

Mulgoa Road Upgrade Jeanette Street to Blaikie Road

Review of Environmental Factors

Roads and Maritime Services | August 2018



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Prepared by Arup and Roads and Maritime Services

RMS.18.965

ISBN: 978-1-925797-66-4

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Approval and authorisation

Title	Mulgoa Road Upgrade Jeanette Street to Blaikie Road review of environmental factors
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Signed:	
Dated:	July 2018

Document status

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Executive summary

The proposal

Roads and Maritime Services (Roads and Maritime) proposes to upgrade a 1.3-kilometre section of Mulgoa Road between Jeanette Street at Regentville and Blaikie Road at Jamisontown. This would form the first stage of the Mulgoa Road/Castlereagh Road corridor upgrade, announced in 2015. Key features of the proposal would include:

- Upgrading 1.3-kilometres of existing road from two lanes to three lanes in each direction
- Extending the southbound left and right-turn slip lanes entering the M4 Motorway
- Interfacing with the M4 Smart Motorway project by providing an upgrade to the exit ramps
- Reducing the width of the embankments supporting the M4 Motorway road bridges and installing retaining structures to create space for through-lanes on the outside of the piers
- Removing the tunnel access to the Penrith Homemakers Centre at Wolseley Street by providing dual right-turn lanes
- Making adjustments to lane width and turning alignments at the Wolseley Street, Factory Road/Jeanette Street, Glenbrook Street, and Blaikie Road intersections
- Relocating the existing footpath along the western side of Mulgoa Road to widen the road
- Providing an active transport corridor along the eastern side of Mulgoa Road, including a 3.5-metre-wide shared use pedestrian and cyclist path
- Connecting Hutchinson Crescent, Huron Place and Peter Court to create a shared transit zone for vehicles and cyclists and providing an adjacent footpath
- Providing bus-priority measures at the Blaikie Road, Glenbrook Street, and Wolseley Street intersections in the form of bus queue jump lanes.

A site compound would be temporarily placed on the Council reserve to the east of Mulgoa Road south of the M4 Motorway interchange. It would include portable buildings with amenities, such as lunch facilities and toilets, secure and bunded storage areas for site materials including fuel and chemicals, office space, and associated parking.

About 0.8 hectares of private land would be acquired from 21 properties to widen the road. This would involve strip acquisition along the front of 17 properties (nine residential properties and seven commercial properties) and the total acquisition of four residential lots.

Construction of the proposal is anticipated to start in 2020 and it would take about two years to complete. It is unlikely that construction work would be continuous as it would need to be planned to account for local conditions, delivery schedules, and contractor and equipment availability.

Mulgoa Road and local roads in the area are expected to remain open to traffic during construction, and all users would still have access to the range of commercial, public and private properties in the area. Traffic management controls would be introduced at different times during construction, which may include speed restrictions, the use of traffic controllers, the temporary relocation of bus-stops or diversion of footpaths. On occasion, for safety reasons, lane and road closures may be needed outside of peak periods to carry out some of the construction activities. The community and public would be notified in advance of any major traffic disruption.

Need for the proposal

The need for the proposal was identified as a priority to develop the Western Parkland City, part of Greater Sydney. The Greater Sydney Commission, who is responsible for leading metropolitan planning in the region, has developed three key spatial development plans that identify the public infrastructure needed to develop Greater Sydney. The development of key transport links, public transport provisions and pedestrian and cyclist opportunities are key elements identified in the plans needed to support the expected

growth in Greater Sydney over the next 40 years. The need for the proposal is also recognised at the local level, through an expected growth in traffic of about 1.2 per cent year-on-year. This growth is driven by a series of approved, committed and planned precinct developments in the area that would see a 20 per cent increase in the residential population and a 46 per cent increase in jobs over the coming two decades.

Rather than upgrading the whole of the Mulgoa Road/Castlereagh Road corridor at the same time, it was divided into stages. The section between Jeanette Street and north of Blaikie Road was prioritised for upgrade given the congestion and delays that currently occur during peak periods. It was identified that widening the road would provide the needed increase in capacity to support the volume of traffic generated by planned development in the area in the future.

Proposal objectives and development criteria

Objectives for the proposal include the need for the proposal to; better-manage congestion and delays along Mulgoa Road and Castlereagh Road during peak periods, reduce travel times and transport costs, increase the capacity to cater for population and employment growth, and offer safe and effective pedestrian and cycling infrastructure. This is supported by objectives to improve; road safety and amenity for all users, the movement of goods and trucks, and the urban design of the road corridor.

Development criteria were also established to achieve the proposal's objectives. They included designing the upgrade to; increase travel efficiency, minimise property acquisition and environmental impacts, deliver enhanced safety benefits, include bus priority measures and pedestrian and cycle provisions, and create an effective contemporary design that includes a successful urban design outcome.

Options considered

The options selection process started in 2015 with the identification, development and refinement of the Mulgoa Road/Castlereagh Road corridor. Six strategic corridor upgrade options were considered for investigation, including 'doing nothing'. The options included selecting a new corridor or widening the existing corridor. Also considered was an option of changing the traffic flows on existing lanes during peak periods (tidal flow operation). All six options were investigated and their performance tested against the proposal objectives and need for developing the road by considering aspects including property, traffic, road safety, environmental constraints, project risks, and value for money

The options analysis concluded that the best solution would be to widen the existing road corridor. The corridor was then split into five sections to help define and analyse widening options. Ten widening options were identified along the entire corridor, two in each of the five sections.

