



New Richmond Bridge and traffic improvements - Stage 1 The Driftway

Review of Environmental Factors

Transport for NSW | November 2021

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Prepared by Jacobs Australia and Transport for NSW

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Executive summary

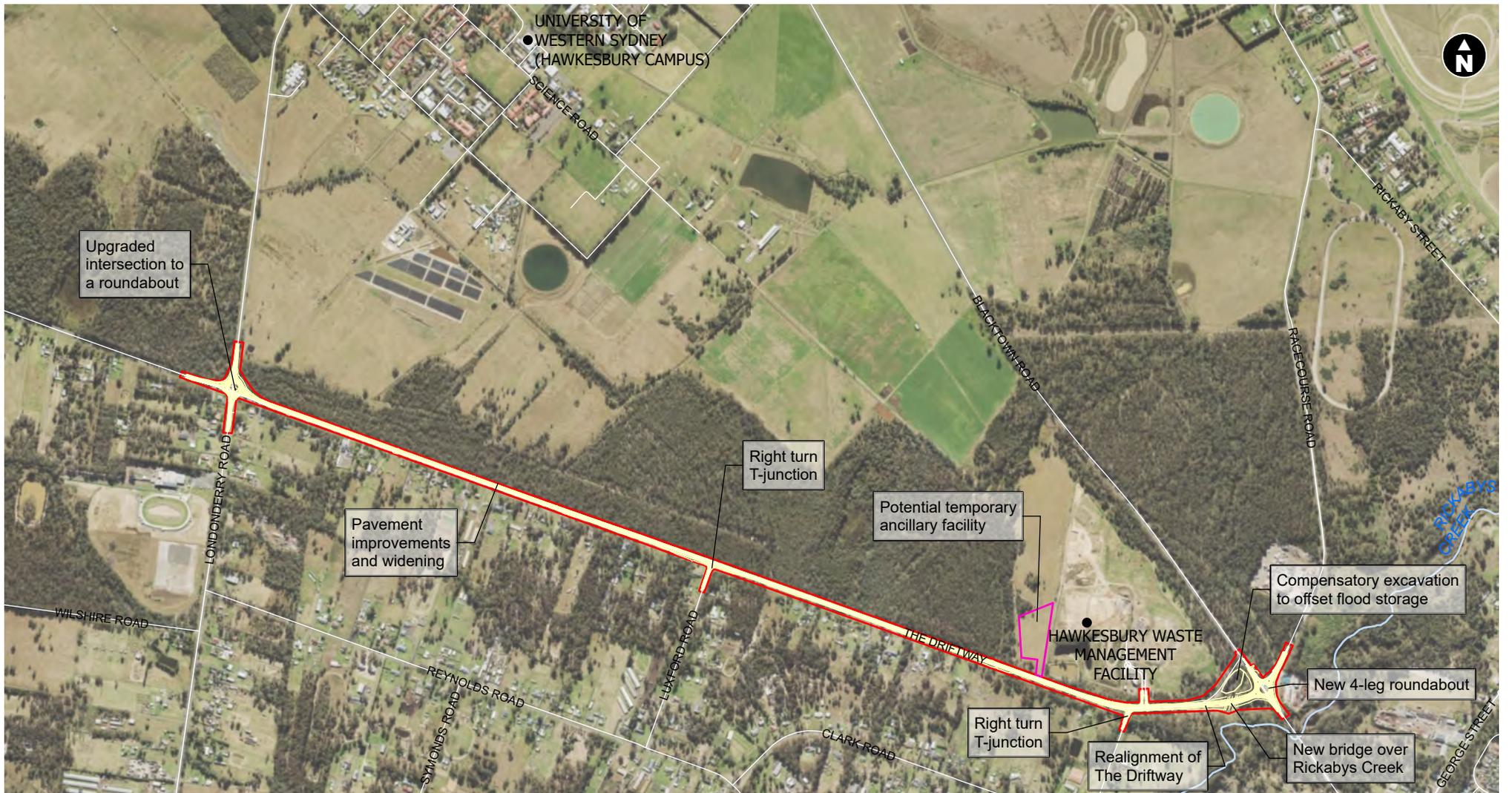
The proposal

Transport for NSW propose to upgrade about 3.6 kilometres of The Driftway between Londonderry Road and Blacktown Road (the proposal). The proposal is located in the suburbs of Richmond, Londonderry and South Windsor, NSW. The upgrade to The Driftway forms Stage 1 of the New Richmond Bridge and traffic improvements (Figure E-1).

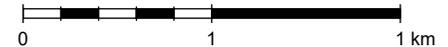
Stage 2 would include a new bridge over the Hawkesbury River and associated traffic improvements around Richmond and North Richmond. Stage 2 would be subject to a future, separate environmental approval assessment and is not included in this review of environmental factors (REF).

Key features of Stage 1 of the proposal would include:

- Upgrade of the intersection of Londonderry Road / The Driftway to a roundabout
- Upgrade of The Driftway intersections with Luxford Road and Reynolds Road to channelised right turn T-junctions
- Realignment of 230 metres of The Driftway at its eastern extent to create a four-leg roundabout with Blacktown Road and Racecourse Road
- A new 24 metre long bridge over a tributary of Rickabys Creek
- A new 30 metre long retaining wall along the north western corner of Racecourse Road and Blacktown Road
- Pavement improvements to 3.6 kilometres of The Driftway, including widening both shoulders to 1.5 metres
- Modifications to driveways and property adjustment works
- Removal of the redundant section of The Driftway and its intersection with Blacktown Road. Reshaping of this area for flood storage capacity
- Drainage improvements along The Driftway
- Relocation and/or adjustments to public utilities and street lighting
- Ancillary work including safety barriers, signage, line marking and environmental protection work
- Landscaping and rehabilitation work
- Temporary ancillary construction facility and laydown areas.



- Legend
- The Driftway design
 - Construction footprint
 - Potential temporary ancillary facility



GDA2020 MGA Zone 56



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Figure E-1 The Proposal

Need for the proposal

The upgrade to The Driftway, as detailed in this REF, forms Stage 1 of the New Richmond Bridge and traffic improvements, facilitating part of the bypass of Richmond town centre and improving road safety. The remaining improvements, including a new bridge over the Hawkesbury River would form Stage 2 of the proposal and would be considered under a separate environmental approval.

Richmond Bridge is currently operating at capacity during morning and afternoon peak periods, resulting in congestion and increased travel times on the Richmond and North Richmond road networks. Predicted population and traffic growth in the area would continue to exacerbate this problem and also increase the risk of crashes. Local road networks, such as The Driftway, already have a poor safety record. From August 2015 to June 2020, 29 crashes occurred on The Driftway between the intersections of Londonderry Road and Blacktown Road.

To reduce congestion between Richmond and North Richmond town centres, improve travel times, cater for future growth and improve connectivity and road safety, specifically at priority intersections along The Driftway, Transport for NSW presented five route options to the community for feedback in late 2019. Each of the five route options included a new bridge over the Hawkesbury River to provide capacity for future traffic growth, long term traffic management, and various alignments to either upgrade through, or bypass Richmond and North Richmond town centres.

In early 2020 four options were shortlisted for further assessment, with the option to upgrade through Richmond town centre removed due to community feedback. Each of the four shortlisted options had a common element to provide improvements to The Driftway between Londonderry and Blacktown Roads as part of a Richmond town centre bypass route, which would result in increased traffic volumes on The Driftway. While the traffic volumes would not be sufficient to require additional lanes on The Driftway, safety improvements such as pavement and intersection improvements would be necessary.

Proposal objectives

The delivery of Stage 1 would facilitate part of the delivery of the New Richmond Bridge and traffic improvements as a whole. The objectives of the proposal include:

- To improve travel times, journey time reliability and cater for future demand for private, public, active and freight transport between North Richmond, Richmond and the connecting arterial road network
- To improve connectivity between Bells Line of Road and Sydney's arterial road network
- To reduce the frequency and severity of crashes on key road corridors between Richmond and North Richmond
- To improve flood resilience
- To support economic development, improved liveability, and Council's long-term vision for the town centres of Richmond and North Richmond.

In pursuing these objectives, Transport for NSW aims to reserve a road corridor that will:

- Improve connections to the Central West of NSW as the alternative connection to the Great Western Highway
- Maintain the historical significance of the area
- Seek to achieve a best fit with the built fabric and natural patterns of the area.

The proposal will also meet the following objectives that are common to road design projects:

- Provide for Safety-by-Design
- Provide appropriate levels of safety for road users
- Develop a cost-effective solution.

Options considered

Two options were identified for consideration:

- Option 1: do nothing – no improvements to The Driftway
- Option 2: improvements to The Driftway – The Driftway would undergo an upgrade which would form Stage 1 of the New Richmond Bridge and traffic improvements proposal.

Multiple options were considered for intersection improvements which are detailed in Section 2.5. Option 2 is considered to be the preferred option, as it addresses NSW Government's priorities and would meet the proposal objectives. The preferred option would have the following advantages:

- Improve travel time reliability and cater for future growth
- Reduce the frequency and severity of crashes at key intersections (The Driftway and Blacktown Road, The Driftway and Londonderry Road), while improving overall safety along The Driftway
- Improve drainage and flood resilience
- Support economic development and improved amenity of the local area and Richmond town centre.

Statutory and planning framework

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

As the proposal meets the definitions of 'road infrastructure facilities' provided by clauses 93 and 94(2) of the ISEPP, and is being carried out by Transport for NSW, it is permissible without consent under ISEPP. As a result, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from council is not required.

This REF fulfils Transport for NSW's obligations to consider the environmental impacts of the proposal under Section 5.5 of the EP&A Act and has been prepared in accordance with the provisions of clause 228 of the Environmental Planning and Assessment Regulation 2000. This REF also addresses the relevant considerations of the *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act), *Heritage Act 1977* (Heritage Act), *National Parks and Wildlife Act 1974* (NPWS Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Community and stakeholder consultation

Consultation for the New Richmond Bridge and traffic improvements, inclusive of The Driftway, is being undertaken by Transport for NSW. Engagement for the project began in December 2018 with key stakeholders and community groups. A Community and Stakeholder Engagement Plan (CSEP) was prepared. The objectives of the CSEP include:

- Inform local community and other key stakeholders of the proposed project, the benefits and what to expect
- Identify key stakeholders and community interest groups to identify their needs, requirements and expectations
- Create stakeholder understanding of the proposed New Richmond Bridge and traffic improvements and its objectives
- Seek community and stakeholder feedback on the options study developed for the proposal with enough time for this feedback to be considered and incorporated into the study where feasible
- Provide the community and stakeholders with regular and targeted information to build awareness about the proposal
- Provide clear information about what we are seeking feedback on, when and why and be transparent in what we do
- Ensure community and stakeholder feedback is continuously fed into communication and engagement

- Listen to feedback, investigate suggestions and report back and encourage participation from communities and other stakeholders
- Engage in a manner that is collaborative, innovative, adaptive and sustainable and ensure that information is distributed in an effective and timely manner
- Ensure that community and stakeholder enquiries about the proposal are managed and resolved effectively.

A range of engagement tools have been implemented by Transport for NSW. Workshops were facilitated throughout 2019 and 2021 to discuss the proposal needs, objectives and options with key stakeholders. In 2019 a community update was delivered to 14,000 households, detailing the route options for the New Richmond Bridge and traffic improvements. Feedback was received via community information sessions, the proposal website or by contacting Transport for NSW directly. Over 750 individual comments were received during the seven week consultation period between November 2019 and January 2020, and these comments were considered accordingly in the options assessment.

In 2021 another community update was delivered to 14,000 households in the area detailing the preferred option for the New Richmond Bridge and traffic improvements. The update outlined the preferred option, benefits and details of the upcoming community information sessions. Submissions and community comments were encouraged. The community update also provided a link to the proposal website, design plans, preferred option report and contact details for the proposal team. One face-to-face community information session, four Facebook Live sessions and six targeted online consultation sessions were held to provide information and to receive feedback on the preferred option.

In accordance with Clauses 13 to 16 of the ISEPP, consultation has been and would continue to be undertaken with Hawkesbury and Penrith City Councils and NSW State Emergency Service (SES).

Transport for NSW has consulted on an ongoing basis with key State and local government agencies, utility providers, local property owners and other stakeholders in the proposal area. This consultation was designed to ensure issues and concerns were understood, documented and addressed, and that stakeholders had an opportunity to discuss any aspect of the proposal.

Environmental impacts

The proposal would have some adverse impacts during construction and longer term positive and adverse impacts during operation which would be managed by the implementation of mitigation measures and safeguards as described in Chapter 6 of this REF. These are summarised below.

Biodiversity

The proposal would directly impact on 5.66 hectares of native vegetation. Direct impacts to NSW BC Act and EPBC Act listed Threatened ecological communities (TECs) include:

- Shale Gravel Transition Forest in the Sydney Basin Bioregion (Endangered) (PCT 724)
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered) (PCT 725)
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) (PCT 835)
- Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered) (PCT 849)
- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (Vulnerable) (PCT 883).

A total of 0.08 hectares of PCT 883 - Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion Community, within the proposal area meets the condition criteria for the EPBC Act listed Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion endangered ecological community.

The proposal would directly impact on up to 5,000 individuals of *Dillwynia tenuifolia* a listed Vulnerable species under the NSW BC Act. The proposal would directly impact on moderate to low quality habitat for

the Cumberland Plain Land Snail (*Meridolum corneovirens*) a listed Vulnerable species under the NSW BC Act.

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a Species Impact Statement or Biodiversity Development Assessment Report are not required. The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

Suitable offsets under Transport for NSW *Guideline for Biodiversity Offsets* (2016) would be required to compensate for impacts to biodiversity. The final offset requirement for the proposal would be determined during detailed design and development of the offset package.

Flooding, drainage, and surface water

The proposal would displace about 37,000 cubic metres of available floodplain storage, 7,000 cubic metres of which would be recaptured by removing the embankment associated with the section of The Driftway which would be abandoned near its intersection with Blacktown Road. The loss of floodplain storage would not result in a significant impact on peak flood levels on the Hawkesbury-Nepean River floodplain. Potential increases in rainfall intensities associated with future climate change would result in a minor increase in the depth of inundation to surrounding lands.

During the construction of the proposal, it would be necessary to implement effective erosion and sediment control measures along the full length of the road corridor to control the transportation of sedimentation and runoff. During operation the network of new grass-lined catch drains in combination with the existing grass-lined engineered channel that presently runs along the northern side of The Driftway would reduce the pollutant load discharging to the receiving drainage lines.

Traffic and transport

During construction there would be travel delays that would affect commuter, bus and heavy vehicles traffic. Properties which have direct access to construction activities within the proposal area (mainly along The Driftway) may require temporary access adjustments during the construction phase. The potential impacts caused by construction vehicle traffic would include:

- Increased travel times on roads within the proposal area due to construction speed limits near the site
- Increased travel times for motorists due to construction vehicles on roads and construction vehicles accessing the construction site
- Potential temporary closure of lanes.

Transport for NSW would consult with affected people within the proposal about property access before construction starts. The proposal would improve road safety and road network performance by providing improvements to key intersections. The proposal would substantially improve traffic efficiency during peak traffic periods by reducing delays for vehicles from The Driftway accessing Londonderry and Blacktown Roads and would improve flood resilience.

Noise and vibration

During construction, there would be noise impacts at some sensitive receivers near the proposal where noise management levels (NMLs) are predicted to be exceeded. For these receivers, noise impacts during some stages of construction may be in the moderate to high range. Construction traffic movements along Blacktown Road, Londonderry Road and The Driftway, during both the daytime and night-time periods, is predicted to result in increases of less than one decibel (dB). These potential impacts would be temporary for the duration of the construction works.

During construction, vibratory rolling may occur within 100 meters of residences and this would also create minor disturbance. Where activities involving vibration generating equipment occur within the vicinity of

residents and other sensitive areas, work methods would be developed to avoid the potential for human discomfort and any building damage. Potential cosmetic damage and / or human comfort impacts due to the construction of the proposal would be managed with safeguards and management measures.

During operation, a total of 37 residential buildings are predicted to experience noise levels that exceed the operational road traffic noise criteria increase by more than 2.0 dB. These exceedances would be due to a mixture of increasing noise levels, exceedances of the cumulative limit criteria and acute road traffic noise levels. The 37 residential buildings would be eligible for consideration of additional noise mitigation. A final operational noise mitigation strategy for the proposal would be determined during detailed design and would consider community preference where appropriate.

Soil and contamination

During construction, moderate alterations to the existing topography are anticipated due to areas of cut and fill associated with the realigned section of The Driftway. Removal of vegetation and earth works have the potential to increase sedimentation and erosion. Soils transported into Rickabys Creek could lead to degraded water quality and reduced hydraulic capacity affecting aquatic ecosystems. There would be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials. Spill containment would be used at the temporary ancillary site to contain spills, and spill response procedures would be followed.

Once the proposal is operational, there would be potential for indirect impacts on soils as a result of run-off and drainage. These potential impacts would be managed by revegetating exposed soils and operational water quality measures.

Aboriginal and Non-Aboriginal heritage

The construction and the operation of the proposal are considered unlikely to impact on Aboriginal or Non-Aboriginal heritage items. If Aboriginal or Non-Aboriginal heritage item are uncovered during the construction works, all works would cease and the steps in Transport for NSW *Unexpected Heritage Items* (2015) would be followed.

Landscape character and visual impact

The proposal would result in visual and landscape changes along The Driftway, largely attributed to the removal of vegetation and vegetation screening. Mitigation measures developed as part of an overall integrated design process would effectively manage key concerns resulting in The Driftway being safe and visually appealing. Landscaping and revegetation efforts along The Driftway would assist with the restoration of impacted areas with the surrounding environment and landform.

Air quality

Construction activities have the potential to increase airborne particulate matter and cause nuisance impact where construction is in proximity to sensitive receivers such as residential dwellings. The primary air quality risk during construction is expected to be dust generated from construction activities as well as from wind erosion of exposed areas. Other potential impacts could result from exhaust emissions from construction plant and equipment and odours and hazardous substances arising from uncovering contaminated materials. Modelled results for operational impacts due to increased traffic were considered unlikely to cause adverse impacts from cumulative concentrations.

Socio-economic

Minor property access adjustments may be required to private properties along The Driftway, including modifications to driveways to accommodate the revised road levels and drainage design. The construction of the proposal may cause changes to local amenity for some residents and local business; however, these impacts would be temporary. Once construction is complete, The Driftway as well as its connections to

Londonderry Road and Blacktown Road would be substantially improved. The improvement in safety is ultimately expected to enhance community values.

Justification and conclusion

Transport for NSW is planning to build a new bridge over the Hawkesbury River and associated traffic improvements. Several route options have been identified and considered. Common to each option was improvements to The Driftway between Londonderry and Blacktown Roads.

As improvements to The Driftway were common to all options, and to deliver early safety benefits to the community, the upgrade would be delivered as Stage 1 of the New Richmond Bridge and traffic improvements, facilitating part of the bypass of Richmond town centre.

While there would be some environmental impacts as a consequence of the proposal such as temporary traffic delays, amenity impacts, vegetation clearing and property impacts, they have been avoided, minimised or mitigated wherever possible through design and site-specific safeguards. The benefits of improving road safety, traffic efficiency, and flood resilience are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal

Display of the review of environmental factors

This REF is on display for comment between 15 November and 10 December 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/Richmond-bridge.

Copies by request

Printed and electronic copies are available by contacting the New Richmond Bridge project team on 1800 370 778, noting that there may be a charge for hard copies, CD or USB.

Staffed displays

In response to the evolving Coronavirus situation, Transport is following NSW Health advice and changing the way it approaches community consultation for important transport infrastructure projects. This means consultation will be carried out in different ways to limit the spread of Coronavirus and ensure the community can have their say.

Online community information sessions will be held at the following times:

- 24 November 2021 6-7pm
- 25 November 2021 12-1pm.

The sessions can be joined using the following link: nswroads.work/richmondbridgeinfosession

The team will also be available between 9am and 6pm Tuesday 30 November to Thursday 2 December 2021 for meetings with stakeholders directly impacted by The Driftway upgrade. Please contact the project team on 1800 370 778 or email richmondbridge@transport.nsw.gov.au to book in a time.

How can I make a submission?

To make a submission about this proposal, please send your written comments to richmondbridge@transport.nsw.gov.au.

Submissions must be received by Friday 10 December 2021. Submissions will be managed in accordance with the Transport for NSW Privacy Statement which can be found at www.transport.nsw.gov.au/privacy-statement.

What happens next?

Transport for NSW will collate and consider the submissions received during public display of the REF.

After this consideration, 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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Appendix C	Biodiversity assessment report
Appendix D	Flooding, drainage and surface water report
Appendix E	Noise and vibration assessment report
Appendix F	Landscape character and visual impact assessment report

1. Introduction

Transport for NSW propose to upgrade about 3.6 kilometres of The Driftway between Londonderry Road and Blacktown Road (the proposal). The proposal is located in the suburbs of Richmond, Londonderry and South Windsor, NSW. The upgrade to The Driftway forms Stage 1 of the New Richmond Bridge and traffic improvements.

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- Relocation and/or adjustments to public utilities and street lighting
- Ancillary work including safety barriers, signage, line marking and environmental protection work
- Landscaping and rehabilitation work
- Temporary ancillary construction facility and laydown areas.

The proposal is located in Sydney's North West, between Londonderry Road and Blacktown/Racecourse Road and intersects with three suburbs and two local government areas (LGAs). The suburb of Richmond is located to the north of the proposal, Londonderry to the south and South Windsor to the east. The Hawkesbury LGA lies to the north, Penrith LGA to the south and the Western Sydney University (Hawkesbury Campus) and Hawkesbury City Waste Management Facility are immediately adjacent to the northern boundary of the proposal.

The construction of the proposal is expected to take approximately 18 months to complete. Without the proposed Stage 1 upgrade to The Driftway, delays on The Driftway at key intersections are expected to increase substantially and forecasted growth in traffic and road safety issues would continue to be experienced. The Stage 1 improvements would reduce delays, improve flood resilience and deliver improved safety to an area with a historically poor crash history. A detailed description of the proposal is provided in Chapter 3 of this REF.

The location of the proposal is provided in Figure 1-1 and an overview of the proposal is provided in Figure E-1.

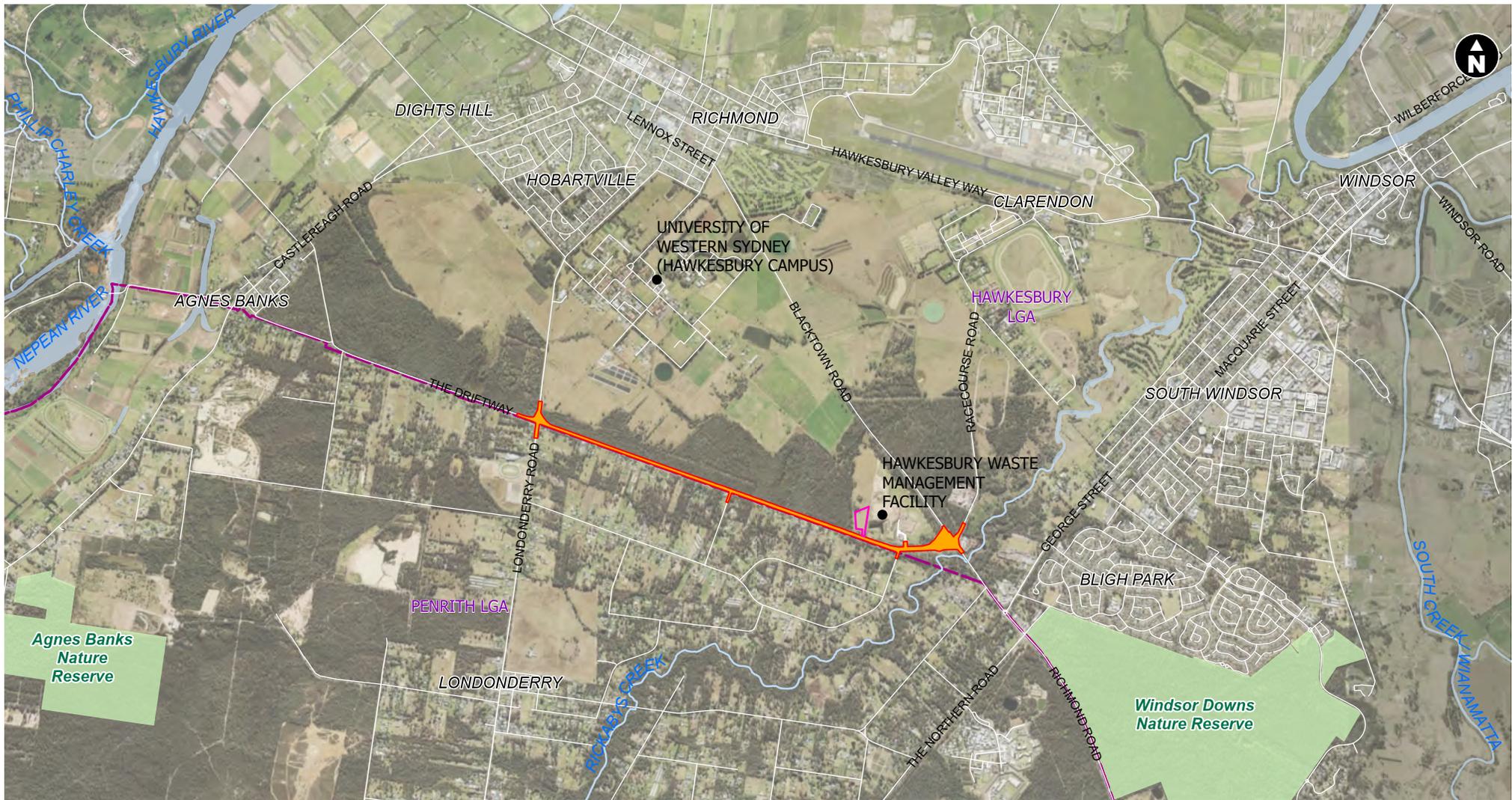


Figure 1-1 Location of the Proposal

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1.1 Purpose of the report

This REF has been prepared by Jacobs Australia on behalf of Transport for NSW. The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented. Transport for NSW is both the proponent and the determining authority for the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The description of the proposed work and an assessment of potential environmental impacts has been undertaken in the context of clause 228 of the *Environmental Planning and Assessment Regulation 2000* (provided in Appendix A), the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979 (Is an EIS required? guidelines)* (DUAP, 1995/1996), *Roads and Related Facilities EIS Guideline* (DUAP 1996) and State and Federal environmental legislation including the *NSW Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In accordance with Section 5.5 of the EP&A Act, this REF considers to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

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

2. Need and options considered

2.1 Strategic need for the proposal

Richmond Bridge is currently operating at capacity during morning and afternoon peak periods, resulting in congestion and increased travel times. Predicted growth in the area would continue to exacerbate this problem. During peak periods, traffic in the road network of Richmond and North Richmond is expected to increase by 44 per cent and traffic crossing the Hawkesbury River is expected to increase by 61 per cent between 2019 and 2046.

Without improvements to the road network, travel times in the morning peak between Richmond and North Richmond are expected to increase by 115 per cent, from about 14 minutes in 2019 to about 30 minutes by 2046. In the afternoon peak, the reverse trip is expected to increase by 73 per cent from about 22 minutes in 2019 to about 38 minutes in 2046. Congestion would also affect journey time, reliability for public transport and increase the potential for crashes.

Local road networks, such as The Driftway, already have a poor safety record. From August 2015 to June 2020, 29 crashes occurred on The Driftway between the intersections of Londonderry Road and Blacktown Road. The 29 crashes resulted in one fatality and 38 injuries.

To reduce congestion between Richmond and North Richmond town centres, improve travel times, cater for future growth and improve connectivity and road safety, specifically at priority intersections along The Driftway, Transport for NSW presented five route options to the community for feedback in late 2019. Each of the five route options included a new bridge over the Hawkesbury River to provide capacity for future traffic growth, long term traffic management, and various alignments to either upgrade through or bypass Richmond and North Richmond town centres.

In early 2020 four options were shortlisted for further assessment, with the option to upgrade through Richmond town centre removed due to community feedback. Each of the four shortlisted options had a common element to upgrade The Driftway between Londonderry and Blacktown Roads as part of a Richmond town centre bypass route which would result in increased traffic volumes on The Driftway. While the traffic volumes would not be sufficient to require additional lanes on The Driftway, safety improvements such as pavement and intersection improvements would be necessary.

The proposed upgrade to The Driftway, as detailed in this REF, forms Stage 1 of the New Richmond Bridge and traffic improvements, facilitating part of the bypass of Richmond town centre while reducing the potential for crashes and increasing road safety. Stage 2 would include a new bridge over the Hawkesbury River and would be considered under a separate environmental approval.

2.2 Strategic planning and policy framework

Several State and local strategic plans refer to the need to improve safety and efficiency in roads in the State. The proposal is consistent with the strategic plans detailed below.

2.2.1 NSW Premiers and State priorities

The NSW Government is working to achieve 12 Premier's priorities and 18 State priorities to grow the economy, deliver infrastructure, protect the vulnerable, and improve health, education and public services across NSW.

The proposal supports the following Premier's priority:

- Building infrastructure – Key infrastructure projects to be delivered on time and on budget across the State. The proposal specifically addresses the need for building infrastructure and supports this Premier's priority by dividing the proposal into stages to allow early delivery of Stage 1.

The proposal supports the following State priorities:

- Safer Communities - Reducing road fatalities. An objective of the proposal is to reduce the number of crashes along the Richmond Bridge corridor
- Infrastructure - Improving road travel reliability. An objective of the proposal is to facilitate 90 per cent journey time reliability for all customers throughout the Richmond Road corridor.

2.2.2 Future Transport Strategy 2056

The *Future Transport Strategy 2056* (Transport for NSW 2018a) builds on the *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) and sets the 40 year vision, strategic directions and outcomes for customer mobility in NSW. The plan identifies the transport challenges that will need to be addressed to support NSW's economic and social performance over the next 20 years and establishes a number of short, medium and long-term actions to address those challenges. These actions provide the overall framework for how the NSW transport system should develop, in terms of services and infrastructure.

By increasing road capacity, which is constructed to current design standards, the proposal would directly support the following Greater Sydney transport customer outcomes:

- Efficient, reliable and easy-to-understand journeys for customers, enabled by a simple hierarchy of services
- A safe transport system for every customer with the aim for zero deaths or serious injuries on the network by 2056
- Transport services and infrastructure are delivered, operated and maintained in a way that is affordable for customers and the community.

2.2.3 Building Momentum: The State Infrastructure Strategy 2018-2038

The State Infrastructure Strategy 2018-2038 (Infrastructure New South Wales, 2017) (the State Infrastructure Strategy) sets out the government's priorities for the next 20 years and combined with the *Future Transport Strategy 2056* and the *Greater Sydney Region Plan*, bring together infrastructure investment and land-use planning for our cities and regions.

The strategy outlines infrastructure NSW's (INSW) recommendations for priority infrastructure projects and initiatives for Sydney and NSW until 2038. In line with the proposal, the strategy identifies road building and upgrading and the associated requirement for new residential dwellings over the next 20 years, as crucial to enabling Sydney's growth.

2.2.4 Greater Sydney Regional Plan

The Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018) envisages three cities where most residents live within 30 minutes of their jobs, education and health facilities, services and leisure opportunities. It includes a structured plan that emphasises how the principal spatial elements of the city are interconnected and integrated to best deliver in four critical areas:

- The integration of the mass transit network with the economic corridors, centres, transit-oriented development, urban renewal and health and education precincts
- The connectivity between the rail freight and strategic road networks and the trade gateways and industrial areas

- The integration of the green grid network with residential neighbourhoods
- The retention of the integrity of the values of the Metropolitan Rural Area and the Protected Natural Area.

Richmond is identified in the plan as a strategic centre and the transport link north-west to the Blue Mountains is identified as a regional corridor. The plan includes ten directions with related objectives, strategies and actions. The proposal directly aligns with the direction of 'A city supported by infrastructure' and the following related objectives:

- Objective 1 – Infrastructure supports the three cities
- Objective 2 – Infrastructure aligns with forecast growth – growth infrastructure compact
- Objective 3 – Infrastructure adapts to meet future needs.

The proposal also supports the following identified directions by providing:

- A city supported by infrastructure
- A well-connected city.

2.2.5 Western City District Plan

The Western City District Plan (Greater Sydney Commission, 2018) is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision of Greater Sydney. It is a guide for implementing the *Greater Sydney Region Plan – A Metropolis of Three Cities*, at a district level and is a bridge between regional and local planning. The Western City District covers the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly LGA's.

The proposal is within this district and directly aligns with:

- Planning Priority W1 – Planning for a city supported by infrastructure and with the following associated objectives from this priority:
 - Objective 1 – Infrastructure supports the three cities
 - Objective 2 – Infrastructure aligns with forecast growth – growth infrastructure compact
 - Objective 3 – Infrastructure adapts to meet future needs.
- Planning Priority W7 – Establishing the land use and transport structure to deliver a liveable, productive and sustainable Western Parkland City and with the following associated objectives from this priority
 - Objective 15 – The Eastern, Greater Parramatta and the Olympic Peninsula, and Western Economic Corridors are better connected and more competitive
 - Objective 16 – Freight and logistics network is competitive and efficient
 - Objective 17 – Regional connectivity is enhanced.
- Planning Priority W10 – Maximising freight and logistics opportunities and planning and managing industrial and urban services land.

2.2.6 Road Safety Plan 2021

The Road Safety Plan 2021 (Transport for NSW, 2018b) sets the direction for road safety in NSW. The NSW Government is committed to reducing fatalities by 30 per cent by 2021. It also aligns the Towards Zero vision with *Future Transport Strategy 2056*, which aims to have an NSW transport network with zero trauma by 2056.

The proposal is consistent with the directions set out in *Road Safety Plan 2021* because it would provide a better standard of road with improved safety through the provision of new, safer intersections at Londonderry Road and Racecourse / Blacktown Road, new right turn bays along The Driftway and new wider road surfaces.

2.2.7 NSW Freight and Ports Strategy

The *NSW Freight and Ports Strategy* (Transport for NSW, 2013) aims to provide a transport network in NSW that enables the efficient flow of goods to the market.

The strategy targets specific challenges associated with the forecast doubling of the NSW freight task by 2031. It recognises that providing a network that minimises congestion would support economic growth and productivity and encourage regional development. In this context the strategy identifies the need to develop and maintain capacity for freight on the road network.

The Richmond Road corridor is identified as a secondary freight route by the *Metropolitan Road Freight Hierarchy on the State Road Network Practice Note* (Transport for NSW, 2011). Secondary freight routes provide links within regions for significant flows of freight serving numerous major businesses and freight origins and destinations within a regional area. Objectives of the strategy which are relevant to the proposal include:

- Delivery of a freight network that efficiently supports the projected growth of the NSW economy
- Balancing freight needs with those of the broader community and the environment.

Actions of the strategy and task actions which are relevant to the proposal include:

- Action 2B – Develop and maintain capacity for freight on the road network
 - Task 2B-2: Prioritise road infrastructure investments
- Action 3B – Manage congestion, noise and emission impacts of freight transport
 - Task 3B-1: Recognise costs of congestion.

The proposal would support these actions by easing traffic congestion, improving travel time and travel reliability for motorists including heavy vehicles. Efficiency of road freight would be improved by increasing safe turning and overtaking opportunities and a new road surface and intersection.

2.2.8 NSW Freight and Ports Plan

The *NSW Freight and Ports Plan* (Transport for NSW, 2018c) supports *Future Transport Strategy 2056* and has the aim of providing a network to move goods in an efficient, safe and environmentally sustainable manner, providing successful outcomes for communities and industry.

The proposal is consistent with this aim because it would assist the safe and efficient freight movements along a secondary freight route.

2.2.9 Hawkesbury-Nepean Valley Flood Risk Management Strategy

The Hawkesbury Nepean Valley has a high flood hazard with a history of flood events. In response to this, INSW prepared the *Resilient Valley, Resilient Communities – the Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW 2017) which is a comprehensive long-term framework for the NSW Government, local councils, businesses and the community to work together to reduce and manage the flood risk in the Hawkesbury-Nepean Valley.

The strategy includes a range of infrastructure and non-infrastructure actions to improve flood resilience. The strategy stated that major regional evacuation road options would not have positive net benefits as they have high construction costs relative to their benefits in terms of reducing risk to life. In addition, these options do not reduce potential economic damages. Therefore, no major regional evacuation road options were selected for the strategy. However, the strategy includes actions to consider flood risk for regional road planning and growth in this Valley.

While Richmond Bridge and The Driftway between Londonderry Road and Blacktown Road do not form part of flood evacuation routes, there is an opportunity to improve flood resilience as part of the proposal. The low point at the eastern end of The Driftway is currently 9.7 metres Australian Height Datum (AHD)

which is below the one in five chance per year flood level. Following improvements to The Driftway, the minimum road level would be raised by over three metres to 13.4 metres AHD which is between the one in ten and one in twenty chance per year flood level, improving network resilience to flooding.

2.3 Limitations of existing infrastructure

There are a number of limitations to the existing infrastructure along The Driftway:

- Injury crash clusters and safety issues have been identified along The Driftway. Many of these crashes relate to conflicts between through and right-turning traffic at key intersections such as The Driftway with Blacktown Road and Londonderry Road. In the last five years, available crash data have recorded one fatality and 38 injuries
- Traffic modelling indicates that both Londonderry Road / The Driftway intersection and the Blacktown Road / The Driftway intersection are expected to be at capacity for future year traffic demands without the upgrade. The Driftway leg of the existing intersection with Blacktown Road is currently at capacity and performing poorly in the morning traffic peak
- Current design infrastructure has poor flood resilience.

2.4 Proposal objectives and development criteria

2.4.1 Proposal objectives

Improvements to The Driftway would form Stage 1 of the New Richmond Bridge and traffic improvements, facilitating part of the bypass of Richmond town centre and substantially improving safety and reducing delays for vehicles accessing Londonderry and Blacktown Roads from The Driftway.

The objectives of the proposal include:

- To improve travel times, journey time reliability and cater for future demand for private, public, active and freight transport between North Richmond, Richmond and the connecting arterial road network
- To improve connectivity between Bells Line of road and Sydney's arterial road network
- To reduce the frequency and severity of crashes on key road corridors between Richmond and North Richmond
- To improve flood resilience
- To support economic development, improved liveability, and Council's long-term vision for the town centres of Richmond and North Richmond.

In pursuing these objectives, Transport for NSW aims to reserve a road corridor that will:

- Improve connections to the Central West of NSW as the alternative connection to the Great Western Highway
- Maintain the historical significance of the area
- Seek to achieve a best fit with the built fabric and natural patterns of the area.

The proposal will also meet the following objectives that are common to road design projects:

- Provide for Safety-by-Design
- Provide appropriate levels of safety for road users
- Develop a cost-effective solution.

2.4.2 Urban design objectives

The following design principles from *Beyond the Pavement – Urban Design Policy, Procedures and Design Principles* (Roads and Maritime, 2014) have been adopted to govern the development of the proposal. The

principles are intended to guide the development of the proposal that meets the functional and engineering criteria while integrating sensitivity with the built, natural and cultural environment.

Urban design objectives for the proposal include:

- Principle 1: Contributes to urban structure and revitalisation
- Principle 2: Fits into the build fabric
- Principle 3: Connects modes and communities
- Principle 4: Fits with the landform
- Principle 5: Responds to the natural pattern
- Principle 6: Incorporates heritage and cultural contexts
- Principle 7: Designing (provides) an experience in movement
- Principle 8: Creates self-explaining road environments
- Principle 9: Achieves integrated and minimal maintenance design.

2.5 Alternatives and options considered

2.5.1 Methodology for selection of preferred option

Several alternatives and options for a new bridge over the Hawkesbury River and improvements to the surrounding road network, including improvements to The Driftway, have been identified and considered in developing the proposal and recommending a preferred option. A detailed description of each option and the approach undertaken to recommend a preferred option is available in the *Richmond Bridge duplication and traffic improvements - Preferred option report* (AECOM, 2021).

Common to each option was improvements to The Driftway between Londonderry and Blacktown Roads, including road widening, drainage, pavement and intersection upgrades. As improvements to The Driftway were common to all options, and to deliver early safety benefits to the community, the upgrade would be delivered as Stage 1 of the New Richmond Bridge and traffic improvements, facilitating part of the bypass of Richmond town centre.

2.5.2 Identified options

Two options were identified for consideration:

- Option 1: do nothing – no improvements to The Driftway
- Option 2: improvements to The Driftway – The Driftway would undergo an upgrade which would form Stage 1 of the New Richmond Bridge and traffic improvements proposal.

Analysis of options

Option 1: Do nothing

- Option 1 would fail to support efforts to reduce congestion or cater for predicted traffic increases and population growth in the local area, nor would it improve safety along The Driftway. Rather, the 'do nothing' option, over time, would lead to an increased safety risk due to unresolved conflicts between through and right-turning traffic at key intersections such as The Driftway and Blacktown and Londonderry Road
- Option 1 would have no construction costs or impacts on the community and the environment as property impacts and vegetation clearing would not be required
- Option 1 would not support the proposal objectives and is not considered to be a feasible option.

Option 2: Improvements to The Driftway

- Option 2 the 'improvements to The Driftway' option would support efforts to reduce congestion and cater for predicted traffic and population growth in the local area by forming Stage 1 of the New Richmond Bridge and traffic improvements proposal. It would improve traffic conditions by reducing delays at key intersections for residents and users of The Driftway. The implementation of safety improvements such as the upgrade of key intersections along The Driftway would significantly reduce the risk of crashes
- Option 2 would have construction costs and would impact on the community and the environment as property impacts and vegetation clearing would be required
- Option 2 would be an appropriate option and a feasible solution to the safety and congestion problems associated with The Driftway and the local area.

Preferred option

Option 2 is considered to be the preferred option, as it addresses the NSW Government's priorities and would meet the proposal objectives. The preferred option would have the following advantages:

- Improve travel time reliability and cater for future growth
- Reduce the frequency and severity of crashes at key intersections (The Driftway and Blacktown Road, The Driftway and Londonderry Road), while improving overall safety along The Driftway
- Improve drainage and flood resilience
- Support economic development and improved amenity of Richmond town centre.

2.6 The Driftway design refinements

2.6.1 Cross section options

To widen the cross section of The Driftway and to improve safety, two options were considered:

- Option 1 – retain the existing 3.25 metre lane widths and widen the shoulders of The Driftway to 1.5 metres to provide improved safety for road users including cyclists on the route. Option 1 would widen the total pavement width by 1.0 metre to 9.5 metres
- Option 2 – widen the cross section in accordance with the *Guide to Road Design* for a rural single carriageway with >3000 vehicles per day (Austroads 2009). This would require 3.5 metres of pavement widening and shifting of the open table drain to achieve 3.5 metre-wide lanes and 2.5 metre-wide shoulders.

Analysis of options

- Both Option 1 and Option 2 would require vegetation removal, impacting on Threatened Ecological Communities (TECs) listed under the NSW BC Act and / or EPBC Act which are present along the boundaries of The Driftway
- Option 2 would directly impact on an additional two hectares of TEC than Option 1.

Preferred option

Option 1 was considered to be the preferred option due to the reduced impact to TECs, reduced construction costs and overall environmental impacts. Further, review of the most recent five years of crash data shows crashes have only occurred at intersections with no mid-block crashes. Option 1 would support the proposal objectives.

2.6.2 Widening options

Following selection of a preferred option for the cross section, options for widening the road were considered:

- Option 1 – widen the road to the north
- Option 2 – widen the road to the south
- Option 3 – widen the road to north and the south.

Analysis of options

- Option 1 would increase impact on TECs present along the northern border and in the east of The Driftway. The preference is to minimise impacts to NSW BC Act and / or EPBC Act listed TECs where possible
- Option 2 would be constrained by the table drain and would impact private residential properties at some locations
- Option 3 would widen the road to the north from 100 metres to 1400 metres east of Londonderry Road transitioning to widening the road to the south from 1400 metres to 3300 metres east of Londonderry Road based on proximity of vegetation and drainage to the road. This would minimise impacts to NSW BC Act and / or EPBC Act listed TECs and the potential for impact to private properties.

