- Identification of safeguards and management measures to manage potential soil and geology impacts associated with the construction and operation of the proposal.

Contamination

A preliminary site investigation (Appendix G) was carried out to identify potential areas of contamination within the site investigation area that may pose a potential risk to workers or the environment during construction of the proposal. The preliminary site investigation included:

- Desktop searches, including:
    - A review of historical aerial photographs and land zoning maps
    - A review of geology, topography, hydrology, hydrogeology and acid sulfate soils information
    - A review of contaminated land registers, including the NSW EPA Contaminated Land Record (EPA, 2020), National Waste Management Site Database (DAWE, 2018) and National Liquid Fuel Facilities (Geoscience Australia, 2017)
    - An assessment of past and present potentially contaminating activities in the site investigation area and surrounding area
- A site inspection that comprised:

    - Observing obvious signs of potential contamination and/or contaminant sources, such as fragments of potential asbestos containing material, stains, spills, odours and distressed vegetation
    - Observing visual evidence of current or former potentially contaminating activities
    - Observing potentially hazardous materials in infrastructure within the site investigation area
    - Anecdotal interviews with local businesses and residents on the history, current and former land uses within the site investigation area
- Identification of known and potential sources of contamination and contaminants of concerns, their potential impact to human and ecological receptors and assessment of their exposure pathways
- Identification of areas of environmental concern and their associated risks
- Identification of safeguards and management measures to manage potential contamination risks associated with the construction and operation of the proposal.

Relevant legislation, plans and policies

The impact assessment of the proposal on soils and contamination has been prepared in accordance with the following legislation:

- *State Environmental Planning Policy No. 55 – Remediation of land*
- *Protection of the Environment Operations Act 1997*
- *Contaminated Land Management Act 1997*.

This legislation is discussed in Section 4.

Soils and contamination assessment study area

The soils and contamination assessment study area is equivalent to the review of environmental factors site investigation area (Figure 3-6).

6.6.2 Existing environment

Topography

The site investigation area is relatively flat at 20 to 30 metres Australian Height Datum, gradually sloping from east to west. The largest topographical features are earthen wall embankments of about five metres in height that support the northern section of the Princes Highway and the northern side of Jervis Bay Road near the intersection. A minor gully of about two metres is present immediately north of Willowgreen Road.

Soils and geology

The Wollongong 1:250,000 Geological Map (Rose, 1966) indicates the site investigation area is located within an area underlain by Cainozoic quaternary deposits, consisting of gravel, sand, silt and clay, and Shoalhaven Group Nowra Sandstone, consisting mainly of Palaeozoic quartzose sandstone with minor siltstone and conglomerate beds of the Shoalhaven Group (Figure 6-17).

Two soil landscapes are mapped within the site investigation area: Nowra and Shoalhaven (DPIE, 2020f) (Figure 6-18). Most of the site investigation area comprises the Nowra soil landscape, with an area in the central west of the site, surrounding the intersection, mapped as Shoalhaven. A small area of Disturbed Terrain has been

mapped in the north-west of the site investigation area, near the proposal construction footprint boundary.

The Nowra soil landscape is characterised by moderately to gently undulating rises to low hills on Nowra Sandstone. Soils consist of moderately deep (50 to 100 centimetres) brown podzolic soils on crests and upper slopes, with soloths and/or yellow earths occurring on midslopes. Lower slopes and drainage lines typically contain yellow podzolic soils. Limitations of the Nowra soil landscape include run-on, localised rocky outcrops, localised shallow soils, stoniness, hard-setting, sodicity, low permeability and low wet-bearing strength in the subsoil (DPIE, 2020f).

The Shoalhaven soil landscape is typically level to gently undulating, containing riverbeds and banks. Active floodplains with levees and backwater swamps on alluvium are also present. Soils comprises moderately deep (50 to 100 centimetres) prairie soils on levees, red earths and yellow and red podzolic soils on terraces, and alluvial and gleyed podzolic (potentially acid sulfate) soils occurring on the floodplain. The Shoalhaven soil landscape is limited by flood hazards, seasonal waterlogging, permanently high water tables, hard-setting, acid sulfate soils, sodicity and strong acidity (DPIE, 2020f).

Disturbed terrain occurs within other landscapes, with varying topography. Original soils are likely to have been removed, greatly disturbed or buried and original vegetation completely cleared. Limitations are dependent on the nature of fill material and include subsidence resulting in mass movement hazards, lack of soil permeability (leading to poor drainage) and low fertility (DPIE, 2020f).

Subsurface materials encountered as part of geotechnical investigations are categorised into four discrete units, as described in Table 6-33.

Table 6-33 Characterisation of subsurface materials encountered during geotechnical investigations

ID	Unit	Description
1	Fill	Fill material has been observed primarily along the existing roadways or adjacent to roadways ranging from 1.4 metres to four metres thick. This material has been typically described as a mixture of clays, with sands and gravels that form part of the existing road embankments.
2	Alluvium	Alluvial clay associated with historical tributaries within the Falls Creek area has been encountered in boreholes JBR02 and JBR03 up to 2.2 metres depth. This material is mainly firm sandy silty clays or loose silty clayey sands in consistency. No alluvium was encountered at borehole JBR01.
3	Residual	Residual soil derived from the Nowra Sandstone was encountered boreholes JBR01, JBR02, and JBR03 ranging from two metres to 7.1 metres depth. The encountered residual material comprises mainly firm or better sandy clay. Extremely weathered sandstone bedrock was encountered at depths ranging from four metres to eight metres below ground level with very stiff to hard soil characteristics. Due to the soil like consistencies of the extremely weathered sandstone, they have been interpreted as residual soil. Similarly, extremely weathered claystone was encountered locally in between 4.5 metres to 5.9 metres (stiff, medium plasticity clay properties).
4	Sandstone	The sandstone grades to a dark grey colour and transitions to moderately to slightly weathered from 7.1 metres to eight metres depth. The strength profile generally increases with depth.

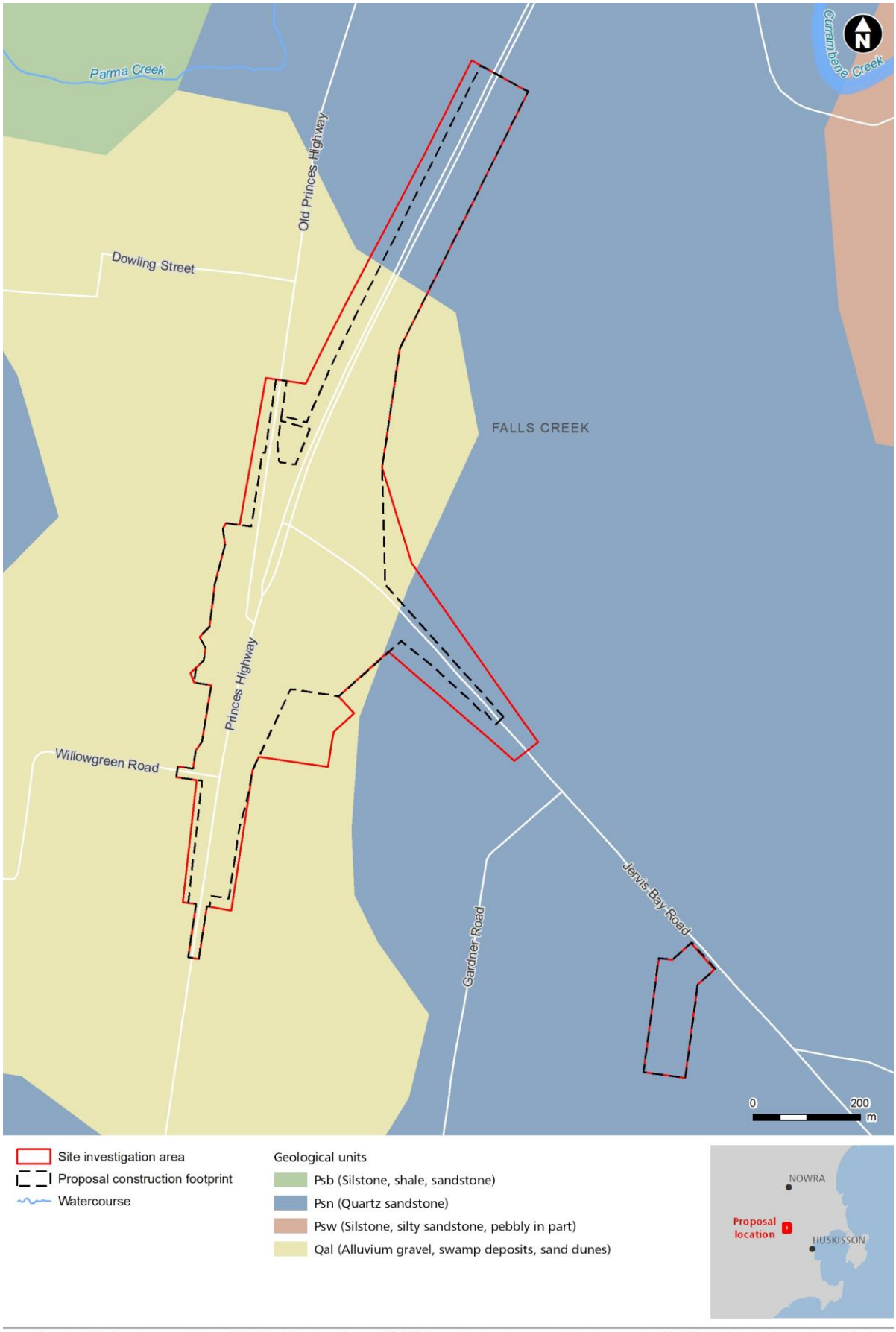
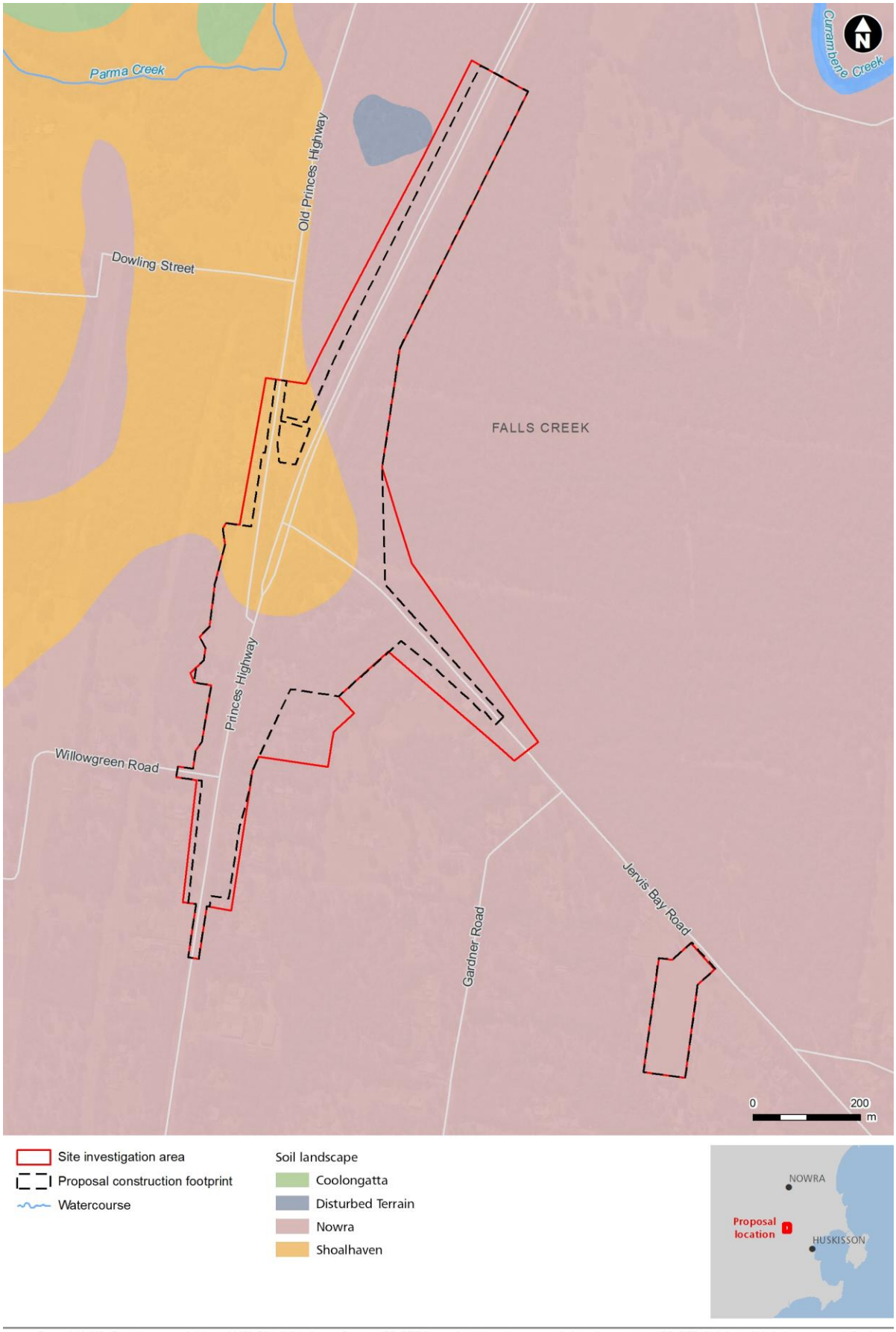


Figure 6-17 Geological units



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Created by : EM Updated by : XX QA by : RP

Figure 6-18 Soil landscapes

Acid sulfate soils

The *Shoalhaven Local Environment Plan 2014* classifies the site investigation area as having an extremely low probability (Class 5) of acid sulfate soils occurrence.

Geotechnical investigations carried out for the proposal did not find acid sulfate soils. The nearest mapped high probability of acid sulfate soils occurrence is about 480 metres northeast of the proposal at Currambene Creek.

Contamination

A search of contaminated land registers (EPA, 2020; DAWE, 2018; Geoscience Australia, 2017) was carried out on 28 August 2020. No records of contaminated land were present within the site investigation area.

A review of historic aerial photographs indicates increasing land clearing and rural development from 1949 to 2020. By 1984, the Princes Highway had been constructed and land south and west of the Jervis Bay Road and Princes Highway Intersection had been cleared. Construction of residential dwellings, warehouses, sheds and fencing is evident from 1993 through to 2020.

Potential contamination was observed and anecdotal evidence was given by property owners during a site visit in September 2020. This includes:

- Highway embankment waste associated with passing vehicles and fill material
- Two former petrol stations with underground storage tanks and other subsurface infrastructure intact (Lot 2 DP557598 and Lot 7 DP32247)
- Visible historical leakage of diesel from an aboveground storage tank and bowser (Lot 2 DP557598)
- Current and former smash repairs and home automotive workshops (Lot 7 DP32247 and Lot 6 DP15507)
- Feedstock and fertiliser mixing and storage (Lot 2 DP557598)
- On site cardboard incineration (Lot 2 DP557598)
- Oil, fuel and chemical storage (Lot 6 DP15507 and Lot 63 DP15507)
- Oil decanting (Lot 63 DP15507)
- Electrical transformers potentially containing Polychlorinated biphenyls are present on power poles on the Old Princes Highway
- Potential asbestos and lead paint in existing buildings
- Potential asbestos containing material in sheet form has been crushed and spread by recent earthworks (Lots 2 and 3 DP244495).

Potential sources of contamination and associated contaminants of potential concern were identified, as summarised in Table 6-34. The potentially affected media and potential receptors for each contaminant are listed in Table 6-35.

Table 6-34 Summary of potential sources of contamination

Activity	Contaminants of potential concern
Highway waste on embankments (off passing vehicles) and fill in embankments	Total recoverable hydrocarbons (TRHs) Benzene, toluene, ethylbenzene xylene, naphthalene (BTEXN) Polycyclic aromatic hydrocarbons (PAHs) Polychlorinated Biphenyls (PCBs) Heavy metals (e.g. arsenic, lead, copper, nickel, zinc)

Activity	Contaminants of potential concern
	Asbestos Organochlorine (OCC) and organophosphorus (OPP) pesticides
Building decommission on Lots 2 and 3 DP244495 for Princes Highway construction	Asbestos and lead (in soil)
Petrol Station	TRHs, BTEXN, PAHs, Heavy metals
Automotive workshop	TRHs, BTEXN, PAHs, PCBs, Heavy metals, Per- and polyfluoroalkyl substances (PFAS)
Infrastructure (all buildings before 2003)	Asbestos and lead paint
Transformers	PCBs
Incineration	PAHs

Table 6-35 Potentially affected media and potential receptors

Potentially affected media	Contaminant	Potential receptor
Vapour	TRHs, BTEXN	Construction and intrusive maintenance workers Commercial workers Current and future site users, including residents Users of groundwater (domestic and stock bore users) (ie residents) Users of surface water bodies (drainage lines, downgradient creeks) (ie residents, stock and ecological receptors) Livestock and animals
Water (surface and/or ground)	TRHs, BTEXN, PAHs, PCBs, Heavy metals, OCC and OPP pesticides, PFAS	
Soil	TRHs, BTEXN, PAHs, PCBs, Heavy metals, OCC and OPP pesticides, PFAS, Asbestos	

Based on historical and current site information, observations made and identification of potential sources of contamination, three potential areas of environmental concern for contamination have been identified, as described in Table 6-36 and shown in Figure 6-19.

Table 6-36 Potential areas of environmental concern for contamination

Potential area of environmental concern	Location	Description
1	Lot 2 DP557598 – 125 Old Princes Highway	A former petrol station and current stock feed business with an operational diesel aboveground storage tank and observed diesel contamination within the bunded area. This area of environmental concern, including the location of two underground storage tanks and one aboveground storage tank infrastructure, is about 680 square metres.

Potential area of environmental concern	Location	Description
		An additional incineration area of about 5 square metres is present at the south of the site. There is substantial potential asbestos containing material present in fibro structures. The site holds room for residential occupation and is up-gradient of adjacent residential properties and surface water bodies.
2	Lot 7 DP32247 – 124 Old Princes Highway	The former BP Falls Creek Petrol Station, and current residential property with all underground infrastructure intact. This area of environmental concern contains four underground storage tanks, three for petrol and one for diesel to the north of the site. The former service station workshop and former panel beaters/spray shop remains in situ. The area of environmental concern is approximately 780 square metres. This does not include two structures, a toilet block and house,that contain potential asbestos containing material. The site is currently used as a residential and agricultural property and is up-gradient of agricultural land and surface water environmental receptors.
3	Lots 2 and 3 DP244495	Areas of Lots 2 and 3 DP244495 adjacent to the table drain servicing the Princes Highway contain two areas of potential asbestos containing material in soil, with potential asbestos containing material extending into the table drain. The identified potential asbestos containing material is in a recently trafficked area and sheeting has been crushed by earthmoving. The site drains through a culvert to Lot 1 DP244495 and the table drain/native vegetation adjacent the Old Princes Highway.

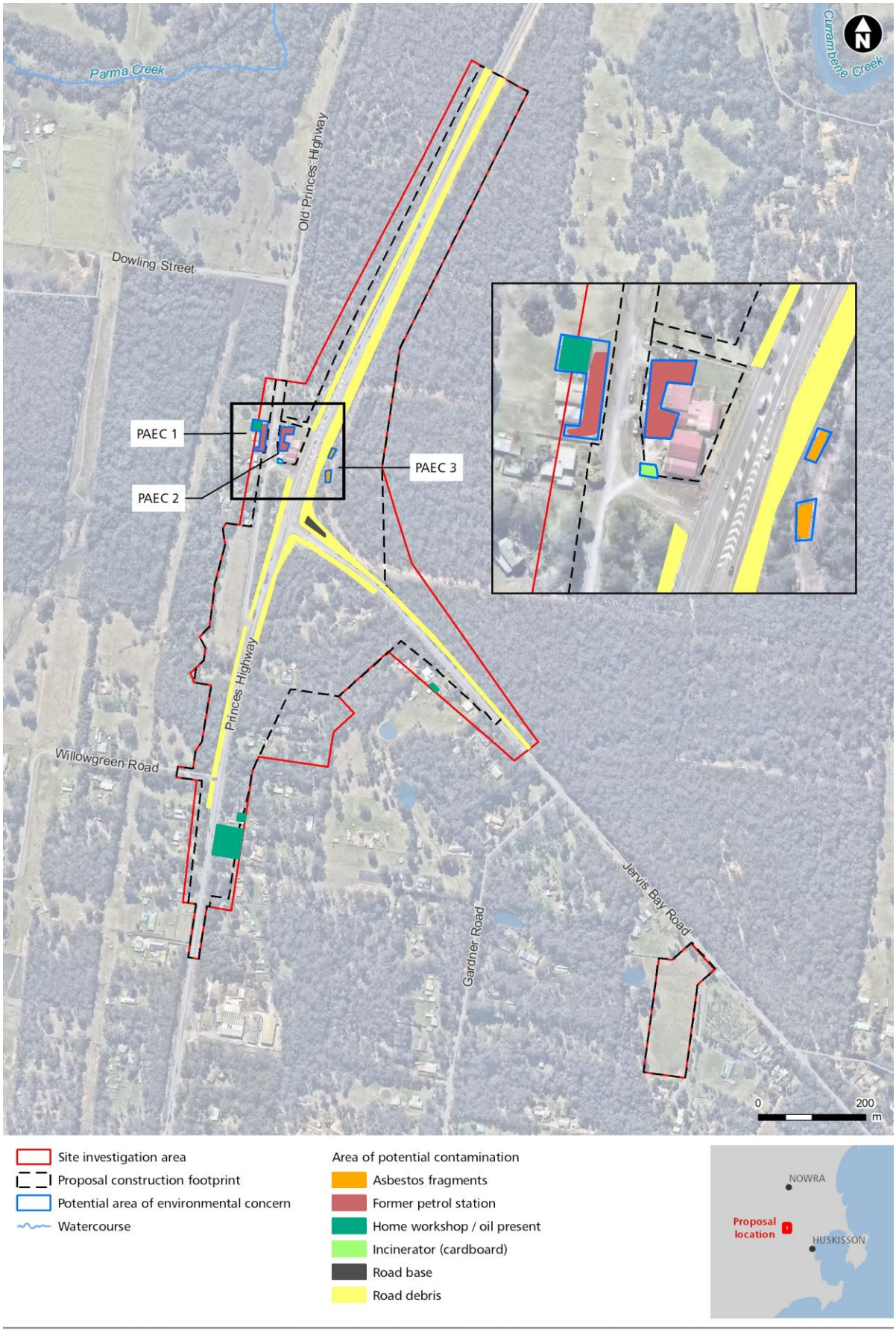

Figure 6-19 Potential areas of environmental concern for contamination

6.6.3 Potential impacts

Construction

Soil erosion and sedimentation

There would be an increased risk of soil erosion during construction, primarily as a result of vegetation clearing and earthworks. The following activities have potential to result in soil erosion and sediment transport:

- Earthworks, including stripping of vegetation and topsoil, excavation or filling
- Stockpiling of topsoil, vegetation and other construction materials
- Transportation of cut or fill materials
- Movement of heavy vehicles across exposed earth
- Piling for the overpass bridge.

Soil erosion can lead to the transportation of soils and sediments via stormwater runoff and wind to nearby watercourses and sensitive receiving environments, resulting in potential water quality impacts as discussed in Section 6.7.

The risks presented by erosion can be managed via the adoption of standard safeguards and management measures, including those detailed in *Managing Urban Stormwater: Soils and Construction* (the Blue Book) (Landcom, 2004) and Transport for NSW's *Soil and Water Management Specification (G38)*.

Acid sulfate soils

There are no acid sulfate soils present in soil samples carried out for the proposal, therefore the potential for encountering acid sulfate soils within the proposal construction footprint is negligible.

Contamination

Three potential areas of environmental concern for contamination have been identified within the proposal construction footprint. Disturbance of contaminated material could lead to increased risk of:

- Lateral migration of contaminants into the environment via stormwater runoff and vertical infiltration of contaminants into previously unaffected soils and groundwater
- Increased risks of exposure for human receptors (workers, and members of the public) via the pathways of skin contact, ingestion and inhalation of volatile or airborne contaminants due to increased proximity to the contaminated materials.

There is potential for chemical and fuel spills to occur during construction, as well as tannin and other organic leachate materials from vegetation stockpiles within ancillary facilities, which may result in localised contamination of soils.

There is potential asbestos containing material in soil north east of the intersection that have the potential to extend into the table drain servicing the Princes Highway. Further investigation (such as a delineation assessment) would be required to determine the depth of contaminated material, whether it is friable or non-friable and identify the appropriate method of removal and disposal, including an asbestos management plan (if required).

Hazardous materials, such as asbestos and lead paint, may be encountered during the demolition of existing dwellings or the relocation of utility infrastructure.

Further investigation would be required to determine presence of these materials and identify the appropriate method of removal and disposal before construction.

Should any contaminated soil be encountered during construction, protocols to deal with the management of potential contamination and unexpected contamination finds would be implemented. These protocols would seek to minimise the movement of contaminated soils and therefore reduce the likelihood of the material entering the river and therefore impacting water quality.

Operation

There would no disturbance of soils or contamination during operation of the proposal.

During operation of the proposal, there is potential for traffic accidents to result in contamination as a result of:

- Spillage of fuel from a ruptured fuel tank
- Spillage of hazardous load being carried by a vehicle (ie fuel, chemicals)
- Use of firefighting foam or fire retardants after an accident.

Potential impacts would be managed via the existing Princes Highway emergency response procedures using Transport for NSW emergency response teams located at Nowra and Berry (17 and 30 kilometres away from the proposal, respectively).

6.6.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
SC01 Soil and water management	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP in accordance with Section 2.1 of QA *G38 Soil and Water Management*. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP will provide: • Measures to minimise/ manage erosion and sediment transport both within the proposal construction footprint and offsite, including requirements for the preparation of an Erosion and Sediment Control Plan (ESCP) in accordance with Section 2.1 of QA *G38 Soil and Water Management* • Arrangements for managing erosion and	Contractor	Pre-construction	Section 2.1 and 2.2 of QA G38 Soil and Water Management

Impact	Environmental safeguards	Responsibility	Timing	Reference
	sediment transport during wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather • Measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation • Measures to manage groundwater de-watering and impacts including mitigation required • Processes for de-watering of water that has accumulated on site, including relevant discharge criteria • Emergency spill procedures, including spill management measures in accordance with the *Code of Practice for Water Management* (Road and Traffic Authority, 1999) and relevant EPA guidelines, and requirement to maintain materials such as spill kits on site • Details of surface water quality monitoring to be carried out before, throughout, and after construction, as required.			
SC02 Erosion and sedimentation	A site specific ESCP will be prepared and implemented as part of the SWMP. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Pre-construction	Section 2.2 of QA G38 Soil and Water Management
SC03	A procedure will be prepared and implemented for the unexpected discovery of	Contractor	Pre-construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	potential contamination before or during construction. The procedure will be incorporated into the CEMP and will outline the process for the identification, assessment and management of the potentially contaminated material.		Construction	

6.7 Flooding and surface water

This section provides an assessment of the potential impacts of the proposal on flooding and surface water and identifies safeguards and management measures to avoid or minimise these impacts. A detailed assessment of flooding and surface water impacts is presented in Appendix H.

6.7.1 Methodology

Flooding

The method of assessment for flooding included:

- A review of available data and existing flood studies within the catchments associated with the proposal
- Development of a set of hydrologic and hydraulic models of the catchments that are located within and surrounding the site investigation area. Rainfall-runoff modelling software packages were used to generate design discharge hydrographs for input to the hydraulic models, while flooding patterns were defined using the TUFLOW two-dimensional (in plan) hydraulic modelling software
- Running the flood models and preparing exhibits showing flood behaviour under present day conditions for design floods with a range of Annual Exceedance Probability (AEP), as well as the probable maximum flood (PMF)
- Assessment of the impact the proposal would have on flood behaviour and flood hazards for the above design flood events
- Assessment of the impact future climate change would have on flood behaviour under operational conditions on state roads
- Assessment of potential measures which are aimed at mitigating the risk of flooding to the proposal and its impact on existing flood behaviour and flood hazards.

Surface water

The method of assessment for surface water included:

- A desktop review and analysis of existing information to determine potential receptors, characterising the existing environment and identify potential issues
- Assessment of potential construction impacts:
    - Qualitative assessment of how construction may impact the receiving environment and the effects of physical disturbance to waterways during construction
- Assessment of potential operation impacts:
    - Obtaining climatic data for inclusion in modelling
    - Modelling of the proposed conditions using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC)
    - Assessment against the water quality objectives defined in the Shoalhaven Development Control Plan 2014 (Table 6-37).

Table 6-37 Water quality objectives as per the *Shoalhaven Development Control Plan 2014*

Objective	Parameter
Suspended solids	85 per cent retention of the average annual load
Total phosphorus	65 per cent retention of the average annual load
Total nitrogen	45 per cent retention of the average annual load
Flow management	Maintain the 1.5 year Average Recurrence Interval (ARI) peak discharge to pre-development magnitude

Relevant legislation, plans and policies

The impact assessment of the proposal on flooding and surface water has been prepared in consideration of:

- *Shoalhaven Local Environmental Plan 2014*
- *Shoalhaven Development Control Plan 2014*
- *NSW Flood Prone Land Policy* (Department of Infrastructure, Planning and Natural Resources, 2005)
- *Australian Rainfall and Runoff: A Guide to Flood Estimation* (Ball *et al.*, 2019) (ARR2019)
- *Floodplain Development Manual* (Department of Infrastructure, Planning and Natural Resources, 2005)
- *Practical Consideration of Climate Change* (DECC, 2007)
- *Managing Urban Stormwater: Soils and construction – Volume 1* ('the blue book') (Landcom, 2004)
- *Policy and Guidelines for Fish Friendly Waterway Crossings* (Department of Primary Industries, 2004)
- *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013)
- *NSW Water Quality Objectives* (DECCW, 2006)
- *Water sensitive urban design guideline* (Roads and Maritime Services, 2017).