Following various workshops and reviews, the preferred option was to widen to the west for the majority of Mulgoa Road between Jeanette Street and Blaikie Road, except at the M4 interchange where widening would be on both sides. This option was preferred as it would reduce the need for property acquisition, reduce ecological impacts, and require less complex and costly utility upgrades. This option also offered a solution that provided sufficient space to widen the road to three lanes in each direction, introduce landscape planting and include pedestrian and cyclist facilities.

Once the decision to largely widen to the west had been made, options for upgrading each of the intersections were identified, developed and evaluated. Also, options to provide pedestrian and cyclist facilities along the eastern side of Mulgoa Road were identified alongside Hutchinson Crescent, Huron Place and Peter Court. The following preferred options were selected:

- Left-in access at Factory Road/Jeanette Street and replacing the tunnel access at Wolseley Street with dual right-turn lanes. This would improve road safety and relieve congestion without affecting network performance locally.
- 'Do nothing' at several intersections as they would continue to provide an acceptable level of service in the future without being upgraded, while in other locations minor adjustments would be needed.

- Join Hutchinson Crescent, Huron Place and Peter Court to improve traffic flow in the area and better support both local access and cyclist and pedestrian connectivity. To avoid traffic and property impacts, a shared transit space for cyclists and vehicles, and a separate footpath would be provided. This preferred option would be safer overall for cyclists than the introduction of conflict points between residents accessing and leaving their driveways and cyclists using a dedicated shared path.

Statutory and planning framework

State Environmental Planning Policy (Infrastructure) 2007 permits the development of roads or roads-related infrastructure to be carried out by, or on behalf of, a public authority.

As the proposal is for a road and road infrastructure facilities, and is to be carried out by Roads and Maritime, it can be determined under division 5.1 of the Environmental Planning and Assessment Act 1979 and is subject to consideration of the objects and provisions of the above Act, and the factors set out in clause 228(2) of the supporting Environmental Planning and Assessment Regulation 2000. Development consent is therefore not needed. However, Roads and Maritime would need to secure a licence to 'occupy' the road and carry out various work consistent with the provisions of section 138 of the Roads Act 1993.

Community and stakeholder consultation

Extensive consultation with Penrith City Council, Fire and Rescue NSW, the Rural Fire Service, key businesses, affected property owners and the local community has been carried out over the past three years. This has involved various meetings, workshops, and community information sessions. 'Community Update' letters have also been issued to the local community, firstly in August 2015 asking for general feedback and comments on the proposal to upgrade the corridor, and then in April 2017 asking for more specific feedback on the preferred option.

Twenty-two (22) people provided feedback in 2015, while 34 people provided feedback in 2017. Key issues raised by the community were:

- Concerns about amenity impacts during construction including increased levels of noise, and access restrictions and delays
- Questions and concerns about possible loss of access or restrictions for people living along Mulgoa Road once the road was upgraded
- Long-term amenity loss for people living in the area through the removal of vegetation and mature trees alongside the road and bringing traffic closer to properties
- Concerns about emergency vehicle access during construction and operation
- Questions about whether the proposal would affect the ability to upgrade the Penrith Panthers Stadium in the future.

Roads and Maritime has proposed several safeguards that would be introduced during construction to mitigate the temporary impacts on the local community and area.

The proposal has been designed to also reduce permanent impacts. This includes measures to improve the amenity, urban design and landscape of the upgraded road corridor, together with measures to ensure any noise impacts can be treated and reduced to acceptable levels. The road has also been designed to increase capacity, which is needed to support future traffic growth in the area, including development of the Penrith Panthers Stadium.

Roads and Maritime would continue to seek feedback from businesses, the local community, Penrith City Council, residents, and other key stakeholders as the design progresses. All interested stakeholders are invited to make a submission against any information in this REF during and immediately following its display. Following the public display period, Roads and Maritime will collate and consider the submissions received and then determine whether the proposal should proceed as described in the REF, or whether any

changes are needed. A submissions report will then be published that will respond to each of the comments received.

Environmental impacts

The main environmental impacts of the proposal and the safeguards and management measures to address these are summarised below.

Beneficial impacts

The proposal is expected to deliver the following benefits:

- Increase capacity on Mulgoa Road to help with the development of Penrith central business district (CBD), the Western Parkland City and the Penrith Panthers Stadium
- Better manage congestion and improve travel times between Penrith and the M4 Motorway
- Provide a safe urban environment for drivers, pedestrians and cyclists
- Promote walking and cycling in the area and encourage more people to travel by public transport.

Adverse impacts

Traffic and transport

The need to introduce temporary traffic management controls on Mulgoa Road would inconvenience road users, pedestrians, cyclists, residents and business owners for the duration of the construction work as there may be minor journey delays for people travelling through traffic controls.

Bus stops along Mulgoa Road, within the proposal area, would need to be temporarily relocated while construction work takes place. While this would be done in consultation with bus operators, it may inconvenience passengers. Pedestrians and cyclists may also be inconvenienced by having to use temporary facilities alongside Mulgoa Road during construction work.

Site and delivery vehicles needed to construct the proposal would generate up to 200 traffic movements per day. This would add less than one per cent to the existing traffic volumes on Mulgoa Road, meaning that there would be negligible impact on congestion. A management plan would be used during construction to minimise impacts, time work activities and traffic controls to avoid peak periods, and ensure there are appropriate controls for people to access properties along Mulgoa Road. This includes maintaining emergency access at Jeanette Street for the fire services, and for customers to the Homemaker Centre on Wolseley Street.