Preferred option

Option 3 was considered the preferred option and would support the proposal objectives.

2.6.3 Pavement improvement options

Two primary pavement options were considered:

- Option 1 – maintain existing pavement levels
- Option 2 – raise the pavement levels by 210 millimetres.

Analysis of options

- Option 1 would require stabilisation to improve the strength and condition of the existing Driftway pavement, based on a 20-year design life. The existing pavement surface would need to be milled before stabilisation to 50 millimetres below the finished road level. Option 1 would result in increased cut and offsite disposal of unsuitable material and import of suitable material to achieve a 20-year design life. This process would result in increased cost and environmental impact associated with disposal of unsuitable material
- Option 2 would involve the stabilisation of existing material and an asphalt overlay on the existing pavement to achieve a 20-year design life. By stabilising existing material, offsite disposal would be minimised reducing project costs and environmental impacts.

Preferred option

Option 2, raising existing levels is the preferred option, minimising waste, costs and environmental impacts. Regardless of the pavement option selected, localised modifications to private property access driveways would be required as a result of driveway cross drainage improvements. Option 2 would support the proposal objectives.

2.6.4 Intersection upgrade options

Two options were considered to upgrade key intersections of The Driftway at Londonderry and Blacktown Roads:

- Option 1 – new roundabout at the intersections
- Option 2 – new traffic signals at the intersections.

Analysis of options

- Option 1, the construction of a roundabout can reduce crashes typical of The Driftway intersections by up to 85 percent, according to Transport for NSW Crash Treatment Reduction Rates Matrix
- Option 2, the construction of traffic signals can reduce crashes typical of The Driftway intersections by up to 70 percent, according to Transport for NSW Crash Treatment Reduction Rates Matrix
- Option 1, roundabouts typically reduce the severity of crashes by slowing vehicles down through intersections by about 46 percent minimising conflict points and changing the angle at which they might intersect (Austroads 2009). Providing greater safety improvements particularly where the speed limit is 80 kilometre per hour with long straight approaches
- Both options would have impacts to NSW BC Act and / or EPBC Act listed TECs and Western Sydney University property near Londonderry Road
- Both Option 1 and Option 2 would improve efficiency particularly for The Driftway which does not have priority over Londonderry Road and Blacktown Roads. The primary crash type at both intersections involves vehicles turning right at intersections colliding with vehicles travelling straight through the intersection
- A variation of Option 1 was also investigated, to avoid Western Sydney University property entirely by shifting the roundabout at Londonderry Road to the south. This would result in impacts to ten private properties including three to five full and five to seven partial acquisitions depending on final design and discussions with property owners and is therefore not preferred.

Preferred option

Option 1 is the preferred option providing greater safety improvements to the key intersections of The Driftway. To minimise impacts to NSW BC Act and / or EPBC Act listed TECs and Western Sydney University property, the dimensions of the roundabout proposed at The Driftway and Londonderry Road were modified, reducing the radius from 22 metres to 20 metres. Option 1 would support the proposal objectives.

2.6.5 Bridge options for the tributary of Rickabys Creek

Two options were considered for the bridge type over the tributary of Rickabys creek:

- Option 1 – 455 millimetre Deep Plank bridge
- Option 2 – 1000-millimetre-deep Bulb-T girders.

Analysis of options

- Option 1 would be comprised of two spans of 12 metre length, with 455-millimetre-deep plank girders. The benefits of this option would include a lower construction cost and the shallow plank girders would provide a greater waterway area underneath the bridge, however, the need for a pier in the centre of the creek to support the bridge would increase the environmental impact creating a barrier to waterway flow. Direct and indirect impacts to the waterway would occur during construction and operation of the bridge
- Option 2 would be comprised of a single span of a 24 metre length with 1000 millimetre-deep Bulb-T girders. Option 2 would have a higher construction cost and deeper girders which reduce the waterway area underneath the bridge, however, it does not require a pier in the centre of the creek for support, reducing direct impacts to the environment and avoiding restrictions to waterway flow.

Preferred option

Option 2 is the preferred option. Although Option 2 is more costly than Option 1 to construct, the direct and indirect impacts to the environment and the waterway would be reduced with Option 2. Option 2 would support the proposal objectives.

3. Description of the proposal

This chapter of the REF describes the proposal and details the existing conditions, the design criteria, the construction and work activities and the associated infrastructure.

3.1 The proposal

Transport for NSW propose to upgrade about 3.6 kilometres of The Driftway between Londonderry Road and Blacktown Road (the proposal). The proposal is located in the suburbs of Richmond, Londonderry and South Windsor, NSW. The upgrade to The Driftway forms Stage 1 of the New Richmond Bridge and traffic improvements. Stage 2 would include a new bridge over the Hawkesbury River and associated traffic improvements and would be subject to a future, separate environmental approval assessment.

Key features of Stage 1 of the proposal would include:

- Upgrade of the intersection of Londonderry Road / The Driftway to a roundabout
- Upgrade of The Driftway intersections with Luxford Road and Reynolds Road to channelised right turn T-junctions
- Realignment of 230 metres of The Driftway at its eastern extent to create a four-leg roundabout with Blacktown Road and Racecourse Road
- A new 24 metre long bridge over a tributary of Rickabys Creek
- A new 30 metre long retaining wall along the north western corner of Racecourse Rd and Blacktown Road
- Pavement improvements to 3.6 kilometres of The Driftway including widening both shoulders to 1.5 metres
- Modifications to driveways and property adjustment works
- Removal of the redundant section of The Driftway and its intersection with Blacktown Road. Reshaping of this area for flood storage capacity
- Drainage improvements along The Driftway
- Relocation and/or adjustments to public utilities and street lighting
- Ancillary work including safety barriers, signage, line marking and environmental protection work
- Landscaping and rehabilitation work
- Temporary ancillary construction facility and laydown areas.

The key features of the proposal are shown in Figure 3-1 and Figure 3-2.



Legend

- The Driftway design
- Construction footprint
- Potential temporary ancillary facility



GDA2020 MGA Zone 56

Data sources¹
 Jacobs 2021
 NSW Spatial Services 2021



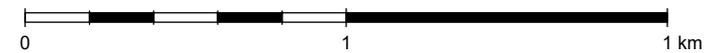
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Figure 3-1 Key features of the proposal (western)



Legend

- The Driftway design
- Construction footprint
- Potential temporary ancillary facility



GDA2020 MGA Zone 56

Data sources2
 Jacobs 2021
 NSW Spatial Services 2021

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Figure 3-2 Key features of the proposal (eastern)

3.2 Design

The proposal design features have been based on the concept design and would be refined through the detailed design phase prior to construction.

3.2.1 Design criteria

The road design has been carried out in accordance with the following guidelines and standards:

- The project specifications
- *Austroads Guide to Road Design* (Austroads, 2009) and *Transport for NSW supplements to the Austroads Guide*
- *Austroads Road Safety Audit Manual* (Austroads, 2009)
- *Transport for NSW Road Design Guide* (Roads and Maritime, updated)
- Other current TfNSW publications.

The design criteria specific to the proposal is provided in Table 3-1. Indicative cross sections are presented in Figure 3-3 and Figure 3-4.

Table 3-1: Design criteria

Design element	Minimum design criteria
Speed	<ul style="list-style-type: none"> • Posted speed: 80 km per hour • Design speed: 90 km per hour
Design vehicle	<ul style="list-style-type: none"> • 26 m B-Double ⁽¹⁾ • 12.5 m single unit truck or bus ⁽²⁾
Check vehicle	<ul style="list-style-type: none"> • PBS Level 3A (36.2 m A-double) ⁽¹⁾ • 19 m semi-trailer ⁽²⁾
Widths	<p>Overall corridor width:</p> <ul style="list-style-type: none"> • Existing road section <ul style="list-style-type: none"> Lane widths: 3.25 m Shoulder width: 1.5 m • Realigned section <ul style="list-style-type: none"> Lane widths: 3.5 m Shoulder width: 2.5 m Right turn lane width: 3.3 m
Shared path	At roundabouts 3.6 m wide
Flooding	Minimum 1 in 10 chance per year flood resilience
Batter slopes	<p>Embankment on realigned section of The Driftway</p> <ul style="list-style-type: none"> • Fill batter: 2:1 • Cut batter: 2:1 <p>Embankment on existing section of The Driftway</p> <ul style="list-style-type: none"> • Fill batter: 2:1 on northern verge, 6:1 on southern verge adjacent to properties

Design element	Minimum design criteria
Pavement	Design life: 20 years
Minimum sight distance	Safe Intersection & Stopping Sight Distance achieved for design speed (90km/h): 126 m
Drainage	<ul style="list-style-type: none"> • Pavement drainage • Cross drainage culverts
Lighting	The Driftway is classified as a local road and the applicable lighting category would be determined by either Hawkesbury or Penrith City Councils. At intersections with State Roads, Transport for NSW would determine the appropriate category

(1) Intersection of The Driftway with Londonderry Road, Blacktown Road Access from The Driftway to Hawkesbury Waste Management Facility
(2) Intersection of The Driftway with: Luxford Road, Reynolds Road

3.2.2 Engineering constraints

The key engineering constraints associated with the proposal include:

- The Driftway is primarily a level road for the majority of its length. The provision of adequate drainage along the length of The Driftway is a continued constraint. The current drainage is affecting the quality of the pavement as water regularly ponds adjacent to the roadway
- The eastern end of The Driftway floods in relatively minor events
- The southern side of The Driftway has several property accesses which would require driveway modification and property adjustment to accommodate new drainage and improvements to the pavement along The Driftway
- The horizontal and vertical curves at the eastern end of The Driftway do not meet current road design standards
- A significant amount of the vegetation which borders the north and eastern end of The Driftway is NSW BC Act and / or EPBC Act listed TECs. A portion of the TECs are within the clear zone for an 80 kilometre per hour posted speed limit and would be directly impacted
- Utilities would require relocation, particularly at intersections.

3.2.3 Major design features

Major design feature 1 – Upgrade of the intersection of Londonderry Road and The Driftway

The existing intersection between Londonderry Road and The Driftway is a four-way intersection that gives priority to Londonderry Road (MR630) and has a stop sign control for The Driftway.

The intersection would be upgraded to a single lane roundabout, which would help reduce vehicle crashes. The roundabout has been positioned to avoid impacts to the two corner residential properties south of The Driftway by shifting the centre of the circulating roadway north from the existing intersection point of the two roads. Each approach to the roundabout has been curved (660 metre radius) to intersect at the centre of the roundabout. The roundabout would include a mountable 1.2 metre wide annulus around the central island to accommodate the turning path of a 36.2 metre long A-double vehicle.

Major design feature 2 – Upgrade of The Driftway intersections with Luxford Road and Reynolds Road

The existing give way T-junction intersection between The Driftway and Luxford Road would be upgraded to include a right turn bay to allow vehicles waiting to turn right into Luxford Road to safely store clear of through traffic. Widening for the right turn bay would be on the southern side of The Driftway to minimise impacts to the wide-open drain and vegetation on the northern side.

The existing give way T-junction intersection between The Driftway and Reynolds Road would also be upgraded to include a right turn bay to allow vehicles waiting to turn right into Reynolds Road and safely stay clear of through traffic.

Major design feature 3 – Realignment of The Driftway and new intersection with Blacktown Road and Racecourse Road

The existing arrangement between Blacktown Road (MR537), The Driftway and Racecourse Road is a staggered T-junction separated by about 130 metres. The Driftway has stop sign control and Racecourse Road has a give way control.

East of Reynolds Road, The Driftway would be realigned to intersect with Blacktown Road at Racecourse Road to make a four-way roundabout intersection to improve the safety performance of the intersection. The roundabout would include a mountable 1.2 metre wide annulus around the central island. The realigned section of The Driftway would eliminate an existing tight curve which requires the posted speed to be set at 60 kilometres per hour at that location.

The vertical alignment for the realigned section of The Driftway approaching Blacktown Road would be about 3.4 metres higher than the low point of the existing road, thus improving the resilience to Hawkesbury River backwater flooding. An existing 10.8 metre long and 6.7 metre wide unused bridge, on the old alignment of The Driftway would be demolished.

The proposal would displace about 37,000 cubic metres of available floodplain storage, 7,000 cubic metres of which would be recaptured by removing the embankment associated with the section of The Driftway which would be abandoned near its intersection with Blacktown Road.

Major design feature 4 – A new 24 metre long bridge over a tributary of Rickabys Creek

A new 24 metre long two lane bridge, over an existing water course that flows to Rickabys Creek, would be required for the realignment of The Driftway near the intersection with Blacktown Road. The bridge configuration would consist a 3.6 metre wide shoulder on the eastbound side, two 3.7 metre wide lanes, a 1.0 metre wide painted median, a 3.0 metre wide shoulder on the westbound side and a 4.0 metre wide footway to make allowance for a shared path on the southern side. The bridge design would allow for future widening to four lanes to provide more capacity for future intersection upgrades if required.

Safety barriers may be required upon approach to the new bridge on the realigned section of The Driftway, near the intersection with Blacktown Road. The exact location and the design of safety barriers would be determined during detailed design.

The proposed cross-section for the bridge (initial bridge configuration) is shown in Figure 3-3.



Figure 3-3: Proposed cross section for The Driftway Bridge over Rickabys Creek

Major design feature 5 – Pavement improvements and widening of The Driftway

Pavement improvements and the widening of The Driftway are proposed for about 3.6 kilometres of the existing alignment from the new roundabout at Londonderry Road to about 200 metres east of Reynolds Road. The alignment of The Driftway would be maintained along this section and would include widening both shoulders to 1.5 metres.

There would be additional widening on the southern side of The Driftway near the intersection with Luxford Road to make provision for the right turn bay. For midblock sections of The Driftway, the existing lane widths of about 3.25 metres would be retained.

The existing pavement would be stabilised, and a new pavement layer placed on top to reduce maintenance issues which would raise the pavement profile by 200 millimetres. Driveways will need to be modified to match the new pavement profile.

Typical, proposed cross sections of The Driftway west of the realigned section is shown on Figure 3-4.

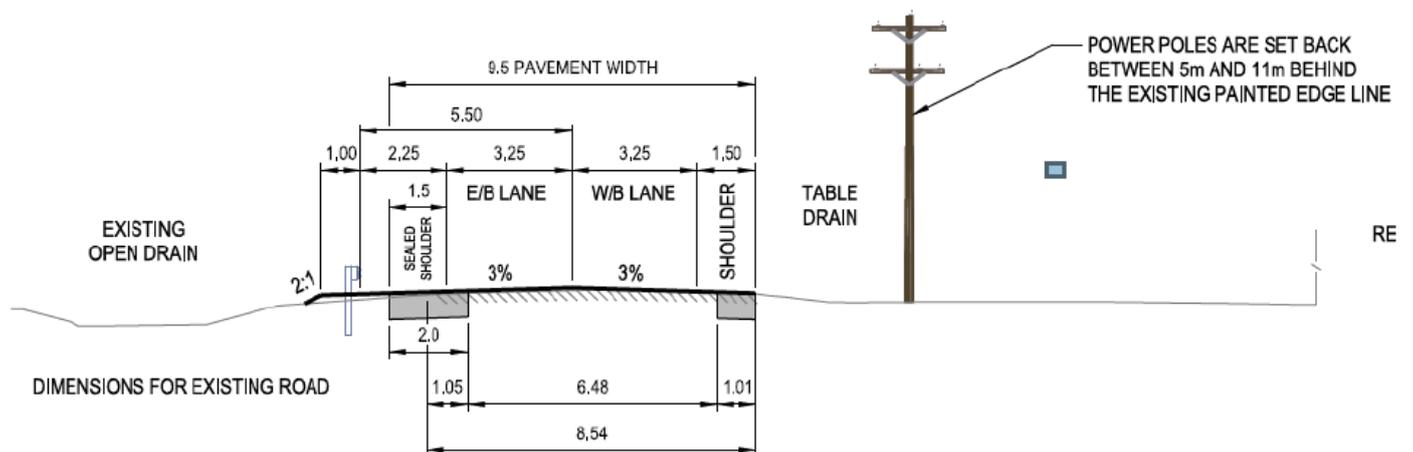


Figure 3-4: Proposed cross section for The Driftway Bridge west of the realigned section

Major design feature 6 – Drainage improvements

Permanent catch and toe drains would be installed during the initial stages of the construction along the southern side of the Driftway, along accesses to driveways and private properties. The catch and toe drains would be augmented with temporary diversion drains in order to direct clean water runoff around the disturbed areas wherever feasible. Transverse drainage works would be carried out during the initial stages

of the construction in order to allow the passage of clean water through the construction site. A summary of the proposed upgraded transverse drainage structure is provided in Table 3-2 below.

Table 3-2: Proposed transverse drainage

Road Name	Approximate Design Road Chainage	Proposed Transverse Drainage				
		Dimensions / Type ⁽²⁾ (mm)	Upstream Invert Level ⁽³⁾ (m AHD)	Upstream Invert Level ⁽³⁾ (m AHD)	Principal Direction of Flow	Adopted ARR2019 Blockage Factor (%)
The Driftway	200	2 off 450 RCPs	21.680	21.610	North	50
	625	1 off 450 RCP	20.810	20.740	North	
	1225	1 off 450 RCP	19.685	19.580	North	
	1750	Existing				
	1850	Replace with new 1 off 450 RCP crossing Luxford Road and discharging to outlet of 2 off 1200 x 900 RCBCs at DRC 1750				
	2150	1 off 450 RCP	20.080	19.981	North	50
	2450	1 off 450 RCP	19.313	19.204	North	
	2725	2 off 450 RCP	18.350	18.230	North	
	2880	Existing + 4 off 1200 x 600 RCBCs	Match Existing		North	
	3075	1 off 450 RCP	18.570	18.413	North	
	3750	24 m long single span bridge			South	0
Blacktown Road	0	Existing				

3.3 Construction activities

This section provides a summary of the probable construction activities that would be associated with the proposal. For the purpose of this REF, an indicative construction plan and methodology are provided.

Detailed construction plans, and methods would be confirmed prior to construction commencing. The actual construction method may vary from the description in this chapter due to factors such as identification of on-site conditions during pre-construction activities, ongoing design refinement and consultation with property owners.

A construction environmental management framework to manage and mitigate impacts is presented in Chapter 7. The final construction plan and methodology would be chosen by the contractor but would be consistent with the framework detailed in this REF.

3.3.1 Work methodology

Construction activities would be guided by a Construction Environmental Management Plan (CEMP) to ensure construction work is carried out to Transport for NSW's specifications. Detailed work methodologies would be identified by the construction contractor.

The proposal would be constructed using conventional methods used on other road projects. These methods may be modified or refined to respond to engineering and environmental constraints. The indicative construction phases and activities for the proposal are described in Table 3-3.

Table 3-3: Indicative construction methodology

Construction phase	Indicative activities
Site establishment and early works	<ul style="list-style-type: none"> • Establish temporary fencing and exclusion zone fencing, and clear demarcation of clearing limits • Install temporary environmental controls including erosion, sediment and water quality controls • Establish temporary ancillary sites including main site compound and stockpile areas • Transport plant and equipment to site • Property adjustment work (including adjustments to property accesses where required) • Install temporary traffic control barriers along the existing roadway to separate the construction site from the travelling public. This would include temporary signage (including variable message signs – VMS), lighting, and other traffic control devices • Adjust/relocate utility infrastructure (water, sewer, overhead electricity and telecommunications) where required.
Vegetation clearing	<ul style="list-style-type: none"> • Remove and mulch vegetation in stages along the new road alignment • Strip and stockpile topsoil in stages • Prepare the surface using graders, dozers and other equipment.
Intersection upgrade (Londonderry Road))	<ul style="list-style-type: none"> • Clearing of vegetation • Removal and stockpiling of topsoil • Cut to fill operations including removal of spoil in preparation for formation construction • Foundation treatment (stabilisation/remove & replace) • Localised pavement drainage works • Stage roundabout.
Realignment work (and Blacktown Road roundabout)	<ul style="list-style-type: none"> • Demolition (milling) of existing asphalt on the Driftway • Clearing of vegetation • Removal and stockpiling of topsoil • Foundation preparation of retaining wall footing at Western corner of Racecourse & Blacktown Road • Footing and retaining wall construction • Backfill with select material and installation of drainage against retaining wall • Cut to fill operations including the removal of spoil to achieve the required levels at the underside of the new road surfaces • Placement and compaction of selected material (usually crushed rock or natural gravels) • Placing, compacting and finishing of either concrete or gravel road surface sub-base layers (to match existing adjacent road surface profile where required) • Placing, compacting and finishing of pavement.

Construction phase	Indicative activities
Bridge construction	<ul style="list-style-type: none"> • Site preparation • Construction of base slab • Place bridge size culverts using crane • Finalise earthworks over culverts Complete road approaches for new bridge.
Drainage upgrades	<ul style="list-style-type: none"> • Cross drainage across The Driftway (RCP and possible culvert installation) • Excavation • Lay geofabric and subsoil pipe • Backfill for subsoil drainage.
Road work - widening and pavement	<ul style="list-style-type: none"> • Implement diversions and traffic management controls as needed • Remove materials to support the new work and depth (referred to as boxing out) • Milling the road surface • Prepare and level the subgrade • Lay and compact new road surface layers • Boxout for possible southern side shared path • Formwork, install of reo and pour shared path.
Property adjustments	<ul style="list-style-type: none"> • Prepare temporary access (surface preparation for ingress/egress of vehicles) as required • Boxout driveway, prime seal surface, chip seal driveway and reinstate access.
Finishing work and demobilisation	<ul style="list-style-type: none"> • Installation of road furniture (lighting, safety barriers, guideposts) • Installation of traffic control signals • Line marking • Installation of urban design treatments and features and landscaping work • Removal of all temporary work (traffic control barriers, lighting) • Landscape and final treatments and finishes • Transport stockpiled waste and spoil to a licensed facility or suitable location • Rehabilitate ancillary sites.

3.3.2 Construction workforce

The construction workforce would fluctuate, depending on the stage of construction and associated activities. A workforce of approximately 50 personnel at any given time is expected during the construction period. The final number of construction workers would be identified by the construction contractor. It is expected that about 50 light vehicle movements to the site prior to the commencement of work shifts and at the conclusion of work shifts would be generated as the workforce travels to and from the site. All staff parking would be accommodated on-site and not in the surrounding local streets.

3.3.3 Construction hours and duration

Construction of the proposal is expected to take 18 months to complete. Table 3-4 below gives an indication of timing for each of the construction phases.

Table 3-4: Indicative timing of the construction phases

Construction phase	Construction timing (months)									
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	
Site establishment / early works	C									
Vegetation clearing		C								
Intersection upgrade (Londonderry Road)		C	C	C	C					
Realignment Blacktown Road roundabout)			C	C	C	C				
Bridge construction			C	C	C					
Drainage upgrades				C	C	C				
Road work – widening / pavement					C	C	C			
Property adjustments		C	C			C	C			
Finishing work and demolition								C	C	

All works undertaken during the construction phase of the proposal would be in accordance with the *Transport for NSW Construction Noise and Vibration Guideline (2016)*:

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

To minimise disruption to the local traffic along key roads affected by construction (such as The Driftway, Londonderry Road, Blacktown Road, Racecourse Road and any local roads), some out of hour’s work may be required (night and weekends). Out of hours work would be carried out in accordance with the *Transport for NSW Construction Noise and Vibration Guideline (2016)* and would be required for work such as emergency work to prevent loss of life or property, to prevent environmental harm, tie-ins with the eastern and western extents of construction, to reduce traffic impacts and/or other work on a case-by-case basis. The expected hours of work for each of the construction phases are described in Table 3-5 below.

Table 3-5: Hours of work for the construction phases

Construction phase	Estimated (weeks)	Hours of work			
		Standard day	Day OOH (Out of Hours)	Evening	Night
Site establishment and early works	4	Yes	-	-	-
Vegetation clearing	4	Yes	-	-	-
Intersection upgrade (Londonderry Road)	16	Yes	Yes	-	Yes
Realignment and pavement work (and Blacktown Road roundabout)	16	Yes	Yes	Yes	Yes
Bridge construction	12	Yes	Yes	-	-
Road work – widening and pavement	12	Yes	Yes	Yes	Yes
Drainage upgrades	12	Yes	-	-	Yes
Finishing work and demolition	6	Yes	Yes	-	-

3.3.4 Plant and equipment

An indicative list of plant and equipment required for each phase of construction is provided in Table 3-6. Additional equipment that would likely to be used would be identified before construction by the construction contractor.

Table 3-6: Indicative construction plant and equipment

Indicative construction plant and equipment	
<ul style="list-style-type: none"> asphalt paver backhoe bobcat bulldozer concrete breaker concrete saw concrete pump and agitator excavator – up to 35 tonnes franna cranes generators grader 	<ul style="list-style-type: none"> handheld tools light and heavy vehicles light vehicles line marking truck milling machine scrapers site office, site shed and amenities soil compactors – up to 35 tonnes trucks and semi-trailers under-boring machine vibrating and static roller

3.3.5 Earthworks

The majority of earthworks for the proposal would be associated with the realignment of The Driftway at its eastern extent to create a four-leg roundabout with Racecourse Road. Approximately 41,000 cubic metres of fill and 15,000 cubic metres of cut would be required.

These estimates may change depending on the actual quality of material, the depth to bedrock, and the suitability of the material for re-use in construction. The material not obtained from the construction site would be sourced from local areas where practicable. Material unsuitable for construction use would need to be transported offsite by a licensed contractor for disposal at a licensed waste management facility following testing and classification. Earthwork's quantities would be confirmed before construction.

3.3.6 Source and quantity of materials

The type and indicative quantities of resources and materials needed for construction of the proposal would include:

- Earthwork's materials (sand, gravel, topsoil, imported fill material, general fill, verge material, rocky fill) and selected material for road formation
- Bitumen and aggregates (stone, sand, gravel) for pavement production
- Cement and aggregates (fly ash, gravel, crushed rock) for concrete used in drainage construction, pavement construction, and miscellaneous work such as barrier kerbs, kerbs and gutters, paving and signpost footings
- Precast concrete elements for drainage construction (pipes, pits and headwalls) and miscellaneous work
- Steel for barrier railings and reinforcement in concrete.

Construction water would be required, but not limited to, compaction, dust suppression and drainage investigations/testing. The amount of water that would be required during construction is unknown at this stage as it would depend on material sources and methodologies applied by the construction contractor. Water for the work would be sourced from authorised off-site sources, including recycled or reused water where available. The quantities of the main materials required for construction would be revised as the design develops.

3.3.7 Traffic management and access

Construction vehicles

Construction would lead to a temporary increase in traffic on The Driftway and the surrounding road network. The movement of plant, equipment, and materials using heavy vehicles would be completed outside of peak traffic periods where possible. The majority of light vehicle movements generated by construction workers would occur outside the traffic peak periods due to shift start and finish times (7 am and 6 pm). Delivery and heavy vehicle movements would generally occur within standard construction hours. This increase is not considered significant in comparison to existing traffic volumes.

Construction vehicle movements are expected to peak during material delivery and during the main earthwork and civil construction with vehicles transporting equipment, materials and spoil, and construction workers accessing the proposal area. Construction traffic would mostly be comprised of light vehicles and light and heavy trucks. Heavy vehicles would be used to deliver construction material and to transfer construction materials to the proposed ancillary facility.

Any haulage movements would be in accordance with an approved Traffic Management Plan (TMP). Further safeguards and management measures for traffic and transport impacts are provided in Section 6.3.4. As most of the required fill material would be sourced from outside the proposal area,

truck haulage routes would be required between the proposal area and the sourced material. These routes would be detailed in the TMP.

Traffic management, control, and signage

Where possible, construction would be programmed to minimise impact on traffic using the local and regional road network. Traffic management measures would be implemented to reduce the risk of increased congestion from the road works while ensuring traffic flow is maintained in the proposal area. Detailed traffic management measures would be documented in the TMP, which would be developed and carried out in accordance with *Transport for NSW's Traffic Control at Work Sites Manual* and *G10 Specification for Traffic Management (2020)*.

The TMP would include traffic control, temporary speed restrictions and temporary lane closures at tie in points and ancillary site access points. It would also detail traffic management measures, lane closures and temporary speed restrictions during pavement and line marking work and the management for oversized vehicles moving through the construction site and work areas.

A Road Occupancy Licence (ROL) would be obtained before construction starts, as required. Construction parking impacts would also be managed through measures identified in the TMP and CEMP. Further details on the management of vehicles during construction are provided in Section 6.3.4.

3.4 Ancillary facility

A single temporary ancillary site would be required to construct the proposal. The ancillary site would be required for use during construction for various activities including material and equipment/plant storage and laydown, vehicle and equipment refuelling, site offices, construction workforce parking and amenities.

A preferred location for the ancillary facility has been identified on the northern side of The Driftway about 350 metres east of Reynolds Road, adjacent to the Hawkesbury City Waste Management Facility. The ancillary site is located on land owned by the Western Sydney University (Hawkesbury Campus) and would only be used pending consultation and a leasing agreement with the University. The indicative location of the ancillary site is shown in Figure 3-2.

Additional stockpile areas may also be required during construction. The ancillary site and any additional stockpile sites would be established and managed in accordance with the *Stockpile Site Management Guideline* (Roads and Maritime, 2015). The site location best practice criteria for ancillary and stockpile sites are set out below:

- Above the 20 year Average Recurrence Interval (ARI) flood level
- At least 40 metres away from the nearest waterway
- At least 100 metres away from residential dwellings and other land uses that may be sensitive to noise
- In previously disturbed areas that do not require the clearing of native vegetation
- In plain view of the public to deter theft and illegal dumping
- Outside the drip line of trees and on level ground wherever possible.

Access to the ancillary site would be established to enable heavy vehicle access and turning movements. The ancillary site would be securely fenced with temporary fencing. Signs would be erected advising the general public of access restrictions and contact details in the event of emergency or incident.

Following construction, the ancillary site, work areas and stockpiles would be removed, and the sites would be cleared of all rubbish and materials and rehabilitated to their existing condition or as otherwise agreed with the landowner on completion of work. The potential impacts of the proposed ancillary facility are considered throughout this REF.

3.5 Public utility adjustment

The location and presence of utilities has been derived from ground surveys. Endeavour Energy 33 kV overhead power lines are located on the southern side of The Driftway and western side of Londonderry Road within the proposal area.

These power lines would be largely unaffected; however, some power pole relocations would be required for the realigned section of the Driftway, east of Reynold Road and at the intersection of The Driftway with Londonderry Road. Other utilities that will require protection or relocation, particularly at intersections include a water main, sewer main, optical fibre and underground electricity.

The ancillary facility may need to be connected to running water, telecommunications and electricity. Utility infrastructure required to connect these sites would be identified during construction planning.

3.6 Property acquisition

Most of the proposal is located within the existing road reserve, with only minor partial property acquisitions required. The proposal would require partial acquisition and lease over land occupied by Western Sydney University as outlined in Table 3-7 and shown on Figure 3-5.

All acquisitions would be conducted in accordance with the *Transport for NSW Land Acquisition Guide* (2014), and compensation and based on the requirements of the *Land Acquisition (Just Terms) Compensation Act 1991*. Final lease and acquisition areas would be confirmed before construction in consultation with landowners.

Table 3-7: Proposed property acquisition

Description	Total (ha)	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
Land required for the road corridor (Londonderry Road roundabout)	0.16	Partial	State of NSW (Western Sydney University)	Lot 31/ DP127080 8	SP1 Special Activities (Education, Agriculture, Research Station) The north east corner of The Driftway and Londonderry Road is in the final stages of being approved under a Biodiversity Stewardship Agreement (BSA). Compensation in accordance with Section 5.16 of the BC Act would be required
	0.04	Partial	State of NSW (Western Sydney University)	Lot 181/DP397 68	SP1 Special Activities (Education, Agriculture, Research Station)
Land required for the temporary ancillary facility	1.9	Lease	State of NSW (Western Sydney University)	Lot 32/ DP127080 8	SP1 Special Activities (Education, Agriculture, Research Station)

Minor property adjustments may be made during construction to existing private property accesses along The Driftway to accommodate the revised road levels. Properties which have direct access to construction activities within the proposal area may require temporary access adjustments during the construction phase. If restrictions are required, for example during utility work or driveway adjustments, this would be for short durations and organised in consultation with the affected property owner(s) and businesses. Emergency services and pedestrian access to properties would be maintained at all time.

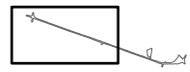


Legend

- | | | | |
|-------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------|------------------|
|  | Construction footprint |  | Acquisition type |
|  | Potential temporary ancillary facility | | Partial |
|  | Cadastre | | |



GDA2020 MGA Zone 56



Data sources¹
 Jacobs 2021
 NSW Spatial Services 2021



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Figure 3-5 Proposed property acquisition

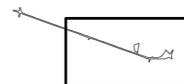


Legend

- | | | | |
|-------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------|------------------|
|  | Construction footprint |  | Acquisition type |
|  | Potential temporary ancillary facility |  | Lease |
|  | Cadastre | | |



GDA2020 MGA Zone 56



Data sources2
 Jacobs 2021
 NSW Spatial Services 2021

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Figure 3-5 Proposed property acquisition

4. Statutory and planning framework

The statutory and planning framework for the proposal is provided below including the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

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

As the proposal is for a road and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not 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 ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development.

Consultation, including consultation as required by ISEPP (where applicable), is discussed in Chapter 5 of this REF and the checklist is provided in Appendix B.

State Environmental Planning Policy (Koala Habitat Protection) 2019

This State Environmental Planning Policy (Koala Habitat Protection) 2019 (Koala SEPP) 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 proposal area is mapped on the Koala Development Application Map. However, this SEPP only applies to development applications under Part 4 of the EP&A Act. Given this assessment is undertaken under Part 5 of the EP&A Act the SEPP does not apply.

Sydney Regional Environmental Plan No.20 – Hawkesbury-Nepean River

Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No 2 – 1997) (SREP 20) is a deemed State Environmental Planning Policy and applies to the investigation area. SREP 20 aims to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context. Clauses 5 and 6 of SREP 20 set out general planning considerations and specific planning policies and recommended strategies respectively. Clause 4(1)(b) requires that those considerations, policies and recommended strategies be taken into consideration by consent authorities and by public authorities proposing to undertake development that does not require consent. SREP 20 planning matters and considerations have been considered in the preparation of this REF.

Table 4-1: Consideration of the provisions of SREP 20

Consideration	Comment
Clause 5	
5(a) The aim of this plan which is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context	The regional impacts of the proposal on the Hawkesbury Nepean River system are assessed in Section 6.2 with regarding to flooding and water quality
5(b) The strategies listed in the Action Plan of the Hawkesbury-Nepean Environmental Planning Strategy	The strategies listed in the Action Plan 2013-2023 are considered throughout this REF
5(c) Whether there are any feasible alternatives to the development or other proposal concerned	The need for the proposal and the options considered are discussed in Chapter 2 of this REF
5(d) The relationship between the different impacts of the development or other proposal and the environment, and how those impacts would be addressed and monitored	The environmental impact assessment is detailed in Chapter 6 and safeguards to manage those impacts are described in Chapter 7
Clause 6	
6(1) Total catchment management is to be integrated with environmental planning for the catchment	The design of the proposal has considered drainage, flooding, erosion and sedimentation risks and are addressed in Section 6.2
6(2) The environmental quality of environmentally sensitive areas must be protected and enhanced through careful control of future land use changes and through management and (where necessary) remediation of existing uses	The proposal would not have a substantial impact on any environmentally sensitive areas
6(3) Future development must be not prejudice the achievement of the goals of use of the river for primary contact recreation (being recreational activities involving direct water contact, such as swimming) and aquatic ecosystem protection in the river system. If the quality of the receiving waters does not currently allow these uses, the current water quality must be maintained, or improved, so as not to jeopardise the achievement of goals in the future. When water quality goals are set by the Government these are to be the goals to be achieved under this policy.	The drainage system is designed to maintain or improve water quality in receiving waterways. Water quality is addressed in Section 6.2
6(4) Aquatic ecosystems must not be adversely affected by development which changes the flow characteristics of surface or groundwater in the catchment.	Surface water flow and quality will not be significantly impacted by the proposal as discussed in Section 6.2. Potential impacts to aquatic ecosystems as a result of changes to surface and water quality are addressed in Section 6.1 and 6.2.

Consideration	Comment
6(5) The importance of the river in contributing to the significance of items and places of cultural heritage significance should be recognised, and these items and places should be protected and sensitively managed, and, if appropriate, enhanced.	Impacts to cultural heritage items are considered unlikely and are addressed in Section 6.7
6(6) Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced.	Impacts to flora and fauna are summarised in Section 6.1
6(7) The scenic quality of the riverine corridor must be protected.	The proposal would not impact on the scenic quality of the riverine corridor. The visual impact of the proposal is summarised in Section 6.8.
6(8) Agriculture must be planned and managed to minimise adverse environmental impacts and be protected from adverse impacts of other forms of development.	The proposal does not result in any severance and would have a minimal impact on agricultural land. Land use is discussed in Section 6.10
6(9) Rural residential development should not reduce agricultural sustainability, contribute to urban sprawl, or have adverse environmental impacts (particularly on the water cycle or on flora or fauna).	The proposal does not involve rural residential development
6(10) All potential adverse environmental impacts of urban development must be assessed and controlled.	The potential impacts of the proposal are managed by the safeguards described in Chapter 7
6(11) The value of the riverine corridor as a significant recreational and tourist asset must be protected.	The proposal would not affect the value of the riverine corridor
6(12) Development should complement the vision, goal, key principles and action plan of the Metropolitan Strategy	The proposal complements the latest metropolitan strategies

4.1.2 Local Environmental Plans

The proposal is located primarily within the Hawkesbury LGA with a small portion located within the Penrith LGA. The Driftway generally forms the border between the Hawkesbury to the north (and including the Driftway) and the Penrith to the south. The land zoning in and around the proposal area is shown on Figure 4-1 and is described in

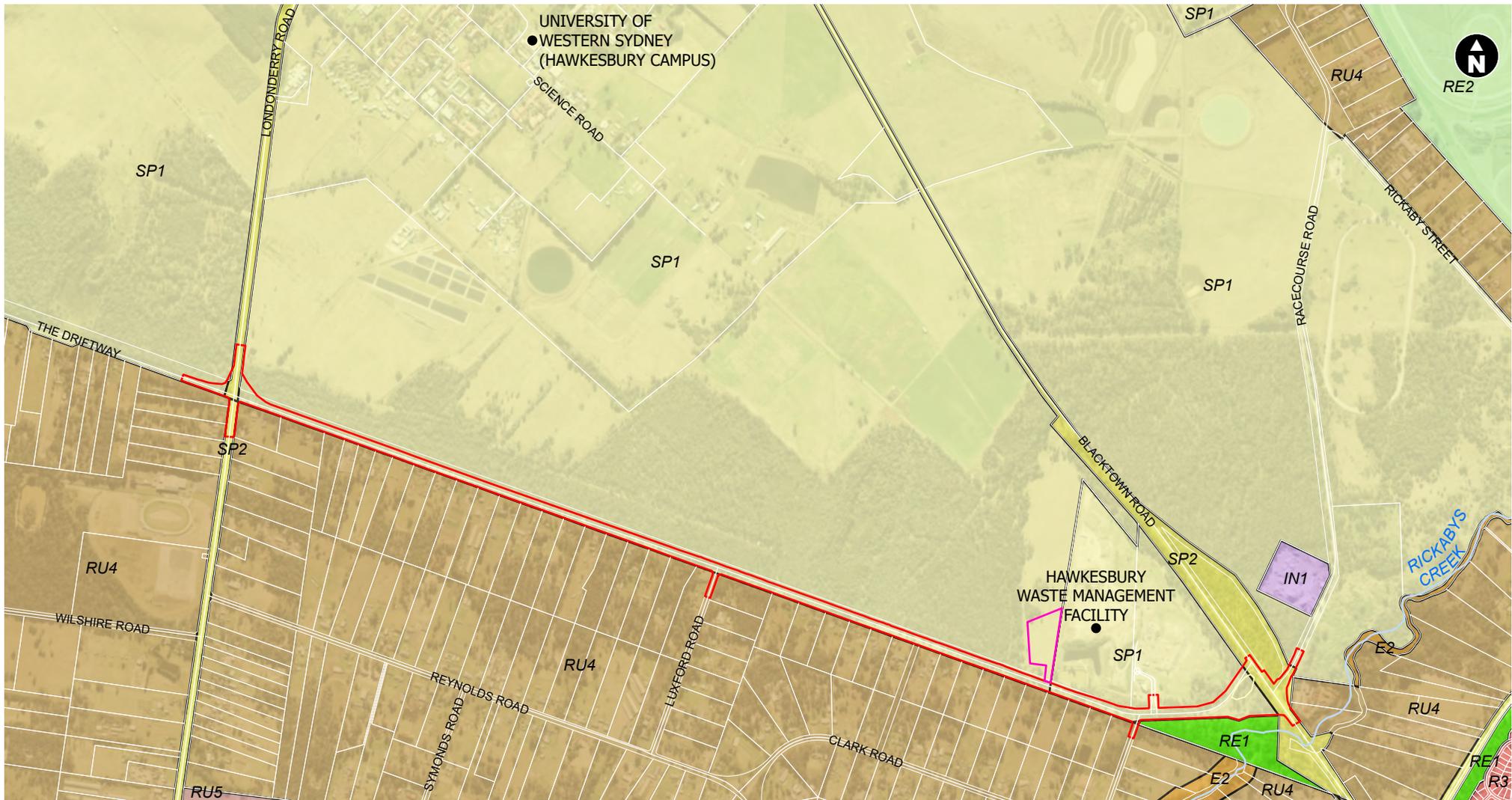
Table 4-2 Land use and development within the two LGAs are regulated by both the *Hawkesbury Local Environmental Plan 2012 (LEP)* and the *Penrith LEP 2010*.

Table 4-2: Land zoning

LEP zone	Objectives
Hawkesbury LEP 2012	
SP2 Infrastructure	<p>Objectives of zone</p> <ul style="list-style-type: none"> To provide for infrastructure and related uses To prevent development that is not compatible with or that may detract from the provision of infrastructure.
SP1 Special Activities (Education, Agriculture, Research Station) (Waste or Resource Management Facility)	<p>Objectives of zone</p> <ul style="list-style-type: none"> To provide for special land uses that are not provided for in other zones To provide for sites with special natural characteristics that are not provided for in other zones To facilitate development that is in keeping with the special characteristics of the site or its existing or intended special use, and that minimises any adverse impacts on surrounding land.
RE1 Public Recreation	<p>Objectives of zone</p> <ul style="list-style-type: none"> To enable land to be used for public open space or recreational purposes To provide a range of recreational settings and activities and compatible land uses To protect and enhance the natural environment for recreational purposes To protect and enhance the natural environment for environmental purposes To restrict development on land required for future open space purposes.
Penrith LEP 2010	
SP2 Infrastructure	<p>Objectives of zone</p> <ul style="list-style-type: none"> To provide for infrastructure and related uses To prevent development that is not compatible with or that may detract from the provision of infrastructure.
RU4 Primary Production Small Lots	<p>Objectives of zone</p> <ul style="list-style-type: none"> To enable sustainable primary industry and other compatible land uses To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are more intensive in nature To minimise conflict between land uses within this zone and land uses within adjoining zones To ensure land uses are of a scale and nature that is compatible with the environmental capabilities of the land To preserve and improve natural resources through appropriate land management practices To maintain the rural landscape character of the land To ensure that development does not unreasonably increase the demand for public services or facilities.

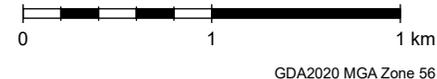
LEP zone	Objectives
E2 Environmental Conservation	<p>Objectives of zone</p> <ul style="list-style-type: none"> • To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values • To prevent development that could destroy, damage or otherwise have an adverse effect on those values • To protect, manage, restore and enhance the ecology, hydrology and scenic values of riparian corridors and waterways, wetlands, groundwater resources, biodiversity corridors, areas of remnant indigenous vegetation and dependent ecosystems • Allow for low impact passive recreational and ancillary land uses that are consistent with the retention of the natural ecological significance.