Flooding and surface water study area

The flooding and surface water assessment study area is equivalent to the review of environmental factors site investigation area presented in Figure 3-6.

6.7.2 Existing environment

Catchment and waterways

The proposal is located within the overall catchment of Currambene Creek, one of a series of short streams which traverse the coastal strip of the South Coast of NSW. Another major tributary sub-catchment, known as Parma Creek, joins Currambene Creek upstream (ie to the west) of the Princes Highway.

The local catchment areas contributing to the site investigation area are primarily drained by two relatively small unnamed ephemeral watercourses.
These watercourses are conveyed under the existing Princes Highway via transverse culverts before discharging to the floodplain associated with a larger tributary

watercourse of Parma Creek. No important substrates, habitat features, or vegetation were recorded within any of the unnamed ephemeral watercourses within the site investigation area during biodiversity surveys (refer to Section 6.5).

The catchment area surrounding the site investigation area is shown in Figure 6-20.

Existing drainage structures

There are six transverse drainage structures, all culverts, within the site investigation area crossing the Princes Highway and allowing flow from east to west, as well as multiple smaller culverts crossing local roads and property accesses (Figure 6-21). The southernmost drainage structure comprising of three 2,700 millimetre diameter culverts, is considered to be undersized and contributes to flooding, as described below.

Flood planning areas

Flood planning areas as identified by Shoalhaven City Council are areas affected by the level of a one per cent AEP flood event plus 0.5 metre freeboard. Currambene Creek, Parma Creek and the Shoalhaven City Council flood planning areas are identified in Figure 6-22.

Existing flood level and extent

The existing one per cent AEP flood extent includes a large area of backwater from Parma Creek and its tributaries adjoining the western side of the Princes Highway embankment. This location is shown in Figure 6-23 and is generally consistent with the flood planning area identified by Shoalhaven City Council.

There is also a large area of ponding adjoining the southern side of the Jervis Bay Road and Princes Highway intersection. This ponding originates from the main waterway south of the intersection where a surcharging box culvert passes under the Princes Highway. Modelling indicates this culvert to be undersized for the estimated flows. This can result in overtopping of the Princes Highway and Jervis Bay Road.

Existing surface water quality

Water quality, based on visual observation during biodiversity surveys, appeared poor (ie signs of pollutants, excess sediments and nutrients) and contained a high density of weeds. Sections of waterways adjacent to the Princes Highway were observed to be subject to edge effects and regular disturbance such as vegetation trimming for powerlines and road works.

Fish habitat

No threatened aquatic species were recorded within the site investigation area, and none are expected to occur. While Parma Creek is mapped as key fish habitat for the Shoalhaven area (Department of Primary Industries, n.d.), the two unnamed ephemeral watercourses located within the site investigation area do not meet the definition of key fish habitat in accordance with the *Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries, 2013) as they are all classified as first order streams. Similarly, any drainage lines and/or dams within the site investigation area are not considered key fish habitat.

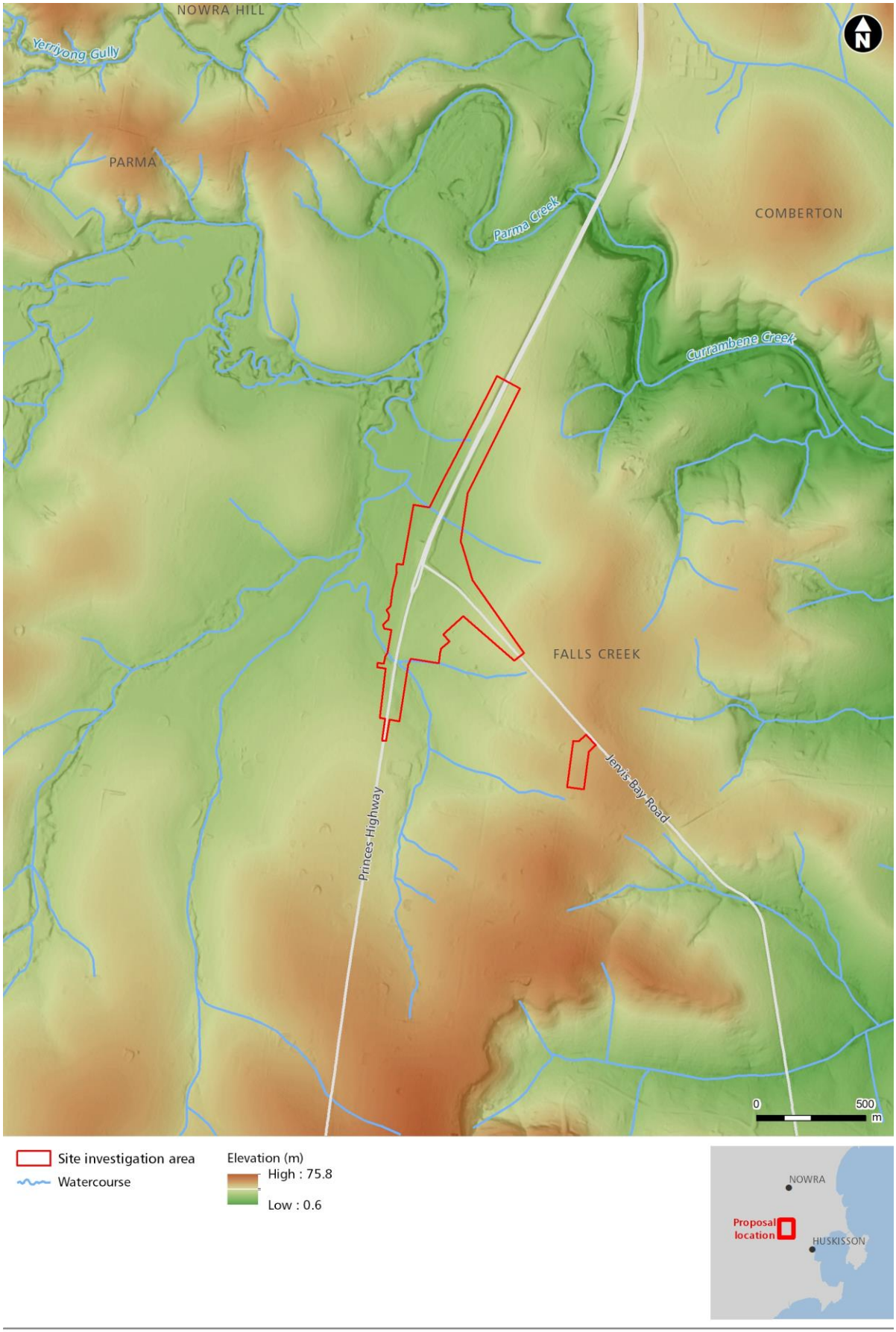

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Figure 6-20 Catchment area surrounding the proposal

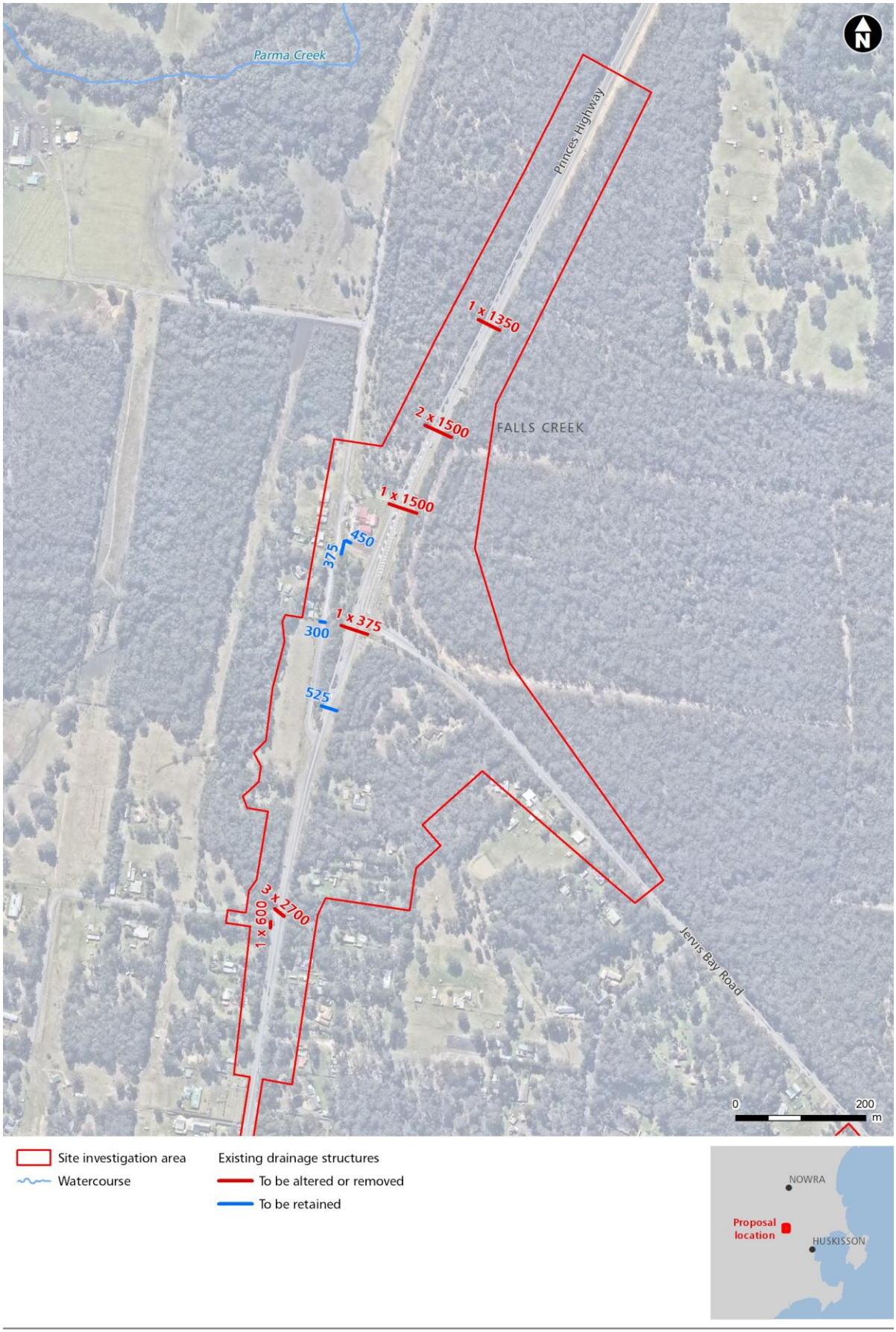

Figure 6-21 Existing drainage structures within the site investigation area

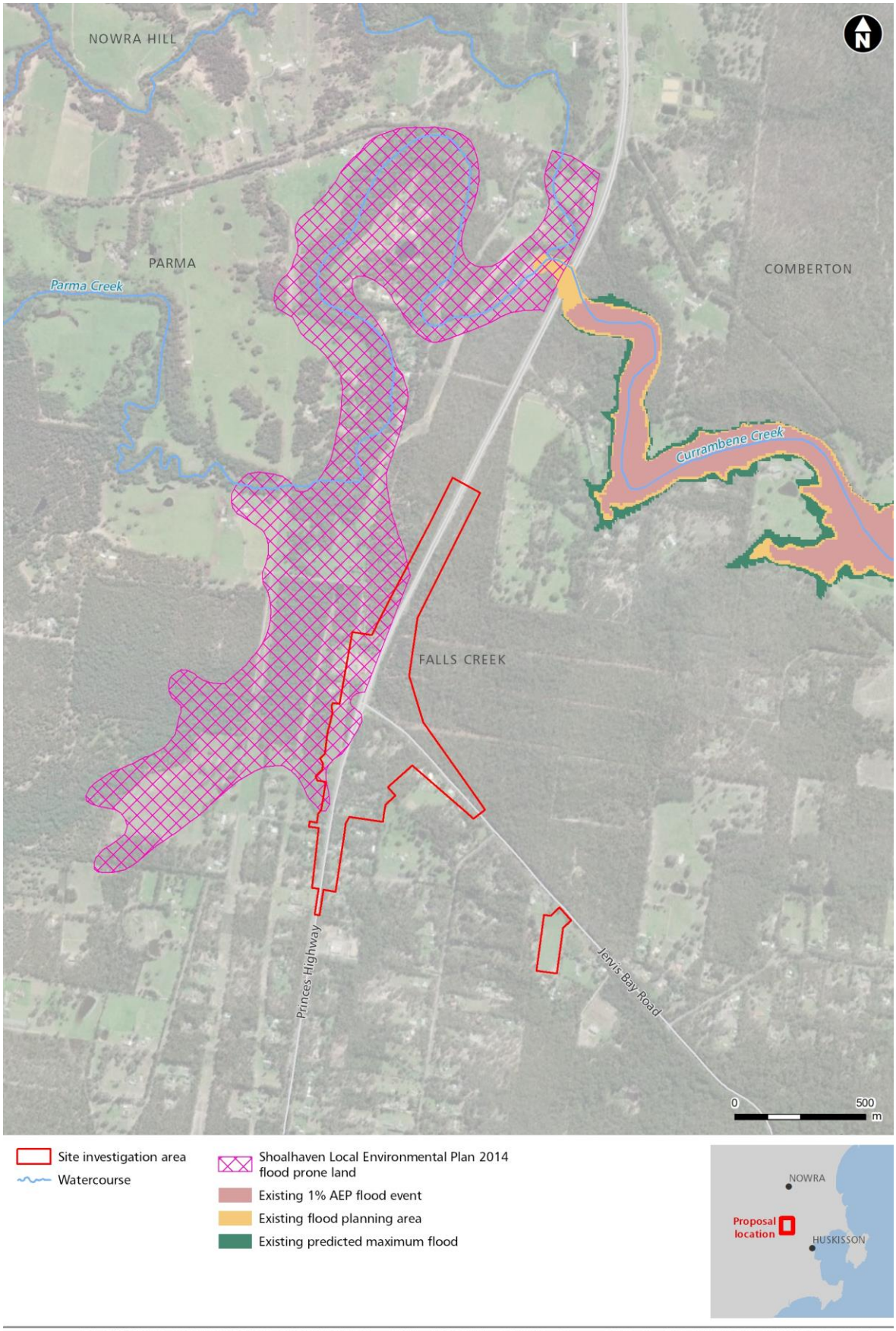

Figure 6-22 Waterways and extent of flood planning area in the vicinity of the proposal

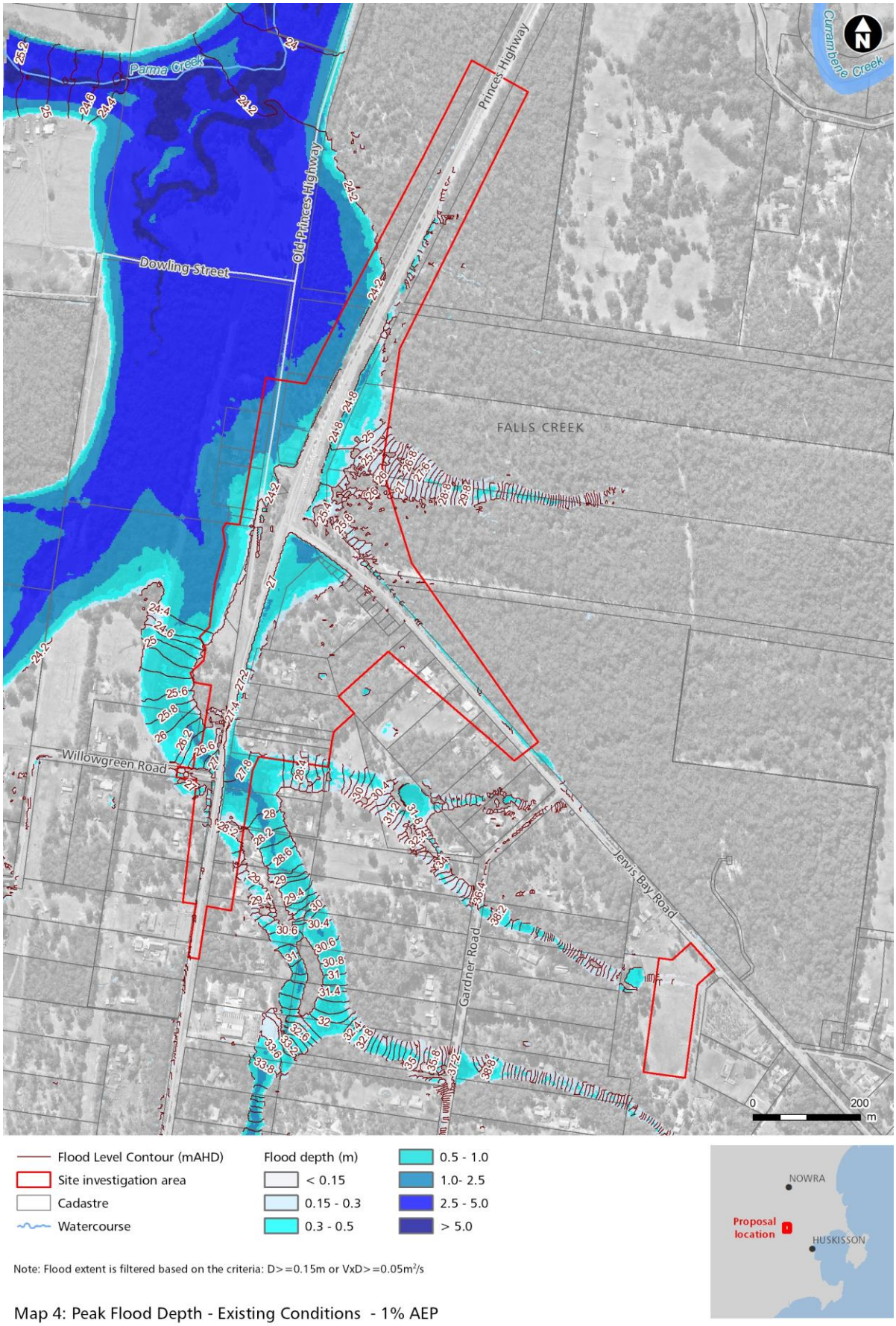

Figure 6-23 Flood levels and extent under existing conditions – one per cent AEP

6.7.3 Potential impacts

Construction

Flooding

During construction, potential impacts to flooding would be associated with changes in the local topography and changes to the existing drainage patterns within the proposal construction footprint. This may result in reduced floodplain storage and increased flooding impacts. Construction activities that may impact flooding include temporary fill within the floodplain (ie the five per cent AEP flood extent) for embankment earthworks and stockpiles, preloading for bridge abutments and construction of culverts or culvert extensions resulting in obstruction of flow paths.

Drainage construction works, in particular works at the southern culvert, have the potential to afflux on one dwelling if these works include blockage of the flow path during high rainfall events. Drainage works would be carried out in a manner that avoids or minimises afflux on private dwellings.

Given that the Princes Highway is designed to be immune from a one per cent AEP event, it follows that embankment earthworks and preloading would be unlikely to cause flooding impacts except potentially in events greater than the one per cent AEP.

The proposed location of ancillary facilities (indicated on Figure 6-24) are generally outside the five per cent AEP flood extent but may slightly encroach around the fringes in some localised areas. Should stockpiles be located within the five per cent AEP flood extent, they would be located and sized to ensure that temporary impacts are not greater than those specified in the design criteria and a flood contingency plan would be prepared.

In addition to obstruction of flow paths and reduced floodplain capacity, loose material stored in the stockpiles at ancillary facilities also has potential to be mobilised during a flood which can become a hazard and may contribute to the blockage of flood management structures.

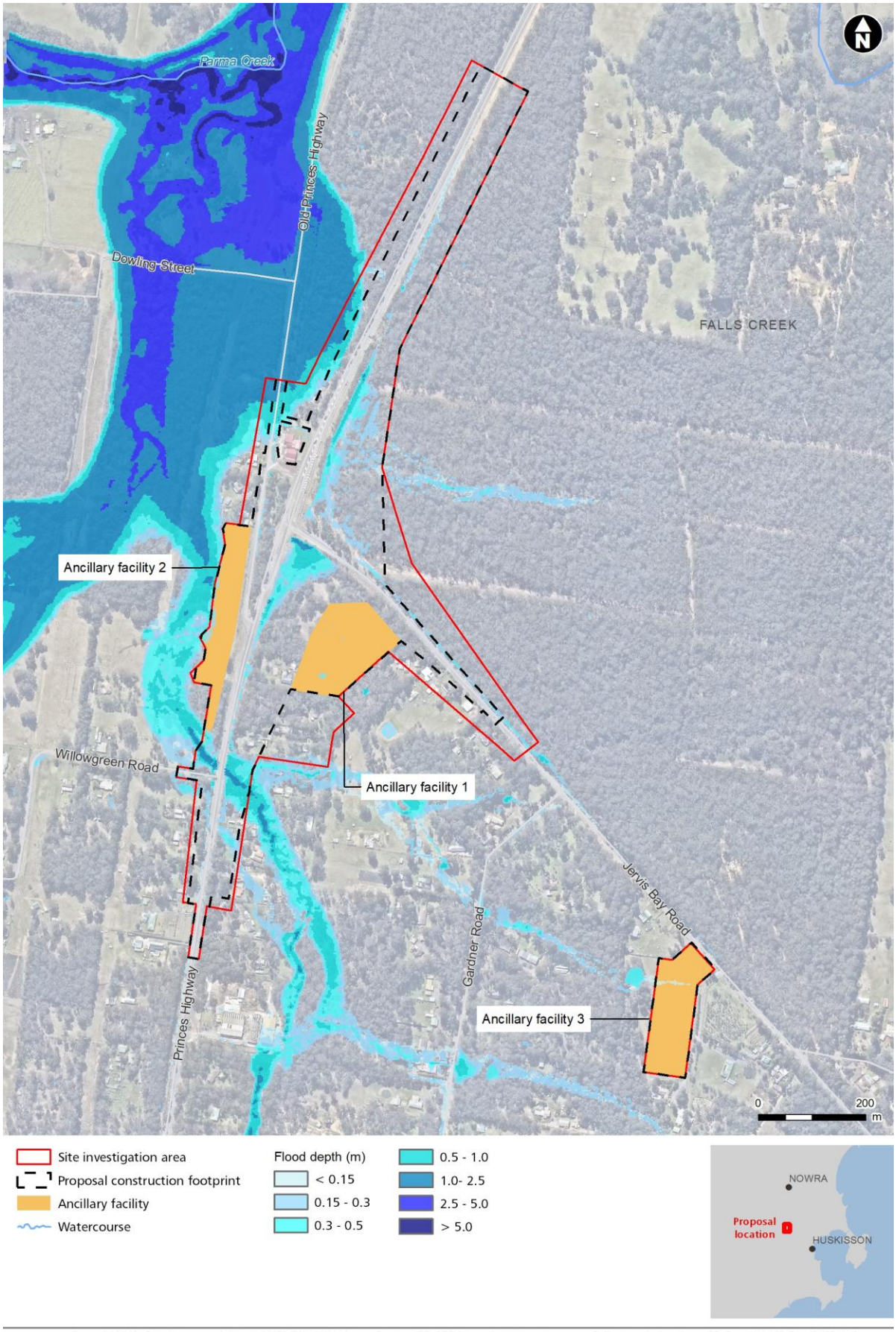

Figure 6-24 Ancillary facilities – five per cent AEP

Surface water

Construction of the proposal may result in an increase in sediment entering watercourses within and surrounding the proposal construction footprint. This could potentially occur through the following activities:

- Sediment release from stockpiles and earthmoving activities
- Runoff from stockpiles after a flood event
- Removal of vegetation to accommodate the proposal construction footprint
- Movement of heavy vehicles across exposed earth
- Transport of material to, from and within the proposal construction footprint
- Settlement of dust generated from construction activities.

An increase in the volume of sediment discharged to watercourses has the potential to increase turbidity, erosion and scouring. The subsequent settlement of sediment in waterways could impact aquatic ecosystem health.

Construction of the proposal could mobilise contaminants and gross pollutants into local watercourses, affecting water quality. Potential mechanisms for mobilisation and discharge could include:

- Spills and leaks from construction plant and equipment
- Runoff or spills from chemical storage areas within ancillary facilities
- General construction waste material and litter entering watercourses
- Discharge or runoff of tannins or other organic leachate materials from vegetation stockpiling within ancillary facilities.

The above potential impacts would be mitigated and managed through the implementation of erosion and sediment control measures as well as the installation of temporary sediment basins (indicative location shown in Figure 6-25). As discussed in Section 6.7.2, the watercourses within the construction footprint are minor, ephemeral streams, with no significant ecological value, and existing surface water quality appears to be poor. Therefore, it is considered that temporary impacts from construction activities would be minor.

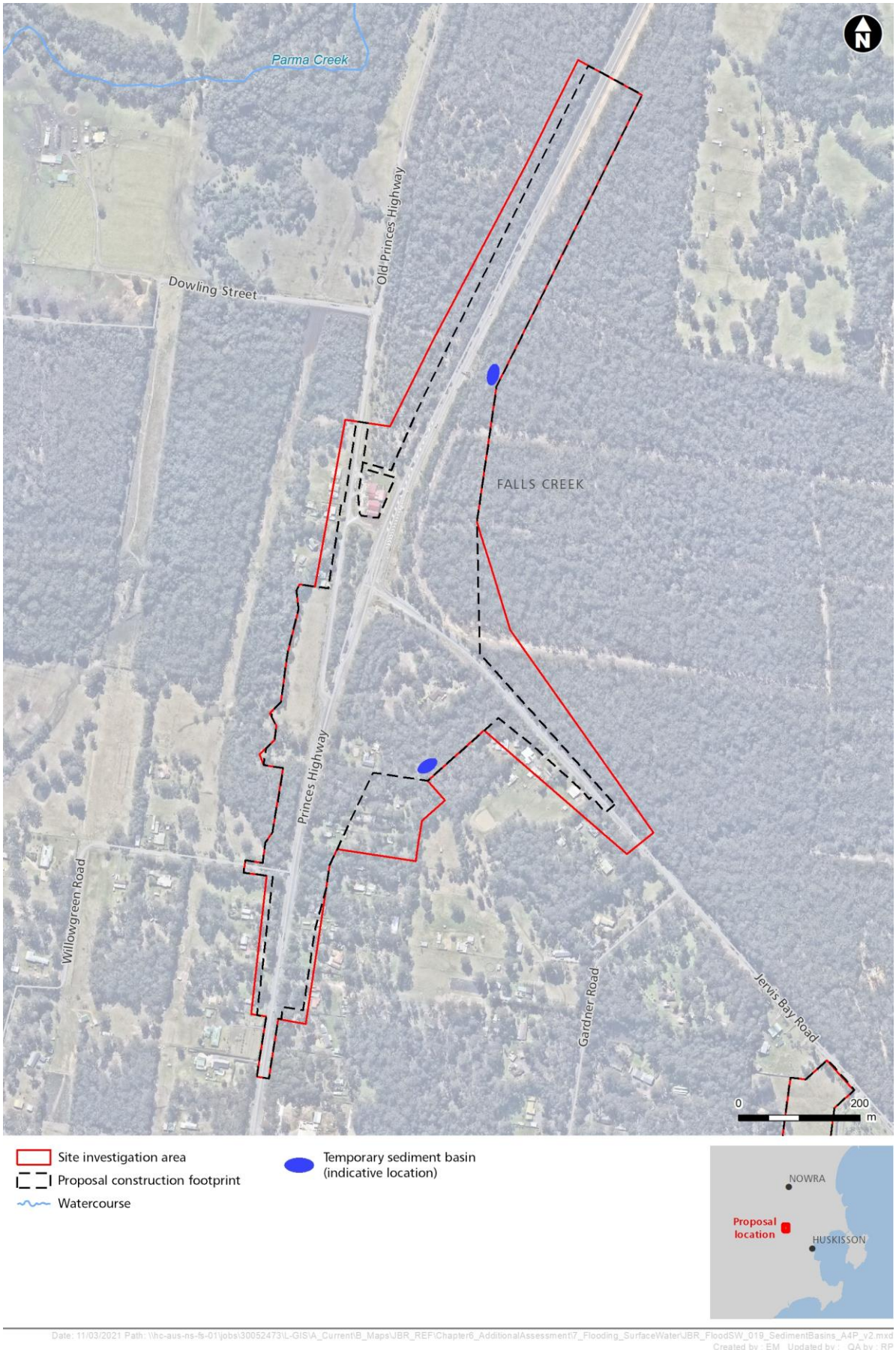

Figure 6-25 Indicative location of temporary sediment basins

Operation

Flooding

The design criteria for the proposal includes flood immunity during a one per cent AEP flood event (refer to Section 3.2).

For the one per cent AEP flood event, the upgrade of the undersized box culverts at the southern end of the proposal construction footprint would result in the removal of the large area of ponding previously adjoining the southern side of the existing intersection. This is due to the proposed culverts being more aligned with natural flow-paths and minimising excess runoff northwards towards Jervis Bay Road.

The large area of backwater from Parma Creek and its tributaries adjoining the western side of the Princes Highway embankment would remain present and would not be exacerbated as a result of the proposal.

Increases in flood level are relatively localised to immediately adjacent to the embankments on the eastern side of the southbound off ramp and around the eastern roundabout of the proposal. These impacts are mainly influenced by the proposed embankments, adjacent to the two proposed culverts, being situated further to the east in higher ground than the existing road. These impacts would mostly be contained within the road corridor and would not adversely impact surrounding properties.

At the southern unnamed watercourse, where the box culverts would be upgraded from three cells to five cells, a decrease in upstream (ie to the east of the Princes Highway) flood levels is predicted in the order of 20 to 40 millimetres.

There would be a subsequent minor increase in flood levels (up to 100 millimetres but mostly less than 50 millimetres increase) immediately downstream (ie to the west of the Princes Highway) of the southern unnamed watercourse, however the impacted area is flood affected under existing conditions and has no dwellings, building structures or agricultural land uses.