The proposal would alter access arrangements at Wolseley Street, Factory Road/Jeanette Street, Glenbrook Street and Blaikie Road. However, there would be no loss of access and the final arrangements would provide the level of service needed to support future traffic volumes. Access arrangements from Peter Court to Glenbrook Street would also be modified. The change in travel and access habits would affect road users in the short-term until they have the opportunity to adjust, with Roads and Maritime continuing to consult with affected parties as the design advances.

Noise and vibration

The majority of construction work would be undertaken during standard construction hours. Construction of the proposal during standard construction hours would exceed the highly noise affected level of 75 decibels at 55 sensitive receivers due to their proximity to the proposed works. However, this would be for loud construction activities, including demolition and excavation work, such as installing the retaining structures under the M4 Motorway bridges and laying asphalt, which are expected to be limited in duration.

Certain work would need to take place outside of standard hours to minimise traffic disruption to road users. In these cases, Roads and Maritime would implement feasible and reasonable measures to minimise noise impacts including scheduling respite periods in the evening and at night, restricting the use

of certain equipment at night, using temporary/permanent shields and noise barriers, and promoting the use of lower noise-generating equipment.

When completed, there would be no significant increase in noise levels as a result of the proposal. However, for 60 of the receivers (52 residential and 8 educational receivers) the increase in noise would be sufficient to require treatment measures to be considered. Based on the preliminary feasible and reasonable assessment of noise mitigation, a noise wall would be an option for residents along the eastern side of Mulgoa Road to the north of the M4 Motorway interchange. Any remaining affected noise receivers, after the installation of the noise wall, would be considered for at-property noise mitigation in accordance with the treatment priorities set out in the NSW Road Noise Policy. At property treatment would be planned and carried out in consultation with property owners.

Biodiversity

The work would take place within the broad footprint of the existing Mulgoa Road corridor, which includes planted roadside vegetation. A key feature in the area is a strip of forest red gum trees, extending along the western side of Mulgoa Road between Wolseley Street and Blaikie Road. Comprising some 50 trees of varying size, age and condition, collectively it is characteristic of river flat eucalypt forest that is found on the flood plains in the local area. This tree community type is listed as endangered under the *Biodiversity Conservation Act 2016*. Most of the trees are also hollow bearing, and as such, provide suitable habitat for a range of fauna species.

Despite this, the tree community occurs as a poor condition remnant patch that has been isolated from higher-quality forest red gums in the local area. While the hollows form an important habitat feature, the fragmented and isolated nature of these trees and their location in an active, noisy urban environment, means that they are unlikely to be inhabited by any important, protected or threatened fauna. Seven bat species are the only threatened fauna recorded in the area. They range over a large area and are likely to make use of better-quality connected habitat. This conclusion is supported by the lack of any breeding camps or roosting observed onsite.

Despite the need to remove about 3.5 hectares of vegetation to widen the road, which would include about 0.8 hectares of forest red gum, the impact of this ecologically would be minor due to its poor condition. The impact assessment concludes that the proposal would not have a significant impact on any threatened species, populations or ecological communities.

Roads and Maritime would continue to look at opportunities to reduce tree loss along the western side of the road during detailed design. A Flora and Fauna Management Plan would be used during construction to minimise impacts, including ensuring pre-clearance checks are carried out before starting work and ecologically sensitive areas are fenced-off and protected. The management plan would also describe how habitat and vegetation would be replaced or reinstated once the work is complete.

Soils, geology and contamination

Industry and commerce in the area includes potentially contaminating land uses such as service stations, industrial areas, vehicle workshops, old buildings, and water treatment works. This is supplemented by areas of infilled vacant land, where there is the potential for contaminated fill material to have been brought onto site. Existing road runoff and wash-off from nearby agricultural land are also potential contaminant sources.

A search for 'Significant' ground contamination, as defined by the Environment Protection Authority, or notifications issued under the *Protection of the Environment Operations Act 1997* found a 7-Eleven service station on the eastern side of Mulgoa Road about 170 metres north of the proposal as an area of potential contamination. However, the service station has been remediated (cleaned up) since it was declared contaminated in 2012.

Despite the area's history and legacy of contaminated land, there is no evidence to suggest that this has affected the quality of the soils within the proposal footprint to the extent that it would present a risk to the staff onsite or the public. A Contaminated Land Management Plan would be prepared that includes the

processes and procedures for dealing with unexpected contamination finds onsite. A separate plan would be developed to deal with the potential discovery of asbestos onsite.

Hydrology and flooding

The proposal is located near the Nepean River and its catchment. Mulgoa Road, within the extent of the proposal footprint, crosses Surveyors Creek which discharges to Peach Tree Creek and in turn the Nepean River about 2.5 kilometres to the west. Just to the south of the proposal footprint, Mulgoa Road crosses School House Creek. This too discharges into the Nepean River, about 1.25 kilometres to the west.

While the runoff from Mulgoa Road discharges into the Nepean River, the catchment receives stormwater runoff from a wide area including the surrounding residential suburbs and commercial/industrial areas. This is supplemented by other regulated and unregulated runoff such as overland flows and washout from agricultural land.