The proposal and the proposal design have considered the objectives of both LEPs. Roads are permissible with development consent under the zonings within each LEP. However, the proposal is permitted without the consent of Council under ISEPP (see Section 4.1) and therefore the consent requirements of the LEP do not apply.



Legend

- | | | | |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
|  Construction footprint |  E2 Environmental Conservation |  R3 Medium Density Residential |  RU5 Village |
|  Potential temporary ancillary facility |  RE2 Private Recreation |  RE1 Public Recreation |  SP1 Special Activities |
| |  IN1 General Industrial |  RU4 Rural Small Holdings |  SP2 Infrastructure |



Data sources

Jacobs 2021
NSW Spatial Services 2021



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Figure 4-1 Land zoning

4.2 Other relevant NSW legislation

4.2.1 Biodiversity Conservation Act 2016

The NSW *Biodiversity Conservation Act 2016* (BC Act) sets out the environmental impact assessment framework for threatened species, threatened ecological communities (TEC) and Areas of Outstanding Biodiversity Value (AOBV) for Division 5.1 activities and other types of development. Under Section 7.2 of the BC Act, a development or activity is likely to significantly affect threatened species if:

- The test of significance, pursuant to Section 7.3 of the BC Act, determines that a significant impact is likely
- The development or activity exceeds the biodiversity offset scheme threshold if the offset scheme applies to the proposed development (this part does not apply to Part 5 activities)
- The development or activity is carried out in an AOBV.

The Biodiversity Assessment Report (BAR) for this proposal is summarised in Section 6.1. The proposal is not considered likely to significantly affect threatened species, ecological communities or their habitats and is not carried out in an AOBV, therefore a Biodiversity Development Assessment Report (BDAR) is not required.

4.2.2 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* provides a streamlined statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds. The primary objective of the Act 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.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. Section 6.1 provides safeguards and management measures to manage these weeds in accordance with the *Biosecurity Act 2015* during construction and operation of the proposal.

4.2.3 Heritage Act 1997

The *Heritage Act 1977* (Heritage Act) aims to provide for the identification, registration and conservation of items of State heritage significance.

A search of heritage registers was undertaken for the proposal which located one heritage item located 450 metres south of the proposal. This heritage item would not be impacted by the construction and operation of the proposal due to its distance from the proposal area. Further information on the heritage searches undertaken are provided in Section 6.7.

4.2.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the protection and management of water resources in NSW. The WM Act controls the extraction of water, how water can be used, the construction of work such as dams and weirs, and the carrying out of activities on or near water sources. The proposal area is covered by the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011 and the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 and is therefore subject to the provisions of the WM Act.

Under Schedule 4 of the Water Management (General) Regulation 2018 (WM Reg), Transport for NSW as the road's authority is exempt from access licence requirements in relation to water required for road construction and road maintenance.

Sections 89 to 91 of the WM Act establish three types of approvals which may be required by a proponent: water use approvals, water management work approvals (including flood work) and activity approvals.

- Water use approvals allow the holder of the approval to construct an embankment in a floodplain that is likely to affect the distribution or flow of floodwater in times of flood. Clause 34(1) of the WM Reg provides that Transport for NSW, as a roads authority, is exempt from a flood work approval in relation to the road proposal as permitted by determination of this REF
- Water management work approvals allow the holder to carry out types of water management work at certain locations, including water supply work, certain drainage work and flood work. The proposal can be classified as a flood work as it would affect the distribution or flow of floodwater during floods. However, clause 47(1) of the WM Reg provides that Transport for NSW as a determining authority, is exempt from a flood work approval
- Activity approvals are required when a certain activity is likely to affect waterfront land or interfere with an aquifer. The proposal would not interfere with an aquifer or affect waterfront land. WM Reg that Transport for NSW is exempt from a controlled activity approval.

Potential impacts to surface and groundwater from the proposal are discussed in Section 6.2.

4.2.5 Land Acquisition (Just Terms Compensation) Act 1991

Most of the proposal is located within the existing road reserve, with only minor partial property acquisitions required. The proposal would require partial acquisition and lease over land owned by the state of NSW and occupied by Western Sydney University as outlined in Table 3-7 and shown on Figure 3-5. Property acquisition would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, which aims to guarantee just compensation terms for land that is acquired by an authority of the State. Transport for NSW would continue to consult with affected landowners during the development of the proposal.

4.2.6 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the primary legislation dealing with Aboriginal cultural heritage in NSW. Items of Aboriginal cultural heritage (Aboriginal objects) or Aboriginal places (declared under section 84) are protected and regulated under the NPW Act. Aboriginal objects are protected under section 86 of the Act. Under Section 90(1) of the Act, the Chief Executive may issue an Aboriginal heritage impact permit (AHIP) for an activity which would harm an Aboriginal object.

An assessment of the potential impacts on Aboriginal cultural heritage was undertaken through desktop assessments and site inspections. The assessment found no potential direct or indirect impacts to Aboriginal heritage as a result of the proposal (KNC 2019 and KNC 2021). The assessment is summarised in Section 6.6.

4.2.7 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides the legal framework for the management of air, noise, water and waste pollution. Under Section 48 of the POEO Act, scheduled activities (as defined in Schedule 1 of the Act) require an Environment Protection Licence (EPL). Based on the concept design and construction methodologies proposed (refer to Section 3.2) the proposal is not considered a scheduled activity under Schedule 1 of the POEO Act and an EPL would not be required.

The POEO Act and the Protection of the Environment (Waste) Regulation 2005 are the key pieces of legislation that regulate waste in NSW. Classification under the NSW EPA *Waste Classification Guidelines* (2014) is required for all materials brought to site for use in the proposal. The proposed reuse of excavated material from the flood storage area is expected to satisfy the 'excavated natural material resource recovery exemption' (pending confirmation by geological testing).

4.2.8 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides for the operation, maintenance and use of roadways in NSW including managing authorities, rites of passage and classification of roads. Section 138 of the Roads Act requires that a person must not carry out work in, on or over a public road or dig up or disturb the surface of a public road without the prior consent of the appropriate roads' authority. Under Section 138(1) of the Roads Act, various activities in, on or over public roads require consent from the roads authority.

Under Section 72 (1)(b) of the Act, Transport for NSW may carry out road work on a road that is not classified, if it is necessary to do so, in connection with carrying out road work on an adjoining classified road. The Driftway forms part of the New Richmond Bridge and traffic improvements proposal and connects to classified roads, and therefore consent is not required.

4.2.9 Waste Avoidance and Resource Recovery Act 2001

The NSW *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) promotes the waste hierarchy to avoid resource consumption and implement resource recovery in the form of material reuse and recycling in preference to waste disposal. The Act acknowledges that certain materials present either human or environmental risk, requiring classification, treatment and disposal of in accordance with specific waste management provisions.

Waste generated during construction and operation of the proposal would be managed in accordance with the waste hierarchy and where required, disposed of in accordance its waste classification and relevant legislation and guidelines.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the *Environment protection Biodiversity Conservation Act 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on 'Matters of National Environmental Significance' (MNES) undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a MNES is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment.

Approval from the Australian Minister for the Environment is not required for proposed road activities that may affect MNES, due to the implementation of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these MNES are also considered in Section 6.1 of the REF and in Appendix C.

Findings – matters of national environmental significance

The assessment of the proposal's impact on MNES and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant MNES or on Commonwealth land. Accordingly, the proposal has not been referred to the DAWE under the EPBC Act.

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

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant MNES. Appendix C and Section 6.1 details the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under clause 94 of ISEPP the proposal is permissible without consent. The proposal is not State Significant Infrastructure or State Significant Development and assessment is permissible under Division 5.1 of the EP&A Act.

This REF fulfils Transport for NSW's obligation under Section 5.5 of the EP&A Act including to examine and consider to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

Transport for NSW has formed the view that the proposal is not likely to significantly affect the environment and would not require the preparation of an SIS.

5. Consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 Project Background

The proposal forms Stage 1 of the New Richmond Bridge and traffic improvements. Stage 2 would involve construction of a new bridge over the Hawkesbury River and associated traffic improvements. Several options were assessed for the New Richmond Bridge and traffic improvements proposal, and consultation has been undertaken with community and stakeholders to recommend a preferred option. Improvements to The Driftway between Londonderry Road and Blacktown Road were common to all options. As a result, the upgrade of The Driftway (the proposal) is necessary regardless of the preferred option selected and would form Stage 1 of the New Richmond Bridge and traffic improvements.

Consultation for Stage 1 has been undertaken in parallel with the consultation undertaken for the overall New Richmond Bridge and traffic improvements.

5.2 Consultation strategy

Consultation for the New Richmond Bridge (which includes the Driftway) is being undertaken by Transport for NSW. A Community and Stakeholder Engagement Plan (CSEP) has been prepared. The objectives of the CSEP include:

- Inform local community and other key stakeholders of the proposed project, the benefits and what to expect
- Identify key stakeholders and community interest groups to identify their needs, requirements and expectations
- Create stakeholder understanding of the proposed New Richmond Bridge and traffic improvements and its objectives
- Seek community and stakeholder feedback on the options study developed for the proposal with enough time for this feedback to be considered and incorporated into the study where feasible
- Provide the community and stakeholders with regular and targeted information to build awareness about the proposal
- Provide clear information about what we are seeking feedback on, when and why and be transparent in what we do
- Ensure community and stakeholder feedback is continuously fed into communication and engagement
- Listen to feedback, investigate suggestions and report back and encourage participation from communities and other stakeholders
- Engage in a manner that is collaborative, innovative, adaptive and sustainable and ensure that information is distributed in an effective and timely manner
- Ensure that community and stakeholder enquiries about the proposal are managed and resolved effectively.

Key stakeholders identified for the consultation include:

- State member for Hawkesbury
- Penrith City Council and Hawkesbury City Council representatives

- Government agencies:
 - NSW Department of Planning Infrastructure and Environment (DPIE)
 - Infrastructure NSW
 - Heritage Council of NSW
 - Greater Sydney Commission
- Others:
 - Emergency services, including State Emergency Services (SES)
 - Aboriginal groups
 - Community and environmental groups
 - Sporting and educational groups
 - Local businesses
 - Transport operators
 - Residents impacted by the proposal
 - Historical interest groups
 - Media.

A range of engagement tools have been implemented by Transport for NSW. Engagement would continue to be used throughout the construction period, to ensure that proposal information is distributed in an effective and timely manner to allow stakeholders and the community feedback. The following sections outline the consultation that has been carried out to date.

5.3 Previous consultation

Engagement for the project began in December 2018 where key stakeholders and community groups, identified in consultation with Hawkesbury City Council, were invited to meetings. These meetings provided an update of the status of the project and outlined the proposed consultation process. The key stakeholders and community groups were asked to identify two representatives from their group to attend future workshops and/or meetings for the project. These workshops have been attended by the Community Working Group, which was comprised of representatives from key stakeholders throughout 2019 to 2021, where project needs, objectives and options have been discussed and developed. Project updates have also been provided on a regular basis in meetings with the group.

In November 2019 a community update was distributed to 14,000 households in the area in regard to the five route options being assessed for the New Richmond Bridge proposal. These households were invited to provide feedback via community information sessions, the project website or by contacting Transport directly. Over 750 individual comments were received during the seven-week consultation period between November 2019 and January 2020, and these comments were considered accordingly in the options assessment.

5.4 Community involvement

In June 2021 a community update was delivered to 14,000 households in the area detailing the preferred option for the New Richmond Bridge and traffic improvements. The update outlined the proposed works, benefits and details of the upcoming community information sessions. Submissions and community comments were encouraged. The community update also provided a link to the proposal website and contact details for the proposal team.

One face-to-face community information session, four Facebook Live sessions and six targeted online consultation sessions were held to provide information and to receive feedback on the preferred option:

- Face-to-face community information session was held on:
 - Wednesday 16 June 2021 between 5 pm and 7 pm

- Facebook Live sessions on:
 - 28 June 2021 at 12pm and 4pm
 - 8 September 2021 at 12pm and 5pm
- Targeted online sessions between 17 August and 1 September, including:
 - Three sessions for residents of Southee Road
 - Two sessions for residents of The Driftway
 - One session for residents of Inalls Lane and adjoining streets
 - One session for residents of Norfolk Place and adjoining streets
 - One session with the NSW Polo Association

Issues raised at The Driftway community information sessions are outlined below in

Table 5-1.

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

Issue raised	Response / where addressed in REF
Concern regarding increased traffic volumes on The Driftway and issues with access in and out of properties	Section 6.3.3 and Section 6.3.4
Concern regarding noise impacts from increased traffic and how that would be treated	Section 6.4.4 and Section 6.4.5
Why does The Driftway need to be used? Why can't the upgrade just be through Richmond town centre?	Chapter 3
Concern regarding existing pavement and drainage issues along The Driftway	Section 6.2.3
Will the speed limit be reduced to improve safety?	Section 6.3

5.5 Aboriginal community involvement

Transport for NSW is committed to effective consultation with Aboriginal communities in regard to proposed activities and the potential for impact on Aboriginal cultural heritage. The *Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI)* (Roads and Maritime, 2011) was developed to provide a consistent means of effective consultation with Aboriginal communities about activities which may impact on Aboriginal cultural heritage, and a consistent assessment process for Transport for NSW activities across NSW. A summary of the four stages and relevant consultation activities for each stage of the PACHCI procedure is provided in Table 5-2.

Table 5-2: Summary of Transport for NSW Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial Transport for NSW assessment Aboriginal Heritage Information Management System (AHIMS) search
Stage 2	Site survey and further assessment Site inspection and assessment on 5 December 2018 with a representative of

Stage	Description	
		the Deerubbin Local Aboriginal Land Council (LALC)
Stage 3	Formal consultation and preparation of a cultural heritage assessment report	Not required
Stage 4	Implement environmental impact assessment recommendations	Not required

The findings from Aboriginal Cultural Heritage Assessments which were undertaken within the proposal area are summarised in Section 6.6.

5.6 ISEPP consultation

Clauses 13 to 16 of the ISEPP specify the requirements for consultation with councils and other public authorities for infrastructure development carried out by, or on behalf of a public authority. Hawkesbury and Penrith City Councils and NSW State Emergency Service (SES) have been consulted in regard to the proposal as per the requirements of clause 13 to 16 of ISEPP. Appendix B contains the ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered. Additionally, consultation was undertaken with Hawkesbury City Council on 28 July 2021 and with Penrith City Council on 19 July 2021. Issues that have been raised as a result of this consultation are outlined below in Table 5-3.

Table 5-3: Issues raised through ISEPP consultation

Agency	Issue raised	Where response is addressed in REF
Hawkesbury City Council	<ul style="list-style-type: none"> • Appropriate mitigation measures to be undertaken for traffic and flooding impacts • Traffic volumes (particularly heavy vehicles) to be redirected to Racecourse Road 	<ul style="list-style-type: none"> • Section 6.2 • Section 6.3 • Section 7.2
Penrith City Council	<ul style="list-style-type: none"> • Traffic modelling outcomes to be provided including redistribution of traffic and operation of intersections • Timing of project delivery to be provided • The reclassification of The Driftway from a local road to a State road needs to be considered as part of the project • Road pavements and associated road infrastructure to be upgraded to meet increased traffic volumes • Consideration must be given to asset maintenance, efficiency, amenity and road safety. 	<ul style="list-style-type: none"> • Section 3.2. • Section 3.3. • Section 6.2
SES	<ul style="list-style-type: none"> • No issues were raised 	<ul style="list-style-type: none"> •

5.7 Government agency and stakeholder involvement

Transport for NSW has consulted on an ongoing basis with key State and local government agencies, utility providers, local property owners and businesses in the proposal area. This consultation was designed to ensure issues and concerns were understood, documented and addressed, and that stakeholders had an opportunity to discuss any aspect of the proposal. Consultation has been carried out with:

- Western Sydney University
- Telstra
- Optus
- NBN
- Endeavour Energy
- AARNet
- Sydney Water
- Jemena

Issues that were raised are outlined in Table 5-4.

Table 5-4: Issues raised through stakeholder consultation

Agency	Issue raised	Response / where addressed in REF
Western Sydney University	The area impacted has high biodiversity conservation value and is proposed to form part of a Biodiversity Stewardship Agreement	Section 6.1
	Options to avoid university land proposed for conservation in perpetuity	Section 2.6.4

5.8 Ongoing or future consultation

This REF will be placed on public display on the proposal webpage for comment by stakeholders and the community:

- Transport for NSW website: nswroads.work/richmond-bridge

Printed and electronic copies would be available on request by contacting the proposal team. Future consultation activities planned for the proposal include:

- Providing current proposal information through the Transport for NSW website
- Ongoing consultation with councils as required
- Start of construction notification carried out via letter box drop to a number of residents around the proposal a minimum of five working days before construction begins. A start of construction notification would also be provided to the local council and emergency services
- Advising NSW SES of any significant delays expected in the operation of any roads during construction
- Ongoing notifications carried out via letter box drop notifying residents of any night work, temporary access arrangements or changed traffic conditions variable message signs (VMS) would be used to inform motorists using these roads of the work and potential disruptions. VMS would be deployed a minimum of five days before the commencement of construction
- Transport for NSW website updated with submissions report and project information on an ongoing basis.

6. Environmental assessment

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

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

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

6.1 Biodiversity

Potential impacts of the proposal on biodiversity are assessed in detail in the BAR provided in Appendix C. The methods used for assessment, the potential impacts and safeguards to mitigate identified impacts are summarised below. The following terms are used throughout this section of the REF to describe particular geographic areas:

- The proposal: Stage 1 of the New Richmond Bridge and traffic improvements, The Driftway, suburbs of Richmond, Londonderry and South Windsor, NSW
- Construction footprint: The maximum extent of physical disturbance likely to be required to accommodate construction activities, including the ancillary site and temporary and permanent infrastructure needed for the proposal construction
- Study area: The area of land which includes the construction footprint and the land to the north (outside of the construction footprint) used to assess the extent of native vegetation, potential habitat and the population size of *Dillwynia tenuifolia*. Some parts of the study area also included areas subject to potential indirect impacts.

6.1.1 Methodology

The methodology used to assess impacts to biodiversity associated with the proposal are summarised below and are detailed in Section 2 of Appendix C.

Background research

Existing information on the flora and fauna of the study area and the locality, including relevant threatened biota was obtained from relevant databases and ecological assessments undertaken within the proposal area. All database searches were carried out within a ten kilometre radius of the construction footprint.

The following database searches were performed:

- BioNet – Atlas of NSW Wildlife: <http://www.bionet.nsw.gov.au> [accessed 8/7/2021]
- NSW DPIE BioNet Vegetation Classification: <http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx> [accessed 8/7/2021]
- NSW Threatened Biodiversity Data Collection: <http://www.environment.nsw.gov.au/atlasapp/> [accessed 9/7/2021]

- DAWE Protected Matters Search Tool (PMST): <http://www.environment.gov.au/epbc/protected-matters-search-tool> [accessed 8/7/2021]
- Atlas of Living Australia: <http://www.ala.org.au/>.

The background research also considered the following sources of data:

- Regional vegetation mapping projects including the remnant Vegetation of the western Cumberland subregion, 2013 Update. VIS_ID 4207 (Office of Environment and Heritage NSW, 2013)
- Area of Outstanding Biodiversity Value register available on the NSW DPIE website: <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value>
- Core Koala Habitat identified by the Koala Habitat Protection SEPP 2019
- National Flying-fox monitoring viewer. <http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf>
- NSW DPI Fisheries Spatial Data Portal: <https://www.dpi.nsw.gov.au/about-us/science-and-research/spatial-data-portal>
- The Commonwealth Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE): <http://www.bom.gov.au/water/groundwater/gde/map.shtml>
- NSW DPI Weed Wise: <http://weeds.dpi.nsw.gov.au/> .

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act was viewed on the NSW Threatened Species Scientific Committee website (NSW DPIE, 2021). There were no preliminary or provisional listings of relevance to the proposal.

The results of the database searches were used to compile a list of threatened species, populations and communities, as listed under the BC Act and EPBC Act that could potentially occur on the study area, and their likelihood of occurrence.

Habitat assessment

A habitat assessment was undertaken to assess the likelihood of species occurring within the study area and to identify species requiring targeted survey based on available habitat.

Field survey

Field surveys were undertaken twice over four days by two ecologists on 22 April 2021 and between 21 and 24 June 2021. Survey effort was carried out in accordance with the Biodiversity Assessment Methodology (BAM) (DPIE, 2020), *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (NSW Department of Environment and Conservation, 2004) and other industry accepted guidelines where applicable and consisted of:

- Walked transects and rapid data points were undertaken to ground-truth vegetation mapping, allocate Plant Community Types (PCTs) and record broad condition classes
- Nine vegetation integrity (VI) plots were completed on 22 April 2021 and an additional three VI plots were completed on 22 June 2021 to sample representative condition classes assigned as vegetation zones for identified PCTs. One plot (P3) in PCT 849 was excluded from the assessment, as it was outside of the study area

- Targeted surveys for threatened flora species were undertaken with reference to *NSW Guide to Surveying Threatened Plants* (DPIE, 2020a) within areas of suitable habitat. Targeted surveys were undertaken for seven threatened flora species: *Acacia pubescens*, *Dillwynia tenuifolia*, *Grevillea juniperina* subsp. *juniperina*, *Micromyrtus minutiflora*, *Persoonia nutans*, *Pimelea spicata* and *Pimelea curviflora* var. *curviflora* and *Pultenaea parviflora*. Based on field observations *Persoonia nutans*, *Pimelea spicata*, *Pimelea curviflora* var. *curviflora* and *Micromyrtus minutiflora* were considered unlikely to occur
- Two methods were used for targeted surveys for *Dillwynia tenuifolia*, a listed Vulnerable species under the NSW BC Act which was known to occur within the construction footprint: (1) determine the species' area of occupancy (suitable habitat extent) and (2) estimate the indicative abundance of the location population. Surveys undertaken during April and June 2021 included:
 - Paired parallel transect, mapping the area of occupancy and rapid counts in dense patches for preliminary abundance estimates (April)
 - A single transect within the middle of the construction footprint to estimate the average abundance of the local population (June)
 - Systematic sampling every 100 metre along the single transect with randomly placed 1 metre square quadrats at each 100 metre interval. Each quadrat measured the density of individuals (June)
 - Additional meanders to map the boundary of the population (June)
 - In suitable habitat to the north of the construction footprint, the extent of the known population was ground truthed. An 80 metre buffer was applied, and rapid counts of plants were undertaken in randomly placed 2 metre squared quadrats (June).
- Targeted surveys for threatened fauna species were undertaken for the Cumberland Plain Land Snail (*Meridolum corneovirens*), a listed Endangered species under the NSW BC Act. Surveys were undertaken throughout the entire construction footprint and in accordance with the *Environmental Impact Assessment Guidelines Cumberland Plain Large Land Snail* (NPWS, 2000)
- Aquatic habitats were assessed by examining characteristics such as the structure and floristics of aquatic vegetation, channel width, the presence of surface water, the presence of shelter (rocks, submerged vegetation and woody debris), and channel substrate and were in accordance with the NSW DPI (Fisheries) *Policy and Guidelines for fish habitat conservation and management* (NSW Department of Primary Industries, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003)
- Assessments of significance for threatened species and ecological communities positively identified during surveys or considered to have a moderate or high likelihood of occurrence
- The identification of potential impacts and associated mitigation measures to reduce and manage potential impacts.

6.1.2 Existing environment

The study area is located within the Cumberland sub-region of the Sydney Basin Bioregion within the Hawkesbury - Nepean Terrace Gravels Mitchell Landscape (NSW NPWS 2002). The Hawkesbury - Nepean Terrace Gravels Mitchell Landscape is not classed as over-cleared landscape, however, only 31 per cent of the original native vegetation remains.

The land to the south of the study area is predominantly cleared, consisting mainly of roadside vegetation, paddocks and small scattered bushland remnants. To the north of the study area are large patches of remnant bushland, part of which lie within the proposed Western Sydney University biodiversity stewardship site.

Plant community types

The construction footprint is comprised of five PCTs, occupying seven vegetation zones (see Table 6-1). The proposed ancillary area, to the north east of the proposal, is cleared of native vegetation and is dominated by exotic grasses such as *Eragrostis curvula* and *Sporobolus africanus*, *Paspalum dilatatum* and *Setaria pumila*. The ancillary site does not constitute a PCT. A detailed description of each PCT is provided in Appendix C.

Table 6-1: PCTs and vegetation zones within the construction footprint

PCT ID	PCT name	Zone / condition	Construction footprint (ha)
724	Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	1_Low	0.51
725	Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	2_Low	0.2
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	3_Low	0.37
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	4_Moderate	0.45
		5_Low	2.9
883	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	6_Moderate	0.08
		7_Low	1.09
Total in construction footprint			5.66 ha

Threatened ecological communities

Five of the PCTs constitute NSW BC Act listed TECs, including:

- Shale Gravel Transition Forest in the Sydney Basin Bioregion (Endangered)
 - 0.51 hectares within the construction footprint
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered)
 - 0.2 hectares within the construction footprint
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)
 - 0.37 hectares within the construction footprint
- Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered)
 - 3.41 hectares within the construction footprint
- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (Vulnerable)
 - 1.17 ha within the construction footprint

The distribution and extent of TECs in the study area are mapped in Figure 3-2 of Appendix C.

Groundwater dependent ecosystems

Four of the PCTs (724, 725, 835 and 849) are considered to have a high likelihood of being groundwater dependent ecosystems (GDE). These PCTs are likely to be an opportunistic facultative GDE. Facultative GDEs are dependent on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) in some locations but not in others, particularly where an alternative source of water, such as rainfall, cannot be accessed to maintain ecological function (Kuginis et al., 2012).

Threatened species

One threatened flora species was identified in the construction footprint during the field survey undertaken for the proposal: *Dillwynia tenuifolia* listed Vulnerable under the NSW BC Act. The habitats in the construction footprint are not considered optimal for any of the remaining threatened flora species due to vegetation degradation, disturbance to the soil, and introduction and spread exotic plant species.

Dillwynia tenuifolia

The *Dillwynia tenuifolia* population (not including any plants occurring on the south side of The Driftway) has an estimated area of occupancy of 67 hectares with about 1.3 hectares occurring in the construction footprint. Dense patches were observed in parts of the roadside in low condition patches of PCT 724 and PCT 849. The species is generally sparser in other parts of the construction footprint in PCT 724 and PCT 883. Only one isolated dense cluster was observed in PCT 835. The construction footprint is estimated to contain about 5,000 individuals comprised of mature plants and seedlings found mostly in dense patches in localised disturbed areas (see Figure 3-4 of Appendix C).

Threatened fauna

Evidence of one threatened fauna species was identified in the construction footprint during the field survey: Cumberland Plain Land Snail listed Endangered under the BC Act. Habitat within the study area is generally moderate to low quality and does not possess many of the features required for threatened fauna species to complete their life cycles.

Threatened fauna considered moderately or highly likely to occur include aerially foraging species such as microbats, flying foxes and migratory or opportunistic bird species such as: Dusky Woodswallow, Little Eagle, Little Lorikeet, Swift Parrot, Varied Sittella, Eastern Coastal Free-tailed Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Grey-headed Flying-fox, Large Bent-winged Bat, Large-eared Pied Bat, Little Bent-winged Bat, Southern Myotis, and the Yellow-bellied Sheathtail-bat. Each of these species may use the study area intermittently to forage, as no tree hollows, roost camps or significant feed trees were identified. More suitable habitat is available to the north.

Cumberland Plain Land Snail

Evidence of the Cumberland Plain Land Snail in the form of empty shells were identified under roadside refuse and leaf litter in low condition PCT 849 (veg zone - 3_low). An assessment was undertaken to rate the value of the habitat in the construction footprint for the species. Veg zone - 3_low was considered moderate condition habitat for the species and moderate to high condition habitat was used to map the remaining suitable habitat for Cumberland Plain Land Snail in the study area. See photographs 9-12 and Figure 3-4 of Appendix C.

Aquatic habitat

The aquatic environment is limited to an unnamed creek (Strahler 3rd order stream) that is mapped as draining from the north of The Driftway to the south on to private property DP752061, before discharging into Rickabys Creek. No suitable habitat for threatened fish was identified in the study area.

Wildlife corridors and connectivity

The Driftway serves as a barrier to fauna movements to the south with limited connectivity to patches of vegetation for terrestrial and arboreal (gliding) fauna. To the north is a large patch of native vegetation, a large portion of the vegetation will be retained in perpetuity in a biodiversity stewardship site agreement. The retention of vegetation to the north will facilitate the movement of species and provide a large expanse of available habitat. The Biodiversity Investment Opportunities Map (BIO Map) identifies priority areas for investment in biodiversity outcomes. These are areas where funding for biodiversity management can make the greatest difference for biodiversity. The construction footprint adjoins land mapped as a Core Area of priority land investment for biodiversity.

Coastal Management SEPP 2018

The study area has areas mapped as *coastal wetlands* and *proximate to coastal wetlands* under the Coastal Management SEPP. The wetland and buffer occur 85 metres north of the construction footprint and would not be directly impacted.

Koala Habitat Protection SEPP 2019

The study area is mapped on the Koala Development Application Map. This assessment comes under Part 5 of the EP&A Act and therefore the SEPP does not apply.

Matters of National Environmental Significance

One of the TECs identified during survey meets the EPBC Act listing criteria and condition thresholds for the Commonwealth listed community:

- 0.08 hectares of PCT 883 - Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion Community endangered ecological community occurs within the construction footprint.

Two threatened flora species listed as Vulnerable under the EPBC Act are considered moderately likely to occur within the study area: *Pultenaea parviflora* and *Acacia pubescens*. Potential habitat occurs in PCT 724, PCT 725 and PCT 883 for *Pultenaea parviflora* and PCT 724, PCT 725, PCT 849 and PCT 883 for *Acacia pubescens*.

Three threatened fauna species listed under the EPBC Act are considered moderately likely to use the study area to forage: Swift Parrot listed as Critically Endangered, Grey-headed Flying-fox and the Large-eared Pied Bat both listed as Vulnerable.

No EPBC Act listed migratory species recorded in the EPBC Act Protected Matters Search (ten kilometre radius of the study area) were considered moderately or highly likely to use the study area. The study area study area is not recognised as important habitat for migratory birds.

Three listed Weeds of National Significance (WONs) were identified within the study area: *Asparagus aethiopicus* (Ground Asparagus), *Lantana camara* (Lantana), *Rubus fruticosus* (Blackberry).

6.1.3 Potential impacts

Construction

Removal of native vegetation

The proposal would directly remove 5.66 hectares of native vegetation. Direct impacts to NSW BC Act and EPBC Act listed TECs are provided below in Table 6-2.

Table 6-2: Direct impacts to NSW BC Act and EPBC Act listed TECs

PCT ID	BC Act	EPBC Act	Zone / condition	Construction footprint (ha)
724	Shale Gravel Transition Forest in the Sydney Basin Bioregion TEC	-	1_Low	0.51
725	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion TEC	-	2_Low	0.2
835	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC	-	3_Low	0.37
849	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC	-	4_Moderate	0.45
		-	5_Low	2.96
883	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion VEC	Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion EEC	6_Moderate	0.08
		-	7_Low	1.09
Total direct impact				5.66 ha

The removal of native vegetation would directly result in a loss of habitat/potential habitat for threatened fauna species listed in Table 6-3.

Table 6-3: Direct impacts to NSW BC Act and EPBC Act listed fauna

Species	BC Act	EPBC Act	Construction footprint (ha)
Threatened bird species			
Dusky Woodswallow	V	-	5.66 ha (foraging habitat including mature and native tree species. Impact has been calculated by the area of associated PCTs within the development footprint, including PCT 724, PCT 725, PCT 835, PCT 849 and PCT 883. No breeding habitat was identified within the study area).
Little Lorikeet	V	-	
Swift Parrot	E	CE	
Little Eagle	V	-	
Varied Sittella	V	-	
Threatened nectarivore/frugivore bat			
Grey-headed Flying-fox	V	V	5.66 ha (foraging habitat including mature and native tree species. Impact has been calculated by the area of associated PCTs within the development footprint, including PCT 724, PCT, 725, PCT 835, PCT 849 and PCT 883. Non-native vegetation and native plantings within the development footprint may also provide habitat for the Grey-headed Flying-fox. No roosting camps are present within the study area).

Species	BC Act	EPBC Act	Construction footprint (ha)
Threatened Insectivorous bats (cave-roosting)			
Large Bent-winged Bat	V	V	5.66 ha (foraging habitat including mature and native tree species. Impact has been calculated by the area of associated PCTs within the development footprint, including PCT 724, PCT, 725, PCT 835, PCT 849 and PCT 883. No breeding habitat was identified within the study area).
Little Bent-wing Bat	V	-	
Eastern False Pipistrelle	V	-	
Yellow-bellied Sheath-tail-bat	V	-	
Eastern Coastal Free-tailed Bat	V	-	
Southern Myotis	V	-	
Large-eared Pied Bat	V	V	
Greater Broad-nosed Bat	V	-	
Threatened invertebrates			
Cumberland Plain Land Snail	E	-	5.66 ha (foraging and breeding habitat within the development footprint, including PCT 724, PCT, 725, PCT 835, PCT 849 and PCT 883).

Removal of threatened flora

The proposal would impact about 5,000 individuals of *Dillwynia tenuifolia* (listed Vulnerable under the NSW BC Act), equating to about 1.3 hectares.

Aquatic impacts

Direct impacts to aquatic habitats are considered to be unlikely during construction with the implementation of mitigation measures and safeguards. The proposal would incorporate drainage to control road runoff to downstream receiving watercourses. Any potential change to water quality, resulting from the increased hard surfaces associated with the proposal, is not likely to have a demonstrable impact on water quality and therefore aquatic ecology.

Hydrology

The proposal may change the extent and depth of flooding inundation during a 1:100-year flood event, resulting in changes to existing flood patterns, most likely effecting patches of PCT 724 immediately next to the roadside and drain. The low expected frequency of a flooding event minimises the potential for impact to this community.

Groundwater dependent ecosystems

The proposal is considered unlikely to intersect groundwater during construction given the shallow excavation required for the proposal and the amount of filling required for the road improvements.

Fauna injury or mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would take place. The extent of this impact would be proportionate to the extent of vegetation that is cleared. The implementation of safeguards during construction activities would significantly reduce the risk to fauna species.

Lighting

Lighting used during construction may deter nocturnal fauna from using the study area. The impact would be temporary and would not have long lasting impact on the local nocturnal fauna species.

Noise and vibration

Increased noise and vibration during construction may cause fauna to temporarily avoid habitats near construction activities. Existing traffic noise and vibration would already be a deterrent to some fauna

species, the temporary increase during construction is unlikely to have a long lasting impact on the local fauna species.

Spread of weed species

The spread of weed and pest species is likely to occur during construction and post construction resulting from vegetation clearing and earthworks, movement of soil, and the attachment of seed (and other propagules) to vehicles and machinery. Proposed activities may also cause pest species to disperse into new areas. Weed management should be implemented during and post-construction to minimise weed incursions into surrounding intact native vegetation. Pest populations should be monitored and managed if required.

Invasion and spread of pathogens and disease

Several pathogens have the potential to impact on biodiversity as a result of their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or NSW BC Act:

- Dieback caused by Phytophthora Root Rot (EPBC Act and BC Act)
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction. The risk should be managed in accordance with *Biodiversity Guidelines Protecting and managing biodiversity on RTA projects* (Transport RTA, 2011).

Operation

Wildlife corridors and connectivity

Habitat fragmentation is unlikely to occur from the proposal as it would largely involve the removal of edge vegetation and would not clear large, connected patches. Functional connectivity would be retained; however, any additional loss of vegetation has the potential to impact on local fauna populations.

Edge effects

The potential for impacts resulting from edge effects are considered to be minor, as the proposal is already heavily impacted by edge effects causing weed invasion, increased light levels, increased wind speeds, and temperature fluctuations. There is however potential for weeds to encroach further into the retained vegetation and the neighbouring biodiversity stewardship site if they are not managed.

Noise and vibration

Existing levels of noise and vibration from traffic along Richmond Road, Londonderry Road and The Driftway would unlikely result in increased impacts to biodiversity within the study area or neighbouring vegetation.

Aquatic impacts

Impacts to aquatic habitats are considered to be unlikely with the implementation of mitigation measures and safeguards. The proposal would incorporate drainage to control road runoff including swales and rock check dams to improve water quality prior to reaching downstream receiving watercourses. Any potential change to water quality, resulting from the increased hard surfaces associated with the proposal, is not likely to have a demonstrable impact on water quality and therefore aquatic ecology.

Cumulative impacts

The potential biodiversity impacts of the proposal must be considered as a consequence of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context. The accumulating impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure would likely include continued loss of biodiversity on the Cumberland Plain.

The Hawkesbury - Nepean Channels and Floodplains Mitchell Landscape are an over cleared landscape with 79 percent of native vegetation having been cleared. Only 21 percent of the original native vegetation remains. The Hawkesbury - Nepean Terrace Gravels Mitchell Landscape is not classed as over-cleared, but 69 percent of its native vegetation has been cleared to accommodate economic growth in western Sydney.

While data from all recent projects in the locality is not freely available, information on biodiversity impacts was obtained for the projects listed below:

- Rezoning of the Kellyville Precinct is anticipated to impact on about 5.42 hectares of vegetation from threatened ecological communities and 1.93 hectares of riparian corridor vegetation
- The construction footprint of the M4 Managed Motorway project was anticipated to impact on about 31.25 hectares of planted and remnant vegetation in various states of condition. This area of clearing includes 3.82 hectares of remnant vegetation
- Honeyman Close SIS indicates that approximately 4.5 hectares of native vegetation would be removed from Lot 2 DP 229466
- Great Western Highway and Reservoir Road Intersection Upgrade Biodiversity Assessment indicates that approximately 0.48 hectares of threatened ecological communities would be removed.

The cumulative impact of these projects is about 16.15 hectares of remnant native vegetation from the Cumberland Plain, including six hectares from threatened ecological communities. This is a large cumulative impact in terms of the over-cleared landscape of the region. The impacts from the current proposal add an additional 5.66 hectares of vegetation clearance, however, given this vegetation is highly fragmented, low quality, and along the existing road verge with large areas of exotic species, the proposed vegetation clearance is not considered to significantly impact the regional landscape or this particular community

6.1.4 Assessment of significance

An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat.

Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the NSW BC Act. The tests of significance have been undertaken in accordance with the guidelines provided in the *Threatened Species Test of Significance Guidelines* (Office of Environment and Heritage, 2018).

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the NSW BC Act or FM Act and therefore a SIS or a BDAR are not required.

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the EPBC Act *Significant Impact Guidelines* (Department of Environment, 2013)

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

6.1.5 Biodiversity offsets

Transport for NSW *Guideline for Biodiversity Offsets* (Roads and Maritime, 2016) was used to consider biodiversity offsets to compensate for impacts to threatened biodiversity resulting from the proposal. The assessment identified that the proposal is not likely to have a significant impact on threatened biodiversity listed under the NSW BC Act or the EPBC Act and therefore no like-for-like offsets for MNES are required.

According to the Transport for NSW offset guidelines, suitable offset requirements would include:

- The loss of 0.45 hectares of PCT 849 Cumberland Plain Woodland critically endangered ecological would be at a ratio of 4:1. This would result in an offset requirement of 1.8 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion in moderate to good condition
- The direct impact to species credit species habitat for the Cumberland Plain Land Snail is a loss of 5.66 hectares. A suitable offset for this loss would be at a ratio of 3:1 and would result in an offset requirement of 16.98 hectares
- The direct impact to species credit species habitat for *Dillwynia tenuifolia* is a loss of 1.3 hectares. A suitable offset for this loss would be at a ratio of 3:1 and would result in an offset requirement of 3.9 hectares.

The final offset requirement for the proposal would be determined during detailed design and development of the offset package. During the detailed design phase, the proposal area may change from that assessed in this report which would result in a different offset requirement for the proposal than what is presented in this report.

6.1.6 Safeguards and management measures

Safeguards and management measures for biodiversity are presented in Table 6-4. Additional mitigation measures and safeguards to protect biodiversity are provided in Appendix C.

Table 6-4: Safeguards and management measures - Biodiversity

Impact	Environmental safeguards	Responsibility	Timing	Reference
Removal of vegetation	A Flora and Fauna Management Plan will be prepared in accordance with <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to: <ul style="list-style-type: none"> • Pre-clearing survey • Unexpected find procedure • Inductions • Vegetation removal protocols • Exclusion zones. 	Construction contractor	Detailed design/pre construction	Section 4.8 of QA G36 Environment Protection
	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Post construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Construction	Additional safeguard
Removal of threatened species habitat and habitat features	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bush rock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Construction and post construction	Additional safeguard
Unexpected finds	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011) if TECs, not assessed in the biodiversity assessment, are identified in the construction footprint.	Construction contractor	Construction	Additional safeguard
Induction	All personnel working on site will receive training to ensure awareness of requirements of the Flora and Fauna Management Plan and relevant statutory responsibilities. Site specific training will be given to personnel when working in the vicinity of areas with identified biodiversity values that are to be protected.	Contractor	Detailed design / pre-construction	Additional safeguard
Pre-clearance surveys	Pre-clearance surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Preconstruction	Additional safeguard
Exclusion zones	Exclusion zones will be set up at the limit of clearing the edge of the impact area) in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Construction	Additional safeguard
Aquatic habitat	Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines</i> (RTA, 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).	Construction contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Fauna injury	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines</i> (RTA, 2011).	Construction contractor	Construction	Additional safeguard
Weeds and pathogens	Any soil or other materials imported to the site for use in restoration or rehabilitation will be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks.	Construction contractor	Construction	Additional safeguard
	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Construction	Additional safeguard
	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Construction contractor	Construction	Additional safeguard

6.2 Flooding, drainage and surface water

Potential impacts of the proposal on hydrology and flooding are assessed in detail in the *New Richmond bridge and traffic improvements Stage 1 Flooding and Drainage Investigation* report prepared by Lyall and Associates (2021) provided in Appendix D. The methods used for assessment, the potential impacts and safeguards to mitigate identified impacts are summarised in the section below.

6.2.1 Methodology

The methodology used to assess impacts to flooding and hydrology associated with the proposal are summarised below and are detailed in Section 3 and Section 4 of Appendix D.

The following tasks were undertaken to determine the drainage requirements and the potential impact that the road works would have on local catchment flooding:

- A review of previous studies and available data along the corridor of the Driftway, including:
 - Ortho-rectified aerial photography covering the study area
 - Detailed ground survey along the project corridor
 - Concept road design model and layout of the proposed bridge over the tributary arm of Rickabys Creek
 - Property boundary information in GIS format
 - Detailed design drawings showing details of the stormwater drainage system along The Driftway
 - Detailed design drawings showing details of the transverse drainage structure beneath Blacktown Road immediately south of its intersection with The Driftway
 - Design water surfaces for Hawkesbury-Nepean River floods with AEPs of 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2%, 0.1%, 0.05% and 0.02%
 - LiDAR survey data covering the study area that was flown in 2019.
- Development of a hydrologic (DRAINS) model of the local catchments draining to the proposal corridor to generate discharge hydrographs for input to the hydraulic (TUFLOW) model. Details on each model are provided below
- Development of a hydraulic model of the various drainage lines that cross the proposal corridor to define flooding patterns under pre-project conditions, including data on peak flood levels, depths of inundation and flow velocities
- Hydrologic and hydraulic analyses for post-project conditions to assess changes in flood behaviour, as well as the longitudinal and transverse drainage requirements for Stage 1 of the proposal
- An assessment to quantify the reduction in pollutant load that would be achieved by the provision of the permanent grass-lined swales that would be constructed along sections of The Driftway. The assessment involved the development of a MUSIC model that was used to assess the average annual reduction in total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN) under post-proposal conditions.

DRAINS Model Development

The hydrologic sub-models IL-CL and RAFTS were used to simulate the conversion of rainfall within the DRAINS software, as they are best suited to simulate the rainfall-runoff process in urban and rural/semi-rural areas. Sub-catchment boundaries were digitised based on contour information derived from the available detailed and LIDAR survey data. Sub-catchment slopes used as input to the IL-CLX and RAFTS sub-models were derived using the average sub-catchment slope and vector averaged slope approaches. Aerial photography and site observations were used to assess the degree of urbanisation that is present in each sub-catchment.