Mapping of the Climate Change scenario (the 0.2 per cent AEP) under proposed conditions is required for state roads and is included in Appendix H. Under the modelled Climate Change scenario, flood immunity would be maintained on the Princes Highway and Jervis Bay Road with implementation of the proposal.

Surface water

If unmanaged, stormwater runoff from the proposal has the potential to impact on the water quality of receiving watercourses due to the increase of impermeable surfaces. Typical pollutants associated with stormwater runoff from roads include heavy metals and hydrocarbons, as well as potential for atmospheric deposition of material on the road, which would contribute to stormwater pollution.

The proposal design includes water quality treatment measures to manage these impacts. These treatment measures would likely include vegetated swales, bioretention swales and/or a bioretention basins. Indicative locations of these water quality treatment measures are shown in Figure 6-26. The proposed location of these measures would be refined during further design development based on the available space and the discharge location to the receiving environment.

MUSIC modelling (Table 6-38) indicates that the proposed treatment measures would surpass the pollution retention objectives outlined in the *Shoalhaven Development Control Plan 2014* (Table 6-37). As such, the operational water quality treatment system would produce a future net benefit to water quality.

Further refinement and optimisation of proposed stormwater treatment measures would be carried out during detailed design, including confirmation of the practicality, constructability, maintainability and effectiveness of the proposed measures.

Table 6-38 Water quality treatment modelling results

Parameter	Target retention (per cent)	Retention through proposed design (per cent)
Suspended solids	85	91
Total phosphorus	65	75
Total nitrogen	45	55

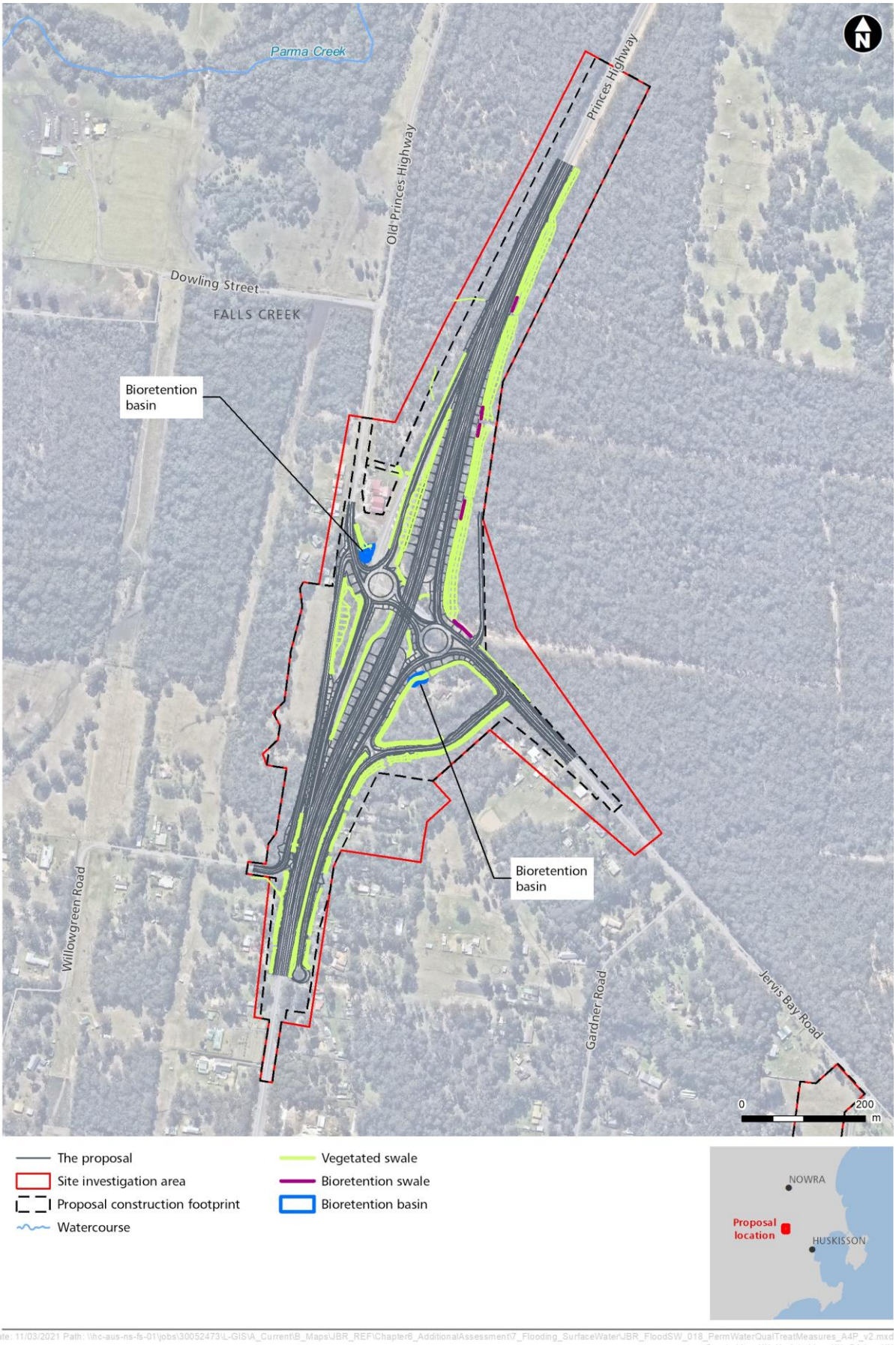

Figure 6-26 Indicative location of permanent water quality treatment measures

6.7.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
FW01 Flooding	A flood contingency plan will be prepared where stockpiles are proposed within areas with flood immunity of less than five per cent AEP. The plan will consider the likelihood of flooding, evacuation routes, warning times, and potential impacts of the ancillary facility flooding. The plan will: • Identify a designated "Site Flood Controller". The Site Flood Controller will familiarise with the Local Flood Plans and advice from the SES to ensure the plan can be executed • Include relevant emergency contact details including the SES • Include instruction on monitoring of the Bureau of Meteorology website and/or the nearby Currambene Creek water level gauge in relation to flooding, if required • Include procedures to be followed in preparation for, during and after a flood event will be developed for the proposal construction footprint. A copy of these procedures will be retained on site at all times • Include details of flood behaviour for the site, including extent and duration of inundation during events • Include information on flooding and training in what to do to prepare, during and after a flood event • Ensure that copies of the SES's "Local Flood Plan" for Currambene Creek area are kept on site at all times.	Contractor	Pre-construction Construction	
FW02 Flooding – afflux during construction	Drainage construction works will avoid and minimise afflux on private dwellings.	Contractor	Construction	
FW03 Flooding –	Ancillary facility layout and stockpile locations would be	Contractor	Pre-construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
ancillary facility layout	planned to minimise any potential flood impacts.		Construction	

Other safeguards and management measures that would address flooding and surface water impacts are identified in Section 6.6.4.

6.8 Groundwater

This section provides an assessment of the potential impacts of the proposal on groundwater and identifies safeguards and management measures to avoid or minimise these impacts.

6.8.1 Methodology

The groundwater assessment included the following:

- Desktop review of existing information, including searches of registered groundwater bores in the vicinity of the proposal
- Consideration of the relevant findings with respect to presence of groundwater documented in the *Geotechnical Interpretation Report* (Arcadis, 2020a), the Preliminary Site Investigation (Appendix G) and geologic logs (Transport for NSW, 2020g)
- Identification and assessment of construction and operational activities that have the potential to disturb or impact on water quality of registered groundwater users and groundwater dependent ecosystems
- Recommendation of safeguards and management measures to manage potential groundwater impacts.

Relevant legislation, plans and policy

The impact assessment of the proposal on groundwater has been prepared in consideration of the following groundwater legislation, plans and policy:

- *Water Management Act 2000*
- *Water Management (General) Regulation 2011*
- *Water Sharing Plan for the Clyde River Unregulated and Alluvial Water Sources 2016*
- *NSW Aquifer Interference Policy* (Office of Water, 2012).

Groundwater assessment study area

The groundwater assessment study area is equivalent to the review of environmental factors site investigation area (Figure 3-6).

6.8.2 Existing environment

Site-specific groundwater information has been derived from the *Geotechnical Interpretation Report* (Arcadis, 2020a) and geologic logs provided by Transport for NSW (Transport for NSW, 2020g). During geotechnical investigations carried out in June 2020, groundwater was encountered in two boreholes, JB02 and JB03 (Figure 6-27), during auguring at depths of 1.6 metres and 1.8 metres, respectively. Further, during investigations carried out in December 2020, groundwater was encountered in one large diameter borehole, LDBH-01 (Figure 6-27) at a depth of 0.5 metres.

Aquifer systems

Aquifers within the site investigation area are fractured or fissured extensive aquifers of low to moderate productivity (Arcadis, 2020b). There are two main aquifer systems present: lower sedimentary rocks, and upper alluvial sediments.

The lower sedimentary rock system is associated with the Shoalhaven Group geological unit consisting of quartzose sandstone, minor siltstone plus conglomerate beds.

The upper alluvial sediment system is associated with undifferentiated alluvium, gravel, sand silt and clay.

Groundwater bores

A search of the Bureau of Meteorology Australian Groundwater Explorer (Bureau of Meteorology, 2020a) identified no groundwater bores within the site investigation area. Within two kilometres of the site investigation area, there are eight bores that are generally used for domestic and stock purposes. Bore depths range from 24 metres to 120 metres. The nearest bore is located about 450 metres northeast of the site investigation area.

Groundwater dependent ecosystems

Groundwater dependent ecosystems, as discussed in Section 6.5, are ecological communities that are dependent, either entirely or in part, on the presence of groundwater for their health or survival. A review of the Bureau of Meteorology Groundwater Dependent Ecosystem Atlas (Bureau of Meteorology, 2020b) and biodiversity site surveys have identified areas with low to moderate potential to be interactive with groundwater within the site investigation area (as shown in Figure 6-15).

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Figure 6-27 Geotechnical investigations borehole locations

6.8.3 Potential impacts

Construction

Aquifer systems

Construction of the proposal would not require any large or deep excavations or cuttings, therefore no major dewatering is expected to be required.

Groundwater may be encountered during excavation of the overpass bridge pile shafts and during upgrade works at the southern culvert. Any groundwater seepage generated from this work would be minor and would be managed through localised small scale dewatering. This would not result in changes in groundwater levels or flows in the area and would not cause drawdown of the water table.

Construction of the proposal could result in fuel and chemical spills occurring by virtue of construction vehicle accidents, refuelling incidents or from stockpile and storage areas. Fuel and chemical leaks could potentially introduce petrol, diesel, hydraulic fluids and lubricants into the local environment, which could contaminate groundwater. With the implementation of safeguards and management measures identified in Section 6.6.4, the risk of these impacts is considered to be low.

Groundwater bores

There are no existing groundwater bores in close proximity to the proposal construction footprint and therefore would not be impacted by construction of the proposal.

Groundwater dependent ecosystems

Due to the small scale of potential dewatering required, there would be no expected impact to groundwater dependent ecosystems.

Fuel and chemical spills, as discussed above in relation to aquifer systems, also have the potential to impact groundwater dependent ecosystems.

Operation

Aquifer systems

The main risk during operation would be in relation to groundwater quality, which has the potential to be impacted by pollution from stormwater runoff or accidental spills. Pollutants present in surface water have the potential to be introduced to groundwater via infiltration and migration through subsurface soils and rocks.

As discussed in Section 6.7, the design incorporates a range of surface water treatment devices to reduce stormwater pollutant loadings, including vegetated swales, bioretention swales and bioretention basins.

These devices would produce a net benefit over the existing situation by reducing the amount of total suspended solids, total phosphorous, total nitrogen and gross pollutants delivered to the receiving waterbodies on an annual basis, despite the increased amount of road surface areas that would generate stormwater runoff. As such, it is expected that the risk of pollution of groundwater would be reduced in the operational phase.

Groundwater bores

There are no existing groundwater bores in close proximity to the proposal and therefore would not be impacted by operation of the proposal.

Groundwater dependent ecosystems

During operation, impacts on groundwater dependent ecosystems are expected to be negligible. As discussed above, surface and water treatment devices would reduce stormwater pollutant loadings, thereby reducing potential operational groundwater pollution risk and reducing impacts of pollution on groundwater dependent ecosystems.

6.8.4 Safeguards and management measures

Safeguards and management measures that would address groundwater impacts are identified in Section 6.6.4.

6.9 Aboriginal heritage

This section provides an assessment of the potential Aboriginal heritage impacts of the proposal, and identifies safeguards and management measures to avoid or minimise these impacts.

6.9.1 Methodology

An Archaeological Survey Report was prepared for the proposal (Artefact Heritage, 2020) (Appendix I) in accordance with Stage 2 of the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime Services, 2011). The Stage 2 investigation included:

- A desktop review to provide an overview of the Aboriginal history of the area and to determine if Aboriginal sites have been previously identified within the study area, including a review of the Aboriginal Heritage Information Management System (AHIMS)
- Consultation with the local Aboriginal community as described in Section 5
- A field survey to identify visible surface evidence of cultural heritage sites and landforms with archaeological sensitivity, carried out in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (the Code of Practice) (DECCW, 2010a)
- An assessment of significance of the study area, including cultural and archaeological values.

The Archaeological Survey Report identified one surface artefact scatter and two areas of potential archaeological deposit (PAD) as described in Section 6.9.2.

An Aboriginal test excavation and cultural heritage assessment (Appendix I) was carried out in accordance with the PACHCI Stage 3 and the Code of Practice for one area of PAD (JBR PAD 01 AHIMS 52-5-0981) that would be subject to direct impact from the proposal. This work included:

- Consultation with the local Aboriginal community as described in Section 5
- Archaeological test excavation, including the hand excavation of 14 test pits (0.5 metres by 0.5 metres) (as shown in Figure 6-28) carried out on 15 and 16 December 2020
- Recording of any newly identified sites, including submission to the AHIMS register
- Assessment of the archaeological and cultural heritage significance of identified items or places
- Assessment of impacts of the proposal on identified items or places
- Identification of safeguards and management measures to manage Aboriginal heritage impacts associated with the construction and operation of the proposal.

Relevant legislation, plans and policies

The impact assessment of the proposal on Aboriginal heritage has been prepared in accordance with:

- *National Parks and Wildlife Act 1974*
- *National Parks and Wildlife Regulation 2019*

- *Aboriginal Land Rights Act 1983*
- *Native Title Act 1993*
- Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (the Code of Practice) (DECCW, 2010a)
- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (the ACHAR Guide) (OEH, 2011)
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (the Consultation Requirements) (DECCW, 2010b)
- The Australia ICOMOS Charter for Places of Cultural Significance 2013 (the Burra Charter) (Australia ICOMOS, 2013).

Study area

Background research, including an extensive AHIMS search, was focussed on an area of several kilometres surrounding the Jervis Bay Road and Princes Highway intersection. This was used to inform the archaeological potential of the site investigation area.

The Aboriginal heritage study area is comprised of the review of environmental factors site investigation area, as well as additional portions of land on Lot 1 DP 871596 (Figure 6-28). Lot 1 DP 871596 was initially included for investigation due to the potential use of land as an ancillary facility site, however as described in Section 6.9.2 and Section 6.9.3, Lot 1 DP 871596 would not be impacted by the proposal.

6.9.2 Existing environment

Ethnohistorical background

Archaeological evidence indicates that Aboriginal people have lived in the Illawarra region for at least 20,000 years (Lampert, 1971), however, Aboriginal occupation in the region could be far older than this. Derived through historical research and consultation with Aboriginal people of the region about the relationship between local Aboriginal grounds and Country (Wesson, 2005), Nowra and its surrounds is within the Country of the Wodi Wodi speakers of the Dharawal language, within the Tuin language group.

Dharawal people have identified themselves as being either fresh-water or salt-water people, depending on whether they occupied the coastal regions or the plateaus and inland river valleys (Wesson, 2005). It is likely that Aboriginal People moved across the landscape between resource zones, and that movement was related to socio-cultural factors such as gatherings and ceremonial obligations (Attenbrow, 2010). Movement across the landscape can be inferred through stone artefact remains, as tools were prepared, used and repaired at campsites or during hunting activities (Artefact Heritage, 2014).

The South Coast is thought to be one of the most densely populated regions before colonisation (Organ and Speechley, 1997). This may be related to the availability of many and varied food resources the locality provided. Early accounts by colonists indicate that the Aboriginal people of the region lived in a society where labour was often divided based upon gender and age. For example, men hunted larger species on land and fished, while women hunted smaller species and gathered vegetable products and shellfish.

While tools used by Aboriginal people made of plant fibre, wood and shell have not survived in the archaeological record, there are surviving relics from local traditional Aboriginal lifestyles are the flaked and shaped stone tools fabricated from the varied stone sources embedded in the local sandstone conglomerate, that were transported as river cobbles in the Shoalhaven River, or which may have been traded during travel or through exchange.

Cultural historical background

Byrne (1983) found that, while the highest density sites in the region were located immediately near the coastline, this density fell off as one travelled inland. High density sites were once again identified in the hinterland between 13 kilometres to 18 kilometres inland. Walkington (1987) suggested that this may have been due to the fact that this distance (from 13 kilometres to 18 kilometres) is close to a maximum day's walk. Aboriginal people moving between the coast and the hinterland would have been unlikely to have camped in the intermediate sandy lowlands of the coast. The closest camping sites en-route to or from the coast would be expected about one days walk inland. The current site investigation area is located about 10 kilometres from the coast suggesting that the site investigation area is unlikely to include high density sites associated with the hinterland region.

Clarke and Kuskie (2006) developed a predictive model for the Shoalhaven region, which suggested that the region could be divided into two main resource zones, each supporting a different range of occupation types:

- Primary resource zones – occur in close proximity to the Shoalhaven and Crookhaven Rivers and have higher probability of containing evidence for a wide range of occupation types including congregations of large groups of people, community base camps, nuclear / extended family base camps, camping by small hunting and/or gathering (without camping) and transitory movement. Occupation is likely to have been regular and potentially longer in duration
- Secondary resource zones – located in close proximity to higher order creeks and/or wetlands, including Parma Creek and Currambene Creek and their associated flats, slopes, and terraces. Occupation is likely to have been sporadic and relatively short in duration.

Areas outside the primary and secondary resource zones include landforms some distance from higher order creeks and/or wetlands, such as lower order drainage depressions and associated slopes and crests. Occupation in these areas is likely to have involved hunting and/or gathering (without camping) and transitory movement and is likely to have been sporadic and very short in duration (Clarke and Kuskie, 2006).

The site investigation area is not within a secondary resource zone but is in the vicinity of Parma and Currambene Creek.

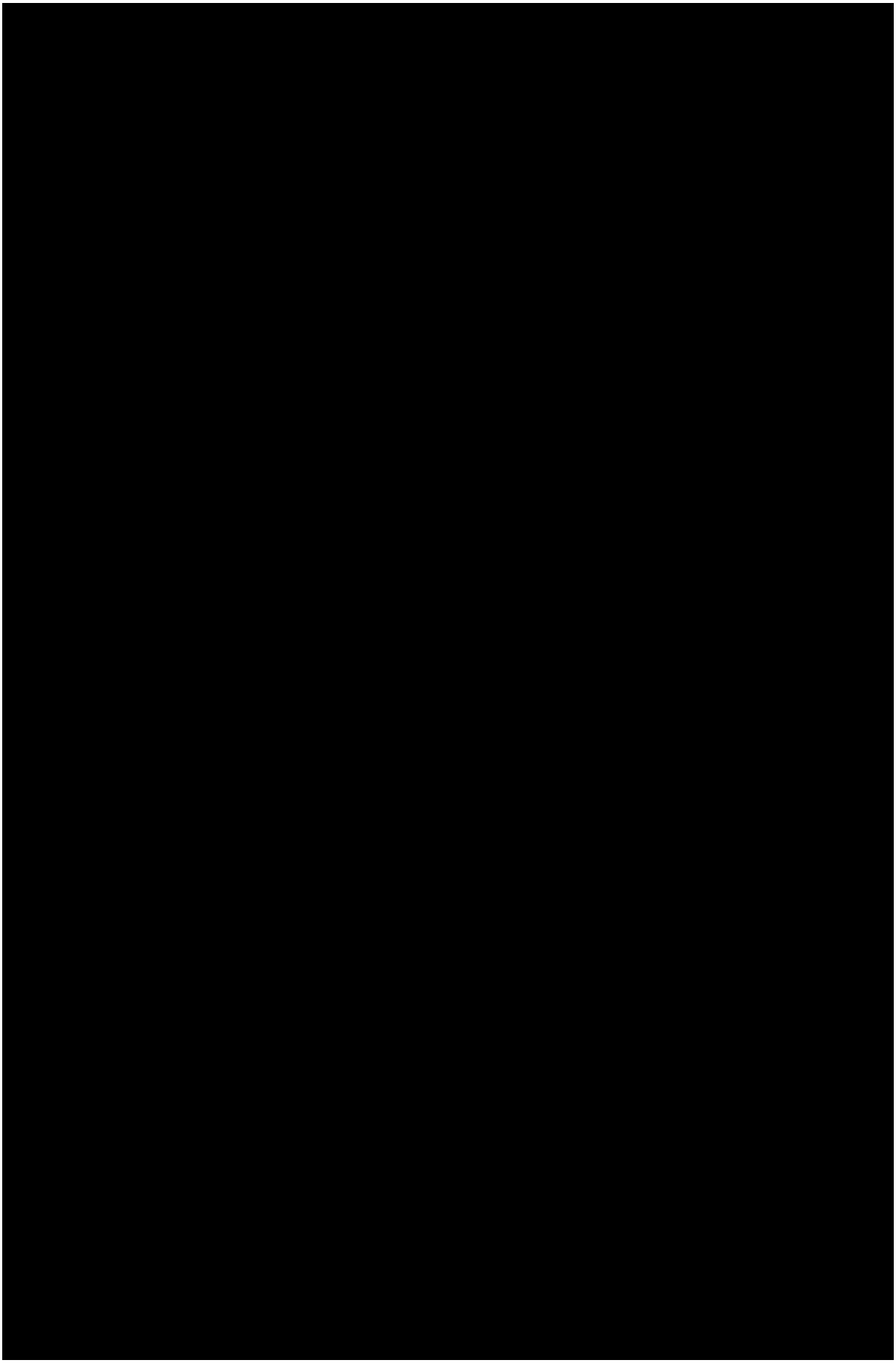


Figure 6-28 Aboriginal heritage study area and test excavation location

Cultural heritage values

Aboriginal cultural heritage values identified within the site investigation area and surroundings through Aboriginal community consultation are provided in Table 6-39.

Table 6-39 Aboriginal cultural heritage values identified through Aboriginal community consultation

Group	Cultural heritage value identified	Response/where addressed in the review of environmental factors
Local Aboriginal land council representative, PACHCI Stage 2 archaeological survey	The presence and significance of several bush tucker species within the site investigation area was noted.	The presence of vegetation within the site investigation area is discussed in the Aboriginal cultural heritage assessment report (Appendix I), the biodiversity assessment report (Appendix F) and Section 6.5.
Local Aboriginal land council representative, PACHCI Stage 2 archaeological survey	The significance of larger waterways and the coastal environment to the south and east was noted as a focus of past Aboriginal occupation.	The importance of waterways and the coastal environment to the Aboriginal community is considered in the Aboriginal cultural heritage assessment report (Appendix I).
Local Aboriginal land council representative, PACHCI Stage 2 archaeological survey	The presence of past camp sites within the vicinity of the Jervis Bay Road Intersection was noted, however no further information about their location was received.	The potential for camp sites within and surrounding the site investigation area is discussed in the Aboriginal cultural heritage assessment report (Appendix I).
Parks Australia 2020	Booderee National Park was formed in 1992 when Jervis Bay National Park and Jervis Bay Botanic Gardens handed back to the local community as part of historic land grant.	The proposal is located about 18 kilometres northwest of Booderee National Park and would not result in impacts.

Identified sites

Previously recorded Aboriginal sites

No previously recorded sites were identified in the AHIMS search carried out on 9 February 2021. The closest previously recorded site is a PAD (PC1-Parma Creek 1 and PC PAD 1, AHIMS ID 52-5-0465) about [redacted] metres north of the study area. This PAD was subject to an Aboriginal Heritage Impact Permit (AHIP) issued in 2007 under Section 90 of the *National Parks and Wildlife Act 1974*. Historical aerial photographs indicate that road upgrades had occurred within the PAD extent by 2009.

Recently recorded Aboriginal sites

One previously unrecorded artefact scatter (JBR AS 01 AHIMS ID 52-5-0981) and two potential archaeological deposits (JBR PAD 01 and JBR PAD 02 AHIMS ID 52-5-0991) were located during the archaeological survey carried out for the proposal. Table 6-40 summarises these sites.

Table 6-40 Aboriginal heritage sites within and near the Aboriginal heritage study area

Site name	AHIMS ID	Assessed significance	Site feature	Within the proposal construction footprint
PC1-Parma Creek 1 and PC PAD 1	52-5-0465	N/A – destroyed	Potential archaeological deposit	No
JBR AS 01	52-5-0981	Low	Artefact scatter	No
JBR IF 01	52-5-0982	Low	Isolated find	Yes
JBR PAD 02	52-5-0991	Unknown	Potential archaeological deposit	No

JBR AS 01 (AHIMS ID 52-5-0981)

JBR AS 01 is an artefact scatter located within a large spoil pile [redacted]. The scatter is comprised of three silcrete artefacts, likely to have been redeposited [redacted]. JBR AS 01 is not located within the proposal construction footprint and would not be impacted as part of the proposal.

JBR PAD 01

JBR PAD 01 is an area of PAD located [redacted]. [redacted], the surrounding area is considered to be intact, with evidence of disturbance limited to tree clearance in this area. JBR PAD 01 is located within the proposal construction footprint and would be impacted as part of the proposal. As JBR PAD 01 is within the proposal construction footprint, archaeological test excavations were carried out to test the extent and nature of potential sub-surface Aboriginal objects which may be subject to impact as part of the proposal.

A single silcrete multi-platform core artefact was recovered from the archaeological test excavations, Jervis Bay Road Isolated Find 01 (JBR IF 01 AHIMS ID 52-5-0982 shown in Figure 6-29). The assemblage from JBR IF 01 indicated that the area was unlikely to have been used as a campsite for a prolonged period of time. The low-density nature of the artefact deposit (0.28 artefacts per square metres) suggests that knapping and other repeated activities that would result in the deposition of artefacts did not occur frequently at this location. Further, the artefact was recovered from a flood prone environment, and it is possible that the artefact has been subject to movement associated with fluvial forces.

JBR PAD 02 (AHIMS ID 52-5-0991)

JBR PAD 02 is an area of PAD [redacted]. Limited evidence of disturbance is noted to be associated with land clearance. [redacted], the site is considered to support the potential for further subsurface artefacts that remain in-situ. JBR PAD 02 is not located within the proposal construction footprint and would not be impacted as part of the proposal.

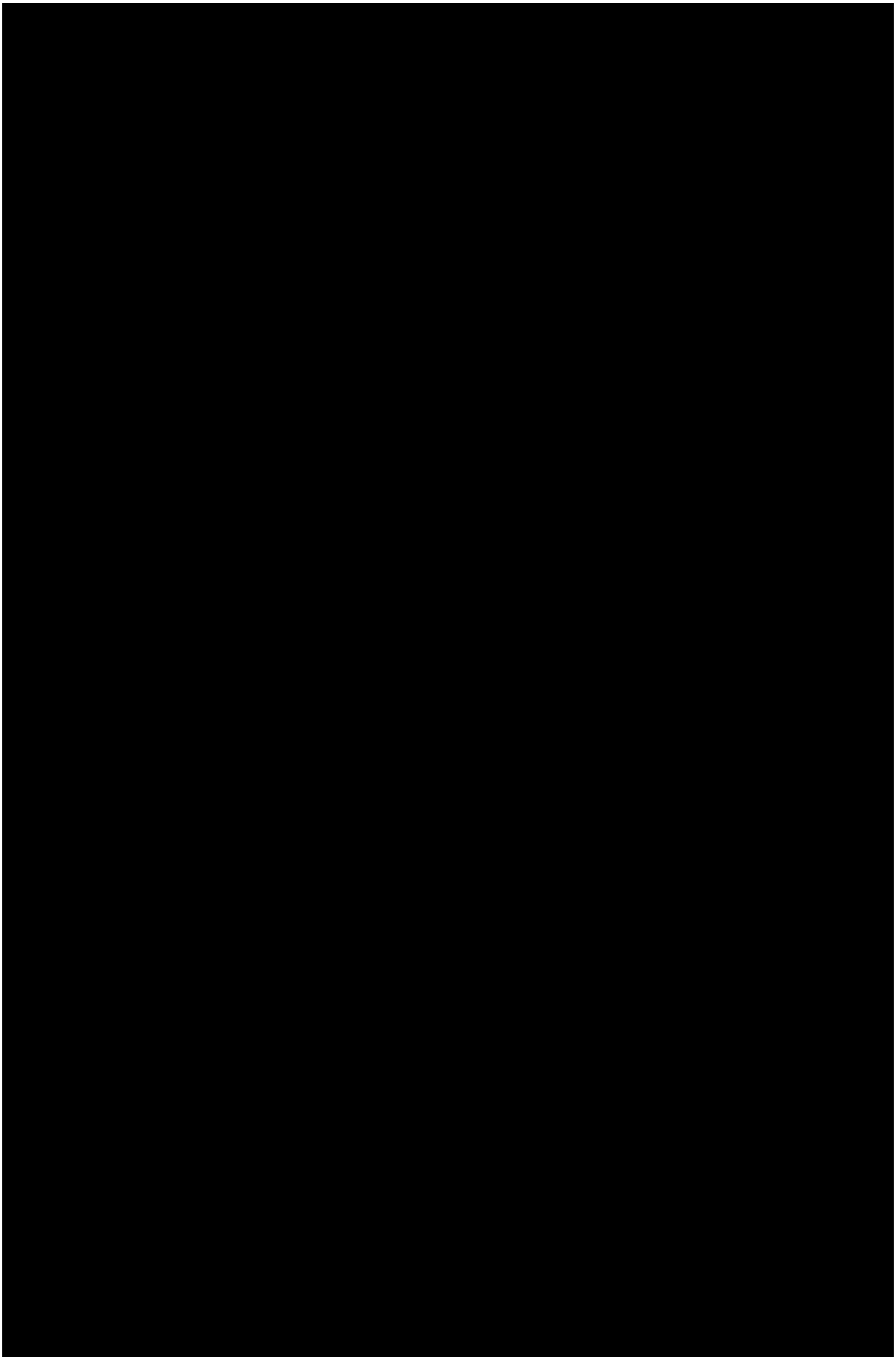


Figure 6-29 Location of identified Aboriginal heritage sites

Significance assessment

Assessing the cultural significance of a place or object means defining why a place or object is culturally important. The site investigation area has been assessed according to the following significance criteria:

- Social and cultural
- Historic
- Aesthetic
- Scientific.