Mulgoa Road is in a low-lying area. While the proposal footprint is outside the Nepean River floodplain it can be subject to flooding through the back-up of water in the creeks and drains, called surcharging. There is also the potential for water to pool and pond in the proposal footprint during and following heavy rainfall.

Modelling was used to demonstrate that the proposed drainage design would be able to handle the increased volume and rate of stormwater runoff from widening the road during a heavy storm event without the need for additional attenuation controls to regulate runoff. Modelling also predicts that the flood risk to the surrounding land would be largely unchanged. However, the assessment concluded that land which currently experiences flooding, with existing flood depths between 0.10 to 0.30m during a 10 year flood and 0.30 to 0.50m during a 100 year flood, would experience increased afflux between 0.05m and 0.07m for 10, 20 and 100 year floods. These areas include residential premises to the south east of the Glenbrook Road intersection and commercial properties to the west of Surveyors Creek. Further options will be considered during detailed design to avoid additional flood impacts as a result of this proposal. If required, flood mitigation options for affected buildings will be investigated in consultation with landowners.

Landscape character and visual impacts

Widening a road in its existing setting would have limited impact on the regional landscape character or existing land use forms and patterns. However, the existing local landscape character would be impacted by increasing the pavement area, removing vegetation, and introducing additional infrastructure and street furniture. This introduces a new built form, which is difficult to absorb into components of the surrounding landscape as they would be more sensitive to these changes. This includes the residential and commercial/retail zones alongside Mulgoa Road. Also, the proposed tree removal alongside Mulgoa Road would reduce the 'green' character of the road in the short-term until replacement planting and landscaping establishes and matures.

Roads and Maritime has developed a landscape and urban design strategy that is based on adopted guidelines to minimise the landscape and visual impacts described above. This would include key urban design measures and landscape themes which would involve planting trees to offset the removal of mature trees along the road corridor, and a planting strategy to provide boulevard and gateway treatments along Mulgoa Road. Planting would be used to screen views and provide amenity improvements for pedestrians, cyclists, road users, residents and other people with overlooking views. This would be delivered through an urban design plan that would continue to be developed as part of the proposal's detailed design. Currently, the urban design plan aims to seamlessly integrate barriers and noise walls into the design by providing similar patterns and colouring along with planting at the base where feasible and reasonable.

Socio-economics

The proposal would include acquisition of a strip of land from the frontage of residential properties and commercial properties. Four entire residential lots would also be acquired, with the four residential properties being demolished. Lot 111 Mulgoa Road (Council reserve) would be used as a temporary site compound during construction of the project.

The strip acquisition required would not prevent the continued functional use of these properties. However, there would be a loss of outside space, including parts of front gardens and customer parking or forecourt space for commercial properties. Roads and Maritime has engaged with affected property owners, and this consultation is ongoing. Further refinement of the design would be considered to identify opportunities to reduce property impacts.

For people overlooking the road, their amenity would be affected because of the increased dominance of the road in the landscape and the vegetation and tree removal along the corridor. Certain residents and other sensitive receivers would also be affected by increased levels of road traffic noise. For those people that rely on direct access to and from Mulgoa Road, including the fire services and Regentville Kids Academy, (emergency) access provisions have been included in the design to ensure they are not impacted by the upgrade. During construction resident's adjacent to the proposed site compound maybe affected by increased noise, dust and reduced amenity.

Roads and Maritime is committed to continuing to engage and consult with the public, affected property owners and key stakeholders as it advances the design. It has, and would, continue to refine the design to minimise its socio-economic impacts. Access, signage, urban design, landscape planting and noise treatment controls all form part of the design and would be used to minimise the range of amenity-related impacts. The design would be refined in consultation with property and business owners to minimise impacts on their frontages.

Justification and conclusion

The proposal would increase the capacity on this section of Mulgoa Road to manage the predicted increase in traffic volumes over the coming years. This capacity is assessed as being sufficient to provide an adequate level of service in the future. The proposal also provides an opportunity to promote the use of alternative transport modes, including cycling and walking, and complements the recognised need to improve roads in the area to support the development of Greater Sydney and Penrith central business district. It is also a priority as it would help better manage existing congestion on Mulgoa Road and improve travel times in the short and medium term.

Subject to determination and approval, construction is expected to start in 2020 and last for about two years. While construction work takes place, a range of safeguards identified in this REF would be introduced to manage and minimise the proposal's impacts on the receiving environment. This includes several specified traffic, noise and amenity management controls, and other standard best practices proven to be effective in providing environmental protection. This would ensure the proposal is delivered in accordance with its objective of minimising its environmental impacts.

Roads and Maritime is also proposing to continue consultation with affected property owners, the public and key stakeholders to help refine the design. This would be used as an opportunity to reduce some of the amenity and property-related impacts identified in the REF. This would be supplemented by the inclusion of access, signage, urban design, landscape planting and noise treatment controls as part of the design.

Overall, the proposal is considered justified against its need and objectives. It is also considered road development within the meaning and definition of clause 94 of State Environmental Planning Policy (Infrastructure) 2007 that can be determined under division 5.1 of the *Environmental Planning and Assessment Act 1979*. The proposal would not significantly impact on the matters of national environmental significance protected under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and so it has not been referred to the Australian Government Department of Environment and Energy.