The hydrologic modelling is based on the procedures set out in the *Australian Rainfall and Runoff* (ARR) (Geoscience Australia, 2019).

TUFLOW Model Development

Two TUFLOW models were developed, the first which covered the whole of the Rickabys Creek catchment to a location a short distance upstream of its confluence with the Hawkesbury River (Rickabys Creek TUFLOW Model) and the second which covered only the area in the immediate vicinity of the Stage 1 works (Local Catchment TUFLOW Model). A grid spacing of six meters was adopted in the Rickabys Creek TUFLOW Model, while a four-meter grid with a nested two-meter grid along the road corridor was adopted in the Local Catchment TUFLOW Model. This combination of grid spacing was adopted as it provided an appropriate level of definition of features that influence the passage of flow over the natural surface, whilst maintaining a reasonable simulation run times in the two models. Grid elevations were based on LIDAR survey data, ridge and gully lines were added and existing drainage were incorporated.

MUSIC Model

Rainfall records from the Penrith Lakes AWS pluviograph recorder (Station Number 67113) for the period 1999 to 2008 were selected for use in the MUSIC model. The recorder is located less than 12 kilometres to the south of the proposal and is recommended for use by Penrith City Council when undertaking similar assessments in its LGA. Rainfall losses, as well as base and stormwater flow pollutant concentrations were also based on values recommended for use by Penrith City Council.

6.2.2 Existing environment

The Driftway is a local road that is jointly managed by Hawkesbury and Penrith City Councils. The land bordering The Driftway is very flat which has resulted in both Council's needing to construct a network of drainage channels and catch drains that are aimed at draining the area following rainfall events. This includes a large, engineered channel that has been constructed by Penrith City Council along the northern side of The Driftway between its intersection with Londonderry and Reynolds Roads.

The land immediately to the north of The Driftway west of the waste management facility is heavily treed and comprises vegetation that is both State and Federal listed, while the area immediately to the south has generally been cleared and is rural-residential, although large machinery and other equipment is presently being stored in several properties. The road reserve within which The Driftway is located is subject to flooding as a result of backwater flooding from the Hawkesbury-River, as well as local catchment flooding which results from rain falling directly over the Rickabys Creek catchment. Backwater flooding from the Hawkesbury River can inundate the eastern end of The Driftway near its intersection with Blacktown Road by several metres, with the existing two-lane road subject to flooding for a period of several days.

Utilities

Existing utilities are limited to electricity (overhead), water (underground) and comms (underground) that generally run along the southern side of the road corridor.

Hawkesbury-Nepean River Floodplain

The Hawkesbury-Nepean Valley covers around 500 square kilometers and has the highest flood exposure in NSW. The main arm of the Hawkesbury-Nepean River runs in a northerly direction about 4 kilometers to the west of the intersection of The Driftway and Londonderry Road (which forms the western limit of the Stage 1 works). It then turns and runs in an easterly direction, where a major meander in the river is located about 4.6 kilometers to the north of the intersection of The Driftway and Blacktown Road (which forms the eastern limit of the Stage 1 works).

Rickabys Creek is a minor tributary of the Hawkesbury River and has a catchment area of about 90 square kilometers at the location where it crosses Blacktown Road a short distance to the south of its intersection with The Driftway. An additional three unnamed minor tributaries cross various sections of The Driftway. During floods on the Hawkesbury-Nepean River, floodwater backs up Rickabys Creek and its minor tributaries where it inundates sections of The Driftway.

The eastern end of The Driftway is subject to backwater flooding from the Hawkesbury River during events as frequent as 20% Annual Exceedance Probabilities (AEP), with a sag in the road inundated to a maximum depth of about 2.5 meters during a flood with an AEP of 10%. While the extent of The Driftway that would be inundated by a 1% AEP flood on the Hawkesbury-Nepean River would be confined to the section of road that runs between Reynolds Road and Blacktown Road the depth of inundation would be over seven meters at the location of the existing major sag in the eastern end.

Local drainage

The land bordering The Driftway where it runs between Londonderry Road and Reynolds Road is very flat, with a network of channels having been constructed in order to drain the area to its north. One of these channels runs parallel with The Driftway between Londonderry Road and Reynolds Road within the existing road reserve. Runoff generated by the southern portion of the road reserve, as well as runoff from the rural-residential type properties that are located immediately to the south, are generally controlled by a series of catch drains that run along the southern side of the road reserve. Due to the very flat nature of the land immediately to the south of The Driftway, runoff typically ponds in shallow depressions or catch drains for an extended period of time. Runoff intercepted by the catch drains is conveyed to the northern side of The Driftway via a series of small diameter pipes and culverts.

Modeling Results

Flooding patterns in the vicinity of the Stage 1 works for design storms with AEPs of 10%, 5%, 1%, 0.5%, 0.2% and 0.5%, as well as the Probable Maximum Flood (PMF), respectively. The key findings of the investigation as they relate to local catchment dominant flooding are as follows:

- The section of The Driftway between Londonderry and Blacktown Road would generally be free from flooding for all local catchment storm events up to 0.2% AEP in intensity, with the exception of two locations:
 - Immediately to the west of the Luxford Road intersection, where the existing two-lane road would be inundated over a short length during storms as frequent as 10% AEP, albeit to a relatively shallow depth
 - Immediately to the east of the entrance to the Hawkesbury City Waste Management Facility where the eastbound land would be subject to relatively shallow overland flow during storms as frequent as 10% AEP.
- Major overland flow is present in a number of the rural residential type properties that are located along the southern side of The Driftway during storms as frequent as 10% AEP
- Major overland flow originating from several of the rural residential type properties discharges to the catch drains which run along the southern side of The Driftway, while conversely flow surcharges the catch drains at several locations where it discharges into the adjacent residential properties. In this regard, the direction major overland flow takes would vary depending on the intensity and duration of a storm event
- Transverse drainage structures would need to be increased in size and the new roundabouts would require an upgrade to the pavement drainage system. Toe and catch drains would be required to intercept runoff and direct it to either the existing or proposed drainage structures.
- The embankment associated with the abandoned section of The Driftway would be removed to reduce impacts on flood storage capacity
- The MUSIC model identified that the network of new grass-lined catch drains in combination with the existing grass-lined engineered channel that presently runs along the northern side of The Driftway would result in overall reductions in the pollutant load discharging to the receiving drainage lines under operational conditions.

6.2.3 Potential impacts

Construction

Construction of the proposal would involve a range of activities including vegetation clearing and subsequent mulching, cut and fill earthwork, and establishment of construction facilities. These construction activities present a potential risk to downstream water quality if management measures are not implemented, monitored, and maintained through the construction phase. Damage to erosion and sediment control measures and construction equipment may also occur in the event of flooding. Potential construction impacts to flooding, drainage and surface water are provided in

Table 6-5.

Table 6-5: Potential constructional impacts to flooding, drainage and surface water

Construction activity / Source of pollutants	Pollutants of concern	Potential impact
<p>Earthworks, cuttings, stockpiling:</p> <p>Erosion and exposure of sediments and contaminated soils from exposed areas, open cuts and stockpiles due to wind and stormwater runoff leading to sedimentation and contamination of downstream waterways</p>	<ul style="list-style-type: none"> • Sediments • Nutrients • Hydrocarbons • Heavy metal contaminants • Gross pollutants 	<p>Increased sedimentation can result in increased turbidity, nutrient and toxicant concentrations of a waterway. Increased sedimentation may alter waterway geomorphology and increased suspended sediments may increase turbidity and result in poor water clarity, thereby impacting on visual amenity while impacting on aquatic biodiversity</p>
<p>Demolition:</p> <p>Dust, litter and other pollutants from materials associated with demolition which can enter downstream waterways due to wind and stormwater runoff</p>	<ul style="list-style-type: none"> • Sediments • Gross pollutants 	<p>Increased sedimentation can result in increased turbidity, nutrient and toxicant concentrations of a waterway, and may alter waterway geomorphology. Pollution can cause a reduction in biodiversity, cause habitat loss, and result in fish kills from increased concentrations of toxicants. Litter can lead to reduced visual amenity of a waterway</p>
<p>Pollution – leakage or spills:</p> <p>Leakage or spills of petroleum, oils and other toxicants from machinery, plant equipment, refuelling and vehicles traveling to and from site. Spills and leakages could potentially be transported to downstream waterways</p>	<ul style="list-style-type: none"> • Hydrocarbons • Oil and grease • Hydraulic fluids • High pH • Zinc • Heavy metal contaminants 	<p>If pollution is mobilised to waterways, oily films can accumulate on the surface of the water, reducing the visual amenity. Pollution can decrease biodiversity, cause habitat loss, and result in fish kills from increased concentrations of toxicants</p>
<p>Vegetation clearing and mulching:</p> <p>Soil erosion and mobilisation of sediments to waterways due to clearing of vegetation or via stormwater runoff and wind. Tannin leachate from clearing and mulching entering downstream waterways</p>	<ul style="list-style-type: none"> • Sediment • Nutrients • Heavy metals (bound to sediments) • Tannins 	<p>Tannins can result in dark coloured water being discharged from construction sites into downstream waterways. This affects the visual amenity of the waterway, can alter the pH, reduce visibility and light penetration</p>

Construction activity / Source of pollutants	Pollutants of concern	Potential impact
<p>Cut and Fill:</p> <p>Sediment runoff from excavation and excess spoil storage to downstream waterways. Water pollution from dust generated from stockpiles or inappropriate storage, handling and disposal of spoils. Contaminants associated with previous land uses could be exposed and transported downstream.</p>	<ul style="list-style-type: none"> • Sediment • Nutrients • Heavy metal contaminants and waste runoff 	<p>Increased turbidity can smother aquatic flora, and clog fish gills, potentially leading to fish kills. Elevated nutrients can lead to algal blooms and may subsequently result in fish kills. Nutrients can also lead to the proliferation of weeds and degradation of aquatic environments. Increased metal and toxicant concentrations which can impact the health of aquatic organisms and result in fish kills. Increased suspended sediments resulting in high turbidity and poor water clarity impacting on visual amenity</p>
<p>Drainage and surface works:</p> <p>Soil erosion and mobilisation of sediments into receiving waterway as a result of the construction of earth and land forming associated with the project</p>	<ul style="list-style-type: none"> • Sediment • Nutrients • Heavy metal contaminants 	<p>Increased turbidity can limit light penetration through the water column, potentially limiting growth of aquatic plants. Increased turbidity can also smother aquatic flora, and clog fish gills, potentially leading to fish kills. Elevated nutrients can lead to algal blooms and may subsequently result in fish kills. Nutrients can also lead to the proliferation of weeds and degradation of aquatic environments. Disturbance and exposure of contaminated soils could result in release of heavy metals and toxicants to surface water. Increased metal and toxicant concentrations which can impact the health of aquatic organisms and result in fish kills. Increased sedimentation and changes to flow may lead to changes to geomorphology</p>
<p>Culvert construction:</p> <p>Elevated concentrations of sediments entering and polluting the waters from disturbance and erosion of the drainage channel. Pollutants from construction machinery or concrete spills entering waterways</p>	<ul style="list-style-type: none"> • Sediment • Nutrients • Heavy metal contaminants • High alkaline washout water • Chromium • Concrete solids 	<p>Increased turbidity, lower dissolved oxygen levels and increased nutrient concentrations which could result in algal blooms and aquatic weed growth. Permanent in-stream structures and new culverts may change the characteristics of waterways by altering flow rates and flow paths, leading to scour and deposition of sediment. Disturbance and exposure of contaminated soils which could result in release of heavy metals and toxicants to surface water. Changes to geomorphology from installation of culverts and changes to flow. If by-products of concrete are mobilised to waterways, they could result in increased pH of the downstream water quality which can be harmful to aquatic life. Water contaminated with chromium can also accumulate in the gills of fish. Solids that are improperly disposed of can clog stormwater pipes and cause flooding.</p>

Construction activity / Source of pollutants	Pollutants of concern	Potential impact
Dewatering: Discharges from sediment basins to downstream waterways.	<ul style="list-style-type: none"> • Sediment • Nutrients • Heavy metal contaminants and runoff 	Dewatering activities during construction may mobilise sediments and contaminants and increase the turbidity of the nearby receiving environments. Increased turbidity can limit light penetration through the water column potentially limiting growth of aquatic plants. Increased turbidity can also smother aquatic flora, and clog fish gills, potentially leading to fish kills. Elevated nutrients can lead to algal blooms and may subsequently result in fish kills. Nutrients can also lead to the proliferation of weeds and degradation of aquatic environments. Increased suspended sediments resulting in high turbidity and poor water clarity impacting on visual amenity

The proposal is not considered likely to intersect groundwater during construction given the shallow excavation required for the flood offset area and the amount of filling required for the road construction

Operation

The proposal would increase the pavement runoff catchment area, resulting in an increase in impervious surfaces and therefore an increase in pollutant loads into the downstream receivers. The build-up of contaminants on road surfaces and roadside corridors in dry weather can be transported during rainfall events to surrounding watercourses. The generation of additional pollutants are directly attributable to the increased road surface area and associated increased vehicle traffic in the future. The most important pollutants of concern relating to road runoff are:

- Sediments from the paved surface from pavement wear and atmospheric deposition
- Heavy metals attached to particles washed off the paved surface
- Oil and grease and other hydrocarbon products
- Litter from the road corridor
- Nutrients such as nitrogen and phosphorus (organic compounds) from natural atmospheric deposition of fine soil particles.

Additional potential impacts include:

- Displacement of available floodplain storage on the Hawkesbury-Nepean River floodplain, however the loss of floodplain storage would not result in a significant impact on peak flood levels on the Hawkesbury-Nepean River floodplain
- An increase in the depth and duration of inundation would be experienced adjacent to the inlet of the existing transverse drainage structure near the Western Sydney University land boundary. This area is vegetated and the relatively short increase in depth and duration in a low probability flood event is not considered likely to have a significant impact on the vegetation community.
- A decrease in depth and duration of inundation during flood events for most properties, however an increase in the depth and duration of inundation would be experienced at some private properties located along the southern side of The Driftway. Floor level survey would be required to inform detailed design and if any additional drainage improvements are required
- Partial blockage of hydraulic structures would have only a minor impact on flood behaviour on the southern side of The Driftway, but peak 1% AEP flood levels could be increased by as much as 350 millimetres on the northern side of the road
- Potential increases in rainfall intensities associated with future climate change would result in a minor increase in the depth of inundation to surrounding lands

Potential operational impacts to flooding, drainage and surface water are provided in

Table 6-6.

Table 6-6: Potential operational impacts to flooding, drainage and surface water

Operational element / source of pollutants	Pollutants of concern	Potential impact
Stormwater runoff: Untreated stormwater from impervious surfaces which are not conveyed to treatment systems.	<ul style="list-style-type: none"> • Sediments • Nutrients • Hydrocarbons • Heavy metal contaminants • Gross pollutants • Oil and grease 	Increased sediment loads and nutrients reduce light penetration through the water column or can smother aquatic flora and fauna. Decay of organic matter and some hydrocarbons can decrease dissolved oxygen levels resulting in fish kills. Increased concentrations of heavy metals (including aluminium and iron) can be toxic to aquatic biota. Increased nutrients from sediments can result in excessive plant growth, resulting in algal blooms
Spill events (Fuel/oil spillage or car incidents) Discharge of polluted water via stormwater runoff into the drainage system	<ul style="list-style-type: none"> • Fuel and various hazardous chemicals transported from vehicle usage or vehicle incidents • Oil and grease 	Hydrocarbons can decrease dissolved oxygen levels resulting in fish kills. Increased concentrations of heavy metals (including aluminium and iron) can be toxic to aquatic biota. Oily surface films reduce the visual amenity of the waterway

The total annual pollutant load that would be generated by the catchments that contribute to flow in the various receiving drainage lines, as well as the percentage reduction in the pollutant load that would be achieved by the network of grass-lined swales in combination with the grass-lined engineered channel that runs along the northern side of the proposal are provided in Table 6-7. Based on the values, the proposal would lead to a significant overall reduction in gross pollutants (88%) and TSS (78%), as well as a 51% reduction in TP and an 18% reduction in TN discharging the receiving drainage lines.

Table 6-7: Pollutant source load and percentage reduction in receiving drainage lines

MUSIC Model Outlet Location ⁽¹⁾	Gross Pollutant		Total Suspended Solids		Total Phosphorus		Total Nitrogen	
	Source Load (kg/year)	Percentage Reduction						
Driftway West Out	42.7	37.2	421	35.1	0.786	27.1	3.51	8.8
Londonderry North Out	17.9	0	172	0	0.32	0	1.4	0
Londonderry South Out	39.1	61.4	401	53.9	0.759	36	4.14	14.9
Driftway Central 1 Out	880	100	12000	87	23.2	54.6	152	19.6
Driftway Central 2 Out	290	92.9	3020	86.1	5.71	61.7	29.7	26.3
Driftway East Out	125	37.4	1190	24.4	2.24	14.4	12.2	4.6
Rickabys Creek Out	259	83.3	2960	68.9	5.65	48.1	31.6	12.2
Total	1650	87.8	20200	78.1	38.7	51	234	18.3

6.2.4 Safeguards and management measures

Safeguards and management measures for hydrology, flooding and surface water are presented in Table 6-8

Table 6-8: Safeguards and management measures – Hydrology, flooding and surface water

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil erosion and water pollution	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Construction contractor	Preconstruction	Core standard safeguard SW1 Section 2.1 of QA G38 Soil and Water Management
Erosion and sedimentation	A site-specific Erosion and Sediment Control Plan/s (ESCP) will be prepared and implemented as part of the Soil and Water Management Plan. 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.	Construction contractor	Preconstruction	Core standard safeguard SW2 Section 2.2 of QA G38 Soil and Water Management
Contaminants entering receiving environments during construction	Control measures to minimise the risk of water pollution will be included in the ESCP. The following measures will be included to limit sediment and other contaminants entering receiving waterways: <ul style="list-style-type: none"> No stockpiles of materials or storage of fuels or chemicals will be located adjacent to the existing culverts Vehicles and machinery will be properly maintained to minimise the risk of fuel/oil leaks Routine inspections of all construction vehicles and equipment will be undertaken for evidence of fuel/oil leaks. All fuels, chemicals and hazardous liquids will be stored within an impervious bunded area in accordance with Australian standards and NSW EPA Guidelines All water discharges will be undertaken in accordance with Transport for NSW's <i>Water Discharge and Re-use Guideline</i> Emergency spill kits will be kept on-site at all times. All staff will be made aware of the location of the spill kit and be trained in its use 	Construction contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> Construction plant, vehicles and equipment will be refuelled offsite, or in designated re-fuelling areas located at a minimum distance of 50 metres from drainage lines or waterways Groundwater encountered during the construction of the proposal will be managed in accordance with the requirements of the <i>Waste Classification Guidelines</i> (DECCW 2009) and Transport for NSW's <i>Water Discharge and Re-use Guideline</i> Stabilised surfaces will be reinstated as quickly as practicable after construction Material transport from site to surrounding pavement surfaces will be minimised Soil and water management measures will be identified in consultation with relevant government agencies and Councils and will be consistent with the principles and practices detailed in <i>Managing Urban Stormwater: Soils and Construction</i> (2004) (known as the Blue Book). 			
Flood management during construction	<p>A Flood Management Plan will be prepared before construction. This plan will include:</p> <ul style="list-style-type: none"> Review and coordination with existing local flood plans and evacuation procedures Flood emergency preparation, response, and recovery measures which will be implemented during construction Procedure for daily review of the Bureau of Meteorology website Site protection measures to be implemented before and in the event of flooding. 	Construction contractor	Preconstruction/construction	Additional safeguard
Increase the depth and duration of inundation on private properties	<ul style="list-style-type: none"> During detailed design undertake floor level survey on private properties Improved drainage design to avoid impacts to private properties in accordance with criteria identified in Appendix D. 	Design and construction contractor	Preconstruction	Additional safeguard

6.3 Traffic and transport

Potential impacts of the proposal to traffic, transport and access which may occur during construction and operation of the proposal are provided in the section below.

6.3.1 Methodology

The methodology used to assess impacts to traffic and transport associated with the proposal are summarised below:

- A review of the existing traffic and transport conditions in the study area and including the local and state road network, traffic flows, intersection performance, public transport services, pedestrian and cycle facilities and road safety
- Identifying the impacts of the construction and operation of the proposal on existing roads, public transport, active transport infrastructure and road safety
- Modelling existing and forecast traffic scenarios at completion (2026) and 10 years (2036) after completion of the proposal to evaluate impacts, based on two scenarios – without project and with project using 2019 models and recent traffic counts as a basis
- Identifying mitigation measures required to minimise these impacts.

Traffic modelling background

As part of Transport for NSW investigations into options for the new Richmond Bridge and traffic improvements, traffic data was collected in December 2018 and March 2019, and a microsimulation model was developed in AIMSUN for both the morning and evening peak periods to replicate the current traffic conditions in the proposal area.

Historic traffic data and demographic data were reviewed along with the proposed new development areas inside the proposal area as provided by Hawkesbury City Council. Future traffic growth including from outside of the proposal area was estimated from the Transport for NSW Strategic Traffic Forecasting Model (STFM). The traffic growth estimations from the Strategic Traffic Forecasting Model (STFM) were reviewed to understand expected traffic growth in the area.

The STFM is considered suitable for the traffic modelling and forecasting of road schemes with wide reaching network impact, to examine the effect of new residential or employment land releases, major incident, tolling or other strategies. The STFM is linked with the Sydney Travel Model (STM) developed by Transport for NSW Transport Performance and Analytics which undertakes the trip generation, trip distribution and mode choice modules of the traffic forecasting process and incorporates demographic data related to land uses including population, employment, and education enrolment projections.

For STFM, this data is based on the latest population and employment projections based on the latest land use data. Further, the future proposed developments surrounding the proposal area were identified in consultation with the Hawkesbury City Council and included Redbank (1400 lots), Vineyard (2500 lots) and Glossodia (580 lots) which are all expected to be fully developed prior to 2036.

The model was run on the options identified in the Preferred Option report prepared by AECOM (2021). Upgrading of The Driftway (including the new intersections at Londonderry Road and Blacktown / Racecourse Road) was common to each option and was included all traffic modelling. The modelled results of the preferred option (the proposal) and the operational impacts were assessed using traffic modelling for the following assessment scenarios:

- 2019 (base year)
- 2026 (at completion) with and without the proposal
- 2036 (at completion +10 years) with and without the proposal.

The total network traffic demand and growth during morning and afternoon peak periods are shown in Table 6-9 and Table 6-10 below.

Table 6-9: Traffic demand morning (4 hours)

Vehicle type	06:00-10:00		
	2019	2026	2036
Car/LCV	21,260	24,400	26,350
Truck	1,080	1,330	1,580
Total	22,340	25,730	27,930
Total growth		15%	25%
Per annum growth from 2019		2.2%	1.5%

Table 6-10: Traffic demand evening (3 hours)

Vehicle type	15:00-18:00		
	2019	2026	2036
Car/LCV	21,120	23,940	25,590
Truck	740	920	1,040
Total	21,860	24,860	26,630
Total growth		11%	19%
Per annum growth from 2019		1.6%	1.1%

It's expected that the proposal would be open to traffic prior to 2026 and the predicted increase in traffic volumes in future years 2026 and 2036 would likely not occur until Stage 2 is delivered.

6.3.2 Existing environment

Road network

The Driftway is a local road within the Hawkesbury LGA connecting Blacktown Road (MR537), South Windsor in the east to Castlereagh Road (MR570), Agnes Banks in the west. The Driftway has an undivided carriageway with one travel lane in each direction (eastbound and westbound) and is generally signposted as 80 kilometre per hour (80 km/hr) with the exception of a small section at the eastern end between Reynolds Road and Blacktown Road.

The existing intersection with Londonderry Road (MR630) to the west is a four-way intersection that gives priority to Londonderry Road and has stop sign control for The Driftway. The existing arrangement between Blacktown Road, The Driftway and Racecourse Road to the east is a staggered T-junction separated by about 130 metres. The Driftway has stop sign control and Racecourse Road has a give way control. There are two existing intersections along the Driftway in the proposal area:

- A give way T-junction intersection between The Driftway and Reynolds Road
- A give way T-junction intersection between The Driftway and Luxford Road.

Londonderry Road is a State road which connects Richmond in the north to The Northern Road (A9) corridor to the south. In the vicinity of its intersection with The Driftway, Londonderry Road is an undivided carriageway with one travel lane in each direction (northbound and southbound) and is signposted as 80 km/hr within the vicinity of the proposal.

Blacktown Road is a State road which connects Richmond in the north to The Northern Road and Richmond Road in the south. In the vicinity of its intersection with The Driftway, Blacktown Road is an undivided carriageway with one travel lane in each direction (northbound and southbound) and is signposted as 80 km/hr.

Traffic volumes

Traffic data recorded during traffic surveys carried out in June 2021 are provided in Table 6-11. The Driftway currently carries over 200 vehicles per hour in both directions combined during morning and afternoon peak periods and about 300 vehicles per hour in both directions combined in during the evening peak. Londonderry Road currently has higher traffic volumes with about 700 – 750 vehicles per hour during peak periods. Blacktown Road experiences even higher traffic volumes than The Driftway and Londonderry Roads, with about 1,200 – 1,600 per hour in both directions combined during peak periods.

Table 6-11: Traffic volumes in the proposal area

Intersection	AM peak hour	PM Peak hour	7-day average	% Heavy vehicles	
				AM peak	PM peak
The Driftway (between Luxford Road and Londonderry Road)	200	237	2627	12%	8%
The Driftway (between Blacktown Road and Reynolds Road)	282	310	3690	13%	8%
Londonderry Road (north of the Driftway)	702	757	7863	8%	9%
Londonderry Road (south of the Driftway)	752	835	7223	9%	9%

Intersection Performance

Level of Service (LoS) is a measure of the performance (LoS A to F) of intersections based on the delay experienced by vehicles passing through the intersection. As intersections become more congested, the delay increases, reducing the intersection LoS towards F. The LoS for the intersections at both ends of The Driftway during morning (8-9 am) and afternoon (4-5 pm) peak periods are provided in Table 6-12. The intersections that have been included in this analysis are detailed in

Figure 6-1. Currently the intersections are performing well, with the exception of traffic giving way at the priority intersection of Blacktown Road (vehicles turning right or left from the Driftway during the morning peak).

Table 6-12: 2019 intersection performance during peak morning and afternoon traffic periods

Intersection	Approach	2019 AM peak (8- 9am)			2019 PM peak (4-5pm)		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
The Driftway and Londonderry Road	Londonderry Road (north)	227	2	A	374	3	A
	The Driftway (east)	42	20	B	166	56	D
	Londonderry Road (south)	412	0	A	369	1	A
	The Driftway (west)	70	32	C	37	23	B
	Total / average	751	32	C	946	12	A
Blacktown Road and The Driftway	Blacktown Road (north)	628	8	A	602	9	A
	Blacktown Road (south)	665	2	A	816	3	A
	The Driftway (west)	178	113	F	110	41	C
	Total / average	1471	113	F	1528	41	C

Crash history

Injury crash clusters and safety issues have been identified along The Driftway. Many of these crashes relate to conflicts between through and right-turning traffic at key intersections such as The Driftway with Blacktown Road and Londonderry Road, which in the last five years of available crash data have recorded a fatality and a number of injuries. The latest crash data was obtained for the period from August 2015 to June 2020 to estimate the recent accident patterns across the proposal area. Crash and casualty data are provided in Table 6-13 and Table 6-14. All but one crash occurred at either Londonderry Road or Blacktown Road intersections with one crash occurring at the Reynolds Road intersection. No mid-block crashes were recorded on this section of The Driftway.

Table 6-13: Crashes by year along the Driftway (including intersections)

Year of Crash	Fatal	Seriously injured	Moderate injury	Minor injury	Non casualty	Total
2020	-	2	1	-	-	3
2019	-	1	3	-	1	5
2018	-	1	3	1	-	5
2017	1	3	1	-	-	5

Year of Crash	Fatal	Seriously injured	Moderate injury	Minor injury	Non casualty	Total
2016	-	-	3	1	4	8
2015	-	1	2	-	-	3
Total	1	8	13	2	5	29

Table 6-14: Casualties by year of crash along the Driftway (including intersections)

Year of Crash	Fatal	Seriously injured	Moderate injury	Minor injury	Total
2020	-	2	2	-	4
2019	-	2	4		6
2018		1	5	3	9
2017	1	3	2	3	9
2016	-		3	3	6
2015	-	2	3		5
Total	1	10	19	9	39

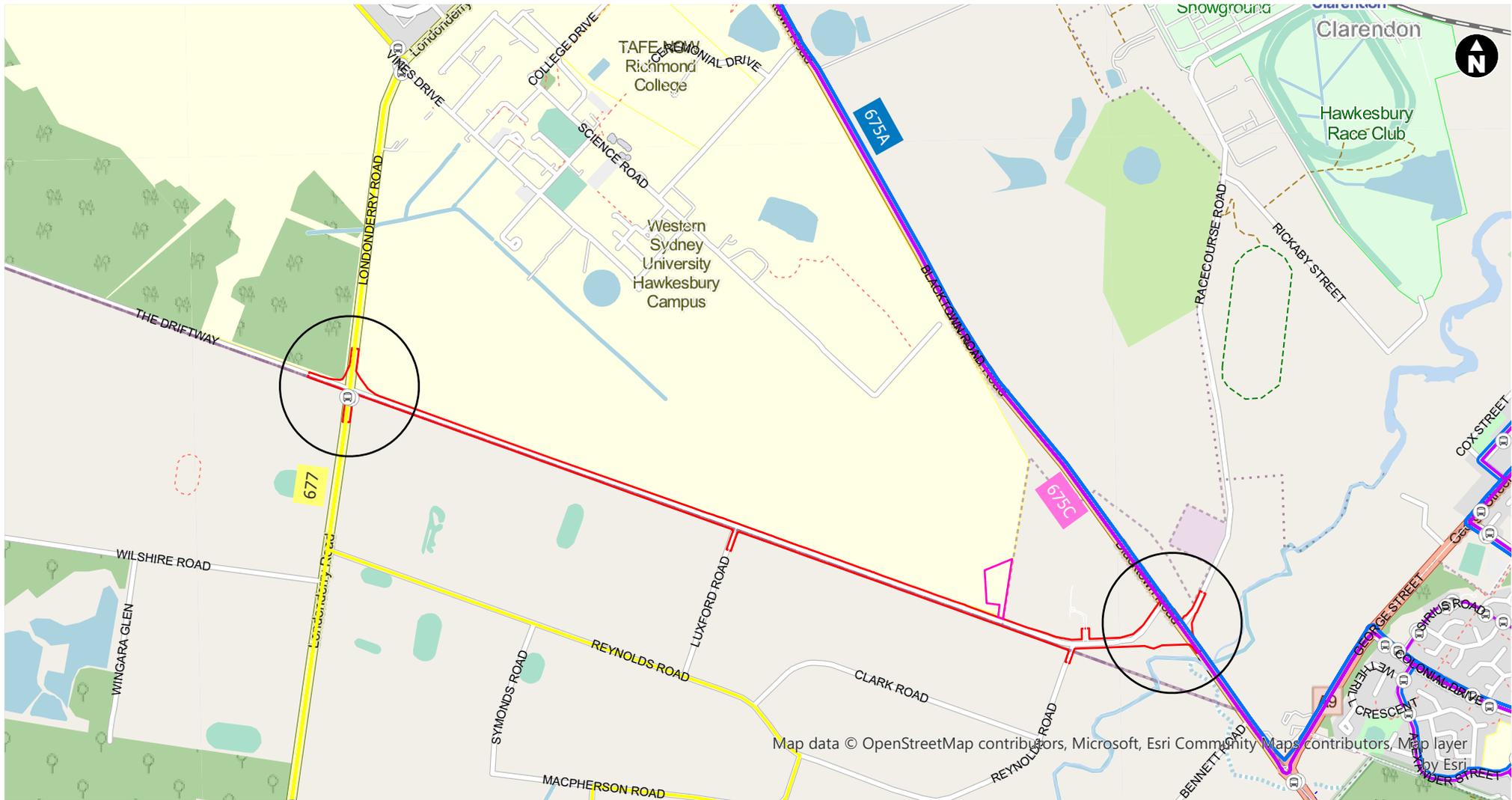
Existing public transport infrastructure

Several public bus routes operate along the surrounding road network, however there are no routes along The Driftway (see

Figure 6-1). Private school buses may drop children on The Driftway. Timetable information shows that these services operate with low frequencies. There is an existing bus stop for Route number 677 both sides of Londonderry Road just south of the intersection with The Driftway. The closest railway stations to the proposal are East Richmond Station and Clarendon Station, both located about 3 kilometres to the north on the Richmond Line.

Active transport

There are no dedicated pedestrian pathways along The Driftway, Londonderry Road or Blacktown Road in the vicinity of the proposal. There are no dedicated bicycle pathways along The Driftway or Londonderry Road. Blacktown Road currently has a bicycle lane utilising shoulders which extends north and south of the intersection with The Driftway.



- Legend**
- Construction footprint
 - Potential temporary ancillary facility
 - Bus stops
 - Bus routes
 - 675A
 - 675C
 - 677

0 1 1 km
GDA2020 MGA Zone 56

Data sources

- Jacobs 2021
- NSW Spatial Services 2021

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Figure 6-1 Intersection analysed and existing bus routes

6.3.3 Potential impacts

Construction

Potential impacts to the surrounding road network and traffic during the construction period would be associated with construction traffic generation, temporary traffic controls affecting traffic flow, changes to access and impacts to public and active transport.

Construction traffic generation

During construction, additional traffic movements would result from light and heavy vehicle movements used for the proposal. Plant and equipment required to construct the proposal would vary across the construction phases. The number of heavy vehicle movements is expected to be at its highest during main earthworks and pavement operations associated with the realigned section of The Driftway.

As outlined in Section 3.3 of this REF, construction activities would occur primarily during the standard construction working hours (7:00 am to 6:00 pm, Monday to Friday and between 8:00 am and 1:00 pm on Saturdays). Some heavy vehicle movements may be required to support out of hours work. Night work is likely to be required at the intersections of The Driftway and Blacktown and Londonderry Road.

About 50 light vehicle movements (in and out) would be generated from construction staff travelling to and from the site each day and up to 10 heavy vehicles movements per day would be required to transport fill and other road materials and to deliver plant and equipment. Construction vehicles would mainly be required to access the proposed temporary ancillary site and along The Driftway, Londonderry, Blacktown and Racecourse Road. Construction vehicles would access the proposal via arterial roads wherever possible.

Additional vehicle movements associated with construction activities would be temporary and it is expected that the construction of the proposal would have a minor impact on existing traffic conditions, given the current traffic volumes. Construction workforce parking would be available in the ancillary site and along the construction alignment. It is not expected that surplus parking demand from construction activities would reduce the availability of surrounding public parking.

Road network impacts

Construction activity is likely to impact traffic operation during:

- Roundabout construction activities at Londonderry Road and Blacktown / Racecourse Road
- Pavement improvements along The Driftway
- Tie-ins of the improved sections of The Driftway with existing roads.

Minor delays at these locations are expected during construction due to reduced speed limits and when manual traffic control is in operation to facilitate the movement of construction vehicles into and out of work sites. Lane closures may be required during the construction of the above and would use traffic controls during the works. This could result in minor delays to the flow of traffic and minor delays at existing intersections in the proposal area. Where possible, lane closures would be timed for out of peak hours to minimise impacts to traffic and the local road network, particularly at key intersections of The Driftway with Blacktown Road and Londonderry Road.

Road closures may be required on side roads of The Driftway (Reynolds and Luxford Roads) to allow for tie-in works. Side roads would not be closed at the same time to enable access from the alternative road. These instances would be scheduled to occur outside of daily peak periods to reduce the impact of construction traffic on through traffic.

A Traffic Management Plan (TMP) would be prepared and implemented to manage traffic and access impacts during construction. Consultation with the public and local businesses would be maintained throughout construction to outline upcoming lane closures and site-specific traffic control measures.

Access

Properties which have direct access to construction activities within the proposal area (mainly along The Driftway) may require temporary access adjustments during the construction phase. If restrictions are required, for example during utility work or driveway adjustments, this would be for short durations and organised in consultation with the affected property owners. Emergency services and pedestrian access to properties would be maintained at all time.

Public Transport and active transport

Several bus routes operate along the surrounding road network, however there are no routes along The Driftway. Bus routes along Londonderry Road (677) and Blacktown Road (675) may experience minor delays to public bus movements during construction as a result of construction speed zones, increased congestion at intersections and any potential short-term traffic control. Given the temporary nature of construction activities along those routes and the low frequencies of bus operations, the potential impact to public transport during construction is considered negligible.

Cyclists using the bicycle shoulder lane along Blacktown Road may experience temporary disturbance during construction of the new roundabout at The Driftway and Racecourse Road. During construction alternative paths or routes would be established to ensure safe passage of cyclists and pedestrians through the proposal area during construction.

Operation

Intersection performance 2026

Traffic modelling for the future year 2026 includes the completed, proposed new Richmond Bridge. The preferred option has been modelled for the proposal. The new bridge provides the network with the additional capacity to accommodate the 2026 future traffic demand. As a result, traffic flows are shown to increase along Londonderry Road and The Driftway due to the release of demand from the North Richmond area and a bypass of Richmond town centre.

The traffic model indicates that both Londonderry Road / The Driftway intersection and the Blacktown Road / The Driftway intersection are expected to be at capacity for future year 2026 demands with the Blacktown Road and The Driftway intersection modelled to be performing at capacity (LoS F) without improvements to the intersections.

The model shows improvements, during the morning peak (8-9am) to intersection performance at the intersection of Londonderry Road / The Driftway from LoS C to LoS B as a result of the proposal - upgrading the intersection to a roundabout. This allows traffic on The Driftway to more easily cross and enter onto Londonderry Road. The model also shows substantial improvements at the intersection of Blacktown Road / The Driftway from LoS F to LoS C as a result of upgrading the intersection to a roundabout, allowing traffic from The Driftway to turn onto Blacktown Road more easily.

Similar improvements in intersection performance can also be seen in the afternoon peak at both intersections. With the upgrade to roundabouts at The Driftway/ Blacktown Road and The Driftway / Londonderry Road intersections, the performance was shown to improve substantially from LoS F to LoS B.

The predicted future year (2026) bypass intersection performance for key intersections during morning and evening peak hours with and without the proposal are provided in Table 6-15 and Table 6-16.

Table 6-15: 2026 morning peak level of service

Intersection	Approach	2026 AM peak (8-9am)					
		Without Proposal			With Proposal		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
The Driftway and Londonderry Road	Londonderry Road (north)	230	2	A	469	8.9	A
	The Driftway (east)	144	40	C	296	14	A
	Londonderry Road (south)	438	0	A	436	5	A
	The Driftway (west)	91	35	C	213	24	B
	Total / average	843	40	C	1413	24	B
Blacktown Road and The Driftway	Blacktown Road (north)	842	11	A	502	32	C
	Blacktown Road (south)	849	2	A	857	9	A
	The Driftway (west)	139	397	F	523	34	C
	Racecourse Road (east)	-	-	-	111	25	B
	Total / average	1830	397	F	1993	34	C

Table 6-16: 2026 evening peak level of service

Intersection	Approach	2026 PM peak (4-5pm)					
		Without Proposal			With Proposal		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
The Driftway and Londonderry Road	Londonderry Road (north)	378	3	A	479	5	A
	The Driftway (east)	223	246	F	585	23	B
	Londonderry Road (south)	433	1	A	430	8	A
	The Driftway (west)	37	30	C	53	23	B
	Total / average	1071	246	F	1547	23	B

Intersection	Approach	2026 PM peak (4-5pm)					
		Without Proposal			With Proposal		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
Blacktown Road and The Driftway	Blacktown Road (north)	762	11	A	629	23	B
	Blacktown Road (south)	1093	4	A	1129	10	A
	The Driftway (west)	110	231	F	238	14	B
	Racecourse Road (east)	-	-	-	133	17	B
	Total / average	1965	231	F	2129	23	B

The intersections of The Driftway with Reynolds and Luxford Roads would continue to operate at LoS A in both AM and PM peaks.

Intersection performance 2036

The modelling again shows substantial improvements are seen at the intersections of Londonderry Road / The Driftway and Blacktown Road / The Driftway as a result of the project upgrading the intersection to a roundabout, allowing traffic from The Driftway to turn onto both roads more easily. The model indicates that while there is an improvement in intersection performance, the intersection of Blacktown Road and The Driftway is approaching capacity by 2036 in the AM peak. The need to upgrade the intersection of The Driftway and Blacktown Road beyond 2036 would be dependent on other major infrastructure projects such as the Castlereagh Freeway and Outer Sydney Orbital which could redistribute traffic in the study area. The modelled future 2036 intersection performance for key intersections during morning and afternoon peak hours with and without the proposal are provided in Table 6-17 and

Table 6-18.

Table 6-17: 2036 morning peak level of service

Intersection	Approach	2036 AM peak (8-9am)					
		Without Proposal (do min)			With Proposal		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
The Driftway and Londonderry Road	Londonderry Road (north)	255	2	A	532	11	A
	The Driftway (east)	170	65	E	331	17	B
	Londonderry Road (south)	512	1	A	509	6.9	A
	The Driftway (west)	111	48	D	229	30	C
	Total / average	1047	65	E	1601	30	C

Intersection	Approach	2036 AM peak (8-9am)					
		Without Proposal (do min)			With Proposal		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
Blacktown Road and The Driftway	Blacktown Road (north)	863	11	A	513	34	C
	Blacktown Road (south)	942	3	A	959	9	A
	The Driftway (west)	124	507	F	553	64	E
	Racecourse Road (east)	-	-	-	119	30	C
	Total / average	1929	507	F	2144	64	E

Table 6-18: 2036 evening peak level of service

Intersection	Approach	2036 PM peak (4-5pm)					
		Without Proposal (do min)			With Proposal		
		Flow	Average delay (seconds)	LoS	Flow	Average delay (seconds)	LoS
The Driftway and Londonderry Road	Londonderry Road (north)	431	3	A	559	6.4	A
	The Driftway (east)	216	349	F	581	36	C
	Londonderry Road (south)	484	1	A	482	10	A
	The Driftway (west)	40	29	B	77	19	B
	Total / average	1171	349	F	1698	36	C
Blacktown Road and The Driftway	Blacktown Road (north)	879	12	A	702	38	C
	Blacktown Road (south)	1183	4	A	1224	13	A
	The Driftway (west)	94	336	F	271	20	B
	Racecourse Road (east)	-	-	-	137	19	B
	Total / average	2157	336	F	2333	38	C

6.3.4 Safeguards and management measures

Safeguards and management measures for traffic and transport are presented in Table 6-19.

Table 6-19: Safeguards and management measures – Traffic and transport

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the <i>Transport for NSW Traffic Control at Work Sites Manual</i> (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i> (Transport for NSW, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • confirmation of haulage routes • measures to maintain access to local roads and properties • site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • requirements and methods to consult and inform the local community of impacts on the local road network • access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • a response plan for any construction traffic incident • consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic monitoring, review and amendment mechanisms. 	Contractor	Detailed design / Pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>
Property access - during construction	<p>Access to properties will be maintained during construction. Where that is not feasible, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority. Any disruptions to property access and traffic will be notified to landowners at least five days prior in accordance with the relevant community consultation processes outlined in the TMP.</p>	Transport for NSW and Contractor	Construction	Additional standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Reduce speeds, traffic delays and disruptions during construction	Road users and local communities will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays owing to construction activities.	Transport for NSW and Contractor	Construction	Additional standard safeguard
	Construction site traffic will be managed to minimise movements during peak periods.	Transport for NSW and Contractor	Construction	Additional standard safeguard
	Clear signage will be provided to direct and guide vehicles not related to the proposal during road construction work. This will be supplemented by variable message signs to advise drivers of traffic diversions, speed restrictions or alternative routes.	Transport for NSW and Contractor	Construction	Additional safeguard
Impacts to the regional road network	If disruptive work is required (lane closures) would be carried out at night where practicable, to minimise potential impacts on the regional road network.	Transport for NSW and Contractor	Construction	Additional safeguard
Parking	Parking will be provided on-site (ancillary site) and not on surrounding local streets.	Transport for NSW and Contractor	Construction	Additional safeguard
Site access and egress	All vehicles will enter and exit construction sites in a forward direction, where feasible and reasonable.	Transport for NSW and Contractor	Construction	Additional safeguard

6.4 Noise and vibration

The potential noise and vibration impacts that may occur during construction and operation of the proposal are assessed in detail in the *New Richmond Bridge Traffic Improvements (Stage 1) REF Assessment Noise and Vibration* prepared by SLR (2021) and provided in Appendix E. The methods used for assessment, the potential impacts and safeguards to mitigate identified impacts are summarised in the section below.