Social/cultural values and significance

The Consultation Requirements (DECCW, 2010b) specifies that the social or cultural value of a place must be identified through consultation with the Aboriginal community. No specific areas of cultural significance were identified by registered Aboriginal party representatives during the field survey, test excavation program or during the Aboriginal focus group meetings. Comment during the Aboriginal focus group meetings and survey did note that there were known former camp sites within the vicinity of Jervis Bay and that this area contained significance associated with these former camp sites and opportunistic use of the landscape for food and resources.

Historic values and significance

There is no historic evidence in the ethnographic literature or within the Aboriginal community for specific use of the site investigation area.

Aesthetic values and significance

The majority of the study area has been subject to substantial modification associated with road networks as well as residential and commercial properties. The site investigation area is considered to contain low aesthetic value.

Scientific values and significance

A summary of the scientific value of each archaeological site within the study area is described below and summarised in Table 6-41.

Table 6-41 Summary of archaeological significance

Name/ AHIMS ID	Research potential	Representative value	Rarity	Education potential	Overall archaeological significance
JBR IF 01 (AHIMS ID 52-5-0982)	Low	Moderate	Low	Low	Low
JBR AS 01 (AHIMS ID 52-5-0981)	Low	Low	Low	Low	Low
JBR PAD 02 (AHIMS ID 52-5-0991)	Moderate	Unknown	Unknown	Unknown	Unknown

JBR IF 01 (AHIMS ID 52-5-0982)

JBR IF 01 is comprised of a single silcrete multi-platform core artefact recovered from the proposal archaeological test excavation. While the artefact was assessed to have

been recovered from an intact archaeological deposit, the interpretive potential of the isolated find was assessed to be limited and subsequently the site was assessed to demonstrate low archaeological research potential. While the site represents a low-density site, it is considered to be consistent with the predicted use of land within the vicinity of secondary resource zones such which is further illustrated through the identification of additional low density artefact sites and isolated finds in the immediate vicinity of the proposal construction footprint. JBR IF 01 is considered to demonstrate moderate representative values and low rarity values. Further, as an isolated artefact JBR IF 01 is considered to demonstrate limited educational potential.

JBR AS 01 (AHIMS ID 52-5-0981)

JBR AS 01 is comprised of a low density artefact scatter located within a disturbed context. Based on the highly disturbed nature of the site the artefacts are not considered to be representative of specific land use practices by Aboriginal people and therefore the site is considered to contain low research potential and representativeness. Silcrete artefact scatters are considered to be relatively common site type and subsequently demonstrates low rarity values. As all identified artefacts were comprised of broken flakes, the artefacts are considered to demonstrate limited educational potential.

JBR PAD 02 (AHIMS ID 52-5-0991)

JBR PAD 02 has been assessed as demonstrating unknown archaeological significance. This is due to the fact that these features are located in areas with limited surface visibility and the nature, extent and significance cannot be determined without further investigation.

6.9.3 Potential impacts

Construction

One Aboriginal site, JBR IF 01, would be subject to direct impact as a result of the proposal, resulting in a total loss of value.

An AHIP would be required for the proposal to allow impacts to JBR IF 01 before the commencement of works in accordance with Section 90 of the *National Parks and Wildlife Act 1974*.

JBR AS 01 and JBR PAD 02 are outside of the proposal construction footprint and would not be impacted by the proposal.

Potential impacts are summarised in Table 6-42.

Table 6-42 Impact assessment summary

Site Name	AHIMS ID	Type of harm	Degree of harm	Consequence of harm
JBR IF 01	52-5-0982	Direct	Whole	Total loss of value
JBR AS 01	52-5-0981	Nil	None	No loss of value
JBR PAD 02	52-5-0991	Nil	None	No loss of value

Operation

Operation of the proposal would not impact Aboriginal heritage as ground disturbance and excavation would be restricted to the construction phase. Should sub-surface maintenance or repairs of infrastructure be required, potential environmental impacts would be considered as relevant.

6.9.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
HE01 Impact on Aboriginal sites	An application for an area based Aboriginal Heritage Impact Permit will be submitted to Heritage NSW for the proposal construction footprint.	Transport for NSW	Pre-construction	
HE02 Unexpected finds	*The Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015) will be followed in the event that any unexpected heritage items of Aboriginal or Non-Aboriginal origin are encountered.	Contactor	Detailed design Pre-construction	Section 4.10 of QA G36 Environment Protection Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime Services, 2015)

6.10 Non-Aboriginal heritage

This section provides an assessment of the potential impacts of the proposal on non-Aboriginal heritage and identifies safeguards and management measures to avoid or minimise these impacts.

6.10.1 Methodology

A desktop review was carried out for this non-Aboriginal heritage assessment, which included:

- A search of the following registers and databases carried out on 26 April 2020 to identify existing items or places of non-Aboriginal heritage located within or adjacent to the construction footprint, and their significance levels:
    - The State Heritage Inventory (DPC, 2020)
    - The Australian Heritage Database (DAWE, 2020b)
    - The Australian National Heritage List (DAWE, 2020c)
    - Transport for NSW s170 Heritage and Conservation Register (Transport for NSW, 2019a)
    - Roads and Maritime s170 Heritage and Conservation Register (Roads and Maritime Services, 2020)
    - Shoalhaven LEP heritage map (Shoalhaven City Council, 2014)
- A literature review of previous reports, heritage studies and regional and local history documents to provide an overview of the historical context and land use of the site investigation area and surrounds.

Potential impacts to any identified non-Aboriginal heritage items were assessed, and safeguards and management measures were recommended to manage potential non-Aboriginal heritage impacts.

Relevant legislation, plans and policies

The impact assessment of the proposal on non-Aboriginal heritage has been prepared in accordance with:

- *Heritage Act 1977*
- *Assessing heritage significance* (Heritage Office, 2001)
- *The Australia ICOMOS Charter for Places of Cultural Significance* (the Burra Charter) (ICOMOS, 2013)

Non-Aboriginal heritage study area

The non-Aboriginal heritage study area is equivalent to the review of environmental factors site investigation area (Figure 3-6).

6.10.2 Existing environment

Historical background and land use

The first recorded European visit to the Shoalhaven region was made by Captain Cook in April of 1770. He noted a protected bay which would later be names Port Jervis, and on April 26 noted ‘several smokes along shore before dark’ (Navin Officer, 2007).

The Shoalhaven region began to be explored by colonists during the late 1790s and surveyed in 1805 by James Meehan (Bayley 1975:18). The first non-Aboriginal

occupants of the region were cedar getters, both legal and illegal, who logged trees in the area from at least 1811, however in 1815 Governor Macquarie forbade timber getters from visiting the district after a number were killed by Aboriginal people (Navin Officer, 2007).

A concerted effort to establish a land-route for transferring cattle into the area from inland pastures came in 1818 by Charles Throsby and 1819 by James Meehan and John Oxley, in which they explored Jervis Bay, Currambene Creek and the sire of Nowra (Navin Officer, 2007).

The earliest significant settler in the Shoalhaven region was Alexander Berry who, along with his business partner Edward Wollstonecraft, established his station on large holdings at the foot of Mount Coolangatta (on the north side of the Shoalhaven River). Berry investigated the region to the south of his lands, became on good terms with the local Aboriginal people, and established the largest convict settlement in the region (Navin Officer, 2007).

By 1840, Berry had acquired over 40,000 acres of land on which they grew maize, tobacco, wheat, barley and potatoes as well as rearing pigs and grazing cattle. Berry sold his produce at a store established on George Street, bought a ship to transport the goods to Sydney and established a road specifically for transport purposes, which is now part of the Princes Highway (Perry, 1966). Many of Berry's convict workers remained in the area once they regained their freedom, living and working on tenant land released by Berry from 1842 onwards.

While a small portion of the site investigation area was within Berry's grant, the majority of the land immediately surrounding was granted in small parcels of 40 to 100 acres to others (Figure 6-30).

Princes Highway history

When Sir Thomas Mitchell published his magisterial map of the State in 1834, he showed no coastal roads at all in Shoalhaven and only a handful of inland tracks. One such track ran south-west from the head of Currambene Creek on the line of the present Braidwood Road, which today runs about parallel with the Princes Highway. The development of a road link between Sydney and the Illawarra was delayed by the coastal cliffs north of Wollongong (Freeman, 2003). As the population in the Wollongong area increased, the need for a better road also increased. Several inland routes were created as far south as Gerringong, and in 1856 the government planned a road south to Berry, however this did not eventuate. Alexander Berry built a road at his own expense connecting Gerringong to Berry, and then to Bomaderry in 1858. A major ferry was constructed in Bomaderry, allowing Nowra to grow significantly (Freeman, 2003).

The new Council of Numbaa, formed in 1868, took over the maintenance of all the roads in the district, most of which had been constructed by Berry for the convenience of his Coolangatta estate. The council steadily improved the road to Gerringong and gradually linked local road systems, eventually creating the main south road. In 1920 it was officially named the Princes Highway in honour of a visit from the Prince of Wales, and after 1925 it became the responsibility of the new Main Road Board (Freeman, 2003). The stretch of road in the Falls Creek area was resurfaced with tar in 1940.

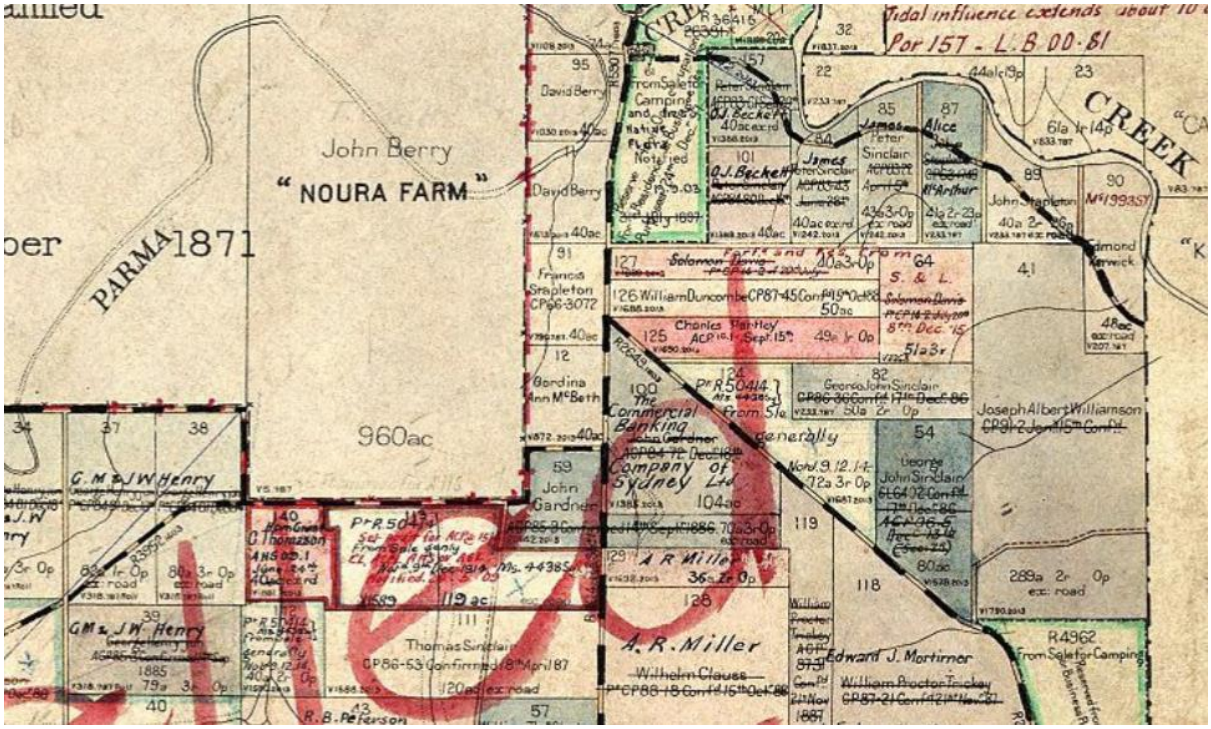


Figure 6-30 Tomerong Parish map, 1916, showing the Jervis Bay Road and Princes Highway intersection and surrounding land ownership

Desktop review

The desktop review identified no non-Aboriginal heritage items located within or adjacent to the site investigation area. The closest heritage items are a farm located about 1.75 kilometres east of the site investigation area and a school building located about two kilometres north of the site investigation area.

Based on the results of the desktop review, there is low archaeological potential within the site investigation area due to the ongoing disturbance and development of the road and surrounds.

6.10.3 Potential impacts

Construction

There are no registered non - Aboriginal heritage items within the proposal construction footprint. The proposal construction footprint has been found to have low archaeological potential and as such, the proposal is unlikely to impact on any non-Aboriginal heritage items.

In the event that non-Aboriginal heritage items are uncovered during construction, the unexpected finds procedure would be implemented.

Operation

The operation of the proposal would not result in any impacts to any known non-Aboriginal heritage items.

6.10.4 Safeguards and management measures

Safeguards and management measures that would address non-Aboriginal heritage impacts are identified in Section 6.9.4.

6.11 Landscape character and visual amenity

This section provides an assessment of the potential impacts of the proposal on landscape character and visual amenity, and identifies safeguards and management measures to avoid or minimise these impacts. A detailed assessment of landscape character and visual impacts is presented in Appendix J.

6.11.1 Methodology

The methodology used to carry out the landscape character and visual impact assessment followed the *Environment impact assessment practice note: Guideline for landscape character and visual impact assessment* (EIA-N04) (Transport for NSW, 2020h), and included:

- Initial site visit and field investigation, review of relevant literature, and analysis of aerial photographs and topographic maps
- Review of the concept design and supporting material to gain an appreciation of the proposal
- Definition of landscape character through a site investigation area analysis
- Identification and description of landscape character zones
- Assessment of the impact of the proposal on these landscape character zones in terms of the sensitivity of the affected areas and the magnitude of the change created by the proposal, to provide an overall impact rating as indicated by the Impact Assessment Grading Matrix (Table 6-43)
- Identification of the visual catchment of the proposal
- Selection of viewpoints within the visual catchment representing a range of different land uses
- Assessment of the visual impact of the proposal through comparison of the sensitivity of viewpoints and the magnitude of the change created by the proposal, to provide an overall impact rating as indicated by the Impact Assessment Grading Matrix (Table 6-43)
- Identification of urban design and landscape safeguards and management measures.

The landscape character and visual impact assessment was based on the current design which is subject to refinement as the proposal progresses.

Table 6-43 Landscape character and visual impact rating matrix (Transport for NSW, 2020h)

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

Relevant legislation, plans and policies

The impact assessment of the proposal on landscape character and visual amenity has been prepared in accordance with:

- *Environment impact assessment practice note: Guideline for landscape character and visual impact assessment* (EIA-N04) (Transport for NSW, 2020h)
- *Beyond the Pavement* (Transport for NSW, 2020c)
- *Landscape Design Guideline* (Roads and Maritime Services, 2018)
- *Bridge Aesthetics* (Transport for NSW, 2019a)
- *Biodiversity Guidelines* (RTA, 2011)
- Austroads Guide to Road Design, relevant Australian Standards and the relevant Transport for NSW supplements.

Landscape character and visual impact study area

The landscape character and visual impact assessment study area is equivalent to the review of environmental factors site investigation area presented in Figure 3-6.

6.11.2 Existing environment

The project is located within the township of Falls Creek in the Shoalhaven local government area, a rural area surrounded by bush scenery. Residential properties are located along the Princes Highway, the Old Princes Highway and Jervis Bay Road. The land surrounding the proposal has a rural character and is dominated by mature native vegetation.

The topography of the site investigation area is primarily flat, gently sloping towards a low area west of the Princes Highway. Views from the road corridor are dominated by bushland on both sides of the Princes Highway and Jervis Bay Road. This vegetation also provides screening to the residences adjacent to the road corridor.

The surrounding land uses are shown in Figure 6-31.

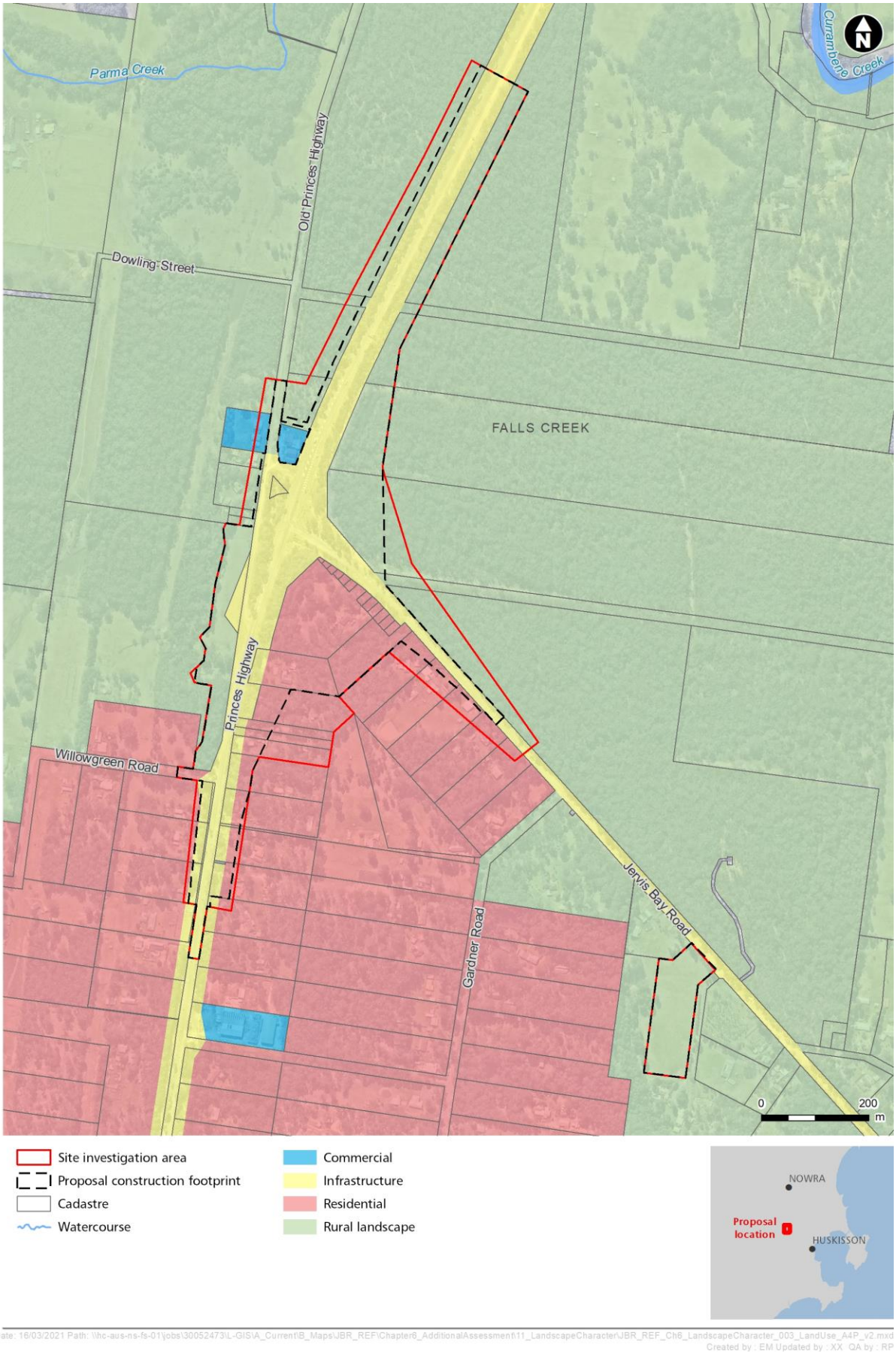


Figure 6-31 Surrounding land use

Landscape character zones

Within and surrounding the site investigation area, three Landscape Character Zones (LCZs) have been identified, as shown in Figure 6-33 and described below.

LCZ 1 - Rural residential

LCZ 1 includes the rural residential properties south of Jervis Bay Road and both sides of the Princes Highway. The properties typically comprise large size lots with mostly single storey residences, with a variety of architectural styles. Most of the properties retain dense stands of native trees which provide some screening to the road corridors and contribute to the scenic quality of the area. The topography of this zone is largely flat, gently sloping to the north-west.

LCZ 2 - Mixed use

LCZ 2 includes the areas west of the Princes Highway, between Willowgreen Road and Dowling Street. It is primarily comprised of smaller lots, which contain either single storey residential dwellings or commercial properties. The character of this zone is more modified than the other two zones, with the properties mostly devoid of vegetation. The topography is mainly flat, sitting lower than the Princes Highway.

LCZ 3 – Bushland

LCZ 3 includes the dense native vegetation between Jervis Bay Road, the Princes Highway and the Old Princes Highway. It contains continuous tree canopy and understorey, which provides an enclosed, high scenic quality to the motorist's experience. The existing vegetation is only interrupted by road infrastructure, unsealed tracks, easements and power lines.

Figure 6-32 Existing intersection context: (A) aerial view of the intersection; (B) Residential property on the Princes Highway within LCZ 1; (C) Commercial and residential properties west of the Old Princes Highway within LCZ 2; (D) Bushland north of Jervis Bay Road within LCZ 3

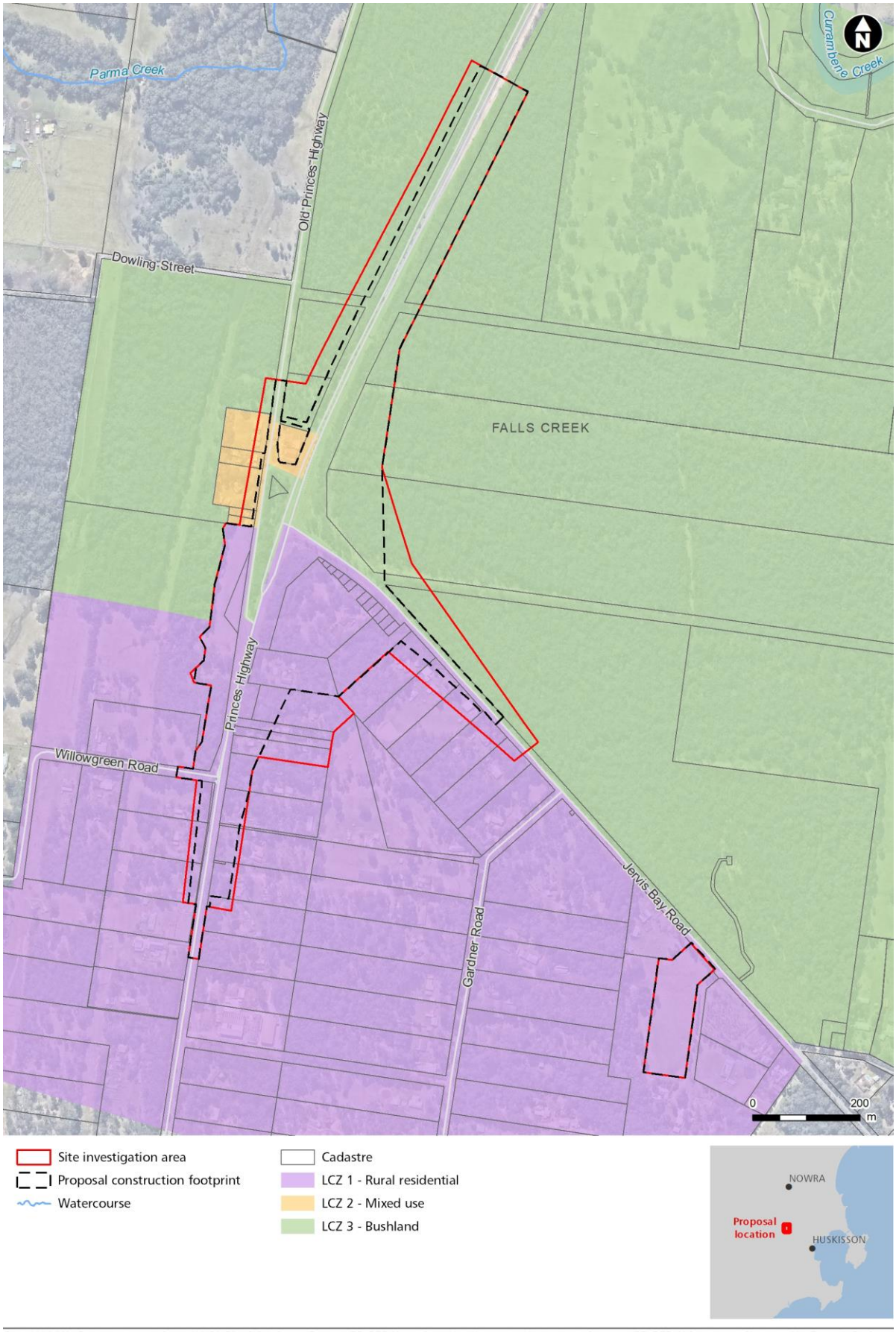


Figure 6-33 Landscape character zones

6.11.3 Potential impacts

Construction

During construction, there would be temporary landscape character and visual impacts. These impacts would include views of large earthmoving and construction equipment, construction activities, stored materials and stockpiles, activities in and around ancillary facilities, vegetation clearing and excavation.

Construction, particularly out of hours work (as identified in Section 3.4.3), would require lighting at ancillary facilities and work areas. These locations could result in light spill impact on adjoining properties. This may result in a visual impact at night, particularly near residences. Safeguards and management measures have been identified for temporary construction works to manage landscape character and visual impacts.

Operation

Landscape character impacts

The proposal would have a high impact on two of the landscape character zones due to vegetation clearing, the introduction of new infrastructure and associated earthworks. The proposal would have a moderate-low impact on one landscape character zone where only small changes to the existing environment are proposed.

Table 6-44 provides an assessment of the magnitude of change as a result of the proposal, the sensitivity of the landscape character zones and the overall landscape character impact the proposal.

A number of urban design and landscape strategies are proposed to minimise potential impacts to landscape character, including:

- The selection of plant species to complement and integrate with existing context, existing plant communities and Shoalhaven Council's suggested species list for Falls Creek
- Fill batters rounded to help integrate into the existing landform and create a more natural appearance
- The design of the abutments of the bridge to complement the existing context and other bridges along Princes Highway
- Maximising planting where reasonable and feasible to reinforce the enclosed, highly scenic quality of the existing environment.

Further safeguards and management measures (as identified in Section 6.11.4) would be implemented to minimise potential landscape character impacts.

Table 6-44 Landscape character impacts

Magnitude of change	Sensitivity of landscape character zone	Landscape character Impact
LCZ 1 – Rural residential		
High magnitude The proposal would introduce new infrastructure and associated earthworks (such as embankments, roundabouts, shared paths, roadside furniture) into the natural, largely unmodified landscape character.	Moderate sensitivity The sensitivity within this zone is considered to be moderate due to the generally attractive rural residential outlook with	High-moderate impact

Magnitude of change	Sensitivity of landscape character zone	Landscape character Impact
The clearance of a large proportion of vegetation would also be required to accommodate the proposal. The proposed changes to this landscape character have resulted in the magnitude of change being assessed as high.	dense native vegetation, particularly at the property boundary.	
LCZ 2 – Mixed use		
Low magnitude The proposal would introduce small changes to this character zone (such as paved areas and minor embankments at connecting road) which has resulted in the magnitude of change being assessed as low.	Moderate sensitivity The sensitivity within this zone is considered to be moderate due to its modified nature and mix of mature vegetation.	Moderate-low impact
LCZ 3 – Bushland		
High magnitude The proposal would introduce new infrastructure and associated earthworks (such as the overpass bridge and mainline realignment, embankments, shard paths, roadside furniture) into the natural, largely unmodified landscape character. The clearance of a large proportion of vegetation would also be required to accommodate the proposal. The proposed changes to this landscape character have resulted in the magnitude of change being assessed as high.	High sensitivity The sensitivity of this area is considered to be high due to the high quality of the bushland setting.	High impact

Visual impacts

There would be moderate to high visual impacts as a result of the proposal. The proposal would be most visible from the properties to the west along Old Princes Highway, including from the commercial properties. The elevated infrastructure of the Jervis Bay Road overpass would be most obvious particularly due to the removal of vegetation associated with the proposed road connecting to Old Princes Highway.

From the eastern and southern sides of the proposal, views from properties would largely be obscured due to the existing vegetation and the relatively flat topography. These properties include the residences along Jervis Bay Road and the proposed access road. Glimpses of the proposal from driveways and between trees would be likely from a number of houses including the two on the western side of Princes Highway on approach to Willowgreen Road. The proposal from the eastern side would be most visible on the approach along Jervis Bay Road.

Four viewpoints have been selected for the purpose of this assessment that represent a range of directions, distances and sensitive receivers within the site investigation area:

- Viewpoint 1 – Commercial property driveway looking south-east
- Viewpoint 2 – Residence along Old Princes Highway looking east
- Viewpoint 3 – Driveway along Jervis Bay Road looking west

- Viewpoint 4 – North-bound along Princes Highway.

The visibility of the proposal and the location of the viewpoints is shown in Figure 6-34.