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Appendix I	Aboriginal heritage assessment
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1. Introduction

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

1.1 Proposal identification

Roads and Maritime Services (Roads and Maritime) proposes to upgrade a 1.3-kilometre section of Mulgoa Road between Jeanette Street at Regentville and Blaikie Road at Jamisontown (the proposal). The proposal is the first scheme to be progressed following the 2015 announcement to upgrade the Mulgoa Road/Castlereagh Road corridor.

Mulgoa Road is a north-south arterial road linking Penrith, Wallacia and the M4 Motorway.

Increased population and employment growth in Western Sydney has placed pressure on Mulgoa Road. This has seen increased congestion during the morning and afternoon peak periods over the last decade. The increase and growth are the result of key local developments, including Penrith Panthers Entertainment Precinct, Riverlink and Nepean River Precincts, Penrith Stadium, Penrith Lakes, urban development at Glenmore Park and Thornton, and the development of the North West and Western Sydney Priority Growth Areas.

Mulgoa Road is an important traffic route for the Penrith central business district (CBD) and more broadly Western Sydney as it is only one of two regional access points to the M4 Motorway. This section of the road is in a mixed-use urban area. Key features locally include the adjacent residential suburbs of Regentville and Jamisontown, with commerce generally focussed around the Penrith Homemaker Centre, and north of the M4 Motorway.

The proposal forms part of the Western Sydney Growth Roads Program (WSGRP). This program aims to upgrade arterial roads in Western Sydney to deliver a more efficient, reliable network that meets future community and economic needs. The \$100 million proposal falls under this program and therefore has secured joint funding by the Australian and State Governments.

A main objective of the proposal is to increase traffic capacity and reduce travel times by widening Mulgoa Road. To achieve this, the proposal would also require the M4 Motorway interchange, main intersections and short sections adjacent local roads to be upgraded. Key features of the proposal would include:

- Upgrading 1.3 kilometres of existing road from two lanes to three lanes in each direction
- Extending the southbound left and right-turn slip lanes entering the M4 Motorway
- Interfacing with the M4 Smart Motorway project by providing an upgrade to the exit ramps
- Reducing the widths of the embankments supporting the M4 Motorway road bridges and installing retaining structures to create space for through-lanes on the outside of the piers
- Removing the grade-separated access to the Penrith Homemakers Centre at Wolseley Street by providing dual right-turn lanes
- Making adjustments to lane widths and turning alignments at the Wolseley Street, Factory Road/Jeanette Street, Glenbrook Street and Blaikie Road intersections
- Providing an active transport corridor along the eastern side of Mulgoa Road, including a 3.5-metre-wide shared use pedestrian and cyclist path
- Connecting Hutchinson Crescent, Huron Place and Peter Court to create a shared transit zone for vehicles and cyclists and providing an adjacent footpath
- Providing bus priority measures at the Blaikie Road, Glenbrook Street, and Wolseley Street intersections in the form of bus queue jump lanes.

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

The proposal footprint (shown in red in Figure 1-1, Figure 1-2 and Figure 1-3) described in this report is the land needed to widen the road. The construction footprint (shown in blue in Figure 1-1, Figure 1-3 and Figure 1-3) includes the total area needed to upgrade and construct the proposal, including utility adjustments and the additional land temporarily needed to support building the proposal.

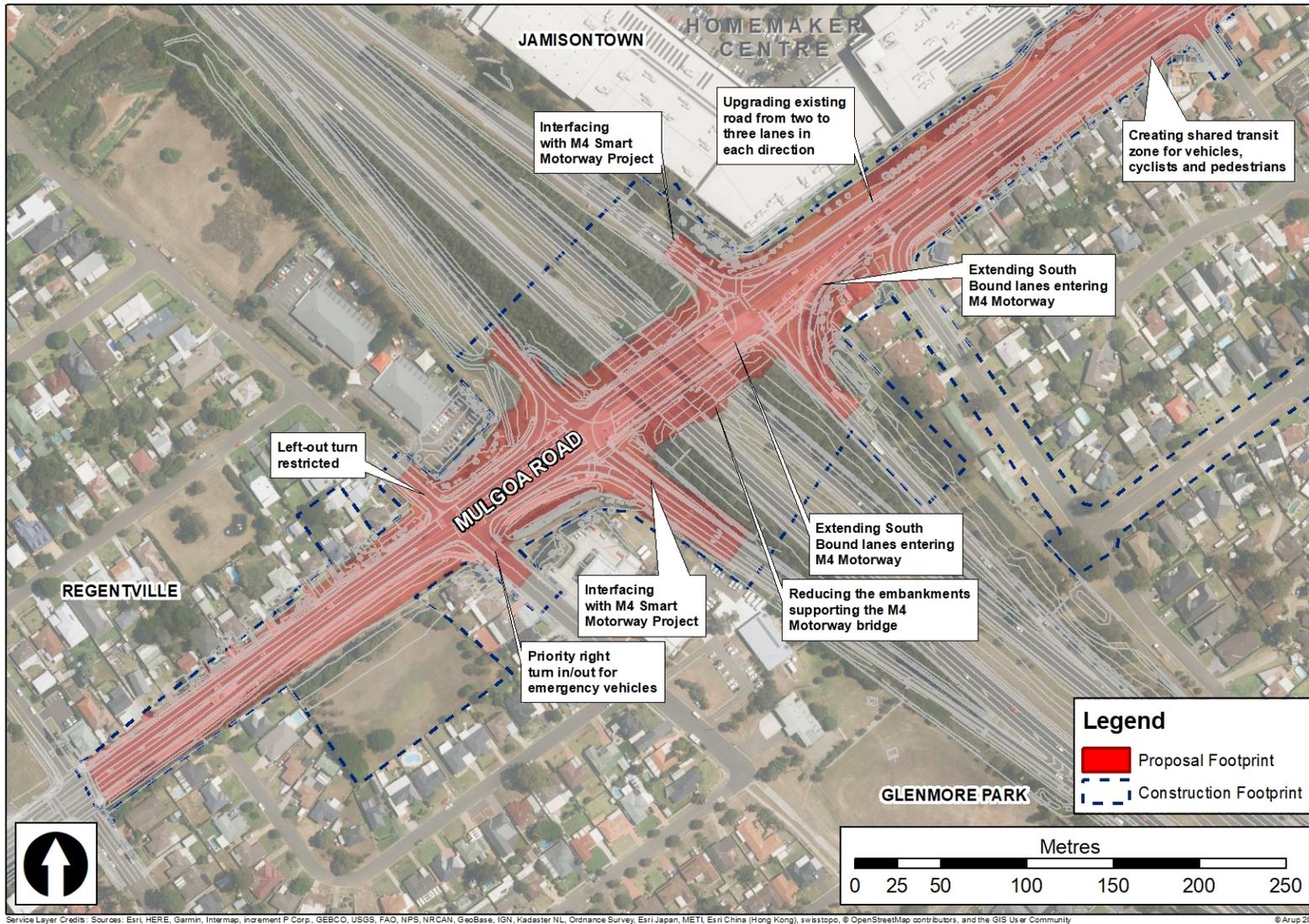
The area of the construction footprint that runs along Warragamba Crescent as shown in Figure 1-1 and Figure 1-3 includes the location of the proposed gas main relocation.