6.4.1 Methodology

The methodology for the noise and vibration assessment included:

- Identifying noise and vibration sensitive receivers in the study area
- Undertaking noise monitoring to determine the existing noise environment
- Establishing noise and vibration assessment criteria
- Undertaking noise modelling of the study area to predict noise levels during construction and operation of the proposal on surrounding sensitive receivers
- Assessing predicted noise and vibration levels against the relevant criteria to determine potential impacts
- Identify safeguards and management measures to be implemented to minimise impacts.

6.4.2 Existing environment

The proposal is located in the Penrith and Hawkesbury LGA. Existing noise levels in the proposal area are generally influenced by road traffic noise from The Driftway, Londonderry Road and Blacktown Road, and general environmental noise. Receivers which adjoin the proposal are typically rural residential properties located along The Driftway.

Sensitive receivers

The proposal area is comprised of a mix of residential and non-residential receivers. The residential receivers adjoin or are located along The Driftway and non-residential receivers are located further from The Driftway and are shown in Table 6-20. Noise Catchment Areas (NCA's) have been established for residential and non-residential receivers their locations are provided Figure 6-2 and in Appendix E.

Table 6-20: Non-residential sensitive receivers

NCA	Description	Address	Type
NCA01	Hawkesbury Function Centre	339 Londonderry Road, Londonderry	Public Building
	Londonderry Park	22-26 Muscharry Road, Londonderry	Outdoor Active
NCA05	Kiddiwinks Play Laugh and Learn	752 George Street, South Windsor	Child Care Centre
	Bligh Park Public School	64 Alexander Street, Bligh Park	Educational
	Bede Polding College	22-30 Rifle Range Road, South Windsor	Educational
	Bligh Park	698 George Street, South Windsor	Outdoor Active
NCA06	Windsor District Baptist Church	739 George Street, South Windsor	Place of Worship
	Rickaby Park	179 Church Street, South Windsor	Outdoor Active
NCA07	Western Sydney University	Bourke Street, Richmond	Educational
	TAFE NSW Richmond	Ceremonial Drive, Richmond	Educational
	Hobartville Public School	16 Valder Avenue, Hobartville	Educational
	Richmond High School	Lennox Street, Richmond	Educational
	Taplin Fields	35 Laurence Street, Hobartville	Outdoor Active

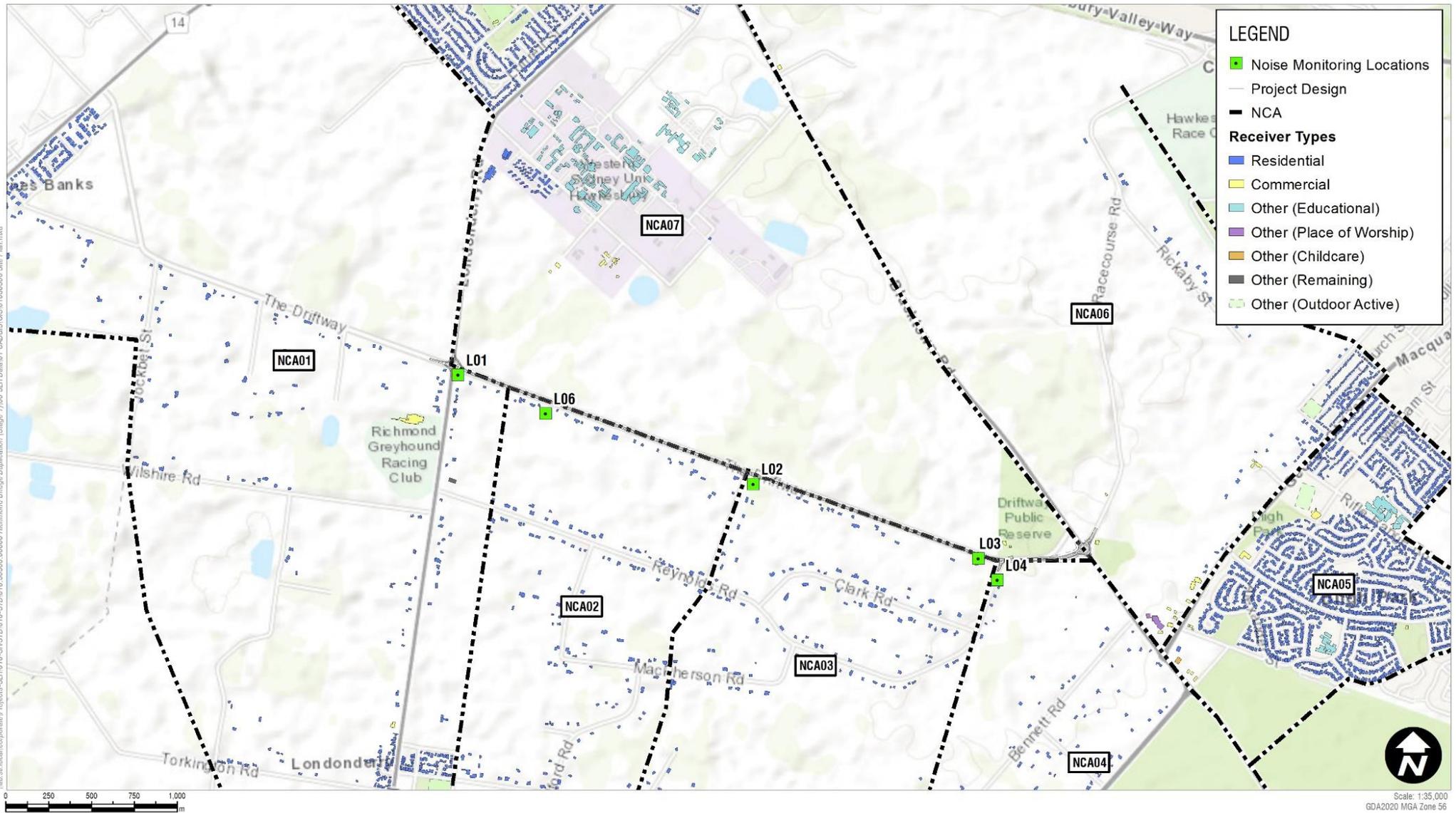


Figure 6-2: Site Plan, Receivers and Noise Monitoring Locations (Source: SLR 2021)

Existing noise environment

The existing noise environment for the study area is based on unattended noise monitoring results undertaken during May and June 2021, at the locations depicted in Table 6-21. The noise levels have been used to set the criteria to assess the potential impacts from the proposal.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time. The results of the noise monitoring are shown in Table 6-21.

Table 6-21: Summary of unattended noise logging results

ID	Address	Measures Noise Level (dBA)							
		Construction						Operational ²	
		Background Noise (RBL)			Average Noise (L _{Aeg})			Average Noise (L _{Aeg})	
		Day	Evening	Night	Day	Evening	Night	Day	Night
L01	281 Londonderry Road, Londonderry	44	40	30 (26) ³	58	56	53	57	54
L02	2-8 Luxford Road, Londonderry	36	32	30 (26) ³	53	52	48	53	49
L03	10-16 The Driftway, Londonderry	39	38	30 (29) ³	58	55	51	58	52
L04	8-14 Reynolds Road, Londonderry	42	40	32	56	54	50	55	51
L05 ⁴	268-274 The Driftway, Londonderry	-	-	-	-	-	-	-	-
L06 ⁵	268-274 The Driftway, Londonderry	35 (33) ³	34	30 (23) ³	50	48	45	50	47

Note 1: Construction noise is assessed during the daytime which is 7 am to 6 pm, the evening which is 6 pm to 10 pm and the night-time which is 10 pm to 7 am. See the NSW EPA *Interim Construction Noise Guideline*.

Note 2: Operational road traffic noise is assessed during the daytime which is 7 am to 10 pm and the night-time which is 10 pm to 7 am. See the NSW EPA *Road Noise Policy*.

Note 3: The monitored level was adjusted to match the minimum background level in the *Noise Policy for Industry*.

Note 4: The noise monitoring equipment failed at this location.

Note 5: The weather station was positioned at this location.

6.4.3 Criteria

Construction

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW. The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the project.

Residential receivers

The ICNG approach for determining NMLs at the residential receivers are shown in Table 6-22.

Table 6-22: ICNG NMLs for residential receivers

Time of Day	NML LA _{eg} (15 minute)	How to apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL ¹ + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise
		Where the predicted or measures LA _{eg} (15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level
		The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dBA	The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise
		Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, considering:
		<ul style="list-style-type: none"> • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Standard Construction Hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours
		The proponent should apply all feasible and reasonable work practices to meet the noise affected level
		Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW Industrial Noise Policy (INP). The INP has been superseded by the NSW EPA Noise Policy for Industry (NPfI).

Based on the results of the noise monitoring outlined in Table 6-22 and the application of the criteria presented above, residential NMLs have been established for each NCA and are outlined in Table 6-23.

Table 6-23: Residential receiver construction NMLs

NCA	Representative Background Monitoring Location	Measures Noise Level (LA _{eq} (15minute) - dBA)				
		Standard Construction (RBL + 10 dB)	Out of Hours (RBL + 5dB)			Sleep Disturbance Screening Criteria (RBL + 15 dB)
			Daytime	Day	Evening	
NCA01	L01	54	49	45	35	45
NCA02	L06	45	40	39	35	45
NCA03	L02	46	41	37	35	45
NCA04	L04	52	47	45	37	47
NCA05	L04	52	47	45	37	47
NCA06	L04	52	47	45	37	47
NCA07	L06	45	40	39	35	45

Note 1: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

Other sensitive receivers

Several non-residential receivers have been identified in the study area. The NMLs for 'other sensitive' receivers are shown in Table 6-24.

Table 6-24: NMLs for 'other sensitive' receivers

Land use	Noise Management Level LA _{eq} (15minute) (dBA) (Applied when the property is in use)	
	Internal	External
ICNG 'Other sensitive' Receivers		
Classrooms at schools and other educational institutions	45	55 ¹
Hospital wards and operating theatres	45	65 ²
Places of worship	45	55 ¹
Active recreation areas (characterised by sporting activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75
Non-ICNG 'Other Sensitive' Receivers		
Childcare centres – sleeping areas ⁴	40	50 ¹
Public building ³	50	60 ¹

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 3: Criteria taken from AS2107.

Note 4: Criteria taken from Association of Australian Acoustical Consultants Guideline for Child Care Centre Acoustic Assessment.

Construction traffic noise

The potential impacts from construction traffic associated with the proposal when travelling on public roads are assessed under the NSW EPA *Road Noise Policy* (RNP) and Roads and Maritime (now TfNSW) *Construction Noise and Vibration Guideline* (CNVG).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB as a result of construction traffic. Where this is considered likely, further assessment is required using the RNP and Roads and Maritime (now TfNSW) *Noise Criteria Guideline* (NCG) base criteria shown in Table 6-25.

Table 6-25 RNP/NCG for assessing construction traffic on public roads

Road Category	Type of Project/Land use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Nighttime (10 pm – 7 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	L _{Aeq} (15hour) 60 (external)	L _{Aeq} (9hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	L _{Aeq} (1hour) 55 (external)	L _{Aeq} (1hour) 50 (external)

Construction vibration

Construction vibration criteria can be separated into three categories being vibration effects on human comfort, vibration effects on building contents and vibration effects on the structural or cosmetic damage of a building.

- Human comfort refers to where the occupants of buildings are disturbed. People can sometimes perceive vibration impacts when vibration generating construction work is located close to occupied buildings. Vibration from construction work tends to be intermittent in nature and the EPA’s *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV), as shown in Table 6-26. While the construction activities for the proposal are generally not expected to result in continuous or impulsive vibration impacts, criteria are provided in Table 6-26.
- Building contents refers to where there may be damage to building contents from vibration. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents. Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes or medical imaging equipment, are in buildings near to construction work. No such equipment has been identified in the study area.
- Structural/cosmetic damage refers to where the integrity of the building may be compromised. If vibration from construction work is sufficiently high, it can cause cosmetic damage to elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in British Standard BS 7385 and German Standard DIN 4150. The limits are shown in Table 6-28.

Table 6-26: Human Comfort Vibration - Vibration dose values for intermittent vibration

Building type	Assessment period	Vibration Dose Value ¹ (m/s ^{1.75})	
		Preferred	Maximum
Critical Working Areas (eg operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration

Table 6-27: Human Comfort Vibration - Preferred and Maximum Weighted Root Mean Square Values for Continuous and Impulsive Vibration Acceleration (m/s²) 1–80 Hz

Location	Assessment period	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Critical working areas ¹	Day or night-time	0.0050	0.0036	0.010	0.0072
Residential	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions, and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical working areas ¹	Day or night-time	0.0050	0.0036	0.010	0.0072
Residential	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Note 1: Such as operating theatres or precision laboratories where sensitive operations are occurring. No such areas have been identified in the study area.

Table 6-28: Cosmetic damage - BS 7385 Transient vibration values for minimal risk of damage

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

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

Heritage buildings or structures

Heritage listed buildings and structures should be considered on a case-by-case basis but as noted in BS 7385 should not be assumed to be more sensitive to vibration, unless structurally unsound. Where a heritage building is deemed to be sensitive, the more stringent guideline values can be applied.

The nearest heritage building or structure to the proposal is Londonderry Cemetery located 400 metres south of the proposal area. Table 6-29 below outlines the CNVG minimum working distances from vibration intensive equipment. In accordance with Table 6-29, no heritage building, or structures are expected to be impacted by the construction of the proposal. The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions.

Table 6-29: Recommended minimum working distances from vibration intensive equipment

Plant Item	Rating/description	Minimum distance		
		Cosmetic damage		Human Response (NSW EPA Guideline)
		Residential and light commercial (BS 7385)	Heritage items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	15 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Handheld	1 m (nominal)	3 m	2 m

Operation

The NSW *Road Noise Policy* (RNP) is used to assess and manage potential airborne noise impact from new and redeveloped road projects. This assessment is undertaken with guidance from *the Noise Criteria Guideline* (NCG) which is Transport for NSW's (previously Roads and Maritime) interpretation of the RNP and provides a consistent approach to identifying road noise criteria for infrastructure projects.

The RNP and NCG provide non-mandatory criteria for residential and 'other sensitive' land uses. Where a project results in road traffic noise levels which are predicted to be above the criteria, the project should investigate feasible and reasonable noise mitigation measures to minimise the impacts.

Residential receivers

The proposal would 'redevelop' The Driftway and connections to surrounding roads. A road is 'redeveloped' where work is in an existing road corridor and the existing road is not substantially realigned. The relevant noise criteria for residential receivers are shown in Table 6-20.

Table 6-30: NCG criteria for residential receivers

Road category	Type of project/Lane use	Assessment criteria	
		Daytime (7am – 10pm)	Night time (10pm – 7am)
Freeway/arterial/sub-arterial roads	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	L _{Aeq} (15 hour) 60 (external)	L _{Aeq} (9 hour) 55 (external)
	6. Existing residences affected by increases in traffic noise of 12 dB or more from redevelopment of existing freeway/arterial/sub-arterial roads ¹	Between L _{Aeq} (15hour) 42-60 (external)	Between L _{Aeq} (9hour) 42-55 (external)
Local roads	8. Existing residences affected by noise from redevelopment of existing local roads	L _{Aeq} (1 hour) 55 (external)	L _{Aeq} (1 hour) 50 (external)

Note 1: The relative increase criterion at each facade is determined from the existing traffic noise level plus 12 dB

Other sensitive receivers

The noise criteria for the 'other sensitive' land uses have been identified in the study area and is shown in Table 6-31.

Table 6-31: NCG criteria for other sensitive receivers

Existing sensitive land use	Assessment criteria (dB)		Additional considerations
	Daytime (7am – 10pm)	Night-time (10pm – 7am)	
School classrooms	L _{Aeq} (1 hour) 40 (internal) ¹	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000). The criteria are internal, ie the inside of a church. Areas outside the place of worship, such as a churchyard or cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established what is in these areas that may be affected by road traffic noise.
Hospital wards	L _{Aeq} (1 hour) 35 (internal)	L _{Aeq} (1 hour) 35 (internal)	
Places of worship	L _{Aeq} (1 hour) 40 (internal) ¹	L _{Aeq} (1 hour) 40 (internal) ¹	
Open space (active use)	L _{Aeq} (15 hour) 60 (external)	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion
Open space (passive use)	L _{Aeq} (15 hour) 55 (external)	-	Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg playing chess, reading).

Existing sensitive land use	Assessment criteria (dB)		Additional considerations
	Daytime (7am – 10pm)	Night-time (10pm – 7am)	
Child care facilities	Sleeping rooms LAeq(1 hour) 35 (internal) ¹ Indoor play areas LAeq(1 hour) 40 (internal) ¹ Outdoor play areas LAeq(1 hour) 55 (internal)	-	Multipurpose spaces (eg shared indoor play/sleeping rooms) should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility, or if these are not known, during the highest hourly traffic noise level during the opening hours of the facility.
Aged care facilities	-	-	The criteria for residential land uses should be applied to these facilities.

Note 1: The criteria are specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are 10 dB higher than the corresponding internal level, which is representative of windows being partially open to provide ventilation.

Potential traffic noise impacts on the surrounding road network

Where a project results in traffic redistribution, noise impacts can occur on the surrounding road network due to vehicles using different routes after the project is complete. The NCG criteria (see Table 6-30) are therefore applied to the surrounding road network where a road project generates an increase in road traffic noise of more than 2.0 dB.

6.4.4 Potential impacts

Construction

The following overview is based on the predicted noise impacts at the most affected receivers in each NCA and is representative of the worst-case situation where construction equipment is at the closest point to each receiver. For most work, the construction noise impacts would frequently be lower than predicted as the worst-case situation is typically only apparent for a relatively short period when noisy equipment is in use nearby. The predicted noise impacts based on the NML are provided in Table 6-32. Table 6-32 below outlines the NML exceedance bands and CNVG perception categories.

Table 6-32: NML exceedance bands and corresponding CNVG perception categories

CNVG Perception categories	Daytime-Standard construction hours		Out of hours periods	
	Symbol	NML Exceedance	Symbol	NML Exceedance
Noticeable	•	<1	◆	1 to 5 dB
Clearly Audible	●	1 to 10dB	●	6 to 15 dB
Moderately Intrusive	◆	11 dB to 20 dB	◆	16 dB to 25 dB
Highly Intrusive	■	> 20 dB	■	> 25 dB

The predicted construction noise impacts are presented for the residential receivers within each NCA that have the potential to be the most affected by construction noise from the proposal. The assessment is generally considered conservative as the calculations assume several items of construction equipment are in use at the same time within individual scenarios. In reality, there would frequently be periods when construction noise levels are much lower than the worst-case levels predicted as well as times when no equipment is in use and no noise impacts occur.

Table 6-33: Worst-case construction noise exceedances - residential receivers

Period	ID	Scenario	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07
Daytime	W.01	Site establishment, early work and utility work - peak	■	■	■	◆	●	●	●
	W.02	Site establishment, early work and utility work - typical	◆	■	■	●	•	•	•
	W.03	Intersection/ realignment work on Blacktown Road and Londonderry Road - peak	■	◆	◆	●	•	•	●
	W.04	Intersection/ realignment work on Blacktown Road and Londonderry Road - typical	◆	•	•	•	•	•	•
	W.05	Bridge construction - peak	•	•	●	●	•	•	•
	W.06	Bridge construction - typical	•	•	•	•	•	•	•
	W.07	Widening and pavement work - peak	■	■	■	◆	•	•	●
	W.08	Widening and pavement work - typical	◆	■	■	●	•	•	•
	W.09	Finishing work and demobilisation	●	◆	◆	•	•	•	•
	W.10	Compounds – general operations	•	•	●	•	•	•	•
Evening	W.01	Site establishment, early work and utility work - peak	n/a						
	W.02	Site establishment, early work and utility work - typical	n/a						
	W.03	Intersection/ realignment work on Blacktown Road and Londonderry Road - peak	■	◆	◆	●	●	●	●
	W.04	Intersection/ realignment work on Blacktown Road and Londonderry Road - typical	◆	◆	●	•	•	•	•
	W.05	Bridge construction - peak	n/a						
	W.06	Bridge construction - typical	n/a						
	W.07	Widening and pavement work - peak	■	■	■	◆	◆	◆	●
	W.08	Widening and pavement work - typical	◆	■	■	●	•	•	•
	W.09	Finishing work and demobilisation	n/a						
	W.10	Compounds – general operations	•	•	●	•	•	•	•
Night-time	W.01	Site establishment, early work and utility work - peak	n/a						
	W.02	Site establishment, early work and utility work - typical	n/a						
	W.03	Intersection/ realignment work on Blacktown Road and Londonderry Road - peak	■	◆	◆	◆	●	●	●
	W.04	Intersection/ realignment work on Blacktown Road and Londonderry Road - typical	■	●	●	●	•	•	•
	W.05	Bridge construction - peak	n/a						
	W.06	Bridge construction - typical	n/a						
	W.07	Widening and pavement work - peak	■	■	■	■	●	●	●
	W.08	Widening and pavement work - typical	■	■	■	◆	◆	◆	◆
	W.09	Finishing work and demobilisation	n/a						
	W.10	Compounds – general operations	•	•	◆	◆	•	•	•

Key to Impacts (see Table 6-32) ◆ Noticeable ● Clearly Audible ◆ Moderately Intrusive ■ Highly Intrusive

Note: n/a = no work expected during this period.

The above assessment shows that the receivers at NCA01, NCA02 and NCA03 are expected experience 'highly intrusive' or 'moderately intrusive' impacts during noisy, daytime construction scenarios. These scenarios include site establishment and early works, intersection/realignment work on Blacktown Road and Londonderry Road, as well as widening and pavement work. The highest impacts are likely to occur when noise intensive equipment such as chainsaws, chippers or concrete saws are being used. These equipment, however, are only required occasionally and are unlikely to be in use for long periods of time.

The worst-case noise levels are predicted to be 75 to 80 dBA at the nearest receivers (NCA01, NCA02 and NCA03) when noise intensive equipment is being used close to receivers. When noise intensive equipment is not being used, the worst-case levels are predicted to be around 65 dBA. The worst-case predictions represent noise levels when construction work is close to a particular receiver, therefore as work moves away to other parts of the project the impacts would substantially reduce.

Residential receivers in other catchments are located further away from the proposal and are predicted to have noise impacts that are correspondingly lower.

Other sensitive receivers

'Moderately intrusive' or 'clearly audible' worst case impacts were predicted at a small number of the nearest commercial receivers in NC07.

Sleep disturbance

The sleep disturbance screening assessment (see Appendix E) found that sleep disturbance screening criterion is likely to be exceeded when night works occur near residential receivers. The receivers that would be potentially affected include NCA01, NCA02 and NCA03. The highest noise levels are only likely to be apparent for relatively short periods.

Vibration

Certain front row receivers are likely to be within the minimum working distances for cosmetic damage. A number of receivers are also likely to be within the human comfort minimum working distances and occupants of these affected buildings may be able to perceive vibration impacts when vibration intensive equipment is in use for short periods of time. No impacts are anticipated for heritage structures. Buildings within the minimum working distances are provided in Appendix E.

Cosmetic damage and human comfort impact due to the construction of the proposal would be managed with safeguards and management measures outlined in Section 6.4.5.

Construction traffic

Construction related traffic has the potential to temporarily increase road traffic noise levels at receivers that are near to haulage routes. It is anticipated that there would be 50 light vehicle movements and ten heavy vehicle movements each day associated with the project.

The existing traffic along Blacktown Road, Londonderry Road and The Driftway is significantly higher than the proposed volume of construction traffic. When assuming 50 light vehicle movements and ten heavy vehicle movements during both the daytime and night-time periods, construction traffic is predicted to result in increases of less than 1 dB from these roads.

Cumulative impacts

There is potential for cumulative construction impacts from multiple construction activities being completed in different areas of the proposal. Since the construction scenarios required for various stages of the proposal would generally require similar items of equipment, concurrent construction work being completed near to a particular area could theoretically increase the worst-case noise levels in this report by around 3 dB (a logarithmic adding of two sources of noise at the same level).

The likelihood of worst-case noise levels being generated by two different work activities at the same time is, however, considered low and rather than increase construction noise levels, the impact of concurrent

work would generally be limited to a potential increase in the duration, and annoyance, of noise impacts on the affected receivers.

In practice, construction noise levels in any one location would vary and would be frequently much lower than the worst-case scenario assessed due to construction staging moving work around within the proposal area and, in many cases, only a few items of equipment being used at any one time.

Operation

Residential receivers

The predicted operational road traffic noise levels at residential receivers have been assessed for 2026 and 2036 future design scenarios, although Stage 1 is expected to be open prior to these dates. The predictions indicate the worst-case impacts in each NCA, typically experienced by receivers nearest to the proposal. The predictions include traffic associated with Stage 2 of the New Richmond Bridge project. The results of the assessment are shown in Table 6-34.

Table 6-34: Predicted road traffic noise levels at most affected residential receivers in each NCA

NCA	Predicted Noise Level (dBA) ¹								Number of Triggered Buildings ²			
	At Opening (2026)				Future Design (2036)							
	No Build (without project)		Build (with project)		No Build (without project)		Build (with project)		Trigger 1 >2.0 dB	Trigger 2 Cumulative	Trigger 3 Acute	Total
	Day	Night	Day	Night	Day	Night	Day	Night				
NCA01	65	59	66	60	65	59	67	60	11	2	1	12
NCA02	63	58	65	59	62	57	66	60	15	1	1	15
NCA03	61	56	64	57	60	55	65	58	10	3	3	10
NCA04	68	64	68	64	69	64	69	64	-	-	-	-
NCA05 ³	-	-	-	-	-	-	-	-	-	-	-	-
NCA06 ⁴	-	-	-	-	-	-	-	-	-	-	-	-
NCA07 ⁴	-	-	-	-	-	-	-	-	-	-	-	-
Total												37

Results of the assessment indicate that the proposal would result in an increase in noise levels by 2.0 dB to 36 residential receivers located in NCA01, NCA02 and NCA03. Five residential receivers would also experience acute noise levels (daytime noise levels of 65 dBA or higher, or nighttime noise levels of 60 dBA or higher) and six residential receivers would experience noise levels above the NCG cumulative limit criteria. In total, 37 residential receivers are considered eligible for consideration of additional noise mitigation, as per the operational road traffic noise criteria. These exceedances are mostly due an increase in traffic noise of greater than 2.0 dB.

Other sensitive receivers

'Other sensitive' receivers are generally distant from the proposal and are not predicted to exceed the operational road traffic noise criteria.

Receivers eligible for consideration of 'additional noise mitigation'

The receivers which have been identified as eligible for consideration of 'additional noise mitigation' (triggered receivers) are outlined below in Table 6-35 and shown in Appendix E.

Table 6-35: Receivers eligible for consideration for 'additional noise mitigation'

NCA	Number of Triggered Buildings (Floors)		Comments
	Residential	Other Sensitive	
NCA01	12 (12)	- (-)	Residential receivers along Londonderry Road and The Driftway are triggered in this catchment due to increased noise, levels exceeding the cumulative limit and acute noise impacts.
NCA02	15 (16)	- (-)	Residential receivers to the south of The Driftway are triggered in this catchment due to increased noise, levels exceeding the cumulative limit and acute noise impacts.
NCA03	10 (11)	- (-)	Residential receivers to the south of The Driftway are triggered in this catchment due to increased noise, levels exceeding the cumulative limit and acute noise impacts.
NCA04	- (-)	- (-)	No receivers are triggered in this catchment.
NCA05	- (-)	- (-)	Receivers are outside the operational assessment area.
NCA06	- (-)	- (-)	Catchment has no residential receivers.
NCA07	- (-)	- (-)	Catchment has no residential receivers.
Total	37 (39)	- (-)	

Maximum road traffic noise levels

Table 6-36: Predicted change in maximum noise levels

NCA	Worst case change	Discussion
NCA01	1	Increases of up to 1 dB are predicted at receivers along The Driftway due to widening of the road. The potential for the frequency of maximum noise events to change would generally correspond to the increase in traffic volumes, particularly heavy vehicles.
NCA02	1	
NCA03	1	
NCA04	0	No change in maximum noise levels predicted.
NCA05	0	This NCA has no sensitive receivers.
NCA06	0	This NCA has no sensitive receivers.
NCA07	0	This NCA has no sensitive receivers.

6.4.5 Safeguards and management measures

Construction noise mitigation

Where noise impacts remain after the use of 'standard mitigation measures', the CNVG requires the use of 'additional mitigation measures' where feasible and reasonable. The 'additional mitigation measures' are determined on the basis of the exceedance of the appropriate management levels. The CNVG approach to how 'additional mitigation measures' are applied to airborne noise impacts are shown in Table 6-27.

Table 6-37: CNVG triggers for additional mitigation measures - airborne noise

Predicted LAeq(15minute) Airborne Noise Level at Receiver			Additional Mitigation Measures	
Perception	dBA above RBL	dBA above NML	Type ¹	Mitigation Levels ²
All hours				
75 dBA or greater			N, V, PC, RO	HNA
Standard Hours: Mon – Fri (7am – 6pm), Sat (8am – 1pm), Sun/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
OOHW Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Public Holiday (8am – 6pm)				
Noticeable	5 to 10	<5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately Intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly Intrusive	>30	>25	V, IB, N, R1, DR, PC, SN	NML+25
OOHW Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Public Holiday (6pm – 7am)				
Noticeable	5 to 10	<5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately Intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+15
Highly Intrusive	>30	>25	AA, V, IB, N, PC, SN, R2, DR	NML+25

Operational noise mitigation

For receivers that qualify for consideration of ‘additional noise mitigation’, the NMG requires that potential noise mitigation measures are to be considered in the following order of preference:

- At source mitigation:
 - Quieter road pavement surfaces
- In-corridor mitigation:
 - Noise mounds
 - Noise barriers
- At receiver mitigation:
 - At-property treatments.

At source mitigation

The type of road surface can affect road traffic noise levels experienced by sensitive receivers. Low noise pavements are to be considered first when specifying noise mitigation as they reduce source noise levels, which provides noise level benefit to both outside areas and internal spaces. They are generally considered feasible to use where there are four or more closely spaced receivers that exceed the operational road traffic noise criteria.

The proposal includes the use of quieter noise pavements in the form of dense grade asphalt (DGA) for all redeveloped roads in the study area. The use of low noise pavements, such as OGA, are unlikely to be a

suitable approach given the presence of intersections, the sparsely distributed nature of receivers and maintenance concerns particularly where drainage is an issue such as long flat roads like The Driftway.

In corridor mitigation

Noise barriers (in the form of walls or mounds) can provide significant noise reductions and also reduce both external and internal noise levels. Where space allows, raised earth mounds can be used as noise barriers and can be enhanced by placing a low wall on top. Noise barriers can, however, result in other impacts such as reduced access to property and utilities, visual impacts, overshadowing, changes to drainage, and safety concerns.

Noise barriers are generally considered where there are four or more closely spaced receivers with exceedances of the NMG triggers. The NMG defines closely spaced receivers as residences that are separated by less than 20 m. The receivers impacted by the project are mostly separated by greater than 20 m and have access from The Driftway, which results in noise barriers being unlikely to be a suitable mitigation option.

At property mitigation

At-property mitigation is considered the most reasonable noise mitigation strategy where receivers are not grouped together or where there is community preference for this measure. The treatment typically involves using architectural treatments to improve building elements such as doors, windows, vents, etc. Installation of boundary acoustic fences or walls close to the receiver can also be considered, which can have the benefit of reducing noise levels in outdoor spaces.

The final operational noise mitigation strategy would be determined by Transport for NSW prior to construction. The final approach would consider community preference where appropriate. Inspection and assessment of individual receivers would be required to determine feasible and reasonable measures where at-property treatment is considered suitable. Receivers that are identified as being eligible for at-property noise mitigation would be identified and offered treatment prior to the start of construction work that has the potential to affect them, where possible.

Safeguards and management measures for noise and vibration are presented below.

Table 6-38: Safeguards and management measures – Noise and vibration

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim <i>Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • Identification of nearby sensitive receivers • Description of work, construction equipment and the hours work would be completed in • Criteria for the proposal and relevant license and approval conditions • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures <p>Details of how respite would be applied where ongoing high impacts are seen at certain receivers.</p>	Contractor	Detailed design / pre-construction	Section 4.6 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>All sensitive receivers for example schools local residents are likely to be affected will be notified at least seven days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contractor	Detailed design / pre-construction	Additional safeguard
Noise and vibration	<p>Location and activity specific noise and vibration impact assessments should be carried out prior to (as a minimum) activities:</p> <ul style="list-style-type: none"> • With the potential to result in noise levels above 75 dBA at any receiver • Required outside Standard Construction Hours likely to result in noise levels greater than relevant NMLs • With the potential to exceed relevant criteria for vibration. <p>The assessments should confirm the predicted impacts at the relevant receivers in the vicinity of the activities to aid the selection of appropriate management measures, consistent with the requirements of the CNVG.</p>	Transport for NSW	Pre-construction	Additional safeguard
Noise exceedances	<p>Where noise intensive equipment is to be used near sensitive receivers, the work should be scheduled for Standard Construction Hours, where possible. If it is not possible to restrict the work to the daytime, then they should be completed as early as possible in each work shift.</p> <p>Appropriate respite should also be provided to affected receivers in accordance with the CNVG and/or the proposal's conditions of approval.</p>	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Ancillary site	Hoarding, or other shielding structures, should be used where receivers are impacted near compounds or fixed work areas with long durations. To provide effective noise mitigation, the barriers should break line-of-sight from the nearest receivers to the work and be of solid construction with minimal gaps.	Contractor	Construction	Additional safeguard
Noise and vibration monitoring	Monitoring should be carried out at the start of noise and/or vibration intensive activities to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures from the CNVG have been implemented.	Transport for NSW	Pre-construction	Additional safeguard

6.5 Soils and contamination

The potential impacts of the proposal on soils and contamination have been assessed based on the information contained within the *Richmond Bridge Duplication and Traffic Improvements Phase 1 Desktop Contamination Study for Options Assessment* (AECOM, 2020) and the *Richmond Bridge Duplication - MR630 Londonderry Rd and The Driftway Upgrade Geotechnical Factual Report* (Transport for NSW 2021).

A detailed site investigation and preliminary (in-situ) waste classification are currently being carried out by Jacobs (2021). Data collected at specific sampling locations along The Driftway, from Londonderry Road to Blacktown Road, to identify contamination within the soil and potential exposure risks and gas migration pathways (if any). Preliminary in-situ waste classification data would support decisions relating to the reuse of excavated material within the proposal area during construction and/or inform preliminary waste management decisions and costs.

6.5.1 Methodology

The methodology used for the Stage 1 desktop contamination study to identify potential risk areas which may require detailed contamination investigation and to support the contingency cost risk assessment are summarised below:

- A desktop review of the following:
 - Historical aerial photographs for each decade dating back to 1947 and available historical information and reporting
 - NSW Environment Protection Authority (EPA) databases including contaminated sites record of notices, notified sites, licensed sites and per-and poly-fluoro alkyl substances (PFAS) investigation sites
 - Site geology, soil and acid sulfate soil risk mapping
 - Registered groundwater bore information
- A site inspection of publicly accessible areas of the proposal to ground truth the information obtained from the desktop review
- A visual assessment for the presence of potential areas of dumped waste or filling based on observations of topography
- A contamination risk rating for each section of the proposal area.

6.5.2 Existing environment

Topography and geology

The Driftway is generally flat with an elevation of between 20 to 24 metres AHD. A gentle slope is located in the east, near the waste management facility to Blacktown Road and in proximity of Rickabys Creek. The Driftway is located in a transitional zone between two physiographic regions, where the western margin of the Cumberland Plain meets the eastern foothills of the Blue Mountains Plateau.

The underlying geology of these physiographic regions strongly influences landform, soil types and hydrologic characteristics of the surrounding area. Tertiary (T1) aged alluvium comprising sand, silt, clay and gravel are mapped for the majority of The Driftway and Londonderry Road with Quaternary Alluvium (Qa1) mapped in the vicinity of Rickabys Creek and Blacktown Road. The *NSW Seamless Geology* surface map (NSW DPIE 2019) indicates the site is predominantly underlain by several Quaternary and Tertiary alluvial sediments as indicated in Table 6-39.

Table 6-39: Surface geology of the proposal area

Period	Name	Stratigraphy description
Quaternary	Alluvial Floodplain Deposits (Q-af)	Silt, very fine to medium grained lithic quartz-rich sand, clay
	Alluvium (CZ-a)	Unconsolidated alluvial clay, silt, sand, and gravel
	Alluvial terrace deposits (CZ_ath)	High-level terrace deposits of sand and gravel
Tertiary	Rickabys Creek Gravel (NM-i)	Conglomerate, matrix supported
	Londonderry Clay (NM-d)	Clay, patches of ferruginised, consolidated sand

Codes are per the NSW Seamless Geology Surface Geology Map

Soil landscape and acid sulfate soils

Review of the Penrith 1:100,000 soil landscape map (NSW DPIE 2021) indicates that the proposal traverses one main soil unit – Berkshire Park (Albp). The alluvial Berkshire Park soil landscape is characterised by dissected, gently undulating low rises on the Tertiary terraces of the Hawkesbury/Nepean. These soils are derived from the underlying Tertiary geology and consist of a sandy loam to sandy clay loam with inclusions of silcrete boulders of up to 20 centimetres in size overlying sandy clay and clay. The soils have a high level of wind erosion where they are cleared and are prone to gully, sheet and rill erosion within dissected areas.

Acid sulfate soils (ASS) are soils and sediments containing iron sulphides (commonly pyrite) that, when disturbed and exposed to oxygen, generate sulfuric acid and toxic quantities of aluminium and other heavy metals. The sulfuric acid and heavy metals are produced in forms that can be readily released into the environment, with potential adverse effects on the natural and built environment and human health. A review of the ASS risk maps (NSW DPIE 2021) was undertaken to assess the probability of ASS being present across the proposal area. Based on this information, the generalised ASS risk across the proposal area has been assessed as a low probability of occurrence.

Salinity

Salinity is the accumulation of salts in soil and water to levels that impact on human and natural assets (plants, animals, aquatic ecosystems, water supplies, agriculture and infrastructure). Salinity occurs where salt in the landscape is mobilised and redistributed closer to the soil surface and / or into waterways by rising groundwater. Rising groundwater is commonly caused by removal of deep-rooted vegetation such as trees and perennial pasture. It is also caused by changes in soil permeability and structure which restrict groundwater movement. Compaction and cut / fill work can be contributors.

Areas associated with Rickabys Creek and its tributaries, to the east of the proposal area are identified as having high salinity potential (Department of Infrastructure, Planning and Natural Resources, 2003). This means these areas are either affected by salinity or predisposed to salinity due to soil, geology, topography and groundwater conditions. The remainder of the proposal area has a moderate salinity potential, which means that scattered areas of scalding and indicator vegetation have been noted but concentrations have not been mapped.

Contamination

A search of the NSW EPA Contaminated Sites Register and Record of Notices, under Sections 58 and 60 of the *Contaminated Land Management Act 1997* (CLM Act), was carried out 18 June 2021 by Jacobs. The search did not identify any regulated sites or sites notified to the NSW EPA within a one-kilometre radius of the proposal area. A review of NSW EPA Public Register under Section 308 of the *Protection of the Environment Operations Act 1997* (POEO Act) did not identify any formerly licenced premises within one kilometre of the proposal.

Areas of environmental concern

Potential areas of environmental concern (AECs) and contaminants of potential concern (CoPC) within the proposal area, identified during the desktop assessment (AECOM 2020) are listed in Table 6-40.

Table 6-40: Areas and contaminants of environmental concern

AEC location	Source(s)	Risk rating	Key CoPC
Portion of Londonderry Road	Potential uncontrolled fill from road construction and service trenches and past fly-tipping within the road reserve.	High (15)	TRH, PAH, heavy metals, asbestos
Intersection of Blacktown Road, The Driftway and Racecourse Road	Potential uncontrolled fill from road construction and service trenches and past fly-tipping within the road reserve, adjacent Hawkesbury Council Waste Facility (landfill) and spoil stockpile on the west side of Racecourse Road	High (15)	TRH, PAH, heavy metals, asbestos, landfill gases

PFAS

RAAF Base Richmond and Hawkesbury River were listed on the NSW EPA PFAS investigation program as of 20 November 2019. RAAF Base Richmond is located about three kilometres north of The Driftway. The Department of Defence has prepared a PFAS Management Area Plan (PMAP) for the RAAF Base and some areas of surrounding land and waterways (AECOM, 2020). PFAS has been detected in a two kilometre by five-kilometre groundwater plume extending from the RAAF Base in a north easterly direction towards the Hawkesbury River – generally away from the proposal area.

6.5.3 Potential impacts

Construction

Construction activities would have the following potential impacts on soils and contamination:

- **Topography:** During construction, moderate alterations to the existing topography are anticipated due to areas of cut and fill associated with the realigned section of The Driftway
- **Soil erosion and loss of topsoil:** This could result from the removal of vegetation (clearing and grubbing) and disturbance of the ground surface during site preparation, earthwork, excavation and other construction activities
- **Sedimentation:** There is the potential for increased sedimentation and erosion of Rickabys Creek and its tributary during construction of the new bridge and upgrades to drainage structures. Soils transported into Rickabys Creek could lead to degraded water quality and reduced hydraulic capacity affecting aquatic ecosystems

- Spills of contaminating materials: There would be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials. Spill containment would be used at the temporary ancillary site to contain spills and spill response procedures would be followed. These impacts would generally be temporary
- Disturbance of contaminated soil: During construction of the proposal there is potential to: Disperse contaminated materials (associated with the identified AEC) into the receiving environments through surface water, groundwater or airborne flows. Disturbance of potentially contaminated materials may also expose construction workers and/or the general public to these contaminants if appropriate controls are not put in place
- Disturbance of potential gas migration pathways: During construction at the location of the Blacktown Road and The Driftway intersection from the Hawkesbury Council Landfill.

The detailed assessment would provide the necessary information to allow decisions to be made relating to potential exposure risks to construction workers to contamination in shallow soils, and to provide preliminary in-situ waste classification data to support decisions relating to the fate and possible reuse of excavated material within the footprint during construction. The results of the detailed assessment and with the implementation of appropriate safeguard measures outlined in Table 6-41 the potential for impacts are considered unlikely.

Operation

Once the proposal is operational, there would be potential for indirect impacts on soils as a result of run-off and drainage. These potential impacts would be managed by revegetating exposed soils and operational water quality measures. Potential contamination impacts would be associated with contaminated run-off, which may arise from normal vehicle operation (tyre wear, minor leaks of lubricants and fuels), maintenance practices, or a spill or accident. The proposal is not expected to result in more contamination impacts than that associated with the current roads in the proposal area.

6.5.4 Safeguards and management measures

Safeguards and management measures for soil and contamination are presented in Table 6-41.