Table 6-44 provides an assessment of the magnitude of the proposal, the sensitivity of the viewpoints and the overall visual impact the proposal.

A number of urban design and landscape strategies are proposed to minimise potential visual impacts, including:

- Fill batters screened where possible using native shrubs and trees
- Fill batters rounded to help integrate into the existing landform and create a more natural appearance
- Opportunities to reduce steeper embankments (2:1 slope) to integrate into the existing landform and maximise vegetation establishment would be explored
- Variation in planting along the 2:1 embankments to provide visual interest while maintaining a native bushland theme
- Maximising screen planting where feasible and reasonable near to existing residential properties along Old Princes Highway, Jervis Bay Road and the new access also providing a headlight screen
- The re-vegetation of acquired properties and roads from the existing plant community types
- Maximise planting where feasible and reasonable to reinforce the enclosed, highly scenic quality of the existing environment.

Further safeguards and management measures as identified in Section 6.11.4 would be implemented to minimise potential visual impacts. Some of the impacts of the proposal would lessen overtime as the shrubs and trees mature.

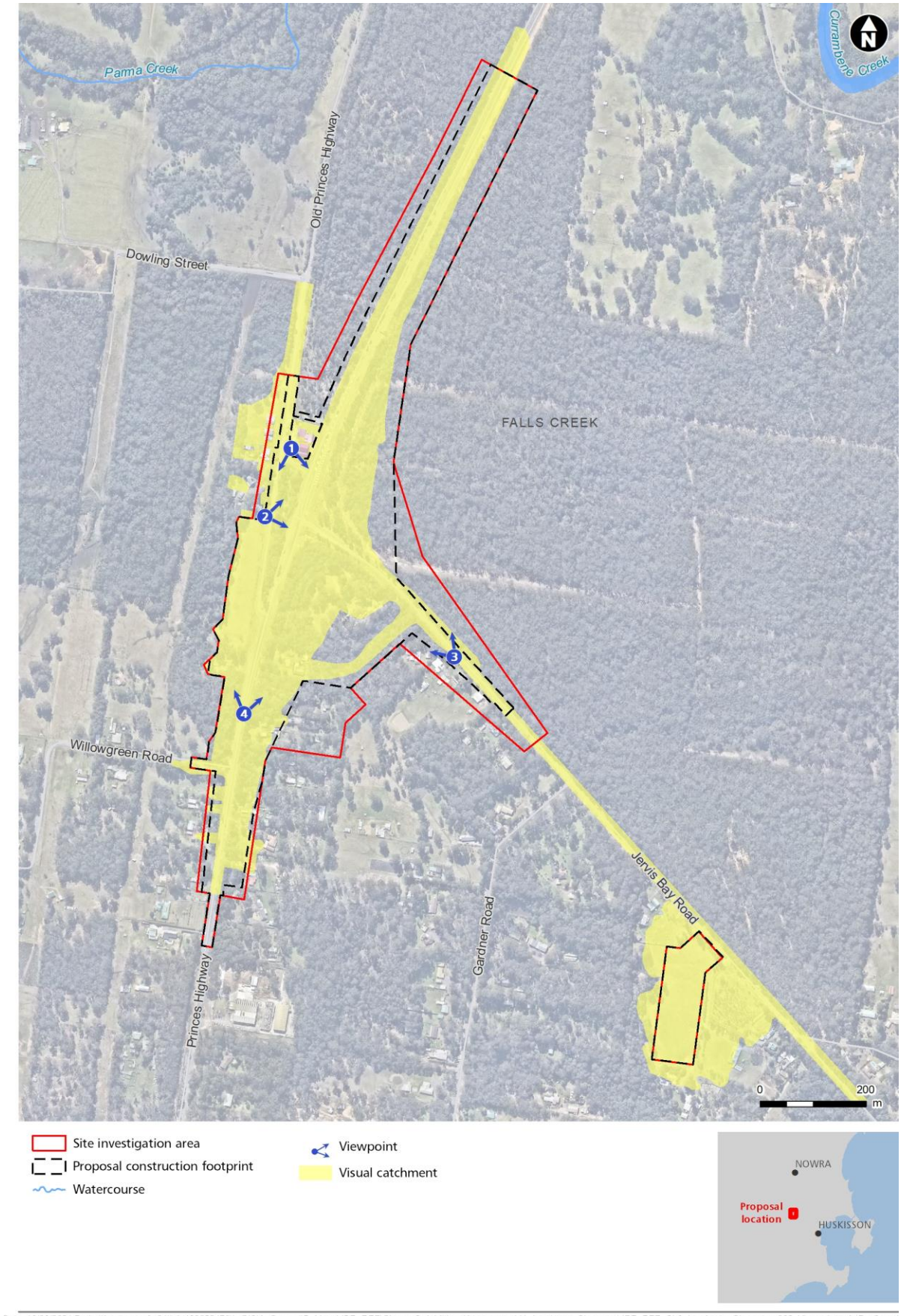
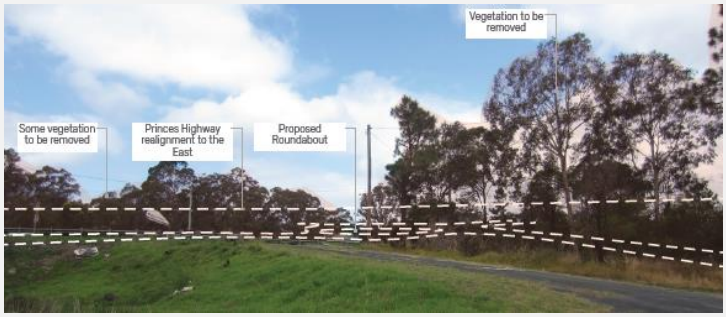
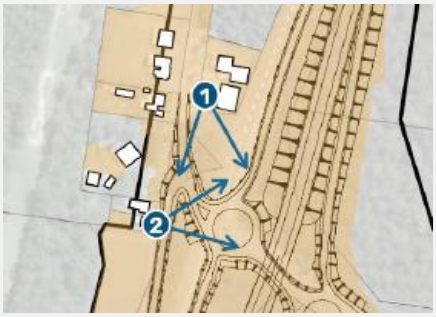
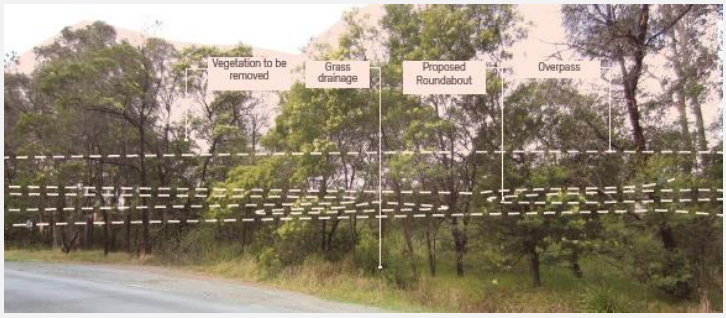
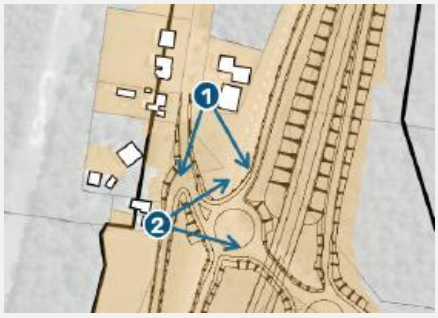
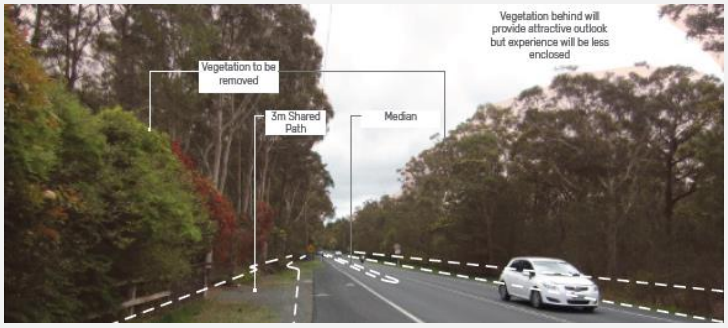


Figure 6-34 Visual catchment and assessment viewpoints

Table 6-45 Visual impacts from select viewpoints

Magnitude of change	Sensitivity of viewpoint	Visual impact
Viewpoint 1 - Commercial property driveway looking south-east		
 		
Moderate magnitude The proposal would introduce a large amount of infrastructure in close proximity (50 to 80 metres) to this viewpoint. The elevated Jervis Bay Road overpass would be about 80 metres away and up to 10 metres high from the existing ground level. Large embankments (2:1 slope), road barriers, traffic and lighting would also be seen from this view. The proposed access road from the roundabout to Old Princes Highway would be shifted about 70 metres to the south and would result in the removal of all vegetation to the right of this view. The shifting of the alignment of Princes Highway to the east would also remove the background vegetation. The existing Princes Highway and access road would require removal and subsequent rehabilitation. The overhead electrical wires would be relocated underground. Revegetation is proposed to mitigate the proposal's impact during the day but also obstruct light glare from headlights at night. The combination of the increased infrastructure and earthworks, as well as the distance to the proposal and revegetation (assuming eight to 10 years maturation) results in the magnitude of change being assessed as moderate.	Moderate sensitivity The commercial property appears to be frequented by many people during the day. It has attractive native vegetation in the mid and backgrounds, however is a modified landscape in the foreground. The combination of these elements and position and frequency of viewers results in the sensitivity of this viewpoint to be considered moderate.	Moderate impact
Viewpoint 2- Residence along Old Princes Highway looking east		
 		
Moderate magnitude The proposal would require the removal of all of the vegetation in this view to accommodate the proposed	High sensitivity The view is dominated by	High-moderate impact

Magnitude of change	Sensitivity of viewpoint	Visual impact
access road from the roundabout and Jervis Bay Road. It would also introduce embankments (2:1 and 4:1), and a large, grassed drainage channel in the fore and mid-grounds about 20 to 40 metres away. The proposed Jervis Bay Road overpass and associated embankments (2:1 slope and up to 10 metres high), road barriers, traffic and lighting would also be seen from this view, about 100 metres away. Some revegetation is proposed to mitigate its impact, however, due to 2:1 embankments of limited space it would be difficult to achieve the existing coverage and subsequent screening from this view. Light glare from headlights at night would also be an issue for the residents in this location and all along Old Princes Highway. The combination of vegetation removal, revegetation (assuming eight to 10 years maturation) and the introduction of significant infrastructure and earthworks in close proximity to this viewpoint, results in the magnitude of change being assessed as moderate.	mature native vegetation and is from a residential property, therefore the sensitivity of this view is considered to be high.	
Viewpoint 3 - Driveway along Jervis Bay Road looking west  		
Moderate magnitude The proposal would introduce a three metre wide shared path along the southern side of Jervis Bay Road, a two metre wide embankment (4:1 slope) and a four metre wide drainage channel to the south of the shared path. This would require about 16 metres to be cleared from the road shoulder on this side which would include a large proportion of the vegetation in this view. These would open some views from the adjacent residential properties particularity where the shrubs are, however some dense mature native vegetation would remain behind that removed in the mid-ground. On the northern side of Jervis Bay Road, about six metres of land from the shoulder would be required to accommodate some minor earthworks and would result in some vegetation loss. As there is dense vegetation behind that to be removed, the view would be similar but more open along the corridor and to the sky.	High sensitivity The view is dominated by mature native vegetation and is representative of the residents' view in this location (closest view possible), therefore the sensitivity of this view is considered to be high.	High-moderate impact

Magnitude of change	Sensitivity of viewpoint	Visual impact
Some planting is proposed where feasible and reasonable to offset the impact of the proposal but would take time to mature. The impact of the vegetation removal, increased infrastructure and minor earthworks results in the magnitude of change being assessed as moderate.		
Viewpoint 4 - North-bound along Princes Highway  		
High magnitude The existing single-lane carriageway would be widened from about 13 metres to 40 metres to accommodate the road connections to and from Jervis Bay Road and the dual carriageway overpass. The overpass would be lifted and large, steep embankments (2:1) would be seen in the mid and background up to 10 metres high. Further east of the existing Princes Highway there would also be a nine metre wide verge, an access road and a large drainage channel increasing the entire intersection footprint to about 70 metres on the eastern side. All of the vegetation on this side would be removed to accommodate the proposal. On the western side minor earthworks (cut), a four metre wide drainage channel and a proposed road connection between Willowgreen Road and Old Princes Highway would be required. About 20 metres from the existing shoulder would be cleared of vegetation in the fore and mid-grounds, as well as the vegetation in the background (verge in the middle of view). There are not many opportunities for revegetation, particularly trees, in this view due to road infrastructure and 2:1 embankments. Due to the extensive infrastructure and the removal of most if not all of the vegetation in this view, the magnitude of change is considered high.	Moderate sensitivity The view is dominated by road infrastructure and dense, mature native vegetation, which provides an attractive enclosed experience for motorists. The combination of elements and motorists being transitory results in the sensitivity being assessed as moderate.	High-moderate impact

6.11.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
LV01 Urban and landscape design	Urban and landscape design inputs into the proposal detailed design will include the following considerations: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls and bridges • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. • Detailed urban and landscape design will be carried out in accordance with relevant guidelines, including: • *Beyond the Pavement* (Transport for NSW, 2020c) • *Landscape design guideline* (Roads and Maritime Services, 2018) • *Bridge Aesthetics* (Transport for NSW, 2019b).	Transport for NSW Contactor	Detailed design Pre-construction	*Beyond the Pavement* (Transport for NSW, 2020c) *Landscape design guideline* (Roads and Maritime Services, 2018) *Bridge Aesthetics* (Transport for NSW, 2019b)
LV02 Vegetation loss	All feasible and reasonable measures will be taken to minimise the loss of existing vegetation along the proposal corridor. Those measures will include	Contractor	Detailed design Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	minimise clearing of trees for construction access and rationalisation of maintenance access.			
LV03 Lighting and signage	Lighting and signage will be installed in accordance with relevant Australian Standards and guidelines, and without reducing the amenity of residential sensitive receivers where feasible and reasonable.	Transport for NSW	Detailed design	
LV04 Planting choice	Incorporate mature screen planting, where space and access is available within the road corridor and road user safety is not compromised, at locations where high-moderate visual impacts have been identified.	Contractor	Detailed design	

6.12 Air quality

This section provides an assessment of the potential impacts of the proposal on air quality and identifies safeguards and management measures to avoid or minimise these impacts.

6.12.1 Methodology

The assessment of the potential construction and operational impacts of the proposal has considered impacts related to the emission of the following pollutants:

- Carbon monoxide (CO)
- Oxides of nitrogen (NO_x)
- Particulate matter (PM_{10} and $PM_{2.5}$)
- Total suspended particulates
- Deposited dust
- Sulfur dioxide (SO_2).

These substances are known to be harmful to human health if the concentration is too high over a particular exposure period. The emissions of SO_2 are directly proportional to the sulfur content of fuel. Given that petrol and diesel in NSW now contain less than 50 parts per million and 10 parts per million of sulfur, respectively, emissions of SO_2 from road vehicles are very low. SO_2 emissions associated with the proposal would therefore be minor, and this pollutant is not considered further in this assessment.

Construction

The main air pollution and amenity considerations during construction are:

- Annoyance due to dust deposition (eg settlement of surfaces at sensitive receivers) and visible dust plumes
- Elevated PM_{10} concentrations due to on-site dust-generating activities
- Increased concentrations of airborne particulate matter and NO_2 due to exhaust emissions from on-site diesel-powered vehicles and construction equipment.

There are other potential impacts of construction activities, such as the release of heavy metals, asbestos fibres or other pollutants during the demolition of certain buildings, or the removal of contaminated soils. Very high levels of settlement can also damage plants and affect the health and diversity of ecosystems (IAQM, 2014).

It is difficult to quantify and model particulate matter emissions from construction activities reliably. Due to the variability of the weather, it is not possible to predict what the weather conditions would be when specific construction activities are carried out. Any effects of construction on airborne particulate matter concentrations would also generally be temporary and relatively short-lived.

A risk-based approach was used for the assessment of construction air quality impacts, which followed the guidance published by the United Kingdom (UK) Institute of Air Quality Management (IAQM, 2014), as described in Appendix K.

Operation

The Transport for NSW Tool for Roadside Air Quality (TRAQ) was used to calculate operational vehicle emissions for the existing (2021) and future (2036) state. TRAQ is linked to the CALINE4 Dispersion Model developed by the California Department of Transportation (Benson, 1989) and uses a conservative approach to estimate pollutant

concentrations near a roadway by considering the interaction between road speed, gradient, traffic mix and traffic volumes for particular road types.

Pollutant concentrations from existing and future traffic were considered for both Jervis Bay Road and the Princes Highway at 10 metres from the kerb as a conservative distance from sensitive receptors to assess compliance with air quality criteria. As there are no sensitive receptors located where potential impacts of both Jervis Bay Road and the Princes Highway would overlap, predicted pollutant concentrations were considered for each road individually.

Relevant legislation, plans and policies

The impact assessment of the proposal on air quality has been prepared in consideration of:

- *Protection of the Environment Operations Act 1997*
- *National Environment Protection Measure for Ambient Air Quality* (NEPC, 2016).

Air quality study area

The air quality study area includes the proposal construction footprint plus a 350 metre buffer around the proposal construction footprint (Figure 6-35).

Air quality criteria

Air quality standards are contained within the *National Environment Protection Measure for Ambient Air Quality* (NEPC, 2016). Criterial relevant to the proposal are summarised in Table 6-46.

Table 6-46 Criteria for relevant air pollutants (NEPC, 2016)

Pollutant	Averaging time	Criteria
Nitrogen dioxide (NO_2)	One hour	246 micrograms per cubic metre ($\mu g/m^3$)
	Annual	62 $\mu g/m^3$
Particulate matter (PM_{10})	24 hours	50 $\mu g/m^3$
	Annual	25 $\mu g/m^3$
Particulate matter ($PM_{2.5}$)	24 hours	25 $\mu g/m^3$
	Annual	8 $\mu g/m^3$
Carbon monoxide (CO)	8 hours	10 milligrams per cubic metre (mg/m^3)

6.12.2 Existing environment

The existing air quality at the study area is generally considered to be good and is mainly influenced by local road traffic and seasonal bushfires. The effects of agriculture and commercial activities surrounding the study area on air quality are considered to be relatively small and localised.

Human receptors

A ‘human receptor’ refers to any location where a person or property may experience the adverse effects of airborne dust or dust settlement, or exposure to PM_{10} over the

averaging time period presented in Table 6-46. There are 53 resident and commercial properties within 350 metres of the proposal construction footprint that are considered to be human receptors (Figure 6-35).

Annoyance effects would most commonly relate to dwellings, but may also refer to other premises such as food manufacturers, amenity areas and horticultural operations (eg soft-fruit production).

Ecological receptors

An 'ecological receptor' refers to any sensitive habitat affected by dust settlement. This includes the direct impacts on vegetation or aquatic ecosystems of dust deposition, and the indirect impacts on fauna.

There are areas within 50 metres of the proposal construction footprint have been considered as ecological receptors (Figure 6-35). To maintain consistency, any areas outside of the site investigation area that were not assessed in the Biodiversity Assessment Report (Appendix F) were considered to have the same level of sensitivity as the adjacent area inside the site investigation area.

Air quality monitoring data

There are no DPIE air quality monitoring stations within the study area. Monitoring data for NO_2, PM_{10} and $PM_{2.5}$ was sourced from the closest air quality monitoring site at Albion Park, about 47 kilometres north of the study area. Monitoring data for CO was sourced from the Wollongong air quality monitoring site, about 68 kilometres north of the study area.

Air quality monitoring data between 2015 and 2019 is displayed in Table 6-47. Recorded pollutant concentrations were below both the one hour and annual average criteria for NO_2, PM_{10}, $PM_{2.5}$ and CO.

Table 6-47 Air quality monitoring data 2015 to 2019 (DPIE, 2020h)

Year	NO_2 (µg/m^3)		PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)		CO (mg/m^3)
	1 hour average	Annual average	24 hour average	Annual average	24 hour average	Annual average	8 hour average
Criteria	246	62	50	25	25	8	10
2015	7.74	6.15	14.00	14	6.14	6.4	0.25
2016	7.75	8.2	14.52	14.9	7.16	7.2	0.25
2017	7.36	8.2	15.57	15.3	6.70	6.6	0.20
2018	8.18	8.2	17.56	17.8	6.68	6.8	0.24
2019	7.82	8.2	18.22	19.5	7.96	8.6	0.26
Median	7.77	7.79	15.97	16.3	6.93	7.12	0.24

A search of the National Pollutant Inventory for the Shoalhaven local government area carried out on 3 December 2020 identified nine air pollution sources during the 2018 to 2019 period (NPI, 2019). The closes identified source of air pollution is a gas import, handling and distribution centre in South Nowra, about 8 kilometres north of the study area, and would be unlikely to influence air quality within the proposal study area.

Climatic conditions

The existing climatic conditions for the project were identified using data published by the Bureau of Meteorology (2020c) collected from the Nowra RAN Air Station Automatic Weather Station (station number 068072), about 5.7 kilometres northwest of the proposal.

Between 2000 and 2020, the annual average maximum and minimum temperatures experienced were 22.5 degrees Celsius and 11.6 degrees Celsius, respectively. On average, January is the hottest month with an average maximum temperature of 27.8 degrees Celsius. July is the coldest month, with average minimum temperature of 6.7 degrees Celsius.

Rainfall data collected between 2000 and 2020 shows that February is the wettest month, with an average rainfall of 145.9 millimetres. The average annual rainfall is 871.9 millimetres.

Between 2000 and 2010, the annual average humidity reading collected at 9 am is 66 per cent, and at 3 pm the annual average is 55 per cent. The months with the highest humidity on average are February and March with a 9 am average of 75 per cent, and the lowest humidity is in August with a 3 pm average of 46 per cent.

Mean monthly wind speeds from 2000 to 2010 is 16.8 kilometres per hour at 9 am and 20.5 kilometres per hour at 3 pm. Wind generally blows in a westerly direction in the morning and an east to southeast direction in the afternoon.

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Figure 6-35 Air quality assessment study area and sensitive human receptors

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Figure 6-36 Air quality sensitive ecological receptors

6.12.3 Potential impacts

Construction

Construction dust impacts

As depicted in Figure 6-35 and Figure 6-36, there are multiple human and ecological receptors within the study area.

The potential dust emission magnitude for each activity type has been categorised as shown in Table 6-48. Earthworks, intersection construction and track out were considered to have the potential for large magnitude of dust emissions. Note assigned magnitude assumes no mitigation measures are in place.

Table 6-48 Dust emission magnitude for the proposal assuming no mitigation

Activity	Dust emission magnitude
Demolition	Small
Earthworks	Large
Intersection construction	Large
Track out	Large

The sensitivity of the study area to dust settlement, human health and ecological impacts is presented in Table 6-49.

The sensitivity to dust settlement and human health impacts is considered medium as about 72 per cent of human receptors are more than 50 metres away from the proposal construction footprint and only about five per cent of human receptors are within 20 metres of the proposal construction footprint.

The sensitivity to ecological receptors is also considered to be medium because of the presence of threatened ecological communities and the presence of threatened flora and fauna habitat and aquatic environments adjacent to the proposal construction footprint.

Table 6-49 Sensitivity of the study area to dust settlement, human health and ecological impacts

Potential impact	Sensitivity of study area			
	Demolition	Earthworks	Intersection construction	Track out
Dust settlement	Medium	Medium	Medium	Medium
Human health	Medium	Medium	Medium	Medium
Ecological	Medium	Medium	Medium	Medium

The risk assessment for each of the dust generating activities is presented in Table 6-50. The risk levels presented on this table assume no mitigation measures are in place.

Table 6-50 Summary of risk assessment assuming no mitigation

Potential impact	Risk[1]			
	Demolition	Earthworks	Intersection construction	Track out
Dust settlement	Low risk	High risk	High risk	High risk
Human health	Low risk	High risk	High risk	High risk
Ecological	Medium risk	High risk	High risk	High risk

Note:

[1] The risk levels presented on this table assume no mitigation measures are in place. Risks would be managed via safeguards and management measures presented in Section 6.12.4.

The study area is considered to have medium to high sensitivity. If unmanaged, the settlement of dust from the proposal construction may impact upon human health and ecological receptors located near the proposal, particularly from earthworks, intersection construction and track out activities.

Provided the implementation of standard dust safeguards and management measures typical of road infrastructure projects, the risk of dust impacts is expected to be low and would be limited to the construction phase only. These measures are presented in Section 6.12.4.

Impacts from construction vehicle and machinery emissions

Emissions from construction vehicles, plant and equipment would be mainly from diesel engines. These engines would emit particulate matter (in the form of soot), and other gaseous emissions such as carbon monoxide, sulphur oxides and nitrogen oxides.

Similar to dust generation, the air quality impacts are considered to be minor as they would be limited to the construction phase only, and would be minimised through the implementation of the safeguards and management measures presented in Section 6.12.4.

Operation

During operation, air pollution would be primarily from vehicle emissions, which does not differ from the existing conditions. The proposal would move some vehicle emission sources above the existing road height due to the grade separated Princes Highway mainline, however the overall changes in air quality would be negligible.

TRAQ was used to assess the operational pollutant concentrations. Predicted pollutant concentrations at 10 metres from the kerb estimated for 2021 (existing road conditions) and 2036 (proposed conditions) is detailed in Table 6-51. This is based on assumed peak period traffic growth of 1.7 per cent per year on the Princes Highway and 2.5 per cent per year on Jervis Bay Road.

For NO_2 and CO, background air quality data is the maximum level recorded, therefore as a result, the cumulative impact provided (ie background plus traffic emissions) is a conservative estimate. The median background levels are considered more appropriate and have been used to assess the cumulative PM_{10} impacts, as regional events are such as dust storms and bushfires can greatly affect PM_{10} levels by short-lived, localised dust generating activities.

Pollutant concentrations were estimated to be below the relevant criteria for NO_2, PM_{10} and CO.

The overall traffic growth would result in an increase of emissions, however this would already occur without the proposal. The increase in efficiency at the intersection and reduced congestion as a result of the proposal would result in a reduction in emissions associated with wait times along Jervis Bay Road during peak periods. The estimate of future emissions does not include changes in fuel efficiency or type of vehicle fuel used. Anticipated future improvements in fuel efficiency and vehicle type may further reduce emissions throughout the transport system in NSW in the longer term.

Table 6-51 Predicted pollutions concentrations 10 metres from the kerb in 2021 and 2036

Pollutant		Criteria	Jervis Bay Road				Princes Highway			
			2021		2036		2021		2036	
			Existing road	Cumulative (including background)	Proposal	Cumulative (including background)	Existing road	Cumulative (including background)	Proposal	Cumulative (including background)
NO_2 ($\mu g/m^3$)	1 hour average	246	76.7	88.2	59.7	71.2	26.3	37.8	17.7	29.2
	Annual average	62	15.3	19.9	11.9	16.5	5.3	9.9	3.5	8.1
PM_{10} ($\mu g/m^3$)	24 hour average	50	22.6	43.6	25.6	46.6	7.6	28.6	7.7	28.7
	Annual average	25	9	22.1	10.3	23.4	3	16.1	3.1	16.2
CO (mg/m^3)	8 hour average	10	1.2	1.9	1.7	2.4	0.5	1.2	0.7	1.4

6.12.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
AQ01 Construction air quality management	A Construction Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include: • Identification of potential risks/impacts due to the work/activities as dust generation activities • Management measures to minimise risk of dust generation associated with earthworks and other activities that disturb the ground surface, stockpiles and haulage routes • A process for monitoring dust on-site • A process for altering management measures as required and reprogramming construction activities if the safeguards and management measures do not adequately restrict dust generation. Dust and air quality complaints will be managed in accordance with the overarching complaints handling process for the proposal. Appropriate corrective actions will be taken to reduce emissions in a timely manner.	Contractor	Pre-construction Construction	
AQ02 Dust emissions	Progressive rehabilitation of disturbed areas will be carried out where feasible and reasonable to minimise soil exposure.	Contractor	Construction	

6.13 Climate change and sustainability

This section provides an assessment of the potential impacts of the proposal on climate change due to the release of greenhouse gas emissions, and an assessment of the potential impacts of climate change upon the proposal. It provides an assessment of sustainability initiatives associated with the proposal. This section also identifies safeguards and management measures to avoid or minimise these impacts.

6.13.1 Methodology

Climate change impact assessment

The methodology applied for the climate change impact assessment follows the approach presented in the *Technical Guide for Climate Change Adaptation for the State Road Network* (Road and Maritime Services, (unpublished, 2015). Use of this technical guide ensures a consistent approach to climate risk assessment and adaption across the wider Transport for NSW road network. In addition to the technical guide, Transport for NSW currently operates under the *Transport for NSW Climate Risk Assessment Guidelines* (Transport for NSW, 2019c).

The assessment approach and key tasks are summarised in Figure 6-37.