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Source: Arup

Figure 1-1: Location of the proposal - (Note: **Proposal Footprint** is the extent of the operational changes proposed to the road, whilst the **construction footprint** is the extent of disturbance (including utilities relocation) required during construction to complete the upgrade)

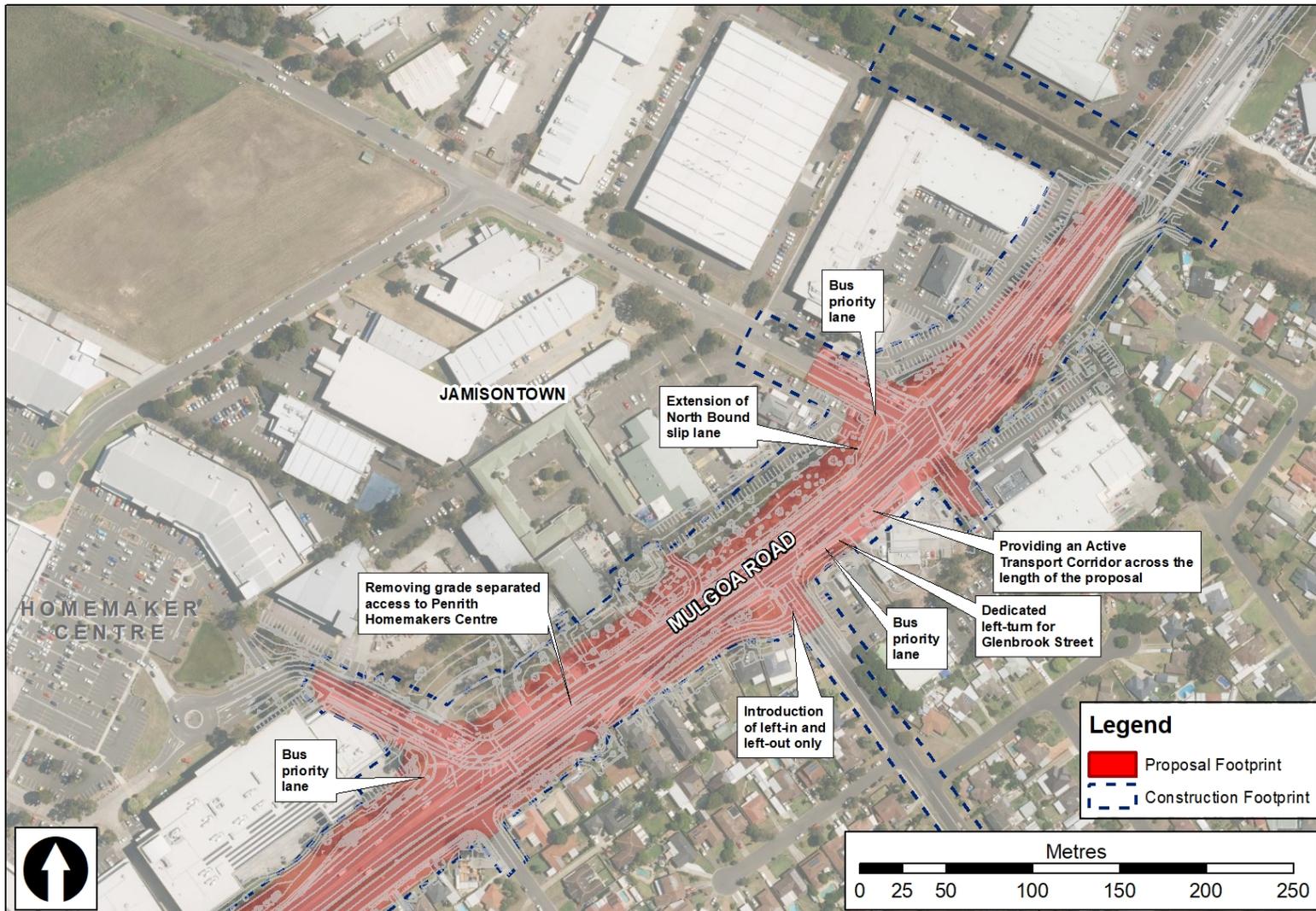


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Southern section

Source: Arup (subject to detailed design)