Table 6-41: Safeguards and management measures – Soil and contamination

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil	Management of impact to soils will be implemented as part of the CEMP. The CEMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design / preconstruction	Section 2.1 of QA G38 <i>Soil and Water Management</i>
Soil	A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the CEMP. 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	Detailed design / preconstruction	Section 2.2 of QA G38 <i>Soil and Water Management</i>

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	<p>A Contaminated Land Management Plan (CLMP) would be prepared in accordance with the <i>Guideline for the Management of Contamination</i> (Transport for NSW, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to:</p> <ul style="list-style-type: none"> • Capture and management of any surface runoff contaminated by exposure to the contaminated land • Further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation • Management of the remediation and subsequent validation of the contaminated land, including any certification required • Measures to ensure the safety of site personnel and local communities during construction. 	Contractor	Detailed design / preconstruction	Section 4.2 of QA G36 <i>Environment Protection</i>
Contaminated land	<p>If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.</p>	Contractor	Detailed design / preconstruction	Section 4.2 of QA G36 <i>Environment Protection</i>
Accidental spill	<p>A site-specific emergency spill plan will be developed and include spill management measures in accordance with the Transport for NSW <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).</p>	Contractor	Detailed design / preconstruction	Section 4.3 of QA G36 <i>Environment Protection</i>

6.6 Aboriginal cultural heritage

The potential impacts to Aboriginal cultural heritage have been informed by:

- *The Driftway Proposed Geotechnical Investigations Plan – Detailed Design Stage Assessment of Impact on Aboriginal Cultural Heritage* (KNC, 2020)
- *The Driftway Potential Temporary Ancillary Facility Assessment of Impact on Aboriginal Cultural Heritage* (KNC, 2021)
- *Richmond bridge Duplication and traffic Improvements options Assessment Aboriginal Archaeological Report Stage 2 PACHCI* (KNC 2021).

The methods used for assessment, the potential impacts and safeguards to mitigate identified impacts are summarised in the section below.

6.6.1 Methodology

The methodology used to assess potential impacts to Aboriginal cultural heritage associated with the proposal are summarised below:

- An AHIMS (Aboriginal Heritage Information Management System) search was completed on 9 September 2020 and on 27 August 2021 to identify any registered (known) Aboriginal sites within or adjacent to the proposal and temporary ancillary site
- A site survey with a representative of Deerubbin Local Aboriginal Land Council was completed on 30 April 2019
- Additional site inspections were undertaken on 12 October 2020 within the proposal area and on 26 August 2021 within the temporary ancillary area.

6.6.2 Existing environment

Archaeological landscape

Previous archaeological investigations have identified a complex archaeological landscape around the major landscape feature of the Hawkesbury-Nepean. Excavations have uncovered high quantities of artefacts from sites located on the Tertiary terraces overlooking the main floodplain and from alluvial terrace systems along tributaries including Rickabys Creek. The wide variety of flora, fauna, diverse vegetation communities and habitats, abundant lithic resources and the availability of permanent fresh water would have made the area attractive for Aboriginal occupation.

Soil landscape

The Driftway soil landscape is comprised mostly of Berkshire Park soils with a smaller area of Agnes Banks sands north west of the proposal area. Both soil landscapes are located south and west of the Richmond township. The alluvial Berkshire Park soil landscape is characterised by dissected, gently undulating low rises on the Tertiary terraces of the Hawkesbury/Nepean. Landforms include flat terraces dissected by small drainage channels and narrow drainage lines with exposed areas of underlying geology due to erosion. These soils are derived from the underlying Tertiary geology and consist of a sandy loam to sandy clay loam with inclusions of silcrete boulders of up to 20 centimetres in size overlying sandy clay and clay.

The soils have a high level of wind erosion when cleared and have gully, sheet and rill erosion within dissected areas. The Agnes Banks sands are an aeolian/alluvial deposit which overlie the Berkshire Park soils at Agnes Banks and at Pitt Town. The soils comprise deep acid sandy soils (strongly leached) overlying yellow sandy clays, forming low parallel dunes on flat terrace surfaces. Local relief is to seven metres, with slopes generally.

Land use

Land use practices have had a variable impact on the landscape within the study area. Existing road and rail corridors have modified the landscape by creating cuttings and artificial embankments in addition to modifying the course of several waterways. A number of dams and drainage line modifications have been constructed throughout the area, altering the area’s hydrology and smaller-scale drainage patterns. Intensive cropping has taken place across the lower river terrace and vegetation clearance has contributed to the erosion of exposed soils along fence lines and infrastructure corridors. Ongoing rural and residential development has also contributed to disturbance.

Aboriginal heritage items

The AHIMS search identified eighteen Aboriginal archaeological sites within the search area. The closest AHIMS site location (AHIMS 45-5-0389) was registered approximately 480 meters east of the proposed temporary ancillary site. No Aboriginal archaeological sites or areas of cultural significance have been previously recorded within the proposed construction footprint. Both the proposal area and the temporary ancillary site exhibit past soil disturbance and unfavourable topography. The nearest sites to the proposal area are shown in Figure 6-3.

6.6.3 Potential impacts

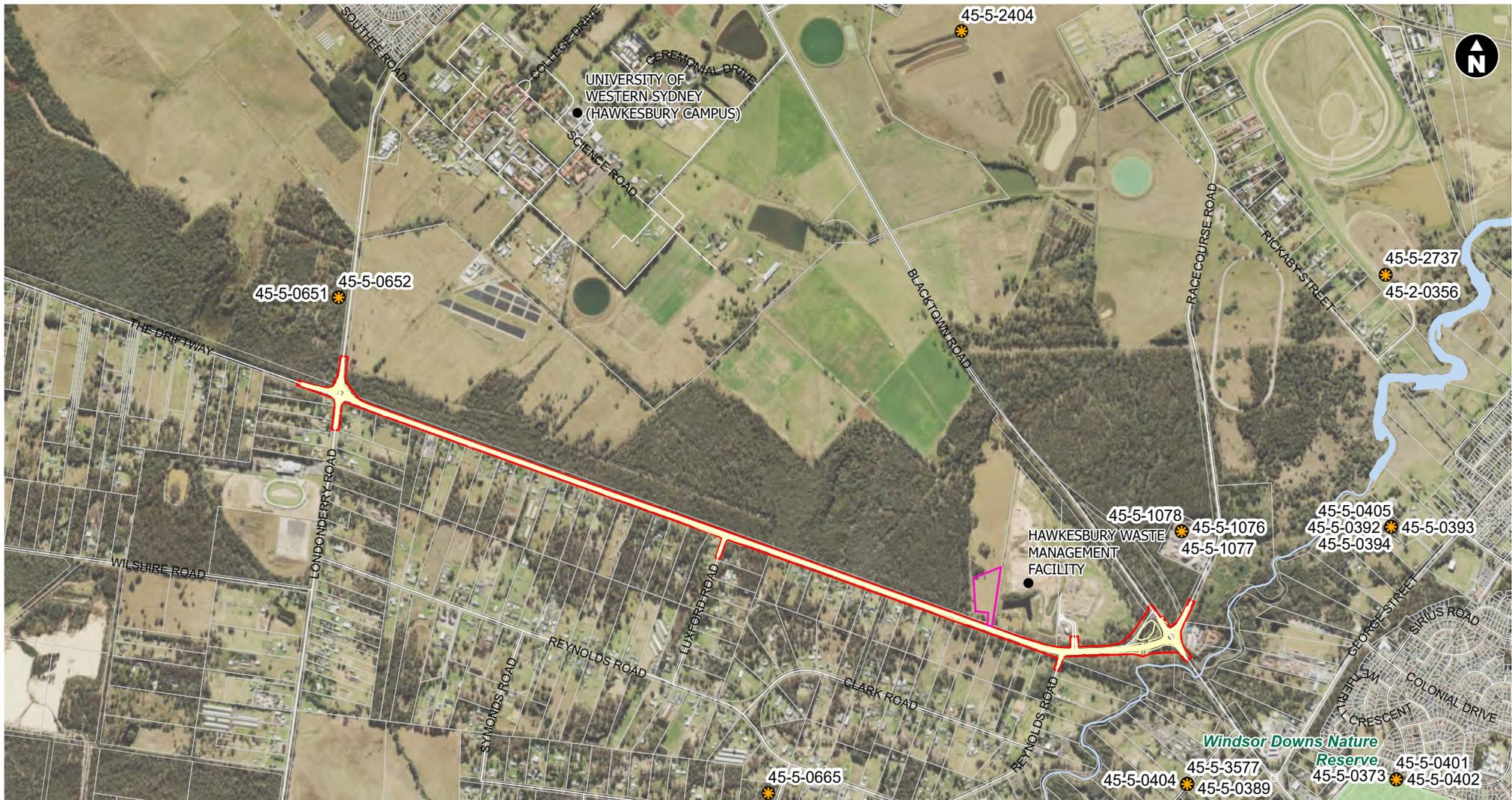
The construction and the operation of the proposal and the use of the temporary ancillary site, are considered unlikely to impact on Aboriginal heritage artefacts, features or remains. If Aboriginal items are uncovered during the construction works, all works would cease, and the Transport for NSW Aboriginal Cultural Heritage advisor and the Environmental Manager would be contacted immediately. The steps in the *Unexpected Heritage Items* (RMS, 2015) would be followed.

6.6.4 Safeguards and management measures

Safeguards and management measures for soil and contamination are presented in Table 6-41.

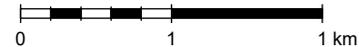
Table 6-42: Safeguards and management measures – Aboriginal cultural heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	<i>The Standard Management Procedure - Unexpected Heritage Items</i> (Transport for NSW, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Transport for NSW does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contact	Construction	Section 4.9 of QA G36 <i>Environment Protection</i>



Legend

- The Driftway design (20210521)
- Construction footprint
- Potential temporary ancillary facility
- ★ AHIMS Sites



GDA2020 MGA Zone 56

Data sources

- Jacobs 2021
- NSW Spatial Services 2021
- DPE NSW



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Figure 6-3 Non -Aboriginal heritage in the proposal area

6.7 Non-Aboriginal heritage

The potential impacts to Non-Aboriginal heritage have been informed by the *Richmond Bridge (Hawkesbury River Bridge) Duplication and Traffic Improvements Heritage Impact Strategy* (Phillips Marler, 2019). The methods used for assessment, the potential impacts and safeguards to mitigate identified impacts are summarised in the section below.

6.7.1 Methodology

The methodology used to assess potential impacts to Non-Aboriginal cultural heritage associated with the proposal are summarised below:

- To identify previously recorded Non-Aboriginal heritage items in the proposal area, and related legislative obligations a desktop search of available heritage registers was undertaken. A 500 metre buffer was applied to the proposal area. Searches included:
 - State Heritage Register (SHR), State Heritage Inventory (SHI), NSW Roads and Maritime Services Section 170 Heritage and Conservation Register, Hawkesbury LEP 2012, Penrith LEP 2010, Register of the National Estate (RNE), Commonwealth Heritage List (CHL), National Heritage List (NHL), World Heritage List (WHL)
- The historical context of the proposal area and surrounding region was researched
- Mitigation and management through the application of the 'avoid, minimise and mitigate' hierarchy.

6.7.2 Existing environment

Historical context

The colonial history of the Hawkesbury River and the significant land around it plays a significant role in the survival and expansion of the early settlement. Following initial British settlement in the Sydney region in January 1788, the Hawkesbury region was taken up by small farmers as early as the 1790s, growing wheat and maize and shipping it to Sydney on the Hawkesbury River. Governor Macquarie founded an urban base for this small farming community including the towns of Wilberforce, Pitt Town, Windsor, Green Hills, Castlereagh and Richmond (NSW Heritage Office and Department of Urban Affairs and Planning 1996:24). The towns were established on high ground to provide flood-free residences for the flood-prone district. By 1810, the Hawkesbury's population had exceeded that of Parramatta and remained so throughout the period of Macquarie's governance, and beyond (Stubbs 2000).

The Hawkesbury region continued into the 1860s as an area of small farming communities, before adding dairying to its industries (NSW Heritage Office and Department of Urban Affairs and Planning 1996:24) and remained substantially rural into the 20th century. The Hawkesbury region is still an important agricultural area which continues to play a vital role in defining the character and landscape of the district. Since the beginning of the twentieth century the Defence force has also maintained a significant presence in the Hawkesbury with the Royal Australian Air Force (RAAF) bases continuing to be a major contributor to the local economy.

The land to the north of the Driftway (now the Western Sydney University Hawkesbury Campus) was originally part of Ham Common, established by Governor King in 1802. It was part of a larger network of 'commons' for grazing livestock and consisted of almost 2000 hectares of higher ground on the floodplain from present-day Castlereagh Road to farms along South Creek (LandArc Pty Limited 2009) – an early precursor to the Travelling Stock Route. Following development in the area, land was excised from the common for the Hawkesbury Racecourse (in 1868) and the Hawkesbury Agricultural College (in 1892) (see Figure 6-4), with a large portion later set aside for the first Air Force base in NSW (<https://www.airforce.gov.au/about-us/bases/new-south-wales/raaf-base-richmond>).

The 2019 heritage assessment (Phillips Marler, 2019) identified the potential for historical fence lines adjacent to The Driftway based on historical plans of the area. Rural fences have been erected by NSW landholders to mark boundaries, manage stock and aid laid management, and fence lines can provide insights in the sequence of land settlement, environmental changes and farming practices. The boundary adjacent The Driftway has been established since the early nineteenth century, however the current fence line fabric is likely not original to the establishment of Ham Common or the agricultural college and would have undergone alterations over time and maintenance as part of its ongoing usage. Its physical fabric is not considered to be of heritage significance, and it has not been considered further in this report.

Londonderry Cemetery (item I115) is a small cemetery on Londonderry Road. The cemetery reserve is located adjacent to Londonderry Road and comprises 12 sandstone memorials mostly dating to 1860. The reserve is enclosed by a modern wire fence and contains stands of regrowth native trees. The cemetery is unusual for its isolation away from a settled area, and orientation of the memorial inscriptions away from the interred body. Some memorials are grouped by familial association and enclosed by stone pillars as found at Castlereagh Anglican Cemetery. There is a Bunya Pine which is an important landscape feature and the only indication of formal landscaping.

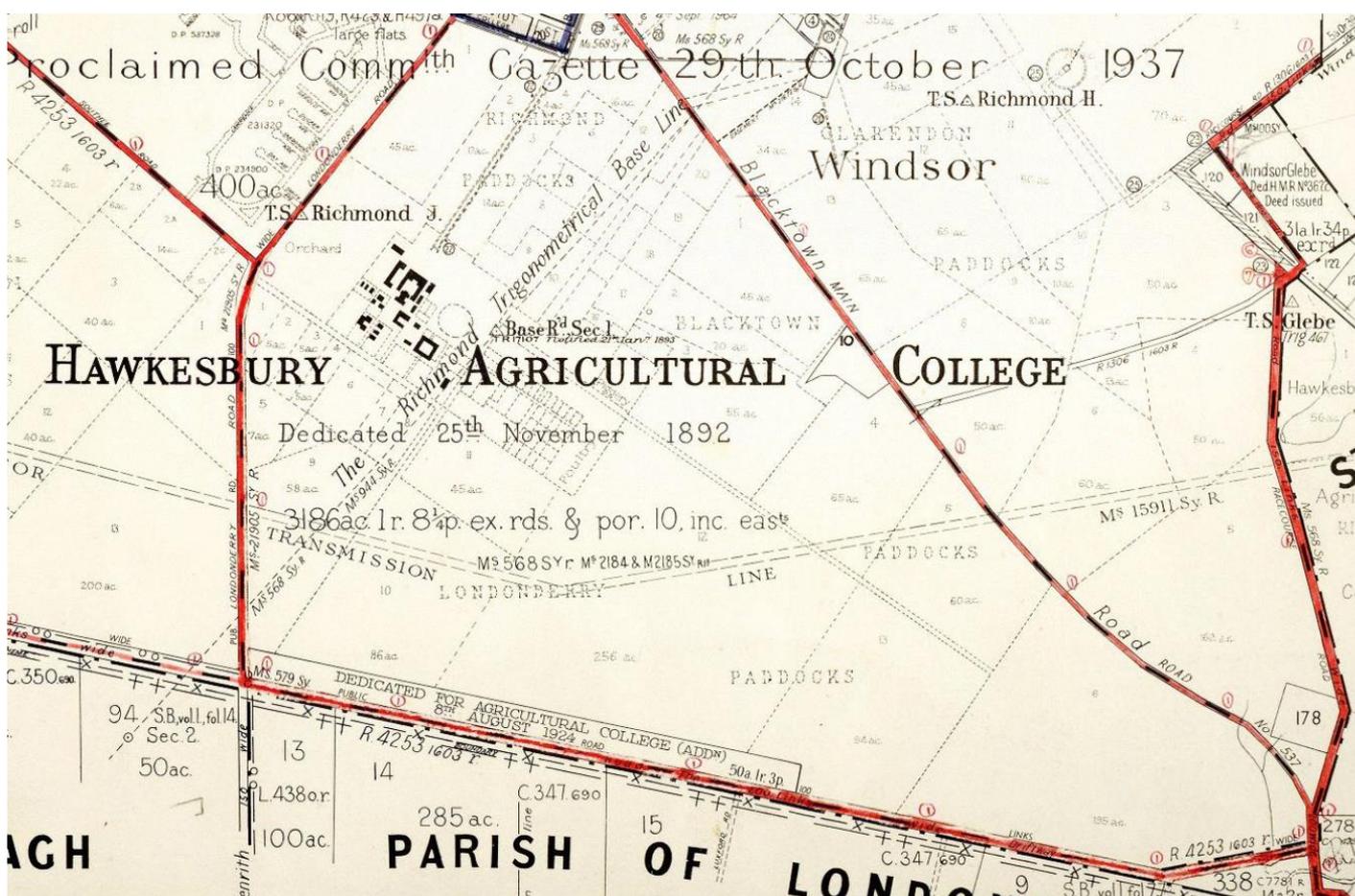


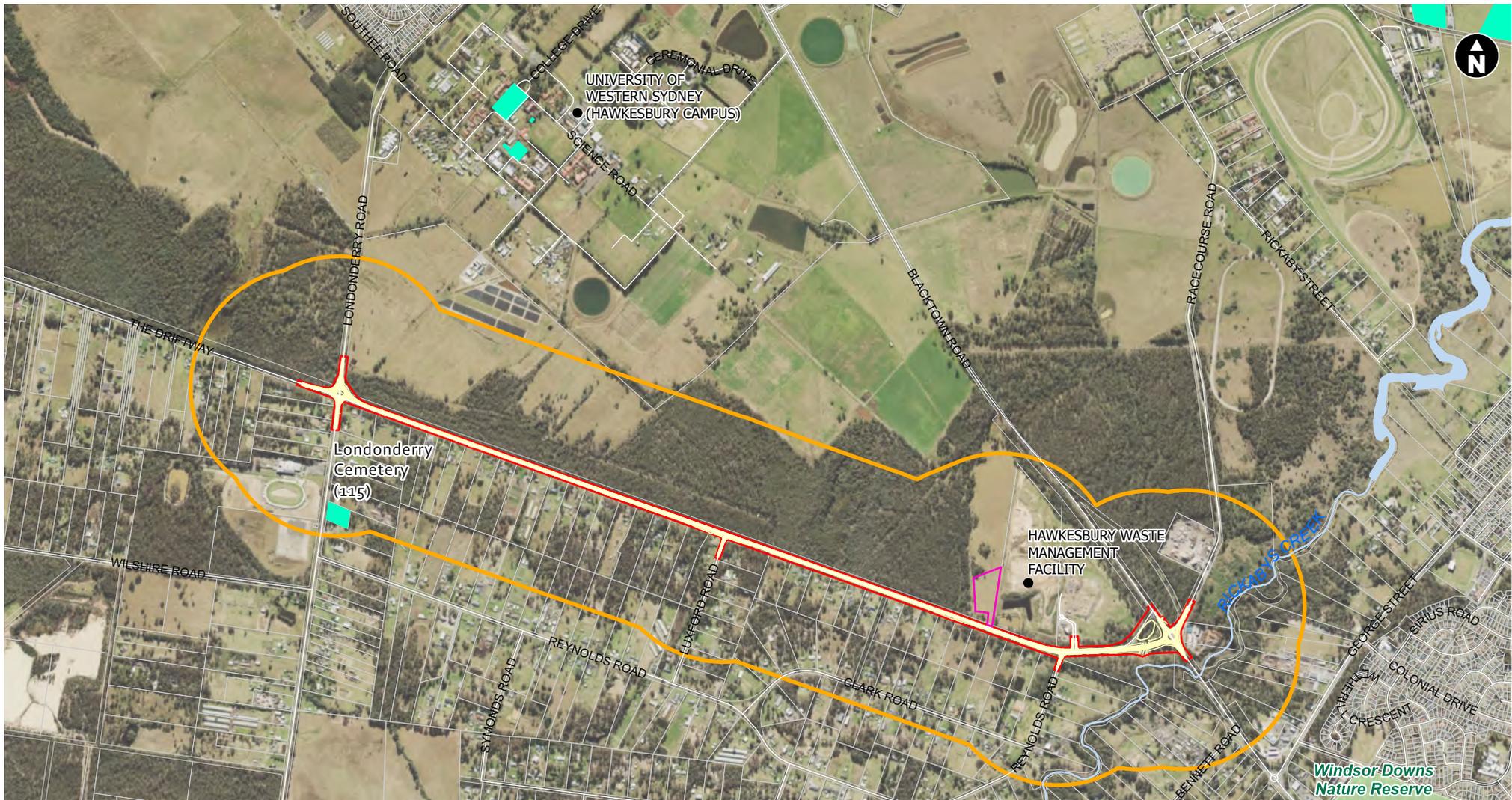
Figure 6-4: Lands of the Hawkesbury Agricultural College, The Driftway is its southern boundary (Source: NSW Land Registry Services)

Non-Aboriginal heritage items

The desktop search identified one item of heritage within 500 metres of the proposal detailed in Table 6-43 and shown on Figure 6-5

Table 6-43 : Listed heritage items within 500 metres of the proposal area

Name	Source / Register	Number	Location
Londonderry Cemetery	Local – Penrith LEP 2010	I115	About 450 m from the proposal



- Legend
- The Driftway design (20210521)
 - Non-Aboriginal heritage study area (500m)
 - Construction footprint
 - LEP Heritage item
 - Potential temporary ancillary facility



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Figure 6-3 Non -Aboriginal heritage in the proposal area

6.7.3 Potential impacts

The construction and the operation of the proposal are considered unlikely to impact on Non- Aboriginal heritage items. The Londonderry Cemetery is located about 450 metres south of The Driftway. If Non- Aboriginal items are uncovered during the construction works, all works would cease, and the Transport for NSW Heritage advisor and the Environmental Manager would be contacted immediately. The steps in the *Unexpected Heritage Items* (RMS, 2015) would be followed.

6.7.4 Safeguards and management measures

Safeguards and management measures for soil and contamination are presented in Table 6-44.

Table 6-44: Safeguards and management measures – Non- Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non- Aboriginal heritage	<p><i>The Standard Management Procedure - Unexpected Heritage Items</i> (Transport for NSW, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered.</p> <p>Work will only re-commence once the requirements of that Procedure have been satisfied.</p>	Contactor	Detailed design / pre-construction	Section 4.10 of QA G36 <i>Environment Protection</i>

6.8 Landscape character and visual impacts

Potential impacts of the proposal on landscape character and its visual amenity including key areas of impact are assessed in detail in the *New Richmond Bridge - Stage 1 The Driftway Urban Design, Landscape Character and Visual Impact Assessment* prepared by Tract (2021) provided in Appendix F. The methods used for assessment, the potential impacts and safeguards to mitigate identified impacts are summarised in the section below.

6.8.1 Methodology

The methodology undertaken was in accordance with the *Environmental Impact Assessment Practice Note: Guideline for Landscape Character and Visual Impact Assessment - EIA-N04* (EIA-N04) (Transport for NSW, 2020). The assessment differentiates between landscape character assessment - the overall impact of the proposal on the areas character and sense of place, the visual impact assessment and the proposals impacts on views.

The assessment involved:

- A review of relevant guidelines, planning and policies
- A desktop assessment of existing conditions to allow for the contextual analysis
- Site inspections to ground truth the proposal area and the landscape character and views
- Consideration of the proposal's urban design strategy for the development of the urban design concept to compliment the surrounding area, support local connections and contribute to the built environment and community setting
- Identification of landscape character zones and assessment of operational impacts on landscape character
- Assessment of visual impacts during operation
- Development of a mitigation strategy.

Landscape character zones

To assess landscape character the local context of the proposal area was divided into several unique units to assist in understanding the local context and the implications of the proposal. These included defining the landscape character zones (LCZ) which are zones of similar spatial or character properties, and the analysis of changes to these LCZ's as a result of the proposal. The purpose of dividing the proposal area into LCZs is to make sure that the impacts assessed are representative for each zone based on its distinct characteristics. The proposal was then assessed in terms of its impacts on these character zones and the impact ranked in terms of sensitivity to change. This assessment differs from a visual assessment in that it assesses the overall impact of a proposal on an area's character and sense of place.

Visual impact assessment

The visual impact assessment involved identifying an estimated visual catchment through desktop analysis and ground truthing to ascertain the theoretical area from where the proposal would be visible considering factors such landform, direction of travel or direction of the view, built structures and vegetation. Vegetation, while often obscuring potential views, is not considered a permanent obstruction as it can be relatively easily removed. This area is known as the visual catchment or visual envelope.

Distance is also an important factor when assessing visual impacts. With increased viewing distance, the proposal may appear smaller, and less detail can be made out. For this reason, very large visual envelopes are often defined by zones or bands of proximity from the proposal. Within the visual envelope several viewpoints were selected for assessment, located both within and outside the proposal's operational footprint.

Viewpoints were chosen to represent a range of views including views from residential properties, public spaces, businesses, and the existing road corridor. The visual impact of the proposal was assessed by considering the sensitivity of the view and the magnitude of change to the view because of the proposal:

- Sensitivity refers to the quality of the view. It is measured by assessing the composition of the view, its capacity to absorb change by identifying sensitive or visually valuable elements in the view, and the length of exposure to the view
- Magnitude refers to the physical character, size and scale of the proposed works and their proximity relative to the viewer. Magnitude also considers overshadowing during the day and lighting at night.

The combination of sensitivity and magnitude provides the rating of the visual impact. Visual impact is calculated using the landscape character and visual impact grading matrix defined below.

Table 6-45: Landscape character and visual impact assessment matrix

Sensitivity	Magnitude			
	High	Moderate	Low	Negligible
High	High	High – moderate	Moderate	Negligible
Moderate	High – Moderate	Moderate	Moderate – Low	Negligible
Low	Moderate	Moderate – Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Qualitative assessment

For the purposes of this environmental assessment, existing landscape character and the likely magnitude and sensitivity of viewers have been described in a qualitative manner. This has been based on the authors’ experience in the field of landscape character and visual assessment. While these methods aim to provide a consistent and unbiased approach to the landscape character and visual assessment, the highly individualistic perception of landscape character and scale of proposed work still often leads to differing opinions with regards to the likely impact of a proposal.

6.8.2 Existing environment

Landform

The Driftway has a mostly straight alignment with a general elevation of between ten and 20 metres above sea level, slightly rising in the northwest. To the southeast are several small ephemeral creeks which flow from the north to the south side of The Driftway via culvert and pipes. No significant landscape features are evident along the corridor of The Driftway. Existing landscape modifications include earth bunding for waste containment for the local landfill.

Drainage

The Hawkesbury Nepean River System is located to the west and north of The Driftway flowing to the north-east, beyond the flood terrace of the Hawkesbury Nepean. The Driftway drains to the southwest away from the Hawkesbury River and into Rickabys Creek. Drainage structures consist of open swales and table drains, culverts and a bridge structure. The south eastern end of the proposal area has the potential to flood, and erosion is evident along some of edges of the drains along the northern boundary of the corridor. The drainage along The Driftway influences how the road responds to flood events, consideration should be given to the design of the proposed drainage structures to ensure flood resilience, stability and limit erodibility.

Vegetation

The proposal area represents a mix of heavily vegetated lands to the north and transitions to cleared agricultural lands and rural residential to the south. Located on the western portion of the Cumberland Plain, the proposal area contains TECs, and one threatened flora species listed under the BC Act and / or the EPBC Act. Historical land use, degradation to the soil and the spread of exotic species have reduced habitat compatibility for many of the threatened species known from the ecological communities which are present. The vegetation along The Driftway is considered instrumental in defining the local character of the area, revegetation after construction activities would protect and enhance retained vegetation.

Aboriginal heritage

While several Aboriginal heritage items have been identified within the broader area, no specific items have been identified within the corridor. Acknowledgement of country should however form part of the overall response to the proposal.

Non-Aboriginal heritage

There are no Non-Aboriginal heritage items within proximity of The Driftway improvements.

Built environment

The built environment within the proposal area is comprised of roads, residential and industrial infrastructure. Major built environment features include:

- Residential properties occur along the southern side of The Driftway. Residential holdings are small, and the houses are setback from the frontage at irregular intervals
- Industrial development occurs in the south-eastern end of The Driftway either side of Blacktown Road. The industrial development has a greater visual impact and detracts from the residential feel.

Utilities

An overhead power supply is located along the southern boundary. Trees in the vicinity of the power supply have been pruned resulting in a visually disconnected canopy in comparison to northern boundary.

Landscape character assessment

The proposal area was classified into four LCZs. The distribution of these character zones and their relationship to the proposal are provided in Figure 6-6 and are summarised below

- LCZ1 – Rural residential
 - Residential properties on the south of The Driftway, parkland setting, pasture and grassland
 - Sensitivity rated as moderate
 - Magnitude rated as low
 - Overall impact of the proposal is considered minor to existing character
- LCZ2 – Woodland
 - Vegetated northern boundary and pockets along the southern boundary
 - Sensitivity rated as high
 - Magnitude rated as low
 - Overall impact is considered to be moderate and would require integrated planning to ensure the existing character is not compromised

- LCZ3 – Industrial woodland
 - Occurs opposite Reynolds Road on the northern side of The Driftway, degraded Cumberland Shale Plains with cleared areas to accommodate the landfill which is still well screened from the road due to vegetation
 - Sensitivity rated as moderate
 - Magnitude rated as high
 - Overall impact is assessed as being moderate to high due to the potential loss of the vegetation screen which would expose the landfill
- LCZ4 – Riverine woodland
 - Occurs in the south eastern corner of the proposal, cleared and regenerating grassland vegetation, a tributary of Rickabys Creek is located in the centre of this zone and the historic bridge is visible in the background of this zone
 - Sensitivity rated as moderate
 - Magnitude rated as moderate
 - Overall impact is considered to be moderate given the changing scale and context proposed.

A detailed description of each zone is provided in Appendix F.

The ranking for character is moderate reflecting a combination of both sensitive receivers and a discernible level of change in character. This change in character is primarily the product of vegetation clearance with the overall road formation increasing by approximately 30 percent with larger increases occurring at intersections. A summary of the landscape character impact assessment is provided in Table 6-46.

Table 6-46: Landscape character and visual impact assessment summary

Character definition	Sensitivity	Magnitude	Summary
LCZ1 – Rural residential	Moderate	Low	Moderate – Low
LCZ2 – Woodland	High	Low	Moderate
LCZ3 – Industrial woodland	Moderate	High	Moderate – High
LCZ4 – Riverine woodland	Moderate	Moderate	Moderate

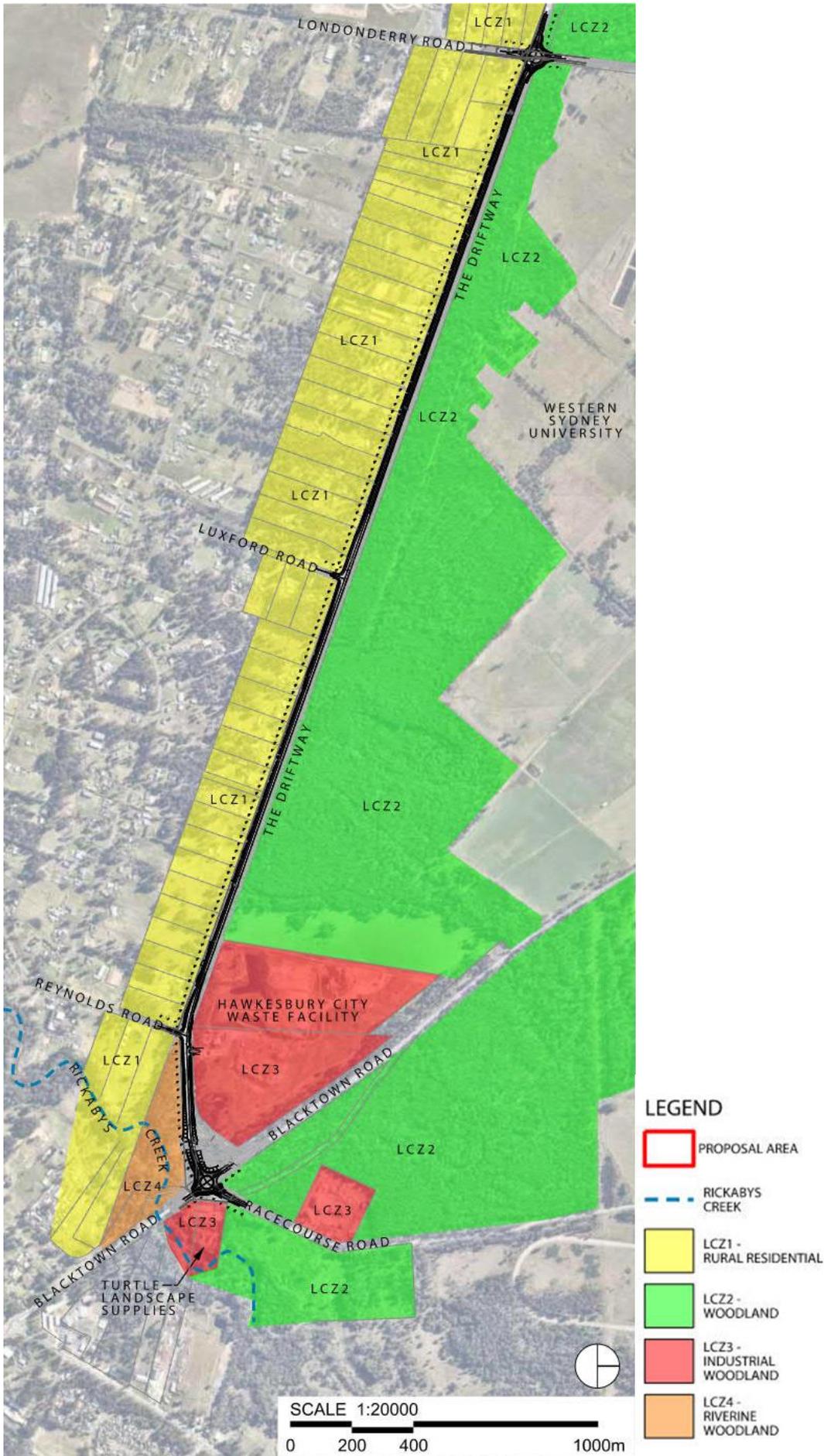


Figure 6-6: Landscape character zones (Source: Tract 2021)

Visual impact assessment

A total of nine viewpoints were assessed in relation to the proposal and are provided in Figure 6-7. The viewpoints selected provide a range of receptors including residents, road users, open space users which reflect a broader cross section of community who will experience changes as a result of the proposal.

Viewpoints ranged in sensitivity and magnitude, with four of the viewpoints having a low / low to moderate rating and five of the viewpoints having a moderate / high to moderate rating. The higher rated viewpoints are a consequence of the removal of vegetation to accommodate the expansion of the road corridor, intersection upgrades and new alignment of The Driftway. A summary of the visual impact assessment is provided in Table 6-46.

Table 6-47: Landscape character and visual impact assessment summary

Viewpoint	Sensitivity	Magnitude	Summary
Viewpoint One	Low	Moderate	Low to Moderate
Viewpoint Two	Low	Low	Low
Viewpoint Three	Low	High	Moderate
Viewpoint Four	Moderate	High	High to Moderate
Viewpoint Five	Moderate	High	High to Moderate
Viewpoint Six	Moderate	Low	Low to Moderate
Viewpoint Seven	Low	Moderate	Low to Moderate
Viewpoint Eight	Moderate	Moderate	Moderate
Viewpoint Nine	Moderate	Moderate	Moderate

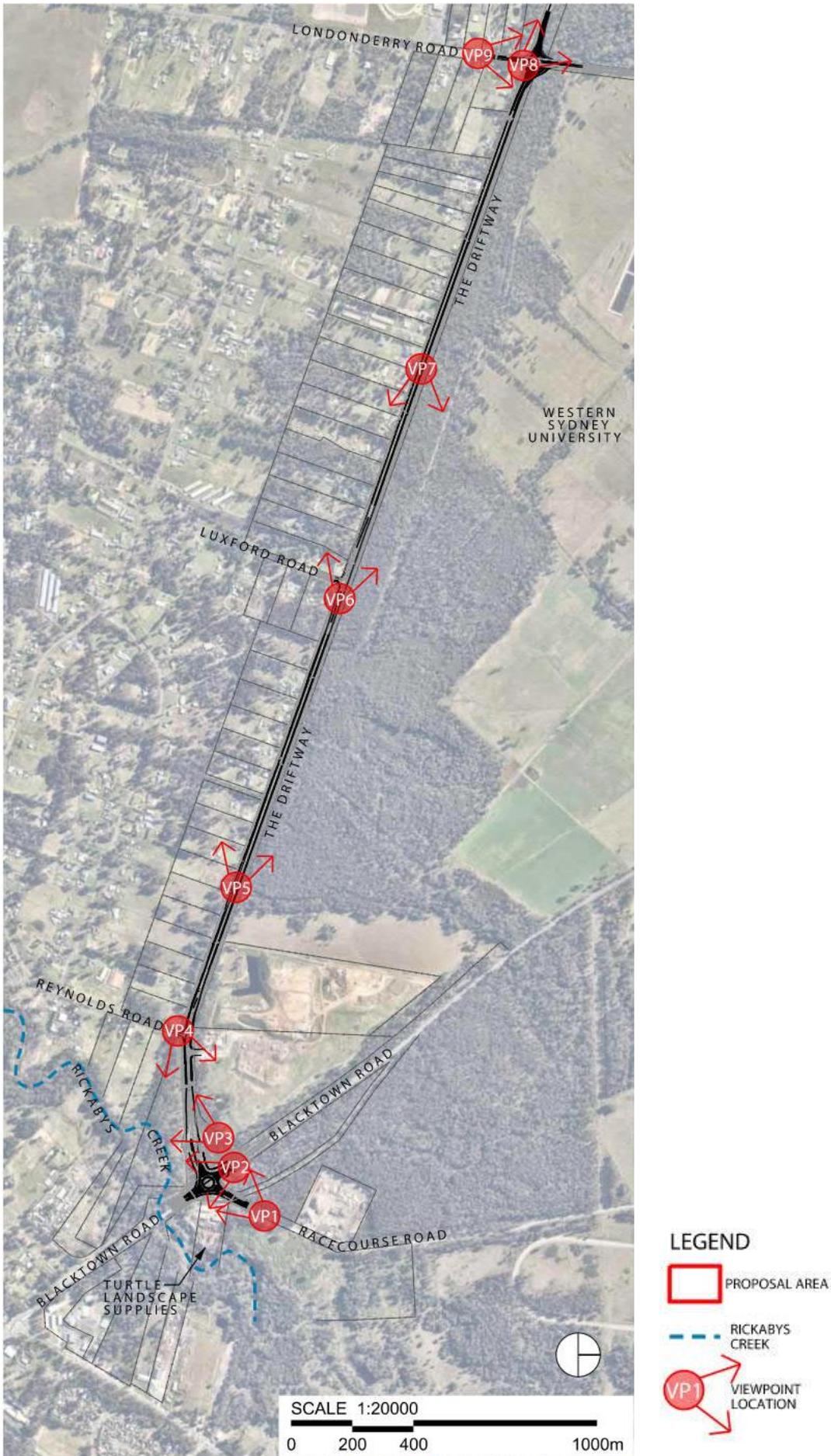


Figure 6-7: Visual impact assessment (Source: Tract 2021)

6.8.3 Potential impacts

Both the landscape character and visual impact assessment identified that The Driftway is sensitive to visual change with moderate rankings in relation to impacts. Mitigation measures developed as part of an overall integrated design process would effectively manage key concerns resulting in a safe and visually appealing road. Potential impacts from the proposal include:

- Visual changes due to the expansion of paved surfaces, removal of trees and increased exposure of the road corridor
- Change in character due to vegetation clearance with the overall road formation increasing by about 30 percent with larger increases occurring at key intersections

6.8.4 Safeguards and management measures

A landscape strategy had been prepared which defines the approach to the varying character along the road corridor. The objective of the design is to retain and strengthen the landscape character of the corridor by reinstating the vegetation along the edges of the Driftway. Both the landscape and design strategy are provided in detail in Appendix F.

Safeguards and management measures landscape character and visual impacts are presented in Table 6-48.

Table 6-48: Safeguards and management measures – Landscape and visual impact

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	<p>The landscape and concept design strategies <i>New Richmond Bridge - Stage 1 The Driftway Urban Design, Landscape Character and Visual Impact Assessment</i> prepared by Tract (2021) will form the basis of future landscape and detailed design development, providing integrated urban design and practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for:</p> <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used [cross-reference any relevant specified biodiversity safeguards] • Built elements including retaining walls, bridges and noise walls • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as lighting, fencing and signs • Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage 	Contractor	Detailed design / pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> Procedures for monitoring and maintaining landscaped or rehabilitated areas. 			
Removal of vegetation	<ul style="list-style-type: none"> Avoid impact to prominent trees and vegetation communities where possible Protect threatened species and retained habitat wherever possible Minimise clearance extent where possible and mark exclusion zones. 	Contractor	Preconstruction /construction	Additional safeguard
	<ul style="list-style-type: none"> Revegetation using local provenance material and match community and landscape character. Revegetation efforts should be implemented progressively to limit erosion and sedimentation Provide screen planting within corridor to limit visibility to the landfill. 	Contractor	Construction/ operation	Additional safeguard
Visual impact of work sites	<ul style="list-style-type: none"> Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate fencing or screening (use of shade cloth), storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials Compound and ancillary facilities will be decommissioned, and the sites rehabilitated to their existing condition or as otherwise agreed with the landowner as soon as possible. 	Construction contractor	Construction	Additional safeguard
Earthworks	<ul style="list-style-type: none"> Integrate with adjoining landform through adoption of appropriate grades, avoiding sharp transition in profile where possible Stabilise/revegetate as works progress to limit erosion and visual impacts through early integration with surrounding vegetation. 	Construction contractor	Detailed design/ construction	Additional safeguard

6.9 Air Quality

Potential impacts of the proposal to air quality which may occur during construction and operation of the proposal are provided in the section below.

6.9.1 Methodology

The methodology used to assess impacts to air quality associated with the proposal are summarised below:

- The identification of key risks during construction and operations
- The identification of relevant criteria for which to evaluate those risks
- The characterisation of key features of the surrounding environment including the location of surrounding receivers and sensitive land use areas, prevailing climate and meteorological conditions and background air quality
- Impacts during construction were evaluated using metrics developed based on guidance from *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines*
- The potential for operational impacts were quantitatively assessed using Transport for NSW prediction model Services Tool for Roadside Air Quality (TRAQ). Changes in operational contributions to local air quality was evaluated by comparing predictions for 'Proposal' and 'No Proposal' options for 'year of opening' and '10 years after opening'
- Safeguards to effectively manage any risks to air quality based on the outcomes of the assessment.

During construction the primary air quality-related risk is expected to be the generation of dust (including total deposited dust, total suspended particulates and fine particulate matter) which would occur during clearing and road construction activities. Exhaust emissions associated with plant and equipment would also be another key air quality risk during construction.

During operations, changes to roadside combustion-related pollutant concentrations is the primary risk as a result of changes to traffic conditions expected as a result of the proposal. *The Australia State of the Environment 2016 Atmosphere* report (SoE 2016) (Keyword, Hibberd & Emmerson, 2017) lists carbon monoxide (CO), oxides of nitrogen (NO_x) including nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}) as the primary pollutants associated with motor vehicle emissions. Volatile organic compounds (VOCs) are also noted to be a key species of pollutants associated with motor vehicle exhaust emissions.

The *Approved Methods for the Modelling and Assessment of Air pollutants in New South Wales* (Approved Methods), (NSW Environment Protection Agency [EPA], 2016) lists the 'impact assessment criteria' outlined in Table 6-49 for the purpose of evaluating the key emissions during construction and operations associated with the proposal.