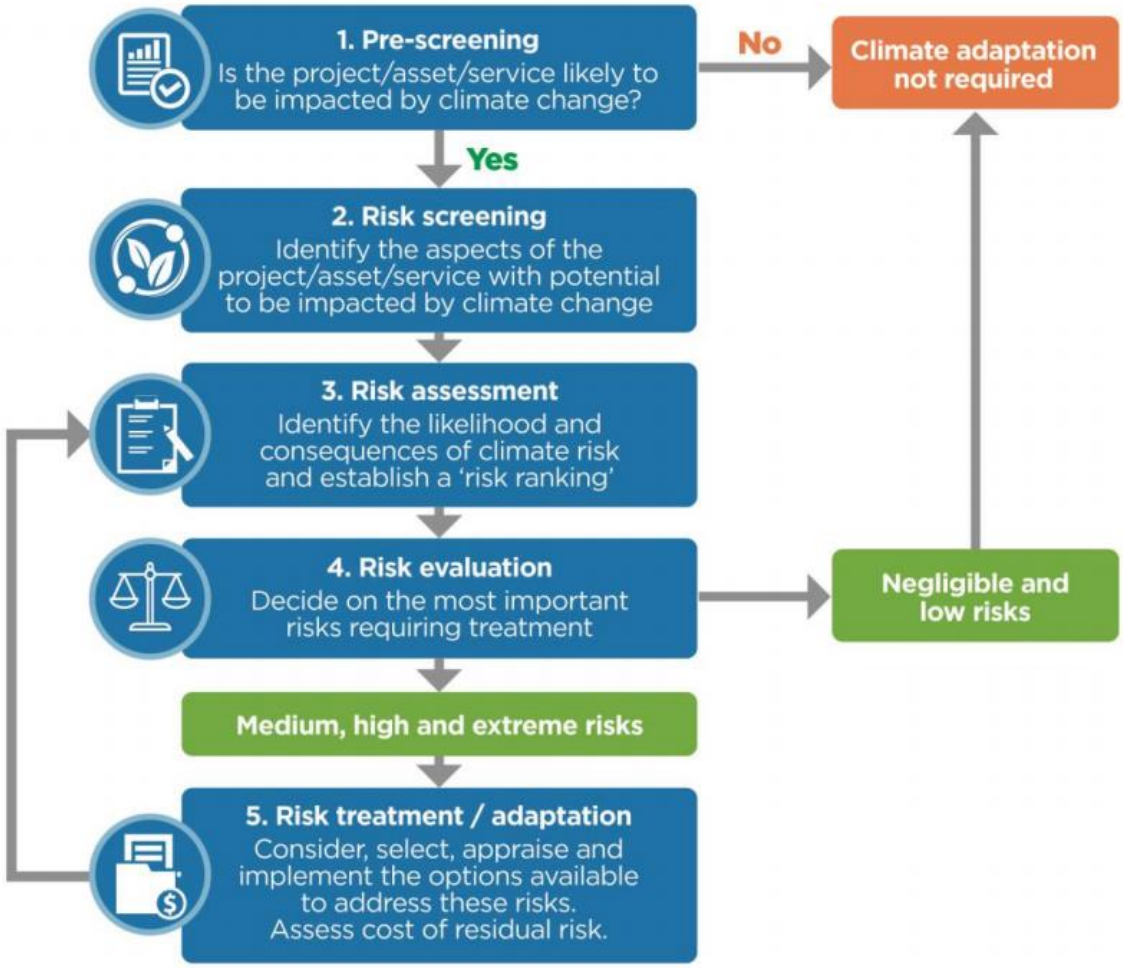

Figure 6-37 Climate change risk assessment approach (adapted from Roads and Maritime Services, [unpublished, 2015])

Greenhouse gas emissions assessment

Transport for NSW (formerly Roads and Maritime Services) in collaboration with other state (and New Zealand) transport authorities, released the *Greenhouse Gas Assessment Workbook for Road Projects* (Transport Authorities Greenhouse Group, 2013) to help standardise greenhouse gas assessments of road construction projects. The workbook was prepared to estimate the greenhouse gas emissions associated with construction, operation (not including traffic usage) and maintenance stages of road projects. The methodology outlined in the workbook formed the basis for this greenhouse gas assessment.

Emissions were categorised into three different categories, known as scopes, to help differentiate between direct emissions from sources that are owned or controlled by the proposal, and indirect emissions that are a consequence of proposal activities, but which occur at sources owned or controlled by another entity. The three scopes are:

- Scope 1 emissions – direct greenhouse gas emissions into the atmosphere as a result of the proposal such as from plant and equipment using fuel
- Scope 2 emissions – indirect greenhouse gas emissions into the atmosphere from the consumption of energy such as electrical lighting
- Scope 3 emissions – other indirect emissions (not included in scope 2) due to upstream or downstream activities such as emissions associated with road users or the embodied energy within a material used to construct the proposal.

The greenhouse gas emissions from construction of the proposal were estimated using the *Carbon Gauge Greenhouse Gas Calculator for Roads Projects* (Carbon Gauge), including emissions associated with fuel consumed during construction by machinery, transport of materials and removal of vegetation.

For emissions generated by road users during operation, *Tools for Roadside Air Quality* (TRAQ) was used. TRAQ is a tool for modelling emissions from vehicles, using input data on traffic numbers and type, average traffic speeds, numbers of lanes and standard emissions factors for road going vehicles. TRAQ was used to calculate emissions associated with current and future operational road use. Greenhouse gas emissions modelled using TRAQ took into account:

- The expected mix of road users (vehicle types)
- Average number of vehicles
- Length of road
- Traffic speeds
- Surface roughness
- Road gradient.

Sustainability assessment

Transport for NSW is committed to ensuring socially and environmentally beneficial transport outcomes by embedding sustainable initiatives into transport infrastructure to address the impacts of climate change.

A high-level assessment of sustainability initiatives associated with the proposal has been carried out in consideration of the Transport for NSW *Environmental Sustainability Strategy 2019-2023* (Roads and Maritime Services, 2019).

6.13.2 Existing environment

Climate change

Climate change is the general term used to refer to the altering of climatic conditions over long periods of time (ie from years to centuries) associated with the accumulation of greenhouse gases in the atmosphere.

The existing climatic conditions for the project were identified using data published by the Bureau of Meteorology (2020c) collected from the Nowra RAN Air Station Automatic Weather Station (station number 068072), about 5.7 kilometres northwest of the proposal, and supplemented by data published by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Grose *et al.,* 2015; CSIRO 2016). Data from the Nowra RAN Air Station Automatic Weather Station was used and is considered to be representative of the current conditions applicable to the proposal.

Climate model projections were identified using data published by CSIRO and accessed through the Climate Futures Tool (2016). The Climate Futures Tool presents a comprehensive set of projections for a range of climate variables and therefore was considered to be a complete and appropriate data source for use in this assessment.

Table 6-52 presents projected changes in each climate variable, with the adoption of a high-emission Representative Concentration Pathway (RCP) 8.5 scenario (representative of a continual rise in emissions throughout the 21st century), for the short (2030), medium (2070) and long (2090) term. The projected climate change includes an increase in both maximum and minimum temperatures, with an increase of more than four degrees Celsius by 2090. Extreme temperature days (ie above 35 and 40 degrees Celsius) and bushfire days are also predicted to increase.

Table 6-52 also shows annual rainfall would likely decrease which, when combined with increased temperatures could result in drier conditions and increased bushfire risk. While an overall annual decrease of rainfall is anticipated, seasonal fluctuations would likely become more extreme and could result in increased risk of flooding or sediment runoff impacts.

Table 6-52 Climate change projections (RCP 8.5 scenario)

Climate variable	Baseline and year	2030	2070	2090
Average annual temperature change (degrees Celsius)	Mean minimum: 11.6 (2000-2020)[1]	+1.0	+3.0	+4.3
	Mean maximum: 22.4 (2000-2020)[1]	+1.1	+3.2	+4.6
Average rainfall change (percentage change)				
• **Annual**	871.8 millimetres (2000-2020)[1]	-1.9	-0.2	-5.5
• **Spring**	178.7 millimetres (2000-2020)[1]	-16.2	-8.0	-25.5
• **Summer**	283.5 millimetres (2000-2020)[1]	+21.7	+9.4	+30.5
• **Autumn**	219.1 millimetres (2000-2020)[1]	-13.8	-0.5	-7.3
• **Winter**	258.8 millimetres (2000-2020)[1]	-9.8	-2.7	-27.2

Climate variable	Baseline and year	2030	2070	2090
Extreme temperature (change in number of days)	2.6 days per year with a daily temperature above 35 degrees Celsius (1981-2010)[2]	Additional 1.2 days above 35 degrees Celsius	Additional 8.9 days above 35 degrees Celsius	Additional 14.5 days above 35 degrees Celsius
	0.2 days per year with a daily temperature above 40 degrees Celsius (1981-2010)[2]	Additional 0.1 days above 40 degrees Celsius	Additional 0.8 days above 40 degrees Celsius	Additional 1.7 days above 40 degrees Celsius
Bushfire weather (number of days)	0.9 severe fire days (1995)[3]	1.2 severe fire days	Data not available[3]	2.6 severe fire days
Average daily wind speed (percentage change)	17.2 kilometres per hour (2000-2010)[4]	-0.4	-0.7	-0.7

Notes:

[1] 2000-2020 are the years of operation of the Nowra RAN Air Station Automatic Weather Station.
[2] 1981-2010 are the baselines years provided by the CSIRO Climate Futures Tool.
[3] 1995 is the baseline year provided by the CSIRO in the Southern Slopes Cluster Report (2015). Projections of the number of severe fire danger days were only made for 2030 and 2090.
[4] Bureau of Meteorology (2020) data available for 2000-2010 only.

Greenhouse gas

The Australian National Greenhouse Gas Accounts *National Inventory Report 2018* (Department of Industry, Science, Energy and Resources, 2020a) and *State and Territory Greenhouse Gas Inventories 2018* (Department of Industry, Science, Energy and Resources, 2020b) provides an overview of the latest available estimates of greenhouse gas emissions at a national and state level.

Australia's total greenhouse gas emissions were estimated to be 537.4 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 2018. NSW accounted for 24.5 per cent (131.7 Mt CO_2-e) of these emissions. The transport sector accounted for 18.8 per cent (100.8 Mt CO_2-e) of total greenhouse gas emissions nationally and about 21.8 per cent (28.7 Mt CO_2-e) of total greenhouse emissions in NSW. About 85 per cent of the Australian transport sector and 85 per cent of the NSW transport sector was attributable to road transportation in 2018.

Greenhouse gas emissions for the existing road network in the vicinity of the proposal, including the Princes Highway and Jervis Bay Road, were modelled using TRAQ to identify the emissions currently produced within the context of the proposal. The TRAQ modelling indicated that annual greenhouse gas emissions from vehicle use for 2020 in the existing road network at the site investigation area would be about 10,511 tonnes of carbon dioxide equivalent (t CO_2-e). Significant queuing along Jervis Bay Road during peak periods would also contribute additional greenhouse gases.

Sustainability

Transport for NSW are committed to integrating sustainability initiatives into core business activities and deliver key achievements. The *Environmental Sustainability Strategy 2019–2023* (Roads and Maritime Services, 2019) identifies 10 focus areas that address the important environmental sustainability aspects associated with the Transport for NSW's activities, and allows for consideration of the impacts of how we plan, deliver, operate, maintain and regulate NSW's road and maritime networks. The objectives of each focus area are outlined in Table 6-53.

Table 6-53 Environmental Sustainability Strategy 2019-2023 (Roads and Maritime Services, 2019) focus areas and objectives

Focus area	Objective
Energy and carbon management	Minimise energy use and reduce carbon emissions without compromising the delivery of services to our customers.
Climate change resilience	Design and construct transport infrastructure to be resilient or adaptable to climate change impacts.
Air quality	Minimise the air quality impacts of road projects and support initiatives that aim to reduce transport-related air emissions.
Resource and waste management	Minimise the use of non-renewable resources and minimise the quantity of waste disposed to landfill.
Pollution control	Minimise noise, water and land pollution from road and maritime construction, operation and maintenance activities.
Biodiversity	Improve outcomes for biodiversity by avoiding, mitigating or offsetting the potential impacts of road and maritime projects on plants, animals and their environments.
Heritage – Aboriginal and non-Aboriginal	Manage and conserve cultural heritage according to its heritage significance and contribute to the awareness of the past.
Liveable communities	Provide high quality urban design outcomes that contribute to the sustainability and liveability of communities in NSW.
Sustainable procurement	Procure goods, services, materials and works for infrastructure development and maintenance projects that over their lifecycle deliver value for money and contribute to the environmental, social and economic wellbeing of the community.
Corporate sustainability	Communicate our sustainability objectives to employees, contractors and other key stakeholders, and foster a culture which encourages innovative thinking to address sustainability challenges.

6.13.3 Potential impacts

Construction

Climate change

Potential impacts of climate change are expected to be minimal due to the relatively short timeframe of the construction phase of the project, as described in Section 3. For this reason, a risk assessment for the construction phase of the proposal is not warranted.

Transport for NSW standard risk management controls carried out during construction would be sufficient to manage any risk associated with current climatic conditions.

Greenhouse gas

Construction emissions associated with the proposal would result from the following:

- Vegetation clearing and decomposition of green waste
- Consumption of electricity from fossil fuel sources
- Consumption of fuel and direct exhaust emissions through use of plant and equipment
- Production and use of construction materials that have a high embodied energy content.

The estimated construction greenhouse gas emissions are provided in Table 6-54. The total greenhouse gas emissions for construction activities is estimated to be 403,616 tonnes of carbon dioxide equivalent (tCO_2-e).

Scope 3 emissions account for the majority (98.7 per cent) of construction related emissions, with the largest proportion of this coming from transport of materials to site. A total of 1.2 per cent of emissions come from plant and equipment that consume fossil fuels (scope 1 emissions). Vegetation removal accounts for less than one per cent of the proposal's construction emissions.

Table 6-54 Annual greenhouse gas emissions by emission source and scope - construction

Summary of activities	Scope 1 (tCO2-e per year)	Scope 2 (tCO2-e per year)[1]	Scope 3 (tCO2-e per year)	Total (tCO2-e per year)	Percentage of total emissions
Site offices / General areas	555	-	42	597	0.15
Demolition and earthworks	1,898	-	145	2,043	0.51
Vegetation removal	1,232	-	-	1,232	0.31
Construction of pavements	535	-	2,663	3,198	0.79
Construction of structures	78	-	836	914	0.23
Construction of drainage	672	-	655	1,327	0.33
Construction of road furniture	12	-	434	446	0.11
Transport of materials to site	-	-	393,859	393,859	97.58
Total	4,982	-	398,634	403,616	100

Note:

[1] The Carbon Gauge calculator assumes all construction phase energy is from diesel sources such as generators. For this reason, there are no scope 2 emissions from electricity use. The comparative greenhouse gas emissions between diesel fuel and electricity is a factor of about 3.5, with higher emissions associated per unit of grid electricity. Therefore, if electricity was available for site offices, this would result in about a two per cent increase in total scope 1 and 2 emissions.

Sustainability

Sustainability initiatives outlined in the Environmental Sustainability Strategy 2019-2023 (Roads and Maritime Services, 2019) that have been considered for the proposal construction stage are presented in Table 6-55.

Table 6-55 Environmental Sustainability Strategy 2019-2023 (Roads and Maritime Services, 2019) initiatives considered for construction

Focus area	Objective	Construction initiatives
Energy and carbon management	Minimise energy use and reduce carbon emissions without compromising the delivery of services to our customers.	Investigate the feasibility of using alternative materials with low embodied carbon (eg using recycled aggregates in road pavement and surfacing) during detailed design.

Focus area	Objective	Construction initiatives
		Investigate the use of energy efficient or low emission plant and equipment during construction. Turn off construction plant and equipment when not in use to limit electricity use and consumption of fuel.
Climate change resilience	Design and construct transport infrastructure to be resilient or adaptable to climate change impacts.	Climate change impacts have been considered within this section.
Air quality	Minimise the air quality impacts of road projects and support initiatives that aim to reduce transport-related air emissions.	Construction air quality impacts and management measures are discussed in Section 6.12. Best practice air emission control methodologies would be applied.
Resource and waste management	Minimise the use of non-renewable resources and minimise the quantity of waste disposed to landfill.	Construction resource and waste impacts and management measures are discussed in Section 6.14. Excavated material will be beneficially reused on site where suitable. Construction planning and staging would consider cut and fill requirements to minimise the generation of excess spoil. Green waste would be mulched (where not contaminated by weeds) and beneficially reused for the proposed landscaped areas where suitable.
Pollution control	Minimise noise, water and land pollution from road and maritime construction, operation and maintenance activities.	Potential construction pollution impacts and management measures are discussed in Sections 0, 6.6 and 6.7. An environmental management system would be maintained throughout construction of the proposal to ensure activities have the smallest possible pollution impact, meet acceptable community standards and comply with all statutory requirements. Construction noise will be managed in accordance with relevant guidelines, as well as proposal-specific measures.
Biodiversity	Improve outcomes for biodiversity by avoiding, mitigating or offsetting the potential impacts of road and maritime projects on plants, animals and their environments.	Biodiversity impacts and management measures are discussed in Section 6.5 and Appendix F. The preferred option adopted for the proposal has less vegetation clearing to the west of the Princes Highway, where the largest and highest condition patches of the TEC Illawarra Lowlands Grassy Woodland is present, compared to other options considered. Direct impacts on clearing of native vegetation and habitat associated with the proposal have also been minimised by:

Focus area	Objective	Construction initiatives
		• Locating two ancillary facilities in areas where there are limited biodiversity values (ie within areas mapped as exotic grassland) • Provisioning the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat within the proposal construction footprint. Safeguards and management measures would be implemented to avoid the spread of weeds, pests and diseases.
Heritage – Aboriginal and non-Aboriginal	Manage and conserve cultural heritage according to its heritage significance and contribute to the awareness of the past.	Potential Aboriginal and non-Aboriginal heritage impacts and management measures are discussed in Sections 6.9 and 6.10. Construction of the proposal would impact one Aboriginal heritage site of low significance, which would be managed in accordance with relevant guidelines and in consultation with the local Aboriginal community. No known items of non-Aboriginal heritage significance would be impacted by the construction of the proposal.
Liveable communities	Provide high quality urban design outcomes that contribute to the sustainability and liveability of communities in NSW.	Transport for NSW's commitment to providing high quality urban design outcomes is described in Table 6-57.
Sustainable procurement	Procure goods, services, materials and works for infrastructure development and maintenance projects that over their lifecycle deliver value for money and contribute to the environmental, social and economic wellbeing of the community.	Transport for NSW would consider implementation of sustainable procurement initiatives where feasible and reasonable at the construction phase, such as: • Ensuring tenders include relevant environmental and social responsibility and sustainability outcomes • Monitoring supply chain to identify and address issues related to poor labour practices • Supporting local suppliers to minimise haulage distances of construction materials.
Corporate sustainability	Communicate our sustainability objectives to employees, contractors and other key stakeholders, and foster a culture which encourages innovative thinking to address sustainability challenges.	Transport for NSW would consider implementation of corporate sustainability initiatives where feasible and reasonable at the construction phase, such as: • Segregating waste and recycling where possible • Ensuring environment and sustainability is incorporated into inductions to increase employee awareness.

Operation

Climate change

The pre-screening assessment determined that the proposal has the potential to be impacted by climate change due to:

- Local topography, including existing flooding characteristics within the site investigation area
- Presence of dense vegetation on bushfire prone land surrounding the proposal
- The design life of the proposal's key components (such as bridges, which have a design life of about 100 years).

Potential operational climate change risks identified for the proposal (rated moderate or high before mitigation) and associated potential adaptation measures are presented in Table 6-56. Additional opportunities to incorporate adaptation measures into the design will be considered in the detailed design stage of the proposal.

Table 6-56 Operational climate change risks and adaptation options

Risk scenario	Risk rating	Adaptation options	Residual risk rating
Increased frequency and intensity of rainfall			
Increased frequency and intensity of extreme rainfall leading to increased scour of embankments resulting in increased likelihood of landslips causing damage to infrastructure.	Moderate	Detailed design would consider inclusion of measures to reduce velocity and volume of stormwater flows to reduce potential impact of scour. All trafficked surfaces would be sealed, cleared areas that would be landscaped and scour protection would be installed as required.	Low
Increased frequency and intensity of extreme rainfall leading to higher frequency of flooding resulting in overtopping of the road and loss of infrastructure service.	High	Stormwater infrastructure has been designed to ensure flood immunity for the proposal up to and including the one per cent AEP flood event. Flood immunity would be maintained on the Princes Highway with implementation of the proposal under the climate change scenario (as discussed in Section 6.7).	Moderate
Increased frequency and intensity of extreme rainfall leading to increased number of road and/or cyclist accidents resulting in health and safety risk to road and shared path users.	High	Variable messaging signs would be used to display messages warning drivers of changes in weather and traffic conditions as required.	High
Increased average and extreme temperatures			
Increased average temperature, and increased frequency and intensity of extreme heat, leading to greater material degradation (eg thermal expansion of joints and paved surfaces, melting or rutting asphalt) resulting in increased maintenance / replacement burden.	High	Detailed design would consider the full range of potential temperature extremes on the proposal (particularly bridge structures) which may occur as a result of climate change and choose materials able to withstand heat, to minimise the likelihood of infrastructure failures.	Moderate
Increased average temperature, and increased frequency and intensity of extreme heat, leading to adverse health impacts for maintenance workers and	Moderate	The design aims to minimise the need for maintenance and proposes an integral bridge structure that removes bearings and expansion joints (ie elements that would need to be inspected frequently).	Low

Risk scenario	Risk rating	Adaptation options	Residual risk rating
potential health and safety incidents for road and shared path users.		An adaptive management approach would be applied to workplace health and safety planning, including the use of any Transport for NSW work health and safety procedures. Examples of potential work health safety practices may include stop work protocols for extreme heat days, or increased training and education for personnel about health and safety procedures during periods of extreme heat.	
Increased frequency and intensity of bushfires			
Increased frequency and severity of bushfires leading to reduced visibility due to smoke, resulting in road users being unable to view signs, signals and other vehicles, and potential health and safety incidents.	Moderate	Variable messaging signs would be used to display messages warning drivers of changes in weather and traffic conditions as required.	Moderate
Increased frequency and severity of bushfires leading to smoke generation, resulting in health effects for maintenance workers and road users, and potential health and safety incidents.	Moderate	An adaptive management approach would be applied to workplace health and safety planning, including the use of any Transport for NSW work health and safety procedures. Variable messaging signs would be used to display messages warning drivers of changes in weather and traffic conditions as required.	Low
Increased frequency and severity of bushfires leading to road closures, resulting in restricted access and increased congestion for road users and emergency vehicles.	Moderate	Variable messaging signs would be used to display messages warning drivers to avoid the area as required. The proposal's grade separated through alignment and dual at grade roundabouts would reduce congestion at the intersection.	Moderate

Greenhouse gas

Activities that would generate greenhouse gas emissions during operation of the proposal include:

- Use of electricity (for street lighting, electronic signage, variable message signs and any other signalling and communication requirements)
- Maintenance of road infrastructure and pavement, including fuel use for the operation of maintenance equipment
- Use of the intersection by vehicles.

Annual use of electricity would result in Scope 2 and Scope 3 greenhouse gas emissions. The predicted total greenhouse gas emissions associated with the use of electricity during operations of the project were estimated to be 97 tCO2-e per year.

Ongoing maintenance of the proposal would result in the use of materials and the combustion of fuel (eg associated with the use of maintenance vehicles and machinery and equipment). Emission estimates for the use of fuel and materials are based on the replacement of five per cent of the asphalt road surface every 50 years, in accordance with the Carbon Gauge assessment method, with only the top layer requiring replacement. The use of fuel and materials to carry out maintenance activities were estimated to generate about 3,440 tCO2-e over a 50 year maintenance assessment period.

Fuel combustion by future road users would generate the greatest amount of greenhouse gas during operation of the proposal. By 2036, the annual greenhouse gas emissions from vehicle at the site investigation area would increase about 2,087 t CO_2-e from existing conditions. This is based on assumed peak period traffic growth of 1.7 per cent per year on the Princes Highway and 2.5 per cent per year on Jervis Bay Road.

Traffic growth is anticipated in the region with or without the proposal, therefore anticipated increased emissions would not occur directly as a result of the proposal. While this overall traffic growth would result in an increase of greenhouse gas, the increase in efficiency at the intersection and reduced congestion as a result of the proposal would result in a reduction in greenhouse gases associated with wait times along Jervis Bay Road during peak periods.

The estimate of future traffic greenhouse gas emissions does not include changes in fuel efficiency or type of vehicle fuel used. Anticipated future improvements in fuel efficiency and vehicle type may further reduce greenhouse gas emissions throughout the transport system in NSW in the longer term.

Sustainability

Sustainability initiatives that would be implemented during operation of the proposal are described in Table 6-57.

Table 6-57 Operational sustainability initiatives

Focus area	Objective	Operational initiatives
Energy and carbon management	Minimise energy use and reduce carbon emissions without compromising the delivery of services to our customers.	The proposal would efficiently integrate with the existing road transport network, allowing more efficient movement and access for heavy and light vehicles. This, in turn, would have a positive impact on fuel consumption. Operation lighting would be LEDs, in accordance with relevant Australian Standards and guidelines. Transport would investigate the feasibility of using alternative materials with low embodied carbon (eg

Focus area	Objective	Operational initiatives
		using recycled aggregates in road pavement and surfacing) during detailed design.
Climate change resilience	Design and construct transport infrastructure to be resilient or adaptable to climate change impacts.	Transport for NSW's response to climate change impacts have been considered within this section.
Air quality	Minimise the air quality impacts of road projects and support initiatives that aim to reduce transport-related air emissions.	Operational air quality impacts and management measures are discussed in Section 6.12. The increase in efficiency at the intersection and reduced congestion as a result of the proposal would result in a reduction in emissions associated with wait times along Jervis Bay Road during peak periods. Anticipated future improvements in fuel efficiency and vehicle type may further reduce emissions throughout the transport system in NSW in the longer term.
Resource and waste management	Minimise the use of non-renewable resources and minimise the quantity of waste disposed to landfill.	The proposal would not result in waste streams or potential waste impacts additional to the current state.
Pollution control	Minimise noise, water and land pollution from road and maritime construction, operation and maintenance activities.	Potential operational pollution impacts and management measures are discussed in Section 0, Section 6.6 and Section 6.7. An environmental management system would be maintained throughout operation of the proposal to ensure activities have the smallest possible pollution impact, meet acceptable community standards and comply with all statutory requirements. At property treatments would be considered at specific noise-sensitive receivers during detailed design. Potential operational soil contamination impacts would be managed via the existing Princes Highway emergency response procedures. The proposal operational design includes water quality treatment measures that surpass pollution reduction targets.
Biodiversity	Improve outcomes for biodiversity by avoiding, mitigating or offsetting the potential impacts of road and maritime projects on plants, animals and their environments.	Biodiversity impacts and management measures are discussed in Section 6.5 and Appendix F. Biodiversity offsets would be managed in accordance with the *Guideline for Biodiversity Offsets* (Roads and Maritime Services, 2016d).
Heritage – Aboriginal and non-Aboriginal	Manage and conserve cultural heritage according to its heritage significance and contribute to the awareness of the past.	Operation of the proposal would not result in impacts to Aboriginal or non-Aboriginal heritage.

Focus area	Objective	Operational initiatives
Liveable communities	Provide high quality urban design outcomes that contribute to the sustainability and liveability of communities in NSW.	The *Beyond the Pavement* (Transport for NSW, 2020c) policy has been applied to the design of the proposal to ensure the infrastructure fits sensitively with the built, natural, community and cultural environment in which is it situated. The proposal provides sustainable social outcomes for the community, including ensures accessibility and connectivity are improved through provisions for all modes of movement (vehicle, walking, cycling and public transport), to support the health and liveability of current and future communities. The proposal would also provide the opportunity for increased intersection resilience for responding to emergency situations, therefore increasing the adaptive capacity and resilience of local communities.
Sustainable procurement	Procure goods, services, materials and works for infrastructure development and maintenance projects that over their lifecycle deliver value for money and contribute to the environmental, social and economic wellbeing of the community.	Transport for NSW would consider implementation of sustainable procurement initiatives where feasible and reasonable, as described in Table 6-55.
Corporate sustainability	Communicate our sustainability objectives to employees, contractors and other key stakeholders, and foster a culture which encourages innovative thinking to address sustainability challenges.	Transport for NSW would consider implementation of corporate sustainability initiatives where feasible and reasonable at the construction phase, as described in Table 6-55.

6.13.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
CC01 Climate change	Detailed design will incorporate adaptation measures for all climate change risks with an original risk rating of moderate or above. These will include but not be limited to: • Consideration of the full range of potential temperature extremes on the proposal (particularly bridge structures) which may occur as a result of climate change and consider material	Contractor	Detailed design	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	capacity to withstand heat during material type selection to minimise the likelihood of infrastructure failures • Consideration of energy dissipation at culvert outlets when velocities exceed existing magnitudes to reduce potential impact of scour.			
CC02 Greenhouse gas emissions	Fuel efficient plant, equipment and vehicles will be selected for use during construction where feasible and reasonable. Construction plant and equipment will be well maintained to maximise fuel efficiency.	Contractor	Construction	
CC03 Greenhouse gas emissions	The procurement of goods and services will consider goods and services that: • Are from local suppliers • Make use of recycled materials or materials with a low embodied energy content • Are energy efficient or have low embodied energy • Minimise the generation of waste.	Contractor	Construction	
CC04 Sustainability	Sustainability initiatives will be considered throughout detailed design, construction and operation of the proposal in accordance with the *Environmental Sustainability Strategy 2019–2023* (Roads and Maritime Services, 2019).	Transport for NSW	Detailed design Construction Operation	Environmental Sustainability Strategy 2019–2023 (Roads and Maritime Services, 2019)

6.14 Waste

Transport for NSW is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act 2001*. These resource management hierarchy principles, in order of priority, are:

- Avoidance of unnecessary resource consumption in operations, maintenance, construction and management
- Resource recovery (including reuse, reprocessing, recycling and energy recovery)
- Disposal.

By adopting the above principles, Transport for NSW aims to efficiently reduce resource use, reduce costs and reduce environmental harm in accordance with the principles of ecologically sustainable development, as outlined in Section 8 of this review of environmental factors.

6.14.1 Legislative framework and guidelines

Legislative framework

The key waste related legislation relevant to the proposal include:

- *Protection of the Environment Operations Act 1977*
- *Protection of the Environment Operations (Waste) Regulation 2014*
- *Waste Avoidance and Resource Recovery Act 2001.*

A description of these legislative instruments and relevance to the proposal is presented in Section 4.