Figure 1-2: Key features of the proposal (Southern section)



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Northern section

Source: Arup (subject to detailed design)

Figure 1-3: Key features of the proposal (Northern section)

1.2 Purpose of the report

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

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

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

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

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

The findings of the REF would be considered when assessing:

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

2. Need and options considered

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

2.1 Strategic need for the proposal

Several Commonwealth and State strategic plans refer to the importance of improving existing road infrastructure safety and efficiency, and enhancing the connectivity of economic centres. The proposal is consistent with these strategic plans and would help achieve the Government's infrastructure priorities and vision for the State.

2.1.1 National Partnership Agreement on Land Transport Infrastructure Projects

In October 2014, the Australian Government entered into an agreement with the States and Territories to jointly contribute to the development of a safe and sustainable national transport system that enhances network interconnectivity and provides significant economic opportunity across the country. This has resulted in the Australian Government, together with the States and Territories, identifying and determining which land-based transport infrastructure projects are funded under this partnership agreement.

The upgrade of Mulgoa Road was one such proposal that was identified for funding under the partnership agreement given its regional importance for accessing the growing Penrith CBD and wider Western Sydney region. Making capacity, safety and efficiency improvements along Mulgoa Road would therefore improve connectivity and journey reliability between the region and the M4 Motorway. It would also help the region's planned economic growth and development.

2.1.2 NSW State Priorities

The NSW State Priorities target growth and economic development. The State priority of providing built infrastructure includes a key aim to improve "road and journey time travel reliability to allow businesses and the community to move around with greater ease, with a focus on boosting productivity". To do this, the State Government is committed to making better use of existing road infrastructure.

By upgrading Mulgoa Road, this responds to improving one of the two key roads that provide access between Penrith and the M4 Motorway, which is consistent with the above aim and priority. It would do this by reducing current traffic congestion and providing additional capacity for forecasted transport growth (refer to section 6.1).