Table 6-49: NSW EPA air quality impact assessment criteria

Pollutant	Averaging time	Criterion	Source
Criterion pollutants			
Carbon monoxide (CO)	1-hour	30,000 µg/m ³	NSW EPA, 2016
	8-hours	10,000 µg/m ³	NSW EPA, 2016
Nitrogen dioxide (NO ₂)	1-hour	246 µg/m ³	NSW EPA, 2016
	Annual	62 µg/m ³	NSW EPA, 2016

Pollutant	Averaging time	Criterion	Source
Particulate matter (as PM ₁₀)	24-hour	50 µg/m ³	NSW EPA, 2016
	Annual	25 µg/m ³	NSW EPA, 2016
Particulate matter (as PM _{2.5})	24-hour	25 µg/m ³	NSW EPA, 2016
	Annual	8 µg/m ³	NSW EPA, 2016
Particulate matter (as TSP)	Annual	90 µg/m ³	NSW EPA, 2016
Air toxins			
Benzene	1-hour	29 µg/m ³	NSW EPA, 2016
Formaldehyde	1-hour	20 µg/m ³	NSW EPA, 2016
Toluene	1-hour	360 µg/m ³	NSW EPA, 2016
Xylenes	1-hour	190 µg/m ³	NSW EPA, 2016

The criteria for CO, NO₂, PM₁₀, PM_{2.5}, and TSP relate to the total concentration in the ambient air. For an air quality impact assessment this comprises of the maximum incremental concentration from the proposal or activity plus background levels due to influences of all other surrounding natural and anthropogenic sources.

The *National Environment Protection Measure for Air Toxics* (NEPM) (NEPC, 2011) identifies 'investigation levels' for five priority air toxics: benzene, formaldehyde, toluene, xylenes and benzo(a)pyrene as a marker for PAHs. The 'investigation levels' are not compliance standards but are used for assessing the significance of monitored levels of air toxics with respect to the protection of human health. Although these criteria do not specifically apply to road projects, they have been used to provide an indication of the significance of the proposal's effect on air quality during operations.

6.9.2 Existing environment

Surrounding receivers

Several sensitive receivers are located within the vicinity of the proposal. Residences are located as close as 20 meters away at the intersection of the Driftway and Londonderry Road and along the Driftway between Londonderry Road and Blacktown Road. There are no sensitive receivers within 200 meters of the section of the Driftway being realigned between Reynolds Road and Blacktown Road. There are also several commercial receivers located within 200 meters of the proposal.

Climate and meteorology

Climate and meteorological conditions are important for determining the direction and rate at which air pollution will disperse. Impacts due to dust generation is the main air quality risk during construction, and long-term climate data is useful for identifying periods throughout the year when conditions conducive to dust generation are most likely (such as warm and/or dry periods).

Long-term temperature and rainfall data were reviewed from the Commonwealth Bureau of Meteorology's (BoM's) Richmond RAAF (Station no. 067105) which is located approximately three kilometres to the northwest of the proposal. This station has been in operation since 1993. Measured temperature and rainfall trends are summarised in Table 6-50.

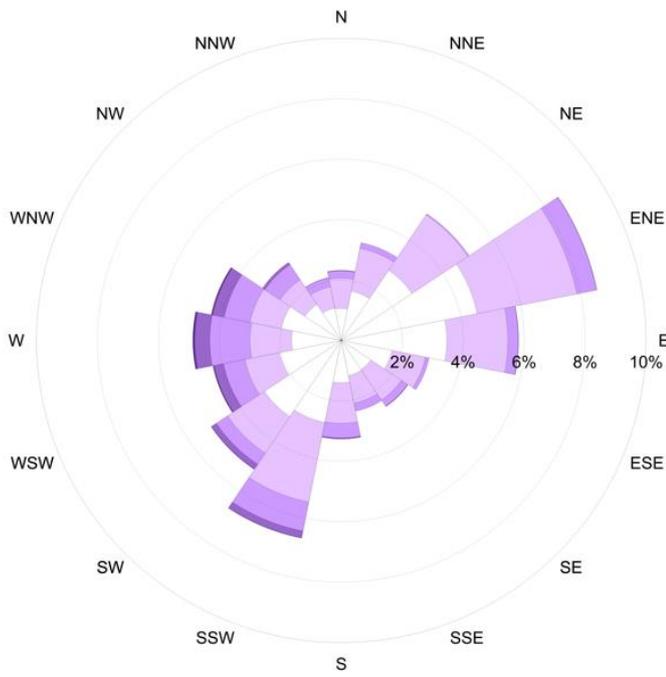
Table 6-50: Long term climate data measured 1993 to present at BoM Richmond RAAF (Station no. 067105)

Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Mean rainfall (mm)	Mean number of rain days (> 1 mm)
January	30.5	17.9	80.3	7.9
February	29.2	17.8	116.1	8.2
March	27	15.8	91.1	8.5
April	24.2	11.7	52.7	5.7
May	20.9	7.5	43.2	4.9
June	18	5.3	53.7	5.9
July	17.8	3.6	29.5	4.1
August	19.8	4.4	31.7	3.6
September	22.9	8	43.8	4.6
October	25.4	11.2	51.7	5.7
November	27.2	14.2	74.6	7.2
December	29	16.2	69.3	6.9
Annual	24.3	11.1	728.1	73.2

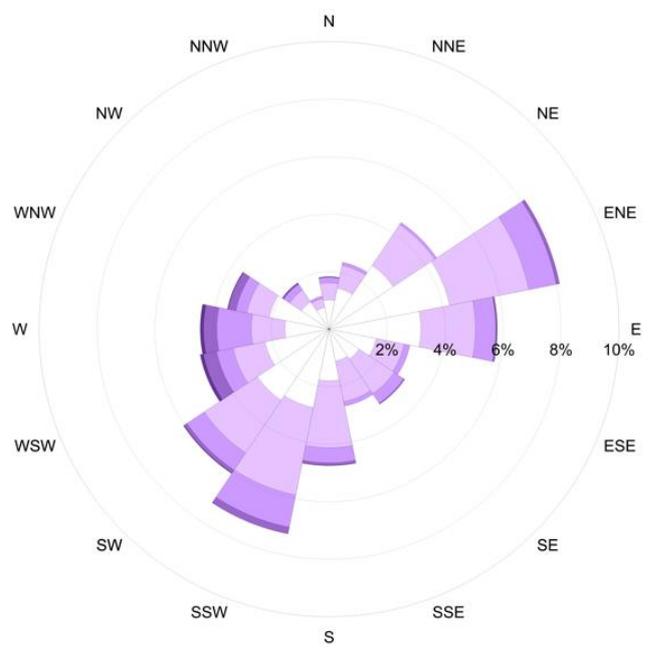
Source: BoM

As Table 6-50 lists, the proposal setting experiences warm and wet summers with mean daily maximum temperatures of around 29 degrees Celsius. The driest period of the year is between July and September when the average monthly rainfall ranges between 29.5 and 43.8 millimetres, below the monthly average of 61 millimetres. It is during periods of low rainfall and/or higher temperature conditions that the potential for dust generation is greatest.

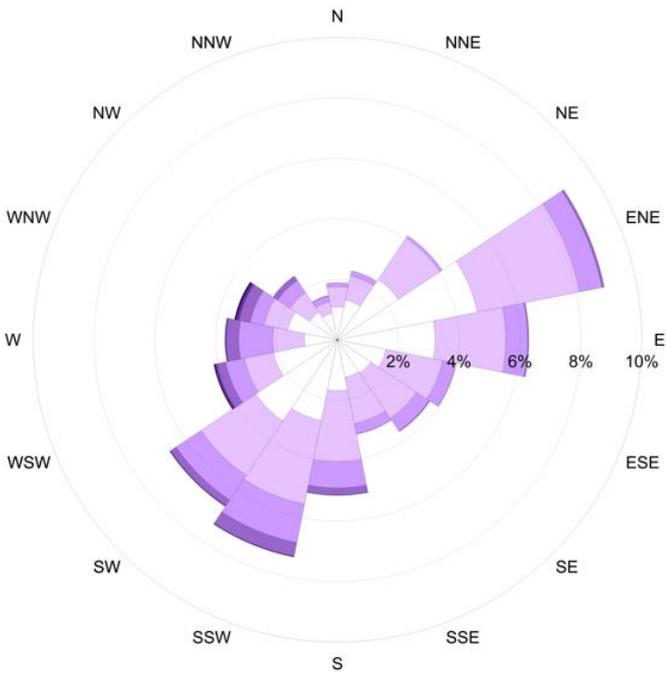
Prevailing meteorological conditions around the proposal were identified by reviewing data collected at the NSW DPIE station at the Western Sydney University Campus, Richmond. This station is located approximately one kilometre to the north of the proposal. Annual wind roses for 2016 to 2020 at the station are displayed in Figure 6-8.



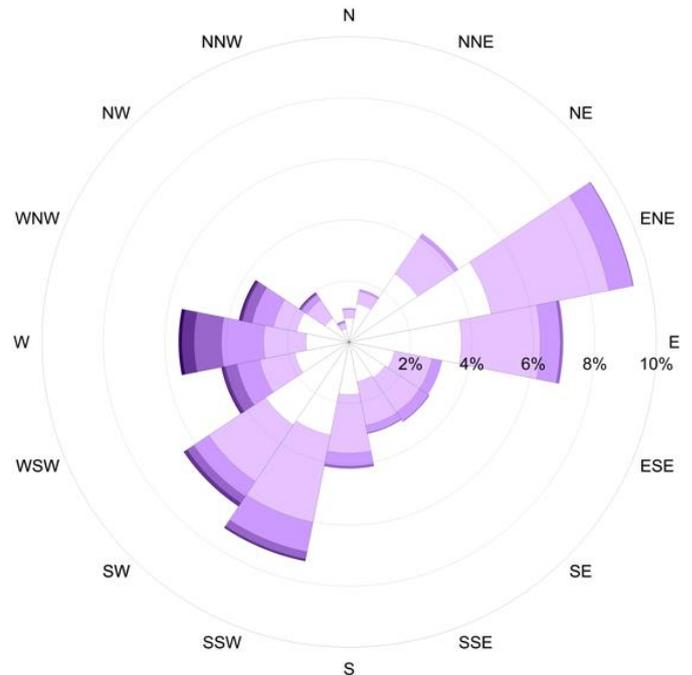
2016



2017



2018



2019

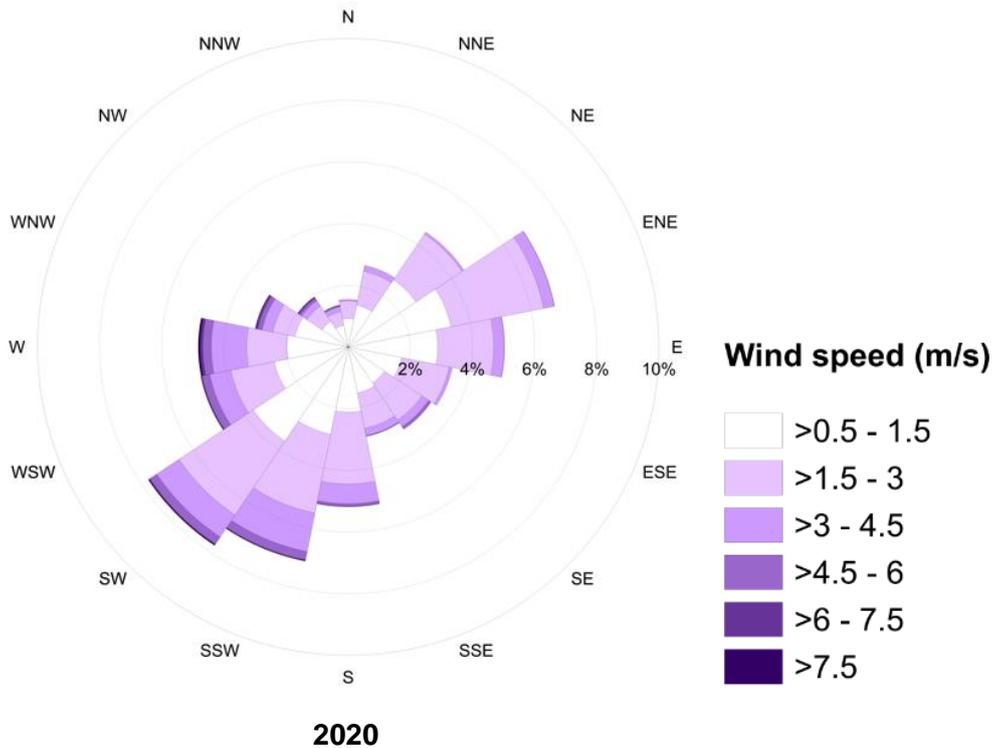


Figure 6-8: Annual wind roses Richmond, 2016 to 2020 (Source: DPIE)

As Figure 6-8 shows winds blowing from the east northeast and southwest / south southwest occurred most often. Considering this, receivers located to the west southwest, northeast and north northeast are expected to experience winds blowing in the direction from the proposal most often.

Background air quality

There are several monitoring stations across NSW which provide current air quality conditions and assist in implementing programs to improve air quality. As noted above, is operated by NSW DPIE at the University of Western Sydney Campus, about one kilometre to the north of the proposal. All of the key pollutants except CO are measured at this station. The nearest monitoring station which CO is measured is at Prospect which is located around 24 kilometres to the southeast. Monitoring results for PM₁₀, PM_{2.5}, NO₂ and SO₂ from Richmond, and CO at Prospect from the last five calendar years are listed in Table 6-51 below.

Table 6-51: Background air quality conditions, Richmond and Prospect (CO), NSW

Pollutant	Averaging time	Impact assessment criteria	2016	2017	2018	2019	2020
PM ₁₀ (µg/m ³)	Max 24-hour	50	103	52	116	193	238
	95 th percentile	-	31	29	35	65	35
	Annual	25	16	16	19	24	17
	Max 24-hour	25	83	34	124	141	93

Pollutant	Averaging time	Impact assessment criteria	2016	2017	2018	2019	2020
PM _{2.5} (µg/m ³)	95 th percentile	-	15	14	14	43	19
	Annual	8	7.9	7.0	8.1	13.1	8.4
CO (mg/m ³)	Max 1-hour	30	<0.1	<0.1	<0.1	0.1	<0.1
	Max 8-hour	10	<0.1	<0.1	<0.1	<0.1	<0.1
NO ₂ (µg/m ³)	Max 1-hour	246	62	53	62	62	72
	Annual	62	8	10	10	10	6
SO ₂ (µg/m ³)	Max 1-hour	570	71	97	49	66	74
	Annual	60	1	1	1	1	1

Source: DPIE

As summarised in Table 6-51, a maximum 24-hour averaged concentrations occasionally exceeded the respective 50 µg/m³ and 25 µg/m³ impact assessment criteria noted by the EPA. Natural events including dust storms and bush fires (including the unprecedented 2019 and early 2020 Australian Bushfires) have historically contributed to short-term particulate matter exceedances in Sydney. Annually averaged PM₁₀ concentrations remained below the 25 µg/m³ impact assessment criterion, but the 8 µg/m³ PM_{2.5} criterion was exceeded in 2018, 2019 and 2020. These observations are consistent with other observations from the air quality monitoring network across Sydney and NSW and underlines the importance of managing the generation of dust including fine particulate matter during construction. NO₂, CO and SO₂ concentrations were measured well below the respective EPA impact assessment criteria.

6.9.3 Potential impacts

Construction

Construction activities have the potential to increase airborne particulate matter and cause nuisance impact where construction is in proximity to sensitive receivers such as residential dwellings. The primary air quality risk during construction is expected to be dust generated from construction activities as well as from wind erosion of exposed areas. Other potential impacts could result from exhaust emissions from construction plant and equipment and odours and hazardous substances arising from uncovering contaminated materials.

To evaluate the potential for air quality impacts during construction a risk-based qualitative assessment method was applied. The likelihood (probability) and consequence (severity) of activities with the potential to result in air quality impacts were evaluated to develop initial, unmitigated risk ratings. This was completed using metrics and guidance from *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines* as shown in the three tables below.

Table 6-52: Air quality risk assessment matrix (based on guidance from AS/NZS ISO 31000:2009)

Consequence	Averaging time				
	Very unlikely	Unlikely	Possible	Likely	Almost certain
Catastrophic	15	19	22	24	25
Major	10	14	18	21	23
Moderate	6	9	13	17	20
Minor	3	5	8	12	16
Insignificant	1	2	4	7	11

Low = Negligible effect or implication on the environment. No injury, insignificant financial loss (i.e. less than \$5,000), minimal environmental damage/health impacts, no complaints. Environmental impact that would not be of concern to a reasonable person

Medium = Minor effect or implication on the environment. First-aid required, on site damage immediately contained with no long-term impacts, minor financial loss (greater than \$5,000 but less than \$50,000), occasional complaints, possible media interest. Localised and reversible damage to the environment.

High = Moderate, medium-term effect or implication on the environment. Medical treatment required, containable localised damage on-site, moderate financial loss (greater than \$50,000 but less than \$5,000,000), low likelihood of prosecution, minimal fines, occasional complains and possible media interest. Extensive and reversible or localised and irreversible environmental damage

Very high = Long-term effect or implication on the environment. Extensive injuries, project suspensions for a period of days, major financial loss (greater than \$5,000,000 but less than \$100,000,000), significant on-site environmental damage, very bad media coverage, community discontent, possible prosecution. Extensive and reversible or localised and irreversible environmental damage.

Extreme = Irreversible, extensive implications on the environment. Death, project suspensions for a period of weeks, massive financial loss (greater than \$100,000,000), significant off-site environmental damage, sustained bad media coverage, sustained complaints and community discontent, probable prosecution.

Table 6-53: Method for determining the sensitivity or likelihood of air quality impacts (based on guidance from AS/NZS ISO 31000:2009)

Likelihood	Definition	Probability
Almost certain	The event is almost certain to occur in the course of normal or abnormal construction / operational circumstances.	Greater than 90%
Likely	The event is more likely than not to occur in the course of normal construction / operational circumstances.	51 to 90%
Possible	The event may occur in the course of normal construction / operational circumstances.	26 to 50%
Unlikely	The event is unlikely to occur in the course of normal construction / operational circumstances.	5 to 25%
Very unlikely	The event may occur in exceptional construction / operational circumstances only.	Less than 5%

Table 6-54: Method for determining the potential consequence or magnitude of air quality impacts (based on guidance from AS/NZS ISO 31000:2009)

Level of consequence	Definition
Catastrophic	Long term (greater than three months) and irreversible impacts. Resulting in a major prosecution under relevant environmental legislation.
Major	Medium term (between one and three months) and potentially irreversible impacts. Resulting fine or equivalent penalty notice under relevant environmental legislation.
Moderate	Moderate and reversible impacts, or medium term (between one and three months).
Minor	Minor and reversible, or short-term impacts (less than one month)
Insignificant	Minor, negligible impacts.

Using this approach initial unmitigated risk category ratings were determined for the phases of construction outlined in Section 3.3.1 as follows:

- Site establishment and early works – ‘low risk’, based on the magnitude of emission expected to be ‘minor’ and likelihood of impacts considered to be ‘unlikely’ noting the limited scale and short duration of the activity
- Vegetation clearing and tree removal – vegetation clearing would create dust and expose topsoils to wind. The scale and duration of the activity is expected to be limited such that magnitude and likelihood ratings of ‘moderate’ and ‘unlikely’ were applied in determining a ‘medium risk’ rating for the activity
- Intersection upgrade (Londonderry Road) – this activity involves the excavation, placement, compaction, storage and transport of bulk materials and would temporarily result in an exposure surface. Noting that soils would be excavated during these works, there is also the potential that contaminated materials may be encountered, leading to potential odours and other air quality risks. Considering this the magnitude of emissions from the task was assessed as being ‘major’. Noting the higher density of nearby receivers around this segment of the project, as well the longer duration for this phase of works, the likelihood of impacts without effective mitigation and management was determined to be ‘possible’. Based on these ratings, the unmitigated risk of air quality impacts from the Londonderry Road intersection improvements was determined as being ‘high’
- Realignment work (and Blacktown roundabout) – this activity would also involve the excavation, placement, compaction, storage and transport of bulk materials and an exposed surface. The activity also has a reasonable chance of encountering contaminated materials, noting the extent of excavation required. Considering this the magnitude of emissions from the task was assessed as being ‘major’. Noting that the density and proximity of nearby receivers compared with Londonderry Road intersection is lower the likelihood of impacts without effective mitigation and management was determined to be ‘unlikely’. Considering these outcomes an unmitigated risk rating of ‘high’ was determined
- Bridge construction – ‘low risk’, based on the magnitude of emission expected to be ‘insignificant’ and likelihood of impacts considered to be ‘very unlikely’ noting the limited scale and short duration of the activity
- Drainage upgrade – drainage upgrade would lead to limited areas of temporarily exposed soils. Considering this, the activity was determined to represent a ‘low risk’ with the level of consequence of potential emissions expected to be ‘minor’ and the likelihood of impact being ‘unlikely’
- Road work, widening and pavement – ‘high risk, consistent with the magnitude and likelihood ratings determined above for the Londonderry Road intersection upgrade and Realignment and Blacktown roundabout works

- Property adjustments – ‘low risk’, based on the magnitude of emission expected to be ‘insignificant’ and likelihood of impacts considered to be ‘very unlikely’ noting the limited scale and short duration of the activity
- Finishing and demobilisation – ‘low risk’, based on the magnitude of emission expected to be ‘insignificant’ and likelihood of impacts considered to be ‘very unlikely’ noting the limited scale and short duration of the activity.

Measures to mitigate or otherwise effectively manage these risks are included below in Section 6.9.4.

Operations

Operational traffic inputs (volumes, mix and road configurations) were provided by Transport for NSW for the following assessment scenarios:

- No proposal, 2026
- Proposal, 2026
- No proposal, 2036
- Proposal, 2036

As outlined above, potential changes in operational air quality were evaluated by comparing results from TRAQ modelling for 2026 and 2036 proposal and no proposal scenarios. Changes were evaluated at sensitive receivers along the following segments of the project:

- Segment 1: The Driftway between Blacktown Road and Reynolds Road
- Segment 2: The Driftway between Reynolds Road and Luxford Road
- Segment 3: The Driftway between Luxford Road and Londonderry Road
- Segment 4: The Driftway west of Londonderry Road intersection
- Segment 5: Londonderry Road south of the intersection with the Driftway
- Segment 6: Londonderry Road north of the intersection with the Driftway
- Segment 7: Blacktown Road south of the intersection with the Driftway
- Segment 8: Blacktown Road north of the intersection with the Driftway
- Segment 9: Racecourse Road East of Blacktown Road intersection

TRAQ was configured as outlined below in Table 6-55.

Table 6-55: TRAQ model set up details

Model setting	Model inputs
Model version	TRAQ version 1.3 (2017)
Modelled meteorological conditions	Worst-case meteorological conditions assumed (that is, wind speed of 1 metre per second, Pasquil atmospheric stability Class F (highly stable), and 15 degrees Celsius)
Road geometry and distances to nearest receivers	Proposal design alignment

Model setting	Model inputs
Traffic inputs	Forecast traffic volume and composition data supplied by TfNSW for the assessment.
Vehicle emissions	2026 NSW EPA emission factors were applied for 2026 and 2036 scenarios. Emissions included worst-case cold start effects.

Using the approach and the inputs outlined above predicted worst-case changes in air quality are summarised below in Table 6-56.

Table 6-56: Predicted worst-case operational air quality results

Pollutant	Averaging time	Cum. impacts assess. Criteria ($\mu\text{g}/\text{m}^3$ unless stated)	Concentration due to modelled sources ($\mu\text{g}/\text{m}^3$ unless stated) at 20m				Background level ($\mu\text{g}/\text{m}^3$ unless stated)	Cumulative including change with proposal ($\mu\text{g}/\text{m}^3$ unless stated)	
			2026 WP	2026 DN	2036 WP	2036 DN		2026	2036
PM ₁₀	24-hour	50	1.4	0.9	1.6	0.7	35	35.5	35.9
	1-year	25	0.6	0.4	0.6	0.3	19	19.5	19.9
PM _{2.5}	24-hour	25	1.4	0.9	1.6	0.7	19	19.2	19.3
	1-year	8	0.6	0.4	0.6	0.3	8.1	8.3	8.4
NO ₂	1-hour	246	5	3.2	4.8	2.1	72	73.8	74.7
	1-year	62	1	0.6	1	0.4	10	10.4	10.6
CO (mg/m^3)	1-hour	30	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1
	8-hour	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOCs	1-hour	29	0.2	0.1	0.2	0.1	-	0.1	0.1

As Table 6-56 shows, cumulative concentrations (background plus changes in road contributions as a result of the proposal) remained below the EPA's impact assessment criteria for all of the pollutants and averaging times assessed with the exception of annually averaged PM_{2.5}. Background annually averaged PM_{2.5} concentrations were already measured above the 8 $\mu\text{g}/\text{m}^3$ impact assessment criterion. Although there are no specific EPA assessment criteria which relate to incremental increases in annual average PM_{2.5}, a criterion was developed for the New M5 Project (ERM, 2020). The criterion developed was that a change less than 1.7 $\mu\text{g}/\text{m}^3$ would manage the risk of all-cause mortality to below one in 10,000. Table 6-56 lists 0.3 $\mu\text{g}/\text{m}^3$ as the highest change in annually averaged PM_{2.5} as a result of the proposal. Given that this change is well below the 1.7 $\mu\text{g}/\text{m}^3$ criterion outlined above, as for the other pollutants assessed, it was determined adverse impacts from changes to PM_{2.5} concentrations as a result of the proposal would be unlikely.

TRAQ was also used to predict changes in annual operational greenhouse gas emissions. Annual predicted greenhouse gas emissions for the four assessment scenarios along the proposal segments.

Table 6-57: Predicted annual CO₂ equivalent operational greenhouse gas emissions

Assessment scenario	Predicted annual greenhouse gas emissions (CO ₂ -e, tonnes)	Percentage change compared with equivalent 2026 or 2036 DN scenario
2026 No proposal	2141.9	+42.47%
2026 Proposal	3051.6	
2036 No proposal	1853.2	+95.49%
2036 Proposal	3622.8	

As Table 6-57, shows, with the proposal CO₂ equivalent greenhouse gas emissions were predicted to increase by up to 95.49% in 2036 compared with the relevant no project assessment scenario. These increases are a result of additional traffic flows anticipated as a result of the proposal.

6.9.4 Safeguards and management measures

Safeguards and management measures for air quality are presented in Table 6-58.

Table 6-58: Safeguards and management measures – Air quality

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality impacts during construction	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to:</p> <ul style="list-style-type: none"> • Potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or DPIE (formerly OEH) guidelines • Methods to manage works during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces • An assessment and responsibility delegation of the management of air quality suppression and management measures <p>A monitoring program to record whether the air quality mitigation, suppression and management measures have been applied and their effectiveness.</p>	Contractor	Detailed design/Pre-construction	Section 4.4 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Reference
Dust emissions during construction	<p>Site planning and work practices:</p> <ul style="list-style-type: none"> • Minimise the extent of disturbed and exposed areas and revegetate finished areas as soon as possible • Minimise the drop heights of materials • Review and, where necessary, modify or suspend activities during dry and windy weather and background air quality conditions • Cover or otherwise regularly stabilise (with water sprays or binders) stockpiles • Regularly water haul routes and ensure that all loads are covered • Regularly inspect and remove debris from plant and equipment to avoid the tracking of materials on to the adjacent road network • To the extent practical, position ancillary sites and stockpiles away from nearby sensitive receivers. 	Contractor	Construction	Additional safeguard
Exhaust emissions from plant and equipment used during construction	<p>Plant and equipment:</p> <ul style="list-style-type: none"> • Inspect all plant and equipment before it is used on-site • Ensure all vehicles, plant, and equipment operate in a proper and efficient manner • Switch off all vehicles, plant and equipment when not in-use • Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable. 	Contractor	Construction	Additional safeguard
Odours and airborne hazardous substances from uncovered contaminated materials	<p>Odour and airborne hazards:</p> <ul style="list-style-type: none"> • Apply odour suppressing agents to materials as necessary to minimise related impacts should any contaminated or hazardous materials be uncovered during the works • Adhere to relevant requirements for removal and disposal listed in the <i>Work Health and Safety Act 2011</i>, and <i>Work Health and Safety Regulation 2017</i>. 	Contractor	Construction	Additional safeguard

6.10 Socio-economic

Potential socio-economic impacts which may occur during construction and operation of the proposal are provided in the section below.

6.10.1 Methodology

The following assessment of potential socio-economic impacts and benefits was prepared in accordance with *Environmental Impact Assessment Practice Note – Socio-economic assessment* (Transport for NSW, 2020) and is based on the 'basic level' of assessment.

Key steps in the assessment involved:

- Scoping the potential socio-economic issues relating to the proposal's construction and operation and potentially affected communities, based on the review of existing information about the proposal and socio-economic environment of the study area
- Reviewing and analysing existing socio-economic characteristics, conditions and values in the study area to provide a baseline from which potential benefits and impacts of the proposal could be assessed
- Identifying and evaluating the proposal's potential impacts on the socio-economic environment of the study area from the construction and operation of the proposal
- Identifying safeguards and management measures to mitigate or manage identified impacts and maximise potential benefits.

For the purposes of this assessment, the study area comprises the Australian Bureau of Statistics (ABS) State Suburbs of Richmond (SSC13360) and Londonderry (SSC12375).

The review and analysis of the existing socio-economic environment principally draws on information from:

- The ABS Census of Population and Housing 2016
- Information sourced from Hawkesbury City Council and Penrith City Council
- *Richmond Bridge duplication & traffic improvements Socio-economic assessment* (Advisian, 2019)
- Desktop review of social infrastructure and businesses near to the proposal.

Population and demographic data presented in this report is mainly from the 2016 ABS Census, which was conducted on 9 August 2016. The most recent census of Australia's population was conducted on 10 August 2021, with data released in June 2022. While this data is five years old, this is the most comprehensive information currently available for Australia's population and demography.

6.10.2 Existing environment

This section provides a social profile of the study area and includes information on the demographic as well as facilities and services, places of special interest and significant community activities within the study area.

Regional context

The proposal is located about 50 kilometres north-west of Sydney central business district (CBD). It is situated primarily within the suburb of Richmond and its western extent is located in the suburb of Londonderry and eastern extent in the suburb of South Windsor. These suburbs are located within the Hawkesbury and Penrith LGA's.

The Hawkesbury LGA is located at the north western fringe of the Sydney Metropolitan area. It encompasses an area of about 2,776 square kilometres and had a population of about 67,749 persons in 2020 (ABS, 2021). Between 2010 and 2020, the population of the LGA grew at an average of 0.6 per cent annually, which was below the growth rate of Greater Sydney over the same period (1.7 per cent). The resident population is expected to grow to about 79,800 persons in 2041 representing an average annual

growth rate of 0.7 per cent. This is below the average rate of growth projected for Greater Sydney, which is 1.7 per cent annually (DPIE, 2019).

The Penrith LGA is located at the western fringe of the Sydney Metropolitan area. It encompasses an area of about 405 square kilometres and had a population of about 216,282 persons in 2020 (ABS, 2021). Over the 10 years to 2020, average population growth in the Penrith City LGA was 1.7 per cent annually, which was the same as Greater Sydney. The resident population is expected to grow to about 369,250 persons in 2041. This represents an average annual population growth of 2.5 per cent, well above the projected rate of growth for Greater Sydney.

Community Profile

Richmond is one of the original settlements in the Greater Sydney area and is an established regional service center. At the 2016 Census, the suburb had a resident population of 5,482 (ABS, 2016). Richmond is identified as a 'strategic center' in the Western City District Plan and is expected to be a focus for residential development, businesses, and productivity growth (Advisian, 2019).

Londonderry is a rural suburb, which had a residential population of 3,906 people in 2016 (ABS, 2016). Although the suburb is located in the northernmost part of the City of Penrith, it has stronger ties with Richmond than it does to Penrith due to its closer proximity to the suburb.

Table 6-59 summarises the key population and demographic statistics of the study area from the 2016 ABS Census.

Table 6-59: Key population and demographic statistics

Indicator	Richmond	Londonderry	Greater Sydney
Population			
Median age	42 years	38 years	36 years
0-14 years (per cent)	13.4	19.4	18.6
15-29 years (per cent)	22.9	21.2	21
30-44	17.4	18.2	22.6
45 - 59	18	21.7	18.8
60 years and over (per cent)	28.5	19.4	18.9
Cultural diversity			
Overseas born (per cent)	25.2	21.8	42.9
Speaks language other than English at home (per cent)	17.6	17.1	41.6
Aboriginal and/or Island Torres Strait Islander (per cent)	3.8	4.5	1.5
Dwellings			
Occupied private dwellings (per cent)	92	94.9	92.3
Separate house (per cent)	55	9.4.2	56.9

Indicator	Richmond	Londonderry	Greater Sydney
Flat or apartment (per cent)	14.1	0.6	28.1
Average people per household	2.6	3.9	3.2
Transport			
Households with no motor vehicles (per cent)	11.3	1.4	11.1
Households with one motor vehicle (per cent)	43.7	15.5	37.1
Households with two or more vehicles (per cent)	41.1	79.7	32.8

Source: ABS Census 2016

Compared to Greater Sydney, the population and demographic statistics of the study area is generally characterized by:

- An older population in Richmond and younger population in Londonderry, with a higher lower proportion of people aged above 60 years age
- Lower levels of cultural diversity with a higher proportion of the population being Australian-born and speaking only English at home
- A higher proportion of Aboriginal and Torres Strait Islander persons
- A higher proportion of the population owning motor vehicles in Londonderry
- A lower proportion of the population living in high density dwellings.

Business and Industry

A number of businesses are located within and adjacent to, the proposal area, including several of which are home based businesses. These businesses are predominantly small businesses that specialise in a range of services including entertainment, retail, and pet services detailed in Table 6-60.

Table 6-60: Businesses within and near the proposal area

Business type	Business	Location	Description
Entertainment	Kidz Zoo	The Driftway, Londonderry (within proposal area)	Mobile petting zoo that can be hired for events
	Caballus Horse Lodge	The Driftway, Londonderry (about 540m west of the proposal area)	Horse lodge that provides horse riding services and can be hired for events on site
Retail	Gallery Equine, home of Showstoppers Equestrian Wear PTY Ltd	The Driftway, Londonderry (within proposal area)	Clothing store for equestrian wear

Business type	Business	Location	Description
	Turtle Landscape Supplies	Racecourse Road, South Windsor (about 30m south-east of the proposal area)	Supplier for garden and landscape materials bought in bulk who also offer delivery services
Pet services	K9 Pro – The K9 Professionals	Londonderry Road, Londonderry (about 265m south of proposal area)	Store for accessories and training services for dogs
	Triple Crown Pet Resort	Reynolds Road, Londonderry (about 650m south of proposal area)	Dog boarding service
	GAP Western Sydney	Reynolds Road, Londonderry (about 510m south of the proposal)	Greyhound adoption service
Fast food and petrol station	Ampol McDonalds Hungry Jacks Guzman y Gomez Harry's Café De Wheels Oporto KFC	Corner of George Street and Blacktown Road	Food and petrol service
Transport	M Leak Transport Pty Ltd	Luxford Road, Londonderry (about 560m south of the proposal)	Trucking company
	Mal Drury Mechanical Repairs	281 Londonderry Road	Mechanic

Social Infrastructure

The social infrastructure near the proposal area includes education facilities and recreational facilities detailed in Table 6-61.

Table 6-61: Social infrastructure within and near the proposal area

Social Infrastructure	Facility	Location	Description
Education facilities	Western Sydney University (WSU), Hawkesbury Campus	Bourke Street, Richmond (directly north of the proposal)	A university campus with libraries, laboratories, classrooms, student accommodation and parking facilities.
Recreation	The Secret Garden & Nursery	Clydesdale Lane University of Western Sydney, Richmond (about 460m north of the proposal)	A non-for-profit community hub situated within the WSU Hawkesbury campus. The hub includes a garden and several animals on site.
	Hawkesbury Function Centre	Londonderry Road, Londonderry (about 630m south of the proposal)	A function centre that is fully catered and has a main function room
	Richmond Race Club	Londonderry Road, Richmond (about 345m south-west of the proposal)	A greyhound racing club with a catered function room that can be hired for events
Waste and recycling facilities	Hawkesbury City Waste Management Facility	The Driftway, South Windsor (within proposal area)	Waste management facility for domestic waste in the Hawkesbury LGA
	Hawkesbury Community Recycling Centre	The Driftway, South Windsor (within proposal area)	Community recycling centre that is free to the public

Transport and Access

The proposal area comprises sections of three separate roads including The Driftway, Londonderry Road and Blacktown Road and intersections with Luxford and Reynolds Road. The Driftway is a local road connecting Blacktown Road (MR537) in the east to Castlereagh Road (MR570), Agnes Banks in the west. Londonderry Road is a State road which connects Richmond in the north to The Northern Road (A9) corridor to the south, and Blacktown Road is a State road which connects Richmond in the north to The Northern Road and Richmond Road in the south.

Several bus routes operate in the road network surrounding the proposal area, although these services operate with low frequencies. There are no bus routes that operate along The Driftway. Bus stops within the proposal area are limited to Londonderry Road, and are located just south of the intersection with The Driftway. There are bus stops on both sides of this road for Route 677. There are no dedicated pedestrian paths within the vicinity of the proposal. Bicycle lanes within the proposal area are limited to Blacktown Road, with a bicycle shoulder lane located north and south of the intersection with The Driftway.

6.10.3 Potential impacts

Construction

Employment

During construction the proposal would have a temporary, positive impact through creation of short-term employment opportunities. The profile and scale of the worker population would fluctuate throughout the construction period in response to work being undertaken. The increased population from the construction workforce would result in increased demand for services and facilities in the local area.

Property Acquisition

The proposal would require partial acquisition and lease over a small area of state land within the Western Sydney University Hawkesbury Campus. Partial property acquisition is required to accommodate the Londonderry Road roundabout and comprises about 0.16 hectares of land that is currently in the process of obtaining approval from the Biodiversity Conservation Trust (BCT) to be managed in perpetuity under a Biodiversity Stewardship Agreement. The proposal would result in a loss of revenue for the university which would need to be considered in determining compensation. The temporary lease would be required for an area of land at the southern end of campus, adjacent to the Hawkesbury City Waste Management Facility. This would be used for the project's ancillary facility and comprises about 1.9 hectares of land currently used by the university as open space. The temporary lease of this land would not impact the operation of the University.

Property adjustment

Minor property access adjustments may be required to private properties along The Driftway to accommodate the revised road levels and drainage design. This would involve changes to driveways and fencing which would minimise ponding of water at property access points. Access to affected properties would be maintained during construction. Property acquisitions and adjustments are further discussed in Section 3.6 of this REF.

Community values

The nearest residents are located next to the proposal on The Driftway. The construction of the proposal may cause changes to local amenity for these residents as a result of:

- Construction noise, vibration, and dust, including noise and dust associated with road works and construction vehicles
- Out of hours' construction works, potentially impacting on the night-time amenity for nearby residents and resulting in temporary sleep disruptions for some residents
- Use of local roads by construction traffic
- Access changes to properties located within the proposal area.

Sleep disruptions due to out of hours work has potential to temporarily impact on the well-being of affected residents, where this occurs over an extended period. Impacts on community values and wellbeing would be managed by the implementation of mitigation measures outlined in Chapter 7.

Local business

During construction local food outlets and associated businesses would likely benefit from increased patronage from construction workers. The impact of construction to local business would generally be limited to amenity impacts such as noise and potential delays due to construction activities. A small number of businesses have retail areas such as Gallery Equine, K9 Pro and Turtle Nursery and Landscape Supplies, although amenity changes from the proposal are expected to be minor and would not impact the experience of customers visiting these businesses. Access to businesses would be maintained during construction.

Social Infrastructure

Western Sydney University is located adjacent to the proposal area, however sensitive receivers within the campus are located at least 600 meters from the proposal area and is not anticipated to be impacted by construction of the proposal.

Access and connectivity

Changes to access and connectivity are expected to temporarily impact residents and road users, particularly for local residents. This is due to the potential traffic delays and traffic controls required during construction. School and public bus routes and may experience slight disruptions due to construction traffic and cyclists and pedestrians who use the local road network for active transport may also be temporarily impacted. These impacts are further discussed in Section 6.3 of the REF.

Operation

Employment

Employment generated during construction would reduce after completion of the proposal. Once operational, the proposal would support improved access and connectivity to existing and future employment uses within the proposal area and surrounding region.

Property Acquisition

The proposal would permanently alter the use of land that is currently in the process of obtaining approval from the BCT to be managed in perpetuity under a Biodiversity Stewardship Agreement. Suitable compensation would be provided to Western Sydney University. The leased area, ancillary site, would be decommissioned, and the site rehabilitated to their existing condition or as otherwise agreed with the landowner as soon as possible.

Property adjustment

The proposal would permanently adjust some private residences driveways and fencing to minimise ponding of water at property access points. The adjustments are considered positive for long term flood resilience and improved safety along the Driftway.

Community values

Once construction is complete, The Driftway as well as sections of Londonderry Road and Blacktown Road would be substantially improved. The improvement in safety, traffic congestion and flood resilience is ultimately expected to enhance community values.

Local business

The proposal would have long-term benefits for businesses within the proposal area and wider region through improved connectivity and congestion relief helping to improve travel times. The operation of the proposal is not expected to change access arrangements to local business.

Social Infrastructure

During operation, the proposal would improve access and connectivity from future residential areas to existing and future community services and facilities in the study area and surrounding suburbs.

Access and connectivity

The proposal would have beneficial impacts for local and regional communities through safer and improved access to support future growth and development of the local area.

6.10.4 Safeguards and management measures

Safeguards and management measures for socio-economic impacts are presented in Table 6-62.

Additional safeguards and management measures that would also address socio-economic impacts are provided in:

- Section 6.3 – Traffic and transport
- Section 6.4 – Noise and vibration
- Section 6.10 – Landscape character and visual impacts
- Section 6.11 – Air Quality.

Table 6-62: Safeguards and management measures – Socio-economic

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic	<p>A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum):</p> <ul style="list-style-type: none"> • mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • contact name and number for complaints. <p>The CP will be prepared in accordance with the <i>Community Involvement and Communications Resource Manual</i> (RTA, 2008).</p>	Contactor	Detailed design / pre-construction	Additional safeguard
Property acquisition and lease	<p>All partial acquisitions and associated property adjustments will be carried out in accordance with the requirements of the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> and Land acquisition Reform 2016 in consultation with landowners. Transport for NSW will provide consultation with affected property owners to ensure they understand the acquisition process and are aware of the potential adjustments required to properties as part of the proposal.</p>	Transport for NSW	Pre-construction	Additional safeguard

6.11 Other impacts

6.11.1 Existing environment and potential impacts

An assessment of other existing environmental and potential impacts are detailed in Table 6-63 below.