Waste Classification Guidelines

The *NSW Waste Classification Guidelines* (EPA, 2014a) provides guidance on the assessment, classification, management and disposal for all waste on the proposal. The waste classification process under the guidelines follows the principles:

- Where practicable, safe and appropriate, it is desirable to separate a mixture containing different classes of wastes before classifying them separately
- Two or more classes of waste must not be mixed in order to reduce the concentration of chemical contaminants. Dilution of contaminants is not an acceptable waste management option. This includes the addition of water to any waste before laboratory analysis for the purpose of waste classification
- When classifying waste using chemical assessment it is not appropriate to exclude sample results. Selectively choosing sample results to classify waste introduces bias and violates fundamental statistical principles. There must be scientifically valid reasons for the exclusion of sample results.

6.14.2 Potential impacts

Construction

The proposal has the potential to generate waste from the following activities:

- Excavation and earthworks
- Vegetation clearing
- Demolition

- Utilities adjustment
- Surplus construction material
- Plant and equipment maintenance
- General site office activities at ancillary facilities.

The waste types likely to be generated from the proposal are listed in in Table 6-58. Refer to Section 6.6 for measures to manage potential contamination from some of the waste types discussed below.

Table 6-58 Construction waste streams

Waste type	Description
Spoil and excavation waste	The proposal would have a net fill requirement (refer to Section 3.4.5 for information on cut and fill material amounts), with the cut to fill amounts from roadworks to be beneficially reused for the proposal, where suitable.
Green waste	This waste type would be generated from clearing existing vegetation (refer to Section 6.5 for estimated amounts of vegetation to be cleared by the proposal) and landscaped areas on the Princes Highway road reserve. Waste would include tree branches, green waste and weeds.
Demolition waste	The proposal would require the demolition of building structures (eg houses and sheds) and the removal and relocation of road pavement, roadside furniture and utilities infrastructure resulting in bricks, asphalt, concrete, gravel, steel and other related waste.
Excess building materials	For example, concrete, asphalt, steel, timber, plastics and packaging materials.
Liquid Waste	Mainly from maintenance of various construction plant and equipment including liquid hazardous waste, fuel and oils. Generation of this waste would generally occur at the proposed construction ancillary facilities, including compound areas where plant is stored.
General waste	For example, food, paper and other waste generated from site compounds and offices
Contaminated material	Potential contamination is present on site, including (but not limited to) former petrol station sites with underground storage tanks, smash repairs and automotive workshops, oil, fuel and chemical storage, and potential asbestos containing material (refer to Section 6.6 for further information).
Wastewater	From washdown and bunded areas within ancillary facilities.
Redundant erosion and sediment controls	Erosion and sediment controls would be removed at the completion of construction.

These waste types could have potential impacts in terms of:

- Excessive volumes of waste generated on-site
- Excessive volumes of waste sent to landfill from the inadequate collection, classification and disposal of waste
- Contamination of soil, surface water and groundwater from inadequate waste handling.

The potential to reuse excavated material would be further investigated during detailed design and construction planning. Unsuitable fill material and all other wastes would be classified in accordance with the *NSW Waste Classification Guidelines* (EPA, 2014a) and disposed of to an appropriately licensed facility.

While the proposal would have a net fill requirement, some unsuitable material may be generated during the construction of the proposal. Unsuitable material is surplus material that cannot be used beneficially elsewhere onsite. This material would need to be disposed of offsite.

Green waste would be mulched (where not contaminated by weeds) and beneficially reused for the proposed interchange landscaped areas as a first preference.

Management of potential contamination is discussed in Section 6.6.

Operation

Limited volumes of waste are currently generated from the operation of the intersection, derived from maintenance activities and road users. Waste includes:

- General waste along the road, including litter
- Trimmed vegetation from landscaped areas
- Excess concrete and asphalt from road maintenance and repair activities
- Vehicle oils and greases from maintenance vehicles
- Vegetation, soil and silt from the clearing of drains and culverts
- Contaminated waste as a result of fuel spills, accidents or leaks.

The proposal would not result in additional waste or potential waste impacts once operational.

6.14.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
WM01 Waste management	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. The WMP will be prepared taking into account the	Contractor	Pre-construction	Environmental Procedure - Management of Wastes on Transport for NSW Land (Roads and Maritime Services, 2014)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Environmental Procedure - Management of Wastes on Transport for NSW Land (Roads and Maritime Services, 2014) and relevant Transport for NSW Waste Fact Sheets.			
WM02 Waste management	All wastes will be managed and disposed of in accordance with the *Protection of the Environment Operations Act* 1997 and the Protection of the Environment Operations (Waste) Regulation 2014.	Contractor	Construction	
WM03 Disposal of waste	Excavated material will be reused on site where feasible and suitable for the intended reuse. Where excavated material cannot be used on site, opportunities for reuse on nearby projects will be investigated.	Contractor	Construction	
WM04 Green waste	Where possible and suitable for use, cleared vegetation will be used as mulch or coarse woody debris for site erosion and sedimentation controls or rehabilitation.	Contractor	Construction	
WM05 Fill material	Any required additional fill material will be sourced from appropriately licensed facilities and/or other construction projects wherever possible. Additional fill material will be sourced and verified as suitable for use in accordance with relevant EPA and Transport for NSW guidelines.	Contractor	Construction	

6.15 Cumulative impacts

Cumulative impacts may arise from the interaction of construction and operation activities of the proposal and other existing or planned projects in the wider area. This may include other Transport for NSW proposals or large scale proposals within the Shoalhaven region.

When considered in isolation, specific project impacts may be considered minor. These minor impacts may be more substantial, however, when the impact of multiple projects on the same receivers is considered. Consequently, the extent to which the proposal contributes to the cumulative impacts of existing and planned developments or activities on the environment has been assessed.

6.15.1 Study area

Recently completed, ongoing, or proposed projects within about 15 kilometres of the site investigation area and their associated impacts have been considered. This analysis was prepared based on the publicly available information as of March 2021.

6.15.2 Overall proposal impacts

The proposed at-grade double roundabout interchange and overpass bridge would provide uninterrupted through movement along the Princes Highway as well as direct access to Jervis Bay Road and Old Princes Highway from the Princes Highway. Operation of the proposal would improve safety, reduce queuing and delay at the intersection, and facilitate multi-modal trips now and into the future.

Key environmental impacts of the proposal include:

- Traffic and transport impacts during construction, including speed limit restrictions, detours, additional heavy vehicle movements and altered property access arrangements
- Noise impacts from construction works, including some out of hours works
- Acquisition of property
- Overall positive socio-economic impacts as a result of congestion alleviation and safety improvements
- Biodiversity impacts, including:
    - Removal of 15.71 hectares of native vegetation:
        - 11.98 hectares of Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
        - 3.73 hectares of Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (PCT 1326), listed as Endangered under the *Biodiversity Conservation Act 2016*, of which 2.64 hectares meets the condition criteria of Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*
    - Direct removal of 55 individual *Hibbertia puberula subsp. Puberula* plants as well as10.51 hectares of suitable habitat for *Hibbertia puberula subsp. puberula,* listed as endangered under the *Biodiversity Conservation Act 2016*
- Direct impact to one Aboriginal heritage site (JBR IF 01AHIMS ID 52-5-0982)
- Potential flooding impacts to upstream dwellings during construction at the southern culvert

- Moderate to high impact on the landscape character and visual amenity of the area surrounding the proposal
- Construction air quality impacts, such as dust deposition and plant and equipment emissions.

Safeguards and management measures have been identified to mitigate and manage potential impacts, as discussed in Section 7.

6.15.3 Broader program of work

The proposal is part of the Princes Highway Upgrade Program and the *Roadmap to 2040* (Transport for NSW, 2020i), which identifies what needs to be done in the short, medium and long term to deliver a safe, reliable, efficient and connected Princes Highway network. The location of the program of works in shown in Figure 6-38 and includes intersection upgrades, road safety works, overtaking lanes and lane duplication, bypasses and bridge replacements.

The most recent commitment to this program is the improvement of the Princes Highway between Jervis Bay Road and Moruya and includes:

- The Jervis Bay Road and Princes Highway intersection upgrade
- The Jervis Bay Road to Sussex Inlet Road upgrade
- The Milton-Ulladulla bypass
- The Burrill Lake to Batemans Bay upgrade
- The Moruya bypass.

Of these projects, the Jervis Bay Road to Sussex Inlet Road upgrade, when combined with the proposal, has the potential to result in cumulative impacts.

Jervis Bay Road to Sussex Inlet Road upgrade

The Princes Highway between Jervis Bay Road and Sussex Inlet Road is a 20 kilometre section of the highway that would be upgraded to two lanes in both directions, improving safety, performance and accessibility. The preferred strategic corridor identified by Transport for NSW in November 2020 would connect with the proposed Jervis Bay Road intersection upgrade design. At the time of writing, the Jervis Bay Road to Sussex Inlet Road upgrade proposal is in the planning and strategic design phase (see https://www.rms.nsw.gov.au/projects/princes-highway/jervis-bay-road-to-sussex-inlet-upgrade.html for proposal updates).

Although an environmental assessment has not yet been carried out, it is assumed the project would result in vegetation clearance, property acquisition, traffic and transport impacts, construction noise and vibration, construction air pollution and waste generation.

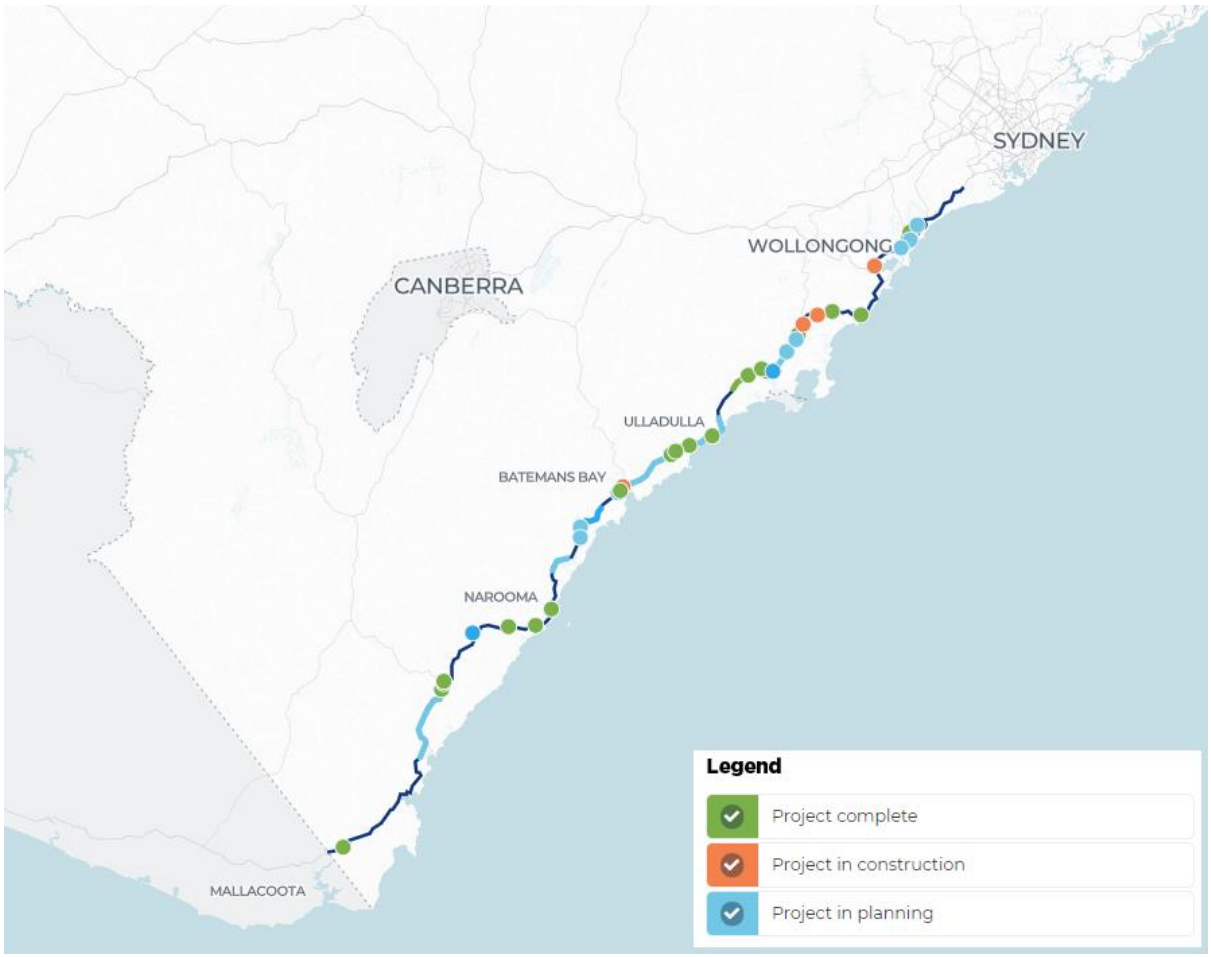

Figure 6-38 Princes Highway Upgrade Program

6.15.4 Other projects and developments

Nowra Bridge project

The Nowra Bridge project will provide a new four lane bridge over the Shoalhaven River, upgraded intersections and additional lanes on the Princes Highway. At the time of writing, the Nowra Bridge project was in its construction phase and was anticipated to be completed by mid-2024 (see https://www.rms.nsw.gov.au/projects/nowra-bridges-shoalhaven-river/index.html for project updates).

Key environmental impacts of the proposal include:

- Traffic and transport impacts, including speed limit restrictions, detours, additional heavy vehicles, altered property access arrangements and temporary impact to about 270 public car spaces during construction
- Noise impacts from construction works, including some out of hours works
- Direct impact items of heritage significance, including seven Aboriginal cultural heritage sites and seven non-Aboriginal heritage items
- Moderate to high impact on views in and around the project that would alter the visual amenity
- Increased flood risk to up to 12 properties previously unaffected by the one and two per cent AEP flood event
- Acquisition of property

- Socio-economic impacts, including closure of parks and parking areas and restriction of watercraft movements during construction
- Biodiversity impacts, including:
    - Removal of over two hectares of native vegetation, of which 0.9 hectares is classified as the endangered ecological community *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*)
    - Removal of 19 Magenta Lilly Pilly (*Syzygium paniculatum*) (listed as endangered under the *Biodiversity Conservation Act 2016*)
    - Removal of up to 0.9 hectares of seagrass (*Zostera muelleri*) (Type 1 key fish habitat under the *Fisheries Management Act 1994*).

Princes Highway and Island Point Road intersection improvements at Tomerong

In October 2020, Transport for NSW completed construction of a roundabout at the intersection of the Princes Highway and Island Point Road in Tomerong to improve safety, traffic efficiency and connectivity in the local area (see https://www.rms.nsw.gov.au/projects/princes-hwy-island-point-rd-tomerong/index.html for additional project information).

Key environmental impacts of the project included:

- Removal of less than one hectare of vegetation, with no threatened species or endangered ecological communities significantly affected
- Noise impacts from construction works, including some out of hours works
- Minor erosion and sedimentation
- Temporary closure of Island Point Road between Grange Road and the Princes Highway and lane road closures on the Princes Highway, with detours resulting in increased traffic and vehicle movements on other local roads during construction.

6.15.5 Potential impacts

Table 6-59 describes the cumulative impacts of the proposal and other existing or planned projects in the wider area during construction and operation. Identified impacts would be managed through the safeguards and management measures outlined in Section 6.15.6.

Table 6-59 Cumulative impact assessment

Environmental factor	Construction	Operation
Traffic and transport	Simultaneous construction of the proposal, the Nowra Bridge project and the Jervis Bay Road to Sussex Inlet Road upgrade would increase construction vehicle movements, increase traffic delays and disruptions along the local and regional road network. Consecutive construction of these projects, as well as the recently completed Princes Highway and Island Point Road intersection improvements, could result in construction fatigue at residential and commercial receivers as	The proposal and other identified projects would result in improved traffic efficiency, safety and performance along the Princes Highway.

Environmental factor	Construction	Operation
	well as Princes Highway road, active transport and public transport users.	
Noise and vibration	Cumulative construction noise and vibration impacts, whether simultaneous or consecutive, would be localised to sensitive receivers in close proximity to the proposal's southern tie-in point with the Jervis Bay Road to Sussex Inlet Road upgrade. Simultaneous construction could potentially generate noise at levels higher than that assessed for these proposals separately as a result of additional noise sources being present at this location. Consecutive construction could result in noise sensitive receivers being exposed to construction noise sources for a prolonged period of time, resulting in construction fatigue.	Some noise sensitive receivers in close proximity to the proposal's southern tie-in point with the Jervis Bay Road to Sussex Inlet Road upgrade may be located closer to the road than the existing condition.
Property and land use	Additional and prolonged land use impacts along the Princes Highway corridor due to adjacent and consecutive construction periods.	Property acquisition was or would be required for the identified projects and proposals, including: • The proposal – seven properties to be fully acquired, 19 properties to be partially acquired and six properties to be leased • Nowra Bridge project – 16 properties fully acquired, 25 properties partially acquired and 18 properties leased • Princes Highway and Island Point Road intersection improvements – one property leased Acquisition and/or lease of land required for the Jervis Bay Road to Sussex Inlet Road upgrade is unknown at the stage.
Socio-economic	Additional and prolonged increase in passing trade for local businesses and services. Temporary positive revenue impact expected during construction. It is unlikely that social infrastructure would be significantly impacted, however, the local road network is an obvious component of infrastructure that would be temporary impacted by road closures and/or diversions during construction.	Congestion at the intersection for vehicles travelling to and from the Jervis Bay area and between Nowra and Ulladulla would be removed by the proposal, therefore becoming more appealing to general traffic and businesses operating in the region.

Environmental factor	Construction	Operation
Biodiversity	Cumulative impacts associated with the identified projects and the proposal include: • The removal of native vegetation that is listed as critically endangered or endangered ecological communities under the *Biodiversity Conservation Act 2016* and/or the *Environment Protection and Biodiversity Conservation Act 1999* • The removal of threatened flora species listed under the Biodiversity Conservation Act 2016 and/or the Environment Protection and Biodiversity Conservation Act 1999 • The removal of habitat for threatened fauna species listed under the Biodiversity Conservation Act 2016 and/or the Environment Protection and Biodiversity Conservation Act 1999 • The degradation of waterways and waterbodies. The impacts of the proposal would contribute to the continued loss of threatened flora, fauna, ecological communities and their habitat within the locality. While the threatened flora species and threatened ecological communities to be impacted differ between the projects and proposals and are relatively minor, their combined loss does negatively impact on the biodiversity of the locality.	Increased size and complexity of infrastructure associated with the proposal, the Jervis Bay Road to Sussex Inlet Road upgrade and the Princes Highway and Island Point Road intersection improvements could result in minor increases in fauna injury and mortality due to vehicle collisions.
Landscape character and visual amenity	The simultaneous and/or consecutive construction of the proposal and the Jervis Bay Road to Sussex Inlet Road upgrade could result in an increased active construction footprint across the two upgrade projects in the vicinity of the proposal's southern tie-in point, potentially for an extended period of time. This would increase and/or prolong the visual presence of construction within the local landscape for both sensitive residential receivers and road users. Consecutive construction would mean that construction zones and construction plant and equipment would be used progressively along the highway, potentially moving south from Falls Creek towards Wandandian as the Jervis Bay Road to Sussex Inlet Road upgrade project construction phases are completed. The consecutive construction of the Princes Highway upgrade program	Vegetation clearing and the introduction of new infrastructure and associated earthworks (ie embankments, shared paths, roundabouts, roadside furniture) would result in permanent impact on landscape character zones and visual amenity.

Environmental factor	Construction	Operation
	would mean that construction equipment would be visible along the road reserve for an extended period of time, which could potentially give rise to construction fatigue for road users along the Princes Highway. Landowners whose properties are located with views to the southern tie-in of the proposal may also be exposed to construction fatigue, as construction equipment would be present at this location for both the proposal and the Jervis Bay Road to Sussex Inlet Road upgrade.	
Air quality	Simultaneous construction of the proposal and the Jervis Bay Road to Sussex Inlet Road upgrade has the potential to increase dust emissions above what has been assessed by either project separately. Consecutive construction would result in prolonged dust emissions between in the area. This could result in construction fatigue for road users, active and public transport users and for sensitive receivers in close proximity to the highway.	No cumulative impacts are expected.

6.15.6 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
CI01 Cumulative construction impacts	Ongoing coordination and consultation will be carried out between the project teams on the Nowra Bridge project and the Jervis Bay Road to Sussex Inlet Road upgrade to manage construction fatigue impacts where possible, and to manage cumulative traffic impacts particularly during peak holiday periods.	Transport for NSW Contractor	Pre-construction Construction	
CI02 Cumulative construction impacts	The CEMP will be reviewed regularly and revised as required to consider potential cumulative impacts of surrounding development activities as they become known.	Contractor	Construction	

7 Environmental management

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

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the review of environmental factors in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

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

The CEMP will be prepared before construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Manager before the commencement of any on-site work. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in:

- *QA Specification G36 – Environmental Protection (Management System)*
- *QA Specification G38 – Soil and Water Management (Soil and Water Plan)*
- *QA Specification G40 – Clearing and Grubbing*
- *QA Specification G10 – Traffic Management*.

7.2 Summary of safeguards and management measures

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

Table 7-1 Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
General					
GEN01	General - minimise environmental impacts during construction	A Construction Environmental Management Plan (CEMP) will be prepared and submitted for review and endorsement of the Transport for NSW Environment Manager before commencement of the activity. As a minimum, the CEMP will address the following: • any requirements associated with statutory approvals • details of how the project will implement the identified safeguards outlined in the review of environmental factors • issue-specific environmental management plans • roles and responsibilities • communication requirements • induction and training requirements • procedures for monitoring and evaluating environmental performance, and for corrective action • reporting requirements and record-keeping • procedures for emergency and incident management • procedures for audit and review. The endorsed CEMP will be implemented during the undertaking of the activity.	Contractor	Pre-construction	Section 3 of QA G36 Environmental Protection
GEN02	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days before commencement of the activity	Contractor Transport for NSW	Pre-construction	
GEN03	General – construction environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular ‘toolbox’ style briefings.	Contractor	Pre-construction Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include but not limited to: • Areas of Aboriginal heritage sensitivity • Threatened species habitat • Adjoining residential areas requiring particular noise management measures.			
Traffic and transport					
TR01	Traffic management during construction	A Traffic Management Plan (TMP) will be prepared and implemented in accordance with *Transport for NSW Specification D&C G10 Traffic Management* and *Traffic Control at Worksites Technical Manua*l (Roads and Maritime Services, 2018). The Traffic Management Plan will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Identification and management of any haulage vehicle marshalling areas • Site-specific traffic control measures, including signage and reduced speed zones, to manage and regulate traffic movement • Signage targeting critical access points to businesses and residences located along the Princes Highway, Old Princes Highway, Jervis Bay Road and properties in the vicinity of the intersection, as required • Measures to manage active transport movements throughout construction • Safe access to ancillary facilities including entry and exit locations and measures to prevent queuing of construction vehicles • A response procedure for any construction road traffic incident.	Contractor	Pre-construction	Section 4.8 of QA G36 *Environment Protection* G10 Traffic Management Traffic Control at Worksites Technical Manual (Roads and Maritime Services, 2018)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
TR02	Public transport impacts	Consultation will be carried out with local and regional bus services that operate in the area before and during construction to confirm any bus stop relocations during construction, and any operational road network changes. Advanced notification will be provided to affected bus customers of bus stops changes. Disruption to bus customers will be minimised by relocating the bus stops to the closest practical alternative.	Transport for NSW Contractor	Detailed design Pre-construction Construction	
TR03	Consultation with emergency services	Consultation will be carried out with local emergency services during the development of the Traffic Management Plan to ensure an unrestricted and safe environment for emergency service vehicles to pass through the proposal construction footprint. Updates will be provided on the staging and progress of construction.	Contractor	Pre-construction	
TR04	Road closures during construction	Partial road closures or short-term full road closures will be avoided along the Princes Highway and Jervis Bay Road during peak periods when vehicle traffic volumes are high.	Contractor Transport for NSW	Construction	
TR05	Changes to local roads and property access during construction	Regular communication and consultation will be carried out with affected landowners and residents where temporary property access changes are required. Landowners and residents will be provided with advance notification of construction schedules and any changes to local roads and property access.	Contractor Transport for NSW	Pre-construction Construction	
TR06	Changes to property access during operation	Property access that is impacted by the proposal will be reinstated or relocated before the end of construction in consultation with affected landowners.	Contractor Transport for NSW	Detailed design Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration					
NV01	Construction noise and vibration management	A construction Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim *Construction Noise Guideline* (DECC, 2009) and the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016), and will identify: • Potential major noise and vibration generating activities associated with the proposal • Standard and additional mitigation measures from the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) and information about when and how each will be applied • Requirements for the development and implementation of an out of hours work protocol • Monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contactor	Pre-construction Construction	Section 4.6 of QA G36 Environment Protection Interim Construction Noise Guideline (DECC, 2009) Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016)
NV02	Construction noise from ancillary facilities	The layout and use of ancillary facilities will be planned to minimise noise and vibration impacts to sensitive receivers. Before establishment of each ancillary facility, the noise and vibration impacts of these ancillary facilities will be confirmed. Standard safeguards and management measures (and additional site-specific measures, where required) will be implemented in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime 2016).	Contractor	Pre-construction Construction	
NV03	Construction ground-borne vibration	Vibration measurements will be carried out at the commencement of works where predicted ground-borne vibration levels exceed the cosmetic damage screening criteria to verify ground-borne vibration predictions.	Contractor	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Management of ground-borne vibration level exceedances will be detailed in the NVMP.			
NV04	Operational road traffic noise impacts	Within 12 months of the commencement of the operation of the proposal, actual operational noise performance will be compared to predicted operational noise performance (as reviewed during detailed design) to analyse the effectiveness of the operational road traffic noise mitigation measures. Additional feasible and reasonable mitigation will be considered where any additional receivers are identified as qualifying for consideration of noise mitigation under the *Noise Mitigation Guideline* (Roads and Maritime, 2015).	Transport for NSW	Operation	*Noise Mitigation Guideline* (Roads and Maritime, 2015)
Property and land use					
PR01	Land acquisition	Land acquisition for the proposal will be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, the *Roads and Maritime Services Land Acquisition Information Guide* (Roads and Maritime Services, 2014) and in accordance with the land acquisition reforms announced by the NSW Government in 2016.	Transport for NSW	Pre-construction Construction	Roads and Maritime Services Land Acquisition Information Guide (Roads and Maritime Services, 2014)
PR02	Property acquisition	Consultation with affected landowners about property acquisition will be carried out throughout the proposal.	Transport for NSW	Detailed design Pre-construction Construction	
PR03	Temporary use of land	Land subject to temporary use will be restored as soon as practicable to an appropriate land use, taking into consideration the location, land use characteristics, area and adjacent land uses. This will be carried out in consultation with the landowner.	Contractor	Construction	
Socio-economic					
SE01	Community engagement	A Community and Stakeholder Engagement Plan (CSEP) will be prepared and implemented. The CSEP will include:	Transport for NSW Contractor	Detailed design Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Procedures and mechanisms that will be implemented in response to the key social impacts identified for the proposal • Procedures and mechanisms that will be used to engage with affected landowners, business owners, and the wider community to identify potential access, parking, business visibility, and other impacts and develop appropriate management measures • Procedures to keep the community informed about construction and any associated changes to conditions (eg detours or lane closures) such as through advertisements in local media and advisory notices or variable message signs • Procedures and mechanisms that will be used to engage with all sensitive receivers likely to be affected by construction noise and vibration before commencement of activities associated with noise and vibration impacts • Procedures to consult with affected landowners about property acquisition • Procedure for the management of complaints and enquiries, including a contact name and number for complaints.			
Biodiversity					
BI01	Flora and fauna management	A Flora and Fauna Management Plan will be prepared and implemented as part of the CEMP. It will include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas, carried out in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) • Pre-clearing survey requirements, carried out in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011)	Contractor	Detailed design Pre-construction	Section 4.8 of QA G36 Environment Protection Protecting and managing biodiversity on RTA projects (RTA, 2011)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Procedures for unexpected threatened species finds and fauna handling • Protocols to manage weeds and pathogens.			
BI02	Removal of native vegetation, threatened species habitat and habitat features, and threatened plants	The detailed design and construction of the proposal will minimise native vegetation clearing and habitat removal, prioritising the avoidance of threatened ecological communities.	Transport for NSW Contractor	Detailed design Construction	
BI03		Vegetation and habitat removal will be carried out in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI04		Any revegetation will be carried out in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Post-construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI05		The unexpected species find procedure under Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) is to be followed if threatened flora, fauna and/or ecological communities not assessed in the review of environmental factors are identified in the proposal construction footprint.	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI06		Any fauna habitat replacement or reinstatement will be carried out in accordance with Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI07		A nest box strategy will be developed and implemented in accordance with Guide 8: Nest boxes of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Transport for NSW Contractor	Detailed design Pre-construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
BI08	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of *the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI, 2013).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011) Policy and guidelines for fish habitat conservation and management Update 2013 (DPI, 2013)
BI09	Injury and mortality of fauna	Fauna will be managed during construction in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI10	Invasion and spread of weeds	Weeds will be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI11	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: *Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Protecting and managing biodiversity on RTA projects (RTA, 2011)
BI12	Noise, light and vibration	• Lighting will only be used as necessary at night and will be turned off when not needed.	Contractor	Construction	
Soils and contamination					
SC01	Soil and water management	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP in accordance with Section 2.1 of QA *G38 Soil and Water Management*. The SWMP will identify all reasonably foreseeable risks relating to	Contractor	Pre-construction	Section 2.1 and 2.2 of QA G38 Soil and Water Management