Table 6-63: Assessment of other impacts

Environmental factor	Existing environment	Potential impacts
Waste and resource use	<p>The existing roads within the proposal area generate minimal waste. Waste sources are limited to roadside litter, some waste material from clearing roadside drainage features and green waste from the maintenance of roadside vegetation.</p> <p>The nearest waste disposal facility is the Hawkesbury City Waste Management Facility located on The Driftway.</p>	<p>Section 3.3 describes the resources that would be needed to build the proposal. These resources are common materials, and their use would not result in any resource supply shortages in the region.</p> <p>Construction would generate waste streams typical of road construction. Specific to the Proposal, these include:</p> <ul style="list-style-type: none"> • Green waste from cleared vegetation • Construction wastes created from surplus excavated materials • Demolition of parts of The Driftway east of Reynolds Road • Excess fill material from the excavation of cuttings and foundations during construction • Excess fill material from compensatory excavation to offset flood storage • Oil, grease and other liquid wastes from the maintenance of construction plant and equipment • General wastes such as packaging materials from items delivered to site • Potential contaminated material unearthed during construction. <p>All waste will be managed in accordance with Transport for NSW guidelines and disposed of by a licensed contractor to an appropriately licensed facility. The quantities of each type of waste would be confirmed before construction. The waste associated with the operation of the proposal would not be expected to change from the existing environment.</p>

Environmental factor	Existing environment	Potential impacts
<p>Hazard and risk management</p>	<p>Hazardous materials and dangerous goods storage or handling of such materials does not currently occur within the Proposal area. Fuel and oil spills may occur as a result from vehicle passing through the study area.</p> <p>The vegetation to the north of The Driftway is classified as Category 1 bushfire prone land, which is considered high risk for bushfire due to its location surrounded by mature vegetation.</p>	<p>Small quantities and inventories of hazardous materials and dangerous goods would be required during construction. As a result, the transportation, use and storage of these materials would occur. A potential impact to soil and water quality and workforce safety may result from spills or inappropriate and inadequate handling and storage of material.</p> <p>The potential impact is not considered to be significant given the implementation of mitigation measures in accordance with applicable legislation and guidelines to manage such risks. Including the National Codes of Practice and Australian Standards for the storage and handling of dangerous goods and materials.</p> <p>The handling and storage of these chemicals and materials would be managed through implementation of standard safeguards and management measures to minimise the potential for spills and leaks.</p> <p>Construction activities that may have potential to increase bushfire risk during construction include mulch stockpiling, hot works such as welding, as well as fuel/chemical storage and plant operation within densely vegetated areas (exhaust fires).</p> <p>Sections of The Driftway and its intersections are proposed to be closed for short periods of time during construction. Access would be maintained for emergency vehicles and implementation of the proposed road closure and detour route would be carried out in consultation with the Transport Management Centre and Emergency Services to minimise potential risks associated with reduced access during a bushfire event.</p>

Environmental factor	Existing environment	Potential impacts
<p>Climate Change and Greenhouse Gases</p>	<p>Greenhouse gases include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons. These gases absorb heat that is reflected from the earth, which results in warming of the air. This effect is known as the greenhouse effect. The primary human produced greenhouse gas is carbon dioxide.</p> <p>Climate change projections for the Sydney Region have been derived from the Intergovernmental Panel on Climate Change's Fifth Assessment Report (AR5, IPCC (2013) which are incorporated into the Climate Futures Tool by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Department of Environment and Energy. They show that climate change for the Sydney Region will include:</p> <ul style="list-style-type: none"> • Increases in average daily maximum and minimum temperatures • Changes to climate variability – changes to rainfall patterns • Increased extreme weather events such as flood and drought. 	<p>Construction of the proposal is anticipated to be completed within about 18 months. During this time, greenhouse gas emissions would be produced, including:</p> <ul style="list-style-type: none"> • Carbon dioxide, methane and nitrous oxide generated from liquid fuel use in plant and vehicles (diesel, petrol) • Embedded emissions associated with the manufacture and delivery of construction materials • Methane generated from land filling any carbon-based waste. <p>The volume of greenhouse gas emissions that would be generated during the construction of the proposal would be dependent on the quantity of construction materials used and the types of plant and equipment used during building the proposal.</p> <p>Given the nature of the proposal, it would not be possible to completely avoid the generation of greenhouse gas emissions during construction (due to the need to consume energy and resources). The volume of greenhouse emissions produced as a result of the proposal would be minimised through the application of standard mitigation measures, as outlined in 6.11.2.</p> <p>Overall, construction related greenhouse gas emissions associated with the proposal would be relatively minor and comparable with similar road upgrade projects.</p>

6.11.2 Safeguards and management measures

Safeguards and management measures for other environmental impacts are presented in Table 6-64.

Table 6-64 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Waste	<p>A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> • measures to avoid and minimise waste associated with the project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • monitoring, record keeping and reporting. <p>The WMP will be prepared considering the <i>Environmental Procedure - Management of Wastes on Transport for NSW Land</i> (Transport for NSW, 2014) and relevant Transport for NSW Waste Fact Sheets.</p>	Contactor	Detailed design / pre-construction	Section 4.2 of QA G36 <i>Environment Protection</i>
Utilities	<p>Prior to the commencement of works:</p> <ul style="list-style-type: none"> • the location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be undertaken. 	Contactor	Detailed design / pre-construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
Hazards and risk management	<p>A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:</p> <ul style="list-style-type: none"> • details of hazards and risks associated with the activity • measures to be implemented during construction to minimise these risks • record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • a monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. <p>The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE (formerly OEH).</p>	Contractor	Detailed design / pre-construction	

6.12 Cumulative impacts

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal and the additive effects of the proposal with other external projects. Transport for NSW is required under clause 228(2) of the Environmental Planning and Assessment Regulation 2000, to consider potential cumulative impacts as a result of the proposal.

6.12.1 Proposal area

The proposal area includes the areas of Richmond, Londonderry and South Windsor. The assessment of cumulative impacts has considered other developments or activities that are under way now or are likely to commence during the proposal's expected construction timeframe within the vicinity.

6.12.2 Other projects and developments

Locally occurring developments that could interact with the proposal were identified through a desktop search of publicly available information on the DPIE major projects and strategic planning website.

Table 6-65: Other projects

Project	Construction	Operational
Hawkesbury Centre of Excellence		
<p>This project involves construction of a new educational facility within the Western Sydney University (Hawkesbury Campus) which would include teaching facilities, administration spaces and short-term on-site accommodation facilities.</p> <p>The site is located in the southwestern corner of the Hawkesbury Campus, approximately 795 metres north of the proposal. It can be accessed through Vine Drive.</p> <p>A number of features of the project include:</p> <ul style="list-style-type: none"> • Three academic blocks, short-term dormitory site accommodation, administrative building and food facilities for university staff and students. • On site staff car parking area, short-term accommodation parking area and minibus drop off and pick up area • Upgrade of the Londonderry Road / Vines Drive intersection to accommodate traffic signals, turning lanes bus stops and pedestrian footpaths. 	<p>Construction impacts of the Hawkesbury Centre of Excellence project may include:</p> <ul style="list-style-type: none"> • Clearing of approximately 4.19 ha PCT 835 • Interim signalised pedestrian crossing south of Vines Drive, across Londonderry Road • Vibration impacts exceeding the NSW EPA human comfort vibration criteria for distances up to around 100 metres. 	<p>Operational impacts of the Hawkesbury Centre of Excellence project may include:</p> <ul style="list-style-type: none"> • Increase in road users for Londonderry Road .

Table 6-66: Potential impacts

Environmental factor	Construction	Operation
Traffic	Construction of the proposal concurrent with the construction of The Hawkesbury Centre of Excellence would likely attract additional construction vehicles along Londonderry Road, possibly resulting in traffic congestion.	Design of the proposal considers future traffic distribution by Stage 2 of The Richmond Bridge project. The additional traffic generation resulting from the operation of The Hawkesbury Centre of Excellence would be minimal in comparison to the traffic on the existing road network and redistributed as a result of Stage 2. The proposal would still, however, improve the safety and efficiency of commuters traveling northwards to Hawkesbury Centre of Excellence by upgrading the intersections at Londonderry Road/The Driftway.
Noise	Construction of the proposal concurrent with The Hawkesbury Centre of Excellence may result in cumulative noise impacts for local residents.	The noise assessment incorporates mitigation measures and includes an assessment for potential cumulative noise impacts.

Table 6-67: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction traffic	TMP would be CEMP will detail mitigation measures to minimise the impact on local traffic networks during construction.	Construction contractor	Construction	Additional safeguard

7. Environmental management

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

7.1 Environmental management plan

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

A CEMP would be prepared to describe the safeguards and management measures identified. The CEMP will provide the framework to implement the mitigation measures and allocate responsibility to appropriate personnel.

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

7.2 Summary of safeguards and management measures

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

Table 7-1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared and submitted for review and endorsement of the Transport for NSW Environment Manager prior to commencement of the activity.</p> <p>As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review. <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>	Contractor / Transport for NSW project manager	Pre-construction / detailed design	
GEN2	General - notification	All businesses, residential properties and other key stakeholders (schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / Transport for NSW project manager	Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN3	General – environmental awareness	<p>All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings.</p> <p>Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:</p> <ul style="list-style-type: none"> • Threatened species habitat • Adjoining residential areas requiring particular noise management measures. 	Contractor / Transport for NSW project manager	Pre-construction / detailed design	
Biodiversity					
B1	Removal of vegetation	<p>A Flora and Fauna Management Plan will be prepared in accordance with <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to:</p> <ul style="list-style-type: none"> • Pre-clearing survey • Unexpected find procedure • Inductions • Vegetation removal protocols • Exclusion zones. 	Contractor	Detailed design/pre construction	Section 4.8 of QA G36 Environment Protection
B2	Removal of vegetation	<p>Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).</p>	Contractor	Post construction	Additional safeguard
B3	Removal of vegetation	<p>Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).</p>	Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B4	Removal of threatened species habitat and habitat features	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bush rock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Contractor	Construction/ Post construction	Additional safeguard
B5	Unexpected finds	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011) if Threatened Ecological Communities (TECs), threatened flora and fauna not assessed in the biodiversity assessment, are identified in the construction footprint.	Contractor	Construction	Additional safeguard
B6	Induction	All personnel working on site will receive training to ensure awareness of requirements of the Flora and Fauna Management Plan and relevant statutory responsibilities during inductions. Site specific training will be given to personnel when working in the vicinity of areas with identified biodiversity values that are to be protected.	Contractor	Detailed design/Preconstruction	Additional safeguard
B7	Pre-clearance surveys	Pre-clearance surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Contractor	Preconstruction	Additional safeguard
B8	Exclusion zones	Exclusion zones will be set up at the limit of clearing the edge of the impact area) in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Contractor	Construction	Additional safeguard
B9	Aquatic habitat	Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines</i> (RTA, 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).	Contractor	Construction	Additional safeguard
B10	Fauna injury	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines</i> (RTA, 2011).	Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B11	Weed and pathogens	Any soil or other materials imported to the site for use in restoration or rehabilitation will be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks.	Contractor	Construction	Additional safeguard
B12	Weed and pathogens	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Contractor	Construction	Additional safeguard
B13	Weed and pathogens	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011).	Contractor	Construction	Additional safeguard
Soil and water					
SW1	Soil erosion and water pollution	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Preconstruction	Section 2.1 of QA G38 Soil and Water Management
SW2	Erosion and sediment	A site-specific Erosion and Sediment Control Plan/s (ESCP) will be prepared and implemented as part of the Soil and Water Management Plan. 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	Preconstruction	Section 2.2 of QA G38 Soil and Water Management

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SW3	Contaminants entering receiving environments during construction	<p>Control measures to minimise the risk of water pollution will be included in the ESCP. The following measures will be included to limit sediment and other contaminants entering receiving waterways:</p> <ul style="list-style-type: none"> • No stockpiles of materials or storage of fuels or chemicals will be located adjacent to the existing culverts • Vehicles and machinery will be properly maintained to minimise the risk of fuel/oil leaks • Routine inspections of all construction vehicles and equipment will be undertaken for evidence of fuel/oil leaks. All fuels, chemicals and hazardous liquids will be stored within an impervious bunded area in accordance with Australian standards and NSW EPA Guidelines • All water discharges will be undertaken in accordance with Transport for NSW's <i>Water Discharge and Re-use Guideline</i> • Emergency spill kits will be kept on-site at all times. All staff will be made aware of the location of the spill kit and be trained in its use • Construction plant, vehicles and equipment will be refuelled offsite, or in designated re-fuelling areas located at a minimum distance of 50 metres from drainage lines or waterways • Groundwater encountered during the construction of the proposal will be managed in accordance with the requirements of the <i>Waste Classification Guidelines</i> (DECCW 2009) and Transport for NSW's <i>Water Discharge and Re-use Guideline</i> • Stabilised surfaces will be reinstated as quickly as practicable after construction • Material transport from site to surrounding pavement surfaces will be minimised. <p>Soil and water management measures will be identified in consultation with relevant government agencies and Councils and will be consistent with the principles and practices detailed in <i>Managing Urban Stormwater: Soils and Construction</i> (2004) (known as the Blue Book).</p>	Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SW4	Flood management during construction	<p>A Flood Management Plan will be prepared before construction. This plan will include:</p> <ul style="list-style-type: none"> • Review and coordination with existing local flood plans and evacuation procedures • Flood emergency preparation, response, and recovery measures which will be implemented during construction • Procedure for daily review of the Bureau of Meteorology website • Site protection measures to be implemented before and in the event of flooding. 	Contractor	Preconstruction/Construction	Additional safeguard
SW5	Increase the depth and duration of inundation on private properties	<ul style="list-style-type: none"> • During detailed design undertake floor level survey on private properties • Improved drainage design to avoid impacts to private properties in accordance with criteria identified in Appendix D. 	Design and construction contractor	Preconstruction	Additional safeguard
Traffic and transport					
TT1	Traffic and transport	<p>A TMP will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Transport for NSW <i>Traffic Control at Work Sites Manual</i> (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i> (Transport for NSW, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic monitoring, review and amendment mechanisms. 	Contractor	Detailed design / Pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
TT2	Property access during construction	Access to properties will be maintained during construction. Where that is not feasible, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority. Any disruptions to property access and traffic will be notified to landowners at least seven days prior in accordance with the relevant community consultation processes outlined in the TMP.	Transport for NSW/Contractor	Construction	Additional safeguard
TT3	Reduce speeds, traffic delays and disruptions during construction	Road users and local communities will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays owing to construction activities.	Transport for NSW/Contractor	Construction	Additional safeguard
TT4		Construction site traffic will be managed to minimise movements during peak periods.	Transport for NSW/Contractor	Construction	Additional safeguard
TT5		Clear signage will be provided to direct and guide vehicles not related to the proposal during road construction work. This will be supplemented by variable message signs to advise drivers of traffic diversions, speed restrictions or alternative routes.	Transport for NSW/Contractor	Construction	Additional safeguard
TT6	Impacts to the regional road network	If disruptive work is required (lane closures) would be carried out at night where practicable, to minimise potential impacts on the regional road network.	Transport for NSW/Contractor	Construction	Additional safeguard
TT7	Parking	Parking will be provided on-site (ancillary site) and not on surrounding local streets.	Transport for NSW/Contractor	Construction	Additional safeguard
TT8	Site access and egress	All vehicles will enter and exit construction sites in a forward direction, where feasible and reasonable.	Transport for NSW/Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration					
NV1	Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim <i>Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • Identification of nearby sensitive receivers • Description of work, construction equipment and the hours work would be completed in • Criteria and mitigation measures for the proposal • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Details of how respite would be applied where ongoing high impacts are seen at certain receivers. 	Contactor	Detailed design/Pre-construction/Construction	Section 4.6 of QA G36 Environment Protection
NV2	Noise and vibration	<p>All sensitive receivers (schools, local residents) likely to be affected will be notified at least seven days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contactor	Detailed design / pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV3	Noise and vibration	<p>Location and activity specific noise and vibration impact assessments should be carried out prior to (as a minimum) activities:</p> <ul style="list-style-type: none"> • With the potential to result in noise levels above 75 dBA at any receiver • Required outside Standard Construction Hours likely to result in noise levels greater than relevant NMLs • With the potential to exceed relevant criteria for vibration. <p>The assessments should confirm the predicted impacts at the relevant receivers in the vicinity of the activities to aid the selection of appropriate management measures, consistent with the requirements of the CNVG.</p>	Transport for NSW	Pre-construction	Additional safeguard
NV4	Noise exceedances	<p>Where noise intensive equipment is to be used near sensitive receivers, the work should be scheduled for Standard Construction Hours, where possible. If it is not possible to restrict the work to the daytime, then they should be completed as early as possible in each work shift. Appropriate respite should also be provided to affected receivers in accordance with the CNVG and/or the proposal's conditions of approval.</p>	Contractor	Construction	Additional safeguard
NV5	Ancillary sites	<p>Hoarding, or other shielding structures, should be used where receivers are impacted near compounds or fixed work areas with long durations. To provide effective noise mitigation, the barriers should break line-of-sight from the nearest receivers to the work and be of solid construction with minimal gaps.</p>	Contractor	Construction	Additional safeguard
NV6	Noise and vibration monitoring	<p>Monitoring should be carried out at the start of noise and/or vibration intensive activities to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures from the CNVG have been implemented.</p>	Transport for NSW	Pre-construction/ Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV7	Vibration	<p>Where work is within the minimum working distances and considered likely to exceed the cosmetic damage criteria:</p> <ul style="list-style-type: none"> • Different construction methods with lower source vibration levels should be investigated and implemented, where feasible • Attended vibration measurements should be undertaken at the start of the work to determine actual vibration levels at the item. Work should be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria. 	Contractor	Pre-construction	Additional safeguard
NV8	Building condition surveys	Building condition surveys should be completed before and after the work where buildings or structures are within the minimum working distances and considered likely to exceed the cosmetic damage criteria during the use of vibration intensive equipment.	Transport for NSW/Contractor	Pre-construction/Post-construction	Additional safeguard
Contamination					
C1	Soil	Management of impact to soils will be implemented as part of the CEMP. The CEMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design /Preconstruction	Section 2.1 of QA G38 Soil and Water Management
C2	Soil	<p>A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the CEMP.</p> <p>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.</p>	Contractor	Detailed design / Preconstruction	Section 2.2 of QA G38 Soil and Water Management

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
C3	Contaminated land	<p>A Contaminated Land Management Plan (CLMP) would be prepared in accordance with the <i>Guideline for the Management of Contamination</i> (Transport for NSW, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to:</p> <ul style="list-style-type: none"> • Capture and management of any surface runoff contaminated by exposure to the contaminated land • Further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2) • Management of the remediation and subsequent validation of the contaminated land, including any certification required • Measures to ensure the safety of site personnel and local communities during construction. 	Contractor	Detailed design / Preconstruction	Section 4.2 of QA G36 Environment Protection
C4	Contaminated land	<p>If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.</p>	Contractor	Detailed design / Preconstruction	Section 4.2 of QA G36 Environment Protection
C5	Accidental spill	<p>A site-specific emergency spill plan will be developed and include spill management measures in accordance with the Transport for NSW Code of Practice for Water Management (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).</p>	Contractor	Detailed design/Preconstruction	Section 4.3 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage					
AH2	Aboriginal heritage unexpected finds	<i>The Standard Management Procedure - Unexpected Heritage Items</i> (Transport for NSW, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Transport for NSW does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design/Pre-construction	Section 4.9 of QA G36 Environment Protection
Non-Aboriginal heritage					
NAH1	Non-Aboriginal heritage unexpected finds	<i>The Standard Management Procedure - Unexpected Heritage Items</i> (Transport for NSW, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design/Pre-construction	Section 4.10 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impacts					
LV1	Landscape character and visual impact	<p>The landscape and concept design strategies <i>New Richmond Bridge - Stage 1 The Driftway Urban Design, Landscape Character and Visual Impact Assessment</i> prepared by Tract (2021) will form the basis of future landscape and detailed design development, providing integrated urban design and practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for:</p> <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise walls • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as lighting, fencing and signs • Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. 	Contractor	Detailed design/Pre-construction	Additional safeguard
LV2	Removal of vegetation	<ul style="list-style-type: none"> • Avoid impact to prominent trees and vegetation communities where possible • Protect threatened species and retained habitat wherever possible • Minimise clearance extent where possible and mark exclusion zones. 	Contractor	Preconstruction/Construction	Additional safeguard
LV3	Removal of vegetation	<ul style="list-style-type: none"> • Revegetation using local provenance material and match community and landscape character. Revegetation efforts should be implemented progressively to limit erosion and sedimentation • Provide screen planting within corridor to limit visibility to the landfill. 	Contractor	Construction/Operation	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
LV4	Visual impact of work sites	<ul style="list-style-type: none"> Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate fencing or screening (use of shade cloth), storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials Compound and ancillary facilities will be decommissioned, and the sites rehabilitated to their existing condition or as otherwise agreed with the landowner as soon as possible. 	Contractor	Construction	Additional safeguard
LV5	Earthworks	<ul style="list-style-type: none"> Integrate with adjoining landform through adoption of appropriate grades, avoiding sharp transition in profile where possible Stabilise/revegetate as works progress to limit erosion and visual impacts through early integration with surrounding vegetation. 	Construction	Detailed design/Construction	Additional safeguard
Air quality					
AQ1	Air quality impacts during construction	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to:</p> <ul style="list-style-type: none"> Potential sources of air pollution Air quality management objectives consistent with any relevant published EPA and/or DPIE (formerly OEH) guidelines Methods to manage works during strong winds or other adverse weather conditions A progressive rehabilitation strategy for exposed surfaces An assessment and responsibility delegation of the management of air quality suppression and management measures A monitoring program to record whether the air quality mitigation, suppression and management measures have been applied and their effectiveness. 	Contractor	Detailed design/Pre-construction	Section 4.4 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
AQ2	Dust emissions during construction	<p>Site planning and work practices:</p> <ul style="list-style-type: none"> • Minimise the extent of disturbed and exposed areas and revegetate finished areas as soon as possible • Minimise the drop heights of materials • Review and, where necessary, modify or suspend activities during dry and windy weather and background air quality conditions • Cover or otherwise regularly stabilise (with water sprays or binders) stockpiles especially prior to any site shutdown periods • Regularly water haul routes and ensure that all loads are covered • Regularly inspect and remove debris from plant and equipment to avoid the tracking of materials on to the adjacent road network • To the extent practical, position ancillary sites and stockpiles away from nearby sensitive receivers. 	Contractor	Construction	Additional safeguard
AQ3	Exhaust emissions from plant and equipment used during construction	<p>Plant and equipment:</p> <ul style="list-style-type: none"> • Inspect all plant and equipment before it is used on-site • Ensure all vehicles, plant, and equipment operate in a proper and efficient manner • Switch off all vehicles, plant and equipment when not in-use • Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable. 	Contractor	Construction	Additional safeguard
AQ4	Odours and airborne hazardous substances from uncovered contaminated materials	<p>Odour and airborne hazards:</p> <ul style="list-style-type: none"> • Apply odour suppressing agents to materials as necessary to minimise related impacts should any contaminated or hazardous materials be uncovered during the works • Adhere to relevant requirements for removal and disposal listed in the <i>Work Health and Safety Act 2011</i>, and <i>Work Health and Safety Regulation 2017</i>. 	Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic					
SE1	Socio-economic	<p>A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum):</p> <ul style="list-style-type: none"> mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions contact name and number for complaints. How the community enquiry/complaint phone number will be managed <p>The CP will be prepared in accordance with the <i>Community Involvement and Communications Resource Manual</i> (RTA, 2008).</p>	Contactator	Detailed design/Pre-construction	Additional safeguard
SE2	Partial property acquisition and lease	All partial acquisitions and associated property adjustments will be carried out in accordance with the requirements of the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> and Land acquisition Reform 2016 in consultation with landowners.	Transport for NSW	Pre-construction	Additional safeguard
Waste					
W1	Waste	<p>A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> measures to avoid and minimise waste associated with the project classification of wastes and management options (re-use, recycle, stockpile, disposal) statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions procedures for storage, transport and disposal monitoring, record keeping and reporting. <p>The WMP will be prepared taking into account the <i>Environmental Procedure - Management of Wastes on Transport for NSW Land</i> (Transport for NSW, 2014) and relevant Transport for NSW Waste Fact Sheets.</p>	Contactator	Detailed design/Pre-construction	Section 4.2 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Utilities					
U1	Utilities	<p>Prior to the commencement of works:</p> <ul style="list-style-type: none"> The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners If the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be undertaken. 	Contractor	Detailed design/Pre-construction	Additional safeguard
Hazards and risk management					
HZ1	Hazards	<p>A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:</p> <ul style="list-style-type: none"> Details of hazards and risks associated with the activity Measures to be implemented during construction to minimise these risks Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials A monitoring program to assess performance in managing the identified risks <p>Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations.</p> <p>The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.</p>	Contractor	Detailed design/Pre-construction	Additional safeguard

8. Conclusion

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

8.1 Justification

Transport for NSW is planning to build a new bridge over the Hawkesbury River and associated traffic improvements to reduce congestion between town centres, improve travel times, cater for future growth and improve connectivity for public and active transport. Several route options have been identified and considered. Common to each option was improvements to The Driftway between Londonderry and Blacktown Roads.

As improvements to The Driftway were common to all options and to deliver early safety benefits to the community, the upgrade would be delivered as Stage 1 of the New Richmond Bridge and traffic improvements, facilitating part of the bypass of Richmond town centre.

While there would be some environmental impacts as a consequence of the proposal, such as temporary traffic delays, amenity impacts, vegetation clearing and property impacts, they have been avoided, minimised or mitigated wherever possible through design and site-specific safeguards. The benefits of improving road safety, traffic efficiency, and flood resilience are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal.

8.1.1 Social factors

As discussed in Section 6.9, the proposal would have some minor short-term negative social impacts as a result of the construction disturbance. The combined effect of construction noise, dust, local access changes and general disruption caused by construction activity, construction traffic and machinery movements would result in a minor loss of amenity for residents, motorists and others who live near or visit the proposal area on a regular basis during construction.

During operation, a total of 37 residential buildings are predicted to experience noise levels that exceed the operational road traffic noise criteria increase by more than 2.0 dB. The 37 residential buildings would be eligible for consideration of additional noise mitigation. A final operational noise mitigation strategy for the proposal would be determined during detailed design and would consider community preference where appropriate.

Despite the short-term inconvenience, the proposal would provide long-term benefits which would accommodate increased traffic, improve travel efficiency, road safety and increasing flood resilience along The Driftway.

8.1.2 Biophysical factors

As discussed in Section 6.1, the proposal would have direct and indirect impacts on biodiversity during the construction and operational phases of the proposal. It is important to note that the project would clear vegetation that is adjacent to an existing road which is already subject to indirect disturbance, as evident by the high level of weed invasion. This indirect impact may be extended to a newly created edge where the future clearing is required.

The proposal would require the direct removal of 5.66 hectares of native vegetation associated with the construction footprint required for the improvement works. This vegetation clearing includes:

- About 0.51 hectares of Shale Gravel Transition Forest in the Sydney Basin Bioregion EEC, under the BC Act
- About 0.20 hectares of Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion EEC, under the BC Act
- About 0.37 hectares of River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC, under the BC Act
- About 3.41 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC, under the BC Act (0.45 moderate condition and 2.96 low condition)
- About 1.17 hectares of Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion Vulnerable Ecological Community (VEC), under the BC Act (0.08 moderate condition and 1.09 low condition). Around 0.08 hectares of this impact meets the condition criteria for the EPBC Act listed Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion endangered ecological community, as this vegetation meets both the key diagnostic characteristics and the condition thresholds.
- About 1.3 hectares, about 5,000 specimens of *Dillwynia tenuifolia*.

An assessment of significance determined that the proposal is not likely to have a significant impact on threatened biodiversity listed under the BC Act and/or the EPBC Act or is the proposal likely to have a “significant” impact on MNES. Like-for-like offsets for MNES are not required. To compensate for impacts to threatened biodiversity resulting from the proposal, the Transport for NSW *Guideline for Biodiversity Offsets* (Roads and Maritime, 2016) would be used to implement suitable offset requirements.

Compensatory offsets would include:

- The loss of 0.45 hectares of PCT 849 Cumberland Plain Woodland critically endangered ecological would be at a ratio of 4:1. This would result in an offset requirement of 1.8 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion in moderate to good condition
- The direct impact to species credit species habitat for the Cumberland Plain Land Snail is a loss of 5.66 hectares. A suitable offset for this loss would be at a ratio of 3:1 and would result in an offset requirement of 16.98 hectares
- The direct impact to species credit species habitat for *Dillwynia tenuifolia* is a loss of 1.3 hectares. A suitable offset for this loss would be at a ratio of 3:1 and would result in an offset requirement of 3.9 hectares.

The final offset requirement for the proposal would be determined during detailed design and development of the offset package.

8.1.3 Economic factors

The proposal would deliver long-term economic benefits by improving connectivity, safety, flood resilience and traffic efficiency by facilitating part of the bypass of Richmond town centre as Stage 1 of the New Richmond Bridge and traffic improvements. Without the proposed Stage 1 upgrade to The Driftway, safety and efficiency benefits would not be realised.

8.1.4 Public interest

The public interest is best served through the equitable distribution of resources, and investment in public infrastructure that fulfils the needs of the majority. The proposal represents a cost-efficient investment in public infrastructure that would improve safety and support future economic growth. Although the proposal

would result in some short-term impacts to amenity, accessibility and transport efficiency during construction, these impacts would be outweighed by the long-term benefits once the proposal is operational. As a result, the proposal is considered to be in the public interest.

8.2 Objects of the EP&A Act

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

Object	Comment
<p>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.</p>	<p>The proposal would ensure safety and traffic efficiency for future traffic growth and facilitating Stage 1 of the New Richmond Bridge proposal, thus promoting the social and economic welfare of the community.</p> <p>The proposal design, impact, safeguards and management measures detailed in this REF allow for the proper management, development and conservation of natural and other resources.</p>
<p>1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.</p>	<p>Ecologically sustainable development is considered in Section 8.2.1.</p> <p>The proposal has considered environmental and social issues in the design and incorporated the value upon environmental resources</p>
<p>1.3(c) To promote the orderly and economic use and development of land.</p>	<p>The proposal is not expected to impact on the economic use of land. Acquisitions are located next to the road or within existing developed areas to avoid severance and minimise effect on future land use.</p> <p>As Stage 1 of the New Richmond Bridge and traffic improvements the proposal would improve access and efficient transport from The Driftway to the wider Richmond and Windsor area catering for future growth.</p>
<p>1.3(d) To promote the delivery and maintenance of affordable housing.</p>	<p>Not relevant to the proposal</p>
<p>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.</p>	<p>Impacts to flora and fauna, including threatened species, populations and ecological communities and their habitats are considered in Chapter 6.1.</p> <p>The proposal would potentially impact up to 5.66 hectares of native vegetation. Assessments of significance carried out as part of the BAR (Jacobs, 2021) found that proposal would be unlikely to have any significant impact on any threatened species, population or ecological communities. Safeguards and management measures would be implemented to manage impacts to biodiversity and cleared areas.</p> <p>Offsets have been considered as per Transport for NSW <i>Guideline for Biodiversity Offsets</i> and would be finalised during detailed design and development of the offset package.</p>

Object	Comment
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would not impact any items of non-Aboriginal and Aboriginal heritage.
1.3(g) To promote good design and amenity of the built environment.	Not relevant to the project.
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 project.
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 project.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	The proposal has been developed as part of consultation that was undertaken for New Richmond Bridge. Consultation has been outlined in Chapter 5.

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 proposal.

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 preferred options development (see Chapter 2). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures in the following ways:

- Best available technical information, environmental standards and measures have been used to minimise environmental risk
- Proposal design was refined to minimise vegetation clearance, with particular consideration of sensitive areas
- Route alignment that minimises potential impacts on existing residential properties and other existing land uses, while also taking into consideration potential impacts on proposed future land use was selected
- Offsets have been considered as per Transport for NSW *Guideline for Biodiversity Offsets* and would be finalised during detailed design and development of the offset package
- Conservative 'worst case' scenarios were considered while assessing environmental impact.

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 Intergenerational equity principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures in the follow ways:

- A preferred route alignment that minimises vegetation clearance within sensitive ecological areas to ensure that such areas are conserved for future generations has been selected
- Water quality, fauna connectivity and hydrological measures were included into the design to ensure that the impacts on the distribution of flora, fauna and ecological communities within sensitive ecological areas are minimised both for the short and long term
- Possible compensatory habitat or offsets would be finalised during detailed design
- The proposal will support economic growth for the local and surrounding areas for the current and future generation were identified
- Existing issues that have potential long-term implications for the local area have been minimised by the proposal – reducing the likelihood of crashes and flooding.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a road with injury crash clusters at key intersections, would have substantial delays at intersections and would continue to be closed due to floods during relatively minor storm events.

Conservation of biological diversity and ecological integrity

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

The proposal is located in an area that has previously been modified and is subject to ongoing edge effects, however, remnant areas of native vegetation and associated habitats remain.

A key objective of the proposal is to minimise adverse impacts on the environmental values of the area. Conservation of biological diversity and ecological integrity has been considered during all stages of the proposal’s development. Potential impacts have been avoided where possible and safeguards and management measures have been included where necessary:

- Landscape strategy and a revegetation works would be implemented which reflected the structure and species of locally endemic flora to ensure that biological diversity in the local area is maintained
- Appropriate scope considered for connectivity and key corridors for species likely to occur in the area
- Design features that would allow safe movement patterns for native fauna species were incorporated
- Site selection criteria were established for construction phase facilities that include minimising native vegetation clearance
- Biodiversity offset package (such as riparian habitat restoration, compensatory habitats, and progressive revegetation using native seedlings) for unavoidable residual impacts would be implemented.

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.

This principle is defined as: improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:

- (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement
- (ii) (the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste

- (iii) environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems. Environmental and social issues were considered in the strategic planning and establishment of the need for the proposal, and in consideration of various proposal options.

The value placed on environmental resources is evident in the extent of the planning and environmental investigations, and in the design of the proposed mitigation measures and safeguards including:

- Environmental issues were considered as key matters in the route selection process and in the economic and financial feasibility assessments for the proposal
- Minimising the division of individual properties and the subsequent potential economic impacts on affected property owners were considered
- The value of the proposal to the community in terms of improved safety was recognised.

8.3 Conclusion

The proposed upgrade to The Driftway is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and considered to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

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

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on biodiversity, noise, hydrology and the visual landscape. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would improve the safety and efficiency of The Driftway and would accommodate for future traffic redistributed from the New Richmond Bridge proposal. On balance the proposal is considered justified, and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. A BDAR or SIS is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on MNES or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the DAWE 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.

Chelayne Whyte

Associate Environmental Consultant

Jacobs Group (Australia) Pty Ltd

Date: 02 November 2011

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



Tim Webster

Project Development Manager

Western Parkland City

Date: 29 October 2021

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Terms and acronyms used in this REF

Term / Acronym	Description
AADT	Average annual daily traffic
ABS	Australian Bureau of Statistics
AEI	Area of environmental interest
AEP	Annual exceedance probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	<i>Aboriginal Heritage Impact Permit</i>
AHMP	Aboriginal Heritage Management Plan
AQMP	Air Quality Management Plan
ASS	Acid sulfate soils
BC Act	Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
CEEC	Critically Endangered Ecological Community
CEMP	<i>Construction Environmental Management Plan</i>
CHL	Commonwealth Heritage List
CMP	Conservation Management Plan
CNVG	Construction Noise and Vibration Guideline
CSEP	Community and Stakeholder Engagement Plan
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
DUAP	Department of Urban Affairs and Planning
EIA	Environmental impact assessment
ENMM	Environmental noise management manual
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environmental Protection License
ESCP	Erosion sediment control plan
ESD	Ecologically sustainable development
FM Act	<i>Fisheries Management Act 1994</i>
Heritage Act	<i>Heritage Act 1977</i>
ICNG	Interim Construction Noise Guideline

Term / Acronym	Description
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LCZ	Landscape character zone
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matters of national environmental significance under the EPBC Act
NCA	Noise catchment area
NHL	National Heritage List
NMG	Noise Mitigation Guideline
NPW	<i>National Parks and Wildlife Act 1974 (NSW)</i>
NVA	Noise and vibration assessment
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PCT	Plant community type
PFAS	Per- and polyfluoroalkyl substances
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
PSI	Preliminary Site Investigation
REF	Review of environmental factors
RNP	Road Noise Policy
ROL	Road occupancy license
SES	State Emergency Services
SIS	Species Impact Statement
SREP	Sydney Regional Environmental Plan
TEC	Threatened ecological community
TMP	Traffic management plan
TRAQ	Tool for Roadside Air Quality
TSS	Total suspended solids
VMS	Variable message signs
WHL	World Heritage List
WMP	Waste Management Plan

Appendix A

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

Clause 228(2) Checklist

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

Factor	Impact
<p>a) Any environmental impact on a community? Construction of the proposal would result in some short-term negative impacts, such as visual amenity impact, traffic and access disruptions, in addition to potential noise and air emissions impacts. These could impact negatively on the local community as described in this REF. Potential visual amenity impact during construction would include the placement and movement of construction vehicles and stockpile areas within the proposal area. Potential traffic impact during construction would include an increase in the volume of heavy vehicles, interruption of traffic flows along Richmond Road and temporary changes in speed limit potentially resulting in increased travel times. Impact to access may be experienced by residences and other sensitive receivers within the proposal area. Construction noise would be generated from construction plant and vehicles. Air quality impacts would result from dust and vehicle emissions. These impacts would likely occur for the duration of construction.</p> <p>The proposal would lead to the long-term negative impact resulting from the direct loss of state and federally listed species and ecological communities. Offsetting and revegetation with endemic species would alleviate some of this loss.</p> <p>The primary long-term positive impact of the proposal would include improved safety and reduced travel times and long-term support for economic growth.</p>	<p>Short term, minor, negative</p> <p>Long term, moderate, negative</p> <p>Long term, positive</p>
<p>b) Any transformation of a locality? Construction of the proposal would temporarily impact the existing locality, predominantly through a negative visual impact, associated with the placement and movement of construction plant and equipment and stockpile areas.</p> <p>In the longer term, the proposal would not result in a substantial transformation of the locality as it comprises widening of the existing road corridor and improved intersection safety.</p>	<p>Short term, minor</p> <p>Long term, positive</p>
<p>c) Any environmental impact on the ecosystems of the locality? The proposal will require removal of around 5.66 hectares of native vegetation associated with the construction footprint required for the upgrade works. This vegetation clearing would include:</p> <ul style="list-style-type: none"> • Shale Gravel Transition Forest in the Sydney Basin Bioregion (Endangered BC Act) (PCT 724) – 0.51 hectares • Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered) (PCT 725) – 0.20 hectares • River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) (PCT 835) – 0.37 hectares • Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered) (PCT 849) – 3.41 hectares • Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (Vulnerable) (PCT 883) – 1.17 hectares • <i>Dillwynia tenuifolia</i> listed as vulnerable under the BC Act. The extent of this local population is 67 hectares with about 1.3 hectares (1.9 %) occurring in the construction footprint and will be directly impacted, this equates to an estimated 5,000 plants 	<p>Long term, moderate, negative</p>

Factor	Impact
<p>This biodiversity assessment identifies that the proposal is not likely to have a significant impact on threatened biodiversity listed under the NSW BC Act and EPBC Act. No like-for-like offsets for MNES are required. With appropriate safeguards and biodiversity offsets under Transport for NSW <i>Guideline for Biodiversity Offsets</i> (2016) impact would be minimised. Revegetation efforts with endemic species would also reduce direct impacts resulting from clearing activities.</p>	<p>Long term, minor, negative</p>
<p>d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? During construction, the proposal would have the potential to create a reduction in the overall aesthetic quality of the proposal due to the equipment associated with construction worksite, dust and noise generation as well as traffic and access disruption. No recreational or scientific qualities of the proposal area are anticipated to be impacted during the construction or operation of the proposal. The removal of vegetation would impact the visual landscape long term, reducing vegetation screening to the landfill site. Revegetation efforts would alleviate this impact. No recreational or scientific qualities of the proposal area are anticipated to be impacted during the construction or operation of the proposal.</p>	<p>Short term, minor, negative</p> <p>Short term, moderate, negative</p>
<p>e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? The proposal will not effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations.</p>	<p>Nil</p>
<p>f) Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)? The proposal would not impact habitat of protected fauna.</p>	<p>Nil</p>
<p>g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The proposal will require removal of around 5.66 hectares of native vegetation associated with the construction footprint required for the upgrade works. This vegetation clearing would include:</p> <ul style="list-style-type: none"> • Shale Gravel Transition Forest in the Sydney Basin Bioregion (Endangered BC Act) (PCT 724) – 0.51 hectares • Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered) (PCT 725) – 0.20 hectares • River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) (PCT 835) – 0.37 hectares • Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered) (PCT 849) – 3.41 hectares • Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (Vulnerable) (PCT 883) – 1.17 hectares • <i>Dillwynia tenuifolia</i> listed as vulnerable under the BC Act. The extent of this local population is 67 hectares with about 1.3 hectares (1.9 %) occurring in the construction footprint and will be directly impacted, this equates to an estimated 5,000 plants <p>This biodiversity assessment identifies that the proposal is not likely to have a significant impact on threatened biodiversity listed under the NSW BC Act and</p>	<p>Long term, moderate, negative</p>

Factor	Impact
<p>EPBC Act. No like-for-like offsets for MNES are required. With appropriate safeguards and biodiversity offsets under Transport for NSW <i>Guideline for Biodiversity Offsets</i> (2016) impact would be minimised. Revegetation efforts with endemic species would also reduce direct impacts resulting from clearing activities. Biodiversity impacts associated with the proposal would be mitigated through the implementation of safeguards outlined in Section 6.1</p>	<p>Long term, minor, negative</p>
<p>h) Any long-term effects on the environment? The proposal would have a long-term impact on the existing environment through permanent clearance of up to 5.66 hectares of native vegetation</p>	<p>Long term, minor, negative</p>
<p>i) Any degradation of the quality of the environment? The proposal has the potential to degrade the quality of the environment through accidental spills, noise, dust and sediment during construction. Management measures outlined in Chapter 7.2 would be implemented to mitigate potential impacts. In the long-term, it is anticipated that the proposal would improve the overall quality of the environment through revegetation, improved drainage and reduce flooding.</p>	<p>Long term, minor, negative</p> <p>Long term, moderate, positive</p>
<p>j) Any risk to the safety of the environment? The construction work has the potential to temporarily decrease safety along Richmond Road due to road work and movement of construction plant. These risks would be mitigated by measures outlined in Chapter 7.</p>	<p>Short-term, minor negative</p>
<p>k) Any reduction in the range of beneficial uses of the environment? The proposal would not result in a significant reduction in the range of beneficial uses of the environment.</p>	<p>Nil</p>
<p>l) Any pollution of the environment? The proposal would potentially cause pollution of the environment (spills, air quality and noise amenity) however the potential impact would be minimised with the implementation of safeguards outlined in Chapter 7.2.</p>	<p>Nil</p>
<p>m) Any environmental problems associated with the disposal of waste? No environmental problems associated with the disposal of waste are expected as a result of the proposal. Waste would be managed as per the safeguards outlined in Section 7.2 of this REF.</p>	<p>Nil</p>
<p>n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The proposal would not create any significant demand on resources. Reuse of excavated material is expected to minimise demand. All required resources for the proposal are considered to be readily available.</p>	<p>Nil</p>
<p>o) Any cumulative environmental effect with other existing or likely future activities? Construction of the proposal may overlap with other local development Resulting in the potential for short-term cumulative impacts (noise, dust, traffic) when construction occurs simultaneously. Cumulative impact as a result of concurrent development would be managed according to safeguards outlined in Section 6.12.</p>	<p>Short-term, minor, negative</p>
<p>p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal is not located within a coastal area and would not result in any impact on coastal processes and coastal hazards.</p>	<p>Nil</p>

Matters of National Environmental Significance and Commonwealth land

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

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

Factor	Impact
a) Any impact on a World Heritage property? The proposal would not have any impact on a World Heritage property.	Nil
b) Any impact on a National Heritage place? The proposal would not have any impact on a National Heritage place.	Nil
c) Any impact on a wetland of international importance? There would be no impact to wetlands of international importance by the proposal.	Nil
d) Any impact on a listed threatened species or communities? The proposal would impact 0.08 hectares of the EPBC Act listed Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion endangered ecological community. The biodiversity assessment determined that the proposal is not likely to have a significant impact on the ecological community or would it have a significant impact on MNES and therefore no like-for-like offsets for MNES are required. Mitigation measures are provided in Section 6.1.	Minor impact
e) Any impacts on listed migratory species? The proposal would not impact any listed migratory species.	Nil
f) Any impact on a Commonwealth marine area? There would be no impact to Commonwealth marine areas by the proposal.	Nil
g) Does the proposal involve a nuclear action (including uranium mining)? The proposal does not involve a nuclear action (including uranium mining).	Nil
h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land? The proposal does not involve any impact on Commonwealth land.	Nil

Appendix B

Statutory consultation checklists

Infrastructure SEPP

Certain development types

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

Development within the Coastal Zone

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

Note: See interactive map here: <https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management>. Note the coastal vulnerability area has not yet been mapped. Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

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

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

Local heritage items

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

Flood liable land

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

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

Public authorities other than councils

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

Appendix C

Biodiversity assessment report

Appendix D

Flooding and drainage investigation

Appendix E

Noise and vibration

Appendix F

Landscape character and visual impact assessment