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP will provide: • Measures to minimise/ manage erosion and sediment transport both within the proposal construction footprint and offsite, including requirements for the preparation of an Erosion and Sediment Control Plan (ESCP) in accordance with Section 2.1 of QA *G38 Soil and Water Management* • Arrangements for managing erosion and sediment transport during wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather • Measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation • Measures to manage groundwater de-watering and impacts including mitigation required • Processes for de-watering of water that has accumulated on site, including relevant discharge criteria • Emergency spill procedures, including spill management measures in accordance with the *Code of Practice for Water Management* (Road and Traffic Authority, 1999) and relevant EPA guidelines, and requirement to maintain materials such as spill kits on site • Details of surface water quality monitoring to be carried out before, throughout, and after construction, as required.			
SC02	Erosion and sedimentation	A site specific ESCP will be prepared and implemented as part of the SWMP. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Pre-construction	Section 2.2 of QA G38 Soil and Water Management

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SC03	Contaminated land	• A procedure will be prepared and implemented for the unexpected discovery of potential contamination before or during construction. The procedure will be incorporated into the CEMP and will outline the process for the identification, assessment and management of the potentially contaminated material.	Contractor	Pre-construction Construction	
Flooding and surface water					
FW01	Flooding	A flood contingency plan will be prepared where stockpiles are proposed within areas with flood immunity of less than five per cent AEP. The plan will consider the likelihood of flooding, evacuation routes, warning times, and potential impacts of the ancillary facility flooding. The plan will: • Identify a designated “Site Flood Controller”. The Site Flood Controller will familiarise with the Local Flood Plans and advice from the SES to ensure the plan can be executed. • Include relevant emergency contact details including the SES • Include instruction on monitoring of the Bureau of Meteorology website and/or the nearby Currambene Creek water level gauge in relation to flooding, if required • Include procedures to be followed in preparation for, during and after a flood event for the proposal construction footprint. A copy of these procedures will be retained on site at all times • Include details of flood behaviour for the site, including extent and duration of inundation during events • Include information on flooding and training in what to do to prepare, during and after a flood event • Ensure that copies of the SES’s “Local Flood Plan” for Currambene Creek area are kept on site at all times.	Contractor	Pre-construction Construction	
FW02	Flooding – afflux during construction	Drainage construction works will avoid or minimise afflux on private dwellings.	Contractor	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
FW03	Flooding – ancillary facility layout	Ancillary facility layout and stockpile locations would be planned to minimise any potential flood impacts.	Contractor	Pre-construction Construction	
Aboriginal and non-Aboriginal heritage					
HE01	Impact on Aboriginal sites	An application for an area based Aboriginal Heritage Impact Permit will be submitted to Heritage NSW for the proposal construction footprint.	Transport for NSW	Pre-construction	
HE02	Unexpected finds	*The Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015b) will be followed in the event that any unexpected heritage items of Aboriginal or Non-Aboriginal origin are encountered.	Contactor	Detailed design Pre-construction	Section 4.10 of QA G36 Environment Protection Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime Services, 2015b)
Landscape character and visual amenity					
LV01	Urban and landscape design	Urban and landscape design inputs into the project detailed design will include the following considerations: • location and identification of existing vegetation and proposed landscaped areas, including species to be used • built elements including retaining walls and bridges • pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • fixtures such as seating, lighting, fencing and signs • details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage • procedures for monitoring and maintaining landscaped or rehabilitated areas.	Transport for NSW Contactor	Detailed design Pre-construction	*Beyond the Pavement* (Transport for NSW, 2020c) *Landscape design guideline* (Roads and Maritime Services, 2018b) *Bridge Aesthetics* (Roads and Maritime 2012)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Detailed urban and landscape design will be carried out in accordance with relevant guidelines, including: • *Beyond the Pavement* (Transport for NSW, 2020c) • *Landscape design guideline* (Roads and Maritime Services, 2018b) • *Bridge Aesthetics* (Roads and Maritime 2012).			
LV02	Vegetation loss	All feasible and reasonable measures will be taken to minimise the loss of existing vegetation along the proposal corridor. Those measures will include minimise clearing of trees for construction access and rationalisation of maintenance access.	Contractor	Detailed design Construction	
LV03	Lighting and signage	Lighting and signage will be installed in accordance with relevant Australian Standards and guidelines, and without reducing the amenity of residential sensitive receivers.	Transport for NSW	Detailed design	
LV04	Planting choice	Incorporate mature screen planting, where space and access is available within the road corridor and road user safety is not compromised, at locations where high-moderate visual impacts have been identified.	Contractor	Detailed design	
Air quality					
AQ01	Construction air quality management	An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include: • Identification of potential risks/impacts due to the work/activities as dust generation activities • Management measures to minimise risk of dust generation associated with earthworks and other activities that disturb the ground surface, stockpiles and haulage routes • A process for monitoring dust on-site • A process for altering management measures as required and reprogramming construction activities if the safeguards and management measures do not adequately restrict dust generation. Dust and air quality complaints will be managed in accordance with the overarching complaints handling process for the	Contractor	Pre-construction Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		proposal. Appropriate corrective actions will be taken to reduce emissions in a timely manner.			
AQ02	Dust emissions	Progressive rehabilitation of disturbed areas will be carried out where feasible and reasonable to minimise soil exposure.	Contractor	Pre-construction Construction	
Climate change and sustainability					
CC01	Climate change adaptation	Detailed design will incorporate adaptation measures for all climate change risks with an original risk rating of moderate or above. These will include but not be limited to: • Consideration of the full range of potential temperature extremes on the proposal (particularly bridge structures) which may occur as a result of climate change and consider material capacity to withstand heat during material type selection to minimise the likelihood of infrastructure failures • Consideration of energy dissipation at culvert outlets when velocities exceed existing magnitudes to reduce potential impact of scour.	Contractor	Detailed design	
CC02	Greenhouse gas emissions	Fuel efficient plant, equipment and vehicles will be selected for use during construction where feasible and reasonable. Construction plant and equipment will be well maintained to maximise fuel efficiency.	Contractor	Construction	
CC03	Greenhouse gas emissions	The procurement of goods and services will consider goods and services that: • Are from local suppliers • Make use of recycled materials or materials with a low embodied energy content • Are energy efficient or have low embodied energy • Minimise the generation of waste.	Contractor	Construction	
CC04	Sustainability	Sustainability initiatives will be considered throughout detailed design, construction and operation of the proposal in accordance with the *Environmental Sustainability Strategy 2019–2023* (Roads and Maritime Services, 2019).	Transport for NSW	Detailed design Construction Operation	Environmental Sustainability Strategy 2019–2023 (Roads and

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
					Maritime Services, 2019)
Waste management					
WM01	Waste management	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • measures to avoid and minimise waste associated with the project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Transport for NSW Land* (Roads and Maritime Services, 2014) and relevant Transport for NSW Waste Fact Sheets.	Contractor	Pre-construction	Environmental Procedure - Management of Wastes on Transport for NSW Land (Roads and Maritime Services, 2014)
WM02	Waste management	All wastes will be managed and disposed of in accordance with the Protection of the Environment Operations Act 1997 and the Protection of the Environment Operations (Waste) Regulation 2014.	Contractor	Construction	
WM03	Disposal of waste	Excavated material will be reused on site where feasible and suitable for the intended reuse. Where excavated material cannot be used on site, opportunities for reuse on nearby projects will be investigated.	Contractor	Construction	
WM04	Green waste	Where possible and suitable for use, cleared vegetation will be used as mulch or coarse woody debris for site erosion and sedimentation controls or rehabilitation.	Contractor	Construction	
WM05	Fill material	Any required additional fill material will be sourced from appropriately licensed facilities and/or other construction	Contractor	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		projects wherever possible. Additional fill material will be sourced and verified as suitable for use in accordance with relevant EPA and Transport for NSW guidelines.			
Cumulative impacts					
CI01	Cumulative construction impacts	Ongoing coordination and consultation will be carried out between the project teams on the Nowra Bridge project and the Jervis Bay Road to Sussex Inlet Road upgrade to manage construction fatigue impacts where possible, and to manage cumulative traffic impacts particularly during peak holiday periods.	Transport for NSW Contractor	Pre-construction Construction	
CI02	Cumulative construction impacts	The CEMP will be reviewed regularly and revised as required to consider potential cumulative impacts of surrounding development activities as they become known.	Contractor	Construction	

7.3 Licensing and approvals

The proposal would require several licences, permits and notifications for its construction and operation. A summary of these requirements is provided in Table 7-2.

Table 7-2 Summary of licensing and approvals required

Instrument	Requirement	Timing
Fisheries Management Act 1994 (s199)	Notification to the Minister for Agriculture and Western NSW before any dredging work	A minimum of 28 days before the work starts
National Parks and Wildlife Act 1974 (s90)	Aboriginal heritage impact permit from Heritage NSW	Before start of the activity
Roads Act 1993 (s138)	Where works are proposed within the road reserve a Road Occupancy Licence is required	Before start of the activity

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8 Conclusion

8.1 Justification

The proposal would result in social, biophysical and economic benefits that act in the public's best interest.

Overall, the proposal would improve accessibility for residents and businesses within the site investigation area and the broader region by improving travel times, as well as reducing delays and frustrations and by improving active transport facilities. Access to employment and community facilities and community connectivity, aspects which are highly valued by the local community, would be improved through the upgraded road and improved infrastructure.

8.1.1 Social benefits

The proposal social benefits compared to retaining the existing intersection include:

- Improved traffic flow and road safety, through grade separation of the Princes Highway
- Reduced congestion and travel times
- Improved safety for property access to the Princes Highway through a connection road to Jervis Bay Road
- Provision of active transport facilities, including shared paths and road shoulders
- Safe access to a centralised bus stop and kiss and ride facility
- Opportunity for sustainable procurement initiatives.

The proposal would provide socially responsible and sustainable outcomes for the community to support the health and liveability of current and future generations through the provision of safe and efficient vehicle, active and public transport.

8.1.2 Biophysical benefits

The biophysical benefits of the proposal compared to retaining the existing intersection include:

- Maintained, and potentially improved, water quality for Parma Creek through implementation of permanent water quality treatment measures
- Improved resilience and flood immunity of the Princes Highway
- Reduction in air emissions associated with reduced vehicle wait times along Jervis Bay Road during peak periods.

8.1.3 Economic benefits

The economic benefits of undertaking the proposal compared to retaining the existing intersection include:

- Decreased travel times resulting in positive economic effects to freight, commuter and tourist traffic travelling within the local areal and longer distance regional trips (originating from, ending within or passing through the proposal)
- Supporting regional tourism through improved access to tourist attractions and destinations along the Princes Highway and in the wider Shoalhaven region

- Improved safety and travel time savings and reliability would facilitate safer and quicker access along the Princes Highway for visitors and tourists, resulting in beneficial impacts for tourism related businesses and destinations.

The proposal is consistent with a number of local, State and federal strategies and plans, as outlined in Section 2.

8.1.4 Resilience

The proposal would improve transport network resilience by providing more than 20 per cent spare network capacity when considering 2039 traffic projections. The proposal would enable through traffic to be maintained in the event of an incident on the Princes Highway by redirecting traffic via the ramps and roundabouts. This infrastructure would also provide for all traffic movements, including turnaround to or from any of the connected roads.

The Princes Highway and Jervis Bay Road are currently susceptible to flooding in a one per cent AEP event. Flood immunity would be achieved for these roads through implementation of the proposal, allowing continued operation in a major flood event. Further, the Princes Highway in this area would remain flood free under the climate change scenario of a one in five hundred year flood (0.2 per cent annual exceedance probability event).

The proposal would ensure accessibility and connectivity are improved, including through public transport, walking and cycling. The proposal has also been designed to enable the delivery of a multimodal interchange in the future.

8.2 Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposal would improve the efficiency of traffic movements at a key section of the Princes Highway. A range of safeguards and management measures have been identified to minimise environmental impacts associated with the proposal.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in Section 8.2.1. The proposal design and environmental assessment has used the best available technical information, environmental standards and measures to minimise environmental risks. Additionally, safeguards have been developed to minimise potential impacts and would be implemented during construction and operation of the proposal. The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. The proposal would benefit future generations by improving safety and reducing congestion which would have a positive benefit for all road users. Maintaining and improving biological integrity and diversity has been achieved through robust biodiversity assessment and landscape planning.
1.3(c) To promote the orderly and economic use and development of land.	The proposal forms part of the Princes Highway Upgrade program. It would increase travel reliability and reduce travel

Object	Comment
	times on the Princes Highway, and encourage the orderly and economic use of land in the Shoalhaven local government area.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	Potential impacts on biodiversity are discussed in Section 6.5. Removal of vegetation would be required in some areas, however the impacts would be minimised through the safeguards and management measures for the proposal and offset where unavoidable. A total of 364 ecosystem credits and 410 species credits would be required to offset the proposed impacts.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	Potential impacts on Aboriginal and non-Aboriginal heritage are discussed in Sections 6.9 and 6.10, respectively. The proposal would directly impact one Aboriginal object. The object would likely be reburied at a location in proximity to the proposal that would not be subject to future impacts, or at a central reburial location for several artefact assemblages associated with the wider Princes Highway Upgrade Program. There would be no impact to non-Aboriginal heritage as a result of the proposal.
1.3(g) To promote good design and amenity of the built environment.	Urban design, landscape character and visual impacts are discussed in Section 6.11 and Appendix J. The proposal would impact the surrounding landscape character and visual amenity due to vegetation clearing, the introduction of new infrastructure and associated earthworks. The urban design for the proposal has been carried out with reference to a set of design objectives that reflect the visual amenity values of the local area. A number of urban design and landscape strategies are proposed to minimise potential landscape and visual impacts of the proposal.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Consultation with the community and relevant government agencies has been ongoing, as described in Section 5. Transport for NSW will continue to identify and manage issues of interest or concern to the community and other stakeholders throughout the proposal life cycle.

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during route options development (refer to Section 2). The precautionary principle has guided the assessment of environmental impacts for this review of environmental factors (Section 6) and the development of safeguards and management measures (Section 7). This includes the selection of a preferred option that minimises vegetation clearance, with particular consideration of sensitive areas.

Specialist studies were incorporated to gain a detailed understanding of the existing environment, and issues that may cause serious or irreversible environmental damage as a result of the proposal have been identified. The proposal design and environmental assessment has used the best available technical information, environmental standards and measures to minimise environmental risks.

Safeguards have been developed to minimise potential impacts and would be implemented during construction and operation of the proposal. In particular, a construction environmental management plan would be prepared prior to construction. This would ensure the proposal achieves a high level of environmental performance.

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. The proposal would benefit future generations by reducing congestion which would have a positive benefit for all road users. The selected preferred option minimises vegetation clearance within sensitive ecological areas to ensure that such areas are conserved for future generations, and offsetting is proposed where impacts are unavoidable.

An Aboriginal cultural heritage assessment, including consultation with the local Aboriginal community, was carried out to avoid or minimise the potential for irreparable damage to occur to Aboriginal cultural heritage during construction.

The economic benefits in the form of freight efficiency and development potential for surrounding areas for the current and future generation were identified.

Requirements to minimise the impact of climate change from greenhouse emissions were identified, for example minimising vegetation clearance, optimising operation of construction plant and equipment and use of recycled materials where feasible.

Should the proposal not proceed, future generations would continue to experience a lower level of service associated with the existing intersection.

Conservation of biological diversity and ecological integrity

This principle is concerned with maintaining and improving the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong.

A robust biodiversity assessment was carried out to identify and manage any potential impacts of the proposal on biodiversity. Biodiversity constraints have been and would continue to be considered throughout the design and construction process. Biodiversity offsetting would be implemented where impacts are unavoidable.

The landscaping plan for the proposal would incorporate a selection of plant species that complement and integrate with the existing context and plant communities of the area, with selection from local plant community types and the Shoalhaven Council suggested species list for Falls Creek.

Two proposed ancillary facilities are located primarily in existing cleared areas.

Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

Environmental issues were considered as key matters in the preferred option selection process and in the economic and financial feasibility assessments for the proposal. The value of the proposal to the community in terms of improved safety and efficiency was recognised. Minimising the division of individual properties and the subsequent potential economic impacts on affected property owners were considered.

The environmental consequences of the proposal have been assessed in this review of environmental factors and safeguards and management measures identified for factors with potential adverse impact. The requirement to implement these management measures would result in an economic cost to Transport for NSW. The implementation of management measures would increase both the capital and operating costs of the proposal. Similarly, the design has been developed with an objective of minimising potential impacts on the surrounding environment.

8.3 Conclusion

The proposed Jervis Bay Road and Princes Highway intersection upgrade at Falls Creek is subject to assessment under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. The review of environmental factors has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (as relevant) of conservation agreements and plans of management under the *National Parks and Wildlife Act 1974*, biodiversity stewardship sites under the *Biodiversity Conservation Act 2016*, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the review of environmental factors best meets the project objectives but would still result in some impacts on traffic (during construction), amenity (associated with construction noise and air quality emissions), biodiversity, water quality and flooding, Aboriginal heritage, property acquisition and visual impacts. Safeguards and management

measures as detailed in this review of environmental factors would ameliorate or minimise these expected impacts. The proposal would also improve safety, reduce queuing and delay at the intersection, and improve the road network resilience. On balance the proposal is considered justified and the following conclusions are made.

8.3.1 Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the *Environmental Planning and Assessment Act 1979*. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Consent from Council is not required.

8.3.2 Significance of impact under Commonwealth legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Government Department of Agriculture, Water and Environment is not required.

9 Certification

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

Rachel Perry

Environmental Consultant, Arcadis

Date: June 2021

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

Nicole Moore

Project Development Manager

Project Development South

Regional Infrastructure Development | Infrastructure & Place

Transport for NSW

Date: June 2021

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Terms and acronyms used in this review of environmental factors

Term/ Acronym	Description
AEP	Annual exceedance probability
AHIMS	Aboriginal Heritage Information Management System
ARI	Annual recurrence interval
ARR	Australian Rainfall and Runoff
AQMP	Air quality management plan
AusRAP	Australian Road Assessment Program
Blue Book	Landcom (2004) Managing Urban Stormwater: Soils and Construction
BTEXN	Benzene, toluene, ethylbenzene xylene, naphthalene
CEMP	Construction environmental management plan
CO	Carbon monoxide
CoA	Commonwealth of Australia
CSEP	Community and stakeholder engagement plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Australian Government Department of Agriculture, Water and the Environment
dB	Decibel
DEC	(former) NSW Government Department of Environment and Conservation
DECC	(former) NSW Government Department of Environment and Climate Change
DECCW	(former) NSW Government Department of Environment, Climate Change and Water
DoE	(former) Australian Government Department of Environment
DPC	NSW Government Department of Premier and Cabinet
DPI	NSW Government Department of Primary Industries
DPIE	NSW Government Department of Planning, Industry and Environment
EPA	NSW Environment Protection Authority
ESCP	Erosion and sediment control plan
ESD	Ecologically sustainable development
IAQM	Institute of Air Quality Management

Term/ Acronym	Description
IBRA	Interim Biogeographic Regionalisation for Australia
L_{Aeq}	The equivalent continuous sound pressure level. The constant noise level that would result in the same total sound energy being produced over a given period.
L_{Amax}	The maximum value that the A-weighted sound pressure level (ie adjusted to reflect the sensitivity of the human ear) reaches during a measurement period.
L_{A90}	Noise level exceeded for 90 per cent of the measurement period. Used to quantify the background noise level.
LCZ	Landscape character zone
mg/m^3	Milligrams per cubic metre
Mt CO_2-e	Million tonnes of carbon dioxide equivalent
MUSIC	Model for Urban Stormwater Improvement Conceptualisation, a stormwater modelling software
NEPC	National Environment Protection Council
NML	Noise management level
NVMP	Noise and vibration management plan
NO_x	Oxides of nitrogen
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OCC	Organochlorine pesticides
OEH	(former) NSW Government Office of Environment and Heritage
OPP	Organophosphorus pesticides
PACHCI	The Transport for NSW (formerly Roads and Maritime Services) Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential archaeological deposit
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyls
PCT	Plant community type
PFAS	Per- and polyfluoroalkyl substances
PMF	Probable maximum flood
PM_{10} / $PM_{2.5}$	Particulate matter
Proposal / the proposal	The upgrade of the Jervis Bay Road and Princes Highway intersection at Falls Creek

Term/ Acronym	Description
Proposal construction footprint	The area required to construct the proposal. This includes any areas required for temporary work such as sedimentation basins, drainage lines, access roads and construction ancillary facilities.
RBL	Rating background level
RCP	Representative concentration pathway
RTA	(former) NSW Roads and Traffic Authority
SES	NSW State Emergency Service
Site investigation area	Area investigated in this review of environmental factors
SO_2	Sulfur dioxide
Study area	Term used to describe broader areas of investigation outside of the site investigation area. The study area varies based on the specific areas of interest targeted for each environmental issue (eg ecology, heritage, flooding, noise, visual amenity etc).
SWL	Sound power level
SWMP	Soil and water management plan
tCO_2-e	Tonnes of carbon dioxide equivalent
TMP	Traffic management plan
TRAQ	Transport for NSW Tool for Roadside Air Quality
TRH	Total recoverable hydrocarbons
$\mu g/m^3$	Micrograms per cubic metre
V	Vulnerable under the Biodiversity Conservation Act 2016 or the Environment Protection and Biodiversity Conservation Act 1999.
WMP	Waste management plan

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Appendix A

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

Clause 228(2) Checklist

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

Factor	Impact
a) Any environmental impact on a community? Proposal construction would result in impacts on the local community associated with property acquisition, changed visual amenity and potential noise, traffic and air quality impacts. Construction impacts would be managed through the implementation of safeguards and management measures identified in Section 7. Once operational, the proposal would improve safety, reduce queuing and delay at the intersection, and improve the road network resilience.	Short term negative Long term positive
b) Any transformation of a locality? The proposal would include construction of a new intersection, including the realignment and widening of the Princes Highway, an overpass bridge over Jervis Bay Road and an unsignalised single-lane at-grade double roundabout interchange for direct access to and from Jervis Bay Road, the Old Princes Highway and the Princes Highway. There would also be some changes to property accesses and local roads. Overall, the proposal would be located in or adjacent to the existing road corridor and as such is not considered to substantially transform the locality.	Nil

c) Any environmental impact on the ecosystems of the locality?
 	
The proposal would result in:
• Clearing of up to 15.71 hectares of native vegetation, including
  ○ 3.73 hectares of the ecological community Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion, listed as endangered under the *Biodiversity Conservation Act 2016*
  ○ Of this vegetation, 2.64 hectares also meets the condition threshold for the critically endangered ecologically community listed under the *Environment Protection and Biodiversity Conservation Act 1999*
• Removal of up to 10.51 hectares of suitable habitat for the threatened flora species Hibbertia puberula subsp. puberula, listed as endangered under the *Biodiversity Conservation Act 2016*. The proposal will also result in the direct removal of 55 individuals of this flora species
• Removal of up to 15.71 hectares of potential habitat for threatened fauna species, including bird species and microbats.
 	
The biodiversity assessment carried out concluded that these impacts would not be significant. Impacts would be managed through implementation of safeguards and management measures identified in Section 7.
	Long term negative

d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	

Factor	Impact
The removal of vegetation associated with the proposal would impact the landscape character and visual amenity of the area. This would be mitigated through landscaping and plantings, however it would take eight to 10 years to reach vegetation maturity. Short term impacts associated with construction of the proposal would be managed through the implementation of safeguards and management measures identified in Section 7.	Medium term negative Short term negative
e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? The proposal would impact one Aboriginal heritage object of low significance. An Aboriginal heritage impact permit would be sought for the proposal construction footprint. The object would be reburied at a location in proximity to the proposal that would not be subject to future impacts, or at a central reburial location for several artefact assemblages associated with the wider Princes Highway Upgrade Program. Impacts to heritage items, known or otherwise, would be managed through the implementation of safeguards and management measures identified in Section 7.	Short term negative
f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?* A total of 15.7 hectares of known or potential habitat for threatened fauna species would be cleared within the proposal construction footprint. Removal of native vegetation would reduce the availability of food resources for some threatened species, such as seeds, fruits and blossoms. Approximately 24 hollow-bearing trees would be cleared. This would impact a range of fauna, largely birds and arboreal mammals. There are hollow resources within the surrounding area that would provide habitat for impacted species. Biodiversity impacts would be managed through implementation of safeguards and management measures identified in Section 7.	Long term negative
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The proposal would not result in the endangering of any species.	Nil
h) Any long-term effects on the environment? The proposal would result in the removal of 15.7 hectares of native vegetation, as well as impacts to landscape character and visual amenity associated with new infrastructure. Urban design and landscaping measures would be incorporated into the detailed design to minimise these impacts.	Long term negative
i) Any degradation of the quality of the environment? Construction of the proposal may degrade the quality of the environment through accidental spills, inadequate construction erosion and sedimentation controls, inadequate air quality controls and vegetation removal.	Short term negative

Factor	Impact
Impacts would be managed through implementation of safeguards and management measures identified in Section 7.	
j) Any risk to the safety of the environment?	
Chemicals, fuels and other hazardous materials used during construction would be stored in appropriately bunded areas to minimise the risk of environmental contamination. This would be managed through implementation of safeguards and management measures identified in Section 7.	Nil
Operation of the proposal would improve traffic safety at the intersection.	Long term positive
k) Any reduction in the range of beneficial uses of the environment?	
The proposal would result in improved safety, efficiency and connectivity, which would support regional economic development, tourism and freight. It would also support an increase in active and public transport use, and increase transport network resilience.	Long term positive
l) Any pollution of the environment?	
Potential construction impacts include accidental spills, erosion and sedimentation, noise, traffic and air quality impacts. This would be managed through implementation of safeguards and management measures identified in Section 7.	Short term negative
Operation of the proposal would increase in efficiency at the intersection and reduce congestion resulting in a reduction in emissions associated with wait times along Jervis Bay Road during peak periods.	Long term positive
m) Any environmental problems associated with the disposal of waste?	
It is not anticipated any waste disposal issues would be encountered. Waste would be managed through the implementation of safeguards and management measures identified in Section 7.	Nil
n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?	
No issues with resource demand or supply have been identified.	Nil
o) Any cumulative environmental effect with other existing or likely future activities?	
There would be potential cumulative impacts associated with the proposal should construction overlap or occur consecutively with other nearby projects, such as the Nowra Bridge project and the Jervis Bay Road to Sussex Inlet Road upgrade. This could include traffic, noise, vibration, air quality, visual amenity, vegetation removal and property acquisition. Potential cumulative construction impacts would be managed through the implementation of safeguards and management measures identified in Section 7.	Short term negative
The proposal, together with other upgrade projects along the Princes Highway, would collectively contribute to improved traffic efficiency, safety and performance.	Long term positive
p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?	
There are no coastal processes or hazards associated with the proposal.	Nil

Matters of National Environmental Significance and Commonwealth land

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

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

Factor	Impact
a) Any impact on a World Heritage property? There are no World Heritage properties within or near the proposal construction footprint.	Nil
b) Any impact on a National Heritage place? There are no National Heritage places within or near the proposal construction footprint.	Nil
c) Any impact on a wetland of international importance? There are no wetlands of international importance within the proposal construction footprint.	Nil
d) Any impact on a listed threatened species or communities? The proposal would result in the clearing of 2.17 hectares of Illawarra and south coast lowland forest and woodland, listed as critically endangered ecologically community listed under the *Environment Protection and Biodiversity Conservation Act 1999*. The biodiversity assessment carried out concluded that these impacts would not be significant. Impacts would be managed through implementation of safeguards and management measures identified in Section 7.	Long term negative
e) Any impacts on listed migratory species? The proposal would not impact on any listed migratory species.	Nil
f) Any impact on a Commonwealth marine area? There are no Commonwealth marine areas within or near the proposal construction footprint.	Nil
g) Does the proposal involve a nuclear action (including uranium mining)? The proposal does not involve a nuclear action.	Nil
h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land? There is no Commonwealth land within or near the proposal construction footprint.	Nil

Appendix B

State Environmental Planning Policy (Infrastructure) 2007 consultation checklist

Certain development types

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

Development within the Coastal Zone

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

Note: See interactive map here: https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management. Note the coastal vulnerability area has not yet been mapped.
Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

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

Issue	Potential impact	Yes/No	If 'yes' consult with	Clause
	capacity of any part of the system?			
Water usage	Would the work involve connection to a council owned water supply system? If so, would this require the use of a *substantial* volume of water?	No	Local council	cl.13(1)(d)
Temporary structures	Would the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	Local council	cl.13(1)(e)
Road & footpath excavation	Would the work involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	Local council	cl.13(1)(f)

Local heritage items

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

Flood liable land

Issue	Potential impact	Yes/No	If 'yes' consult with	Clause
Flood liable land	Is the work located on flood liable land? If so, would the work change flood patterns to more than a *minor* extent?	No	Local council	cl.15

Issue	Potential impact	Yes/No	If 'yes' consult with	Clause
Flood liable land	Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance	Yes	State Emergency Services Email: erm@ses.nsw.gov.au	cl.15AA

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

Public authorities other than councils

Issue	Potential impact	Yes/No	If 'yes' consult with	Clause
National parks and reserves	Is the work adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	No	Environment, Energy and Science, Department of Planning, Industry and Environment	cl.16(2)(a)
National parks and reserves	Is the work on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	Environment, Energy and Science, Department of Planning, Industry and Environment	cl. 16(2)(b)
Aquatic reserves	Is the work adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*?	No	Department of Planning, Industry and Environment	cl.16(2)(c)
Sydney Harbour foreshore	Is the work in the Sydney Harbour Foreshore Area as defined by the *Place Management NSW Act 1998?*	No	Property NSW	cl.16(2)(d)
Bush fire prone land	Is the work for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service	cl.16(2)(f)
Artificial light	Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark	No	Director of the Siding Spring Observatory	cl.16(2)(g)

Issue	Potential impact	Yes/No	If 'yes' consult with	Clause
	sky region is within 200 kilometres of the Siding Spring Observatory)			
Defence communications buffer land	Is the work on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No	Secretary of the Commonwealth Department of Defence	cl. 16(2)(h)
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	cl. 16(2)(i)

June 2021 | TfNSW: 21.106 | ISBN: 978-1-922549-02-0