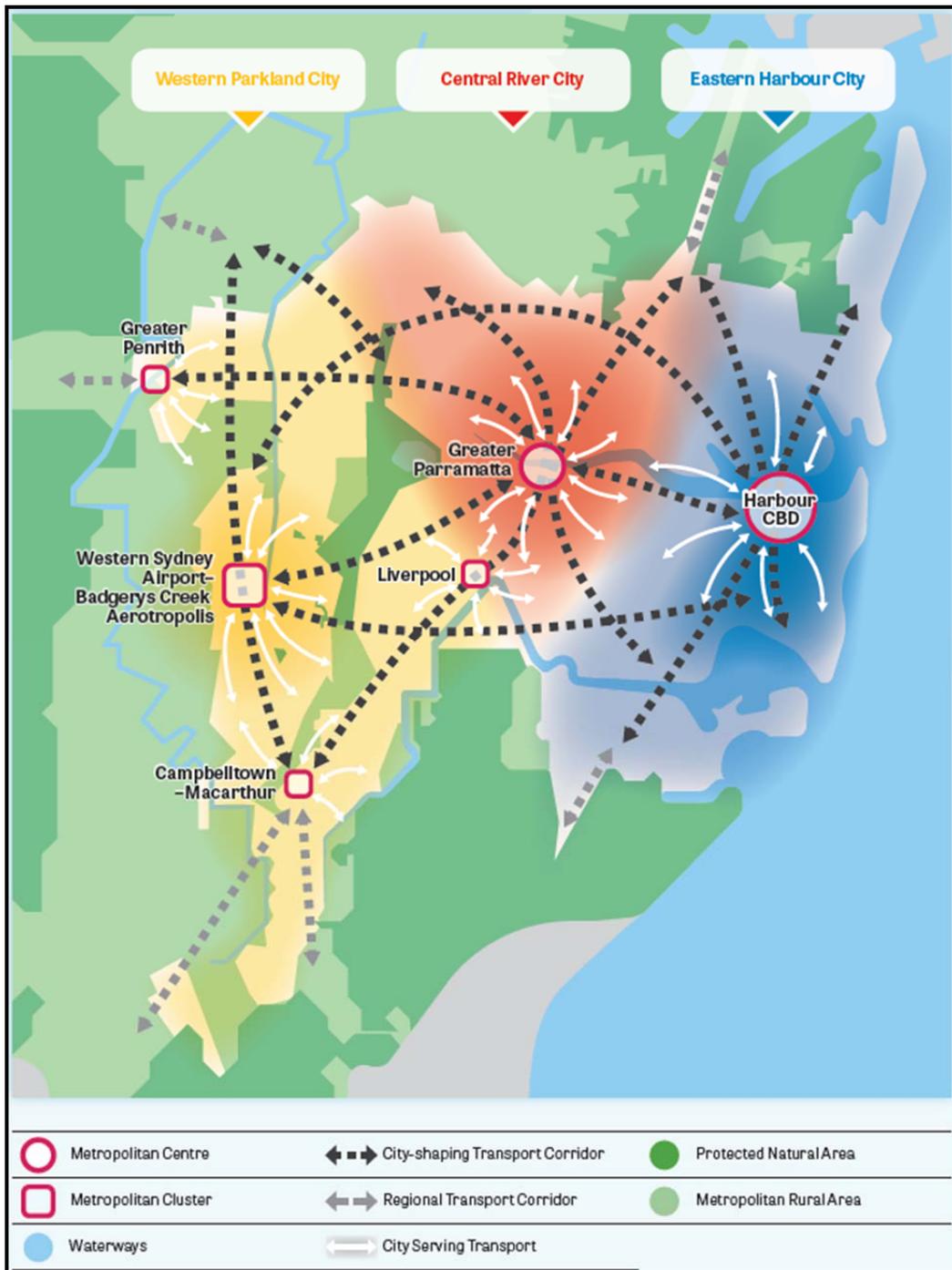
2.1.3 Greater Sydney

The population of Sydney is growing, and planning for Greater Sydney is being led by the recently established Greater Sydney Commission (GSC). The Commission is an organisation funded by the State Government to coordinate and align the planning that would shape the future productivity and sustainability of the Greater Sydney region. The focus is on the formation and development of three 'cities' Western Parkland, Central River and Eastern Harbour. The proposal is located within the limits of the identified Western Parkland City.

The key plans that relate to the proposal are discussed further below.

Directions for a Greater Sydney 2017-2056

Directions for a Greater Sydney 2017-2056 was produced in 2017 to better integrate land use and infrastructure to deliver a more productive, liveable and sustainable Greater Sydney over the next 40 years. Ten directions have been developed to form the planning vision for Greater Sydney. The direction to ‘develop cities supported by infrastructure’ is relevant to the proposal as it focuses on providing adequate transport infrastructure to support population growth. Consequently, by providing additional capacity along Mulgoa Road this would provide adequate infrastructure over the coming years to support growth and development in the Western Parkland City.



Greater Sydney Region Plan – A Metropolis of Three Cities

The Greater Sydney Region Plan: A Metropolis of Three Cities builds on the above Directions by setting a 40-year vision for the development of the three cities. A principal aim is to develop Greater Sydney as a

metropolis where people can access the jobs, education and services they need within 30 minutes of where they live, either by public or active transport. It is driven by major place-making, planning and investment around the planned Western Sydney Airport at Badgerys Creek.

One of the Plan's objectives is to align land use and infrastructure to restructure economic activity and access across the three cities by delivering faster, convenient and reliable travel times. It aims to do this by integrating the spatial elements of landscape, housing and great places, jobs and connectivity.

The proposal would respond to this by improving road transport connections within the Western Parkland City, therefore supporting the economic development of key strategic centres including Penrith CBD. This is important as the Plan identifies that over half of Greater Sydney's jobs are generated in strategic centres. The accessibility to jobs is identified as a key consideration for creating new housing in the right places and the Plan sets targets for the Western Parkland City of 40,000 new homes by 2021 and 185,500 by 2036. While the areas proposed for increased housing supply have not yet been identified it is likely that the proposal would support these goals by increasing connectivity to Penrith CBD as a key employment hub for the area.

Source: NSW Government

Figure 2-1: Greater Sydney Region Plan – A Metropolis of Three Cities

Western City District Plan

Five District Plans were released in early 2018, including the Western City District Plan, which includes the Western Parkland City. This Western City District Plan's objective is to sustainably manage growth in the area over the next 20 years to help contribute towards the longer 40-year vision for Greater Sydney described above. The Plan identifies five Planning Priorities that give effect to the spatial elements of the Greater Sydney Region Plan: A Metropolis of Three Cities described above. Planning Priority W1, infrastructure and collaboration, aims to deliver the following objectives:

- Objective 1: infrastructure that supports the three cities
- Objective 2: infrastructure that aligns with forecast growth, growth infrastructure compact
- Objective 3: infrastructure that adapts to meet future needs
- Objective 4: infrastructure use that is optimised.

The Plan details the need for new infrastructure at local, district and metropolitan levels to deliver transport infrastructure and make connections between the three cities to meet the needs of Greater Sydney. It identifies the importance of safeguarding transport corridors and locations to enable future transport investment. The proposal would result in improved road transport connections within the Western City District by enhancing economic development through providing a stronger gateway to the Penrith CBD.

2.1.4 Future Transport Strategy 2056

Future Transport Strategy 2056 is an update of the State's Long Term Transport Master Plan. It is an overarching strategy that sets a 40-year vision, and provides direction and an outcome framework for customer mobility to guide transport investment in the State. The Strategy is supported by a suite of plans for regional NSW and Greater Sydney to achieve the vision.

The Strategy is built on key outcomes that aim to positively impact the economy, communities and environment. The proposal would provide the necessary upgrade to Mulgoa Road to reduce congestion and increase capacity. It would also improve transport interchange with the M4 Motorway. Collectively, this would deliver a more efficient transport system resulting in greater economic performance for Penrith CBD and Western Sydney. The key outcomes of the Strategy's vision that are supported by the proposal are:

- *Successful places and growing the economy*, the proposal would improve access and connectivity to, and within, Penrith CBD, and by doing so, would support the growth of the local and state economy.
- *Safety and performance*, the proposal has been designed in accordance with current safety standards, while providing additional capacity on Mulgoa Road to manage congestion and improve network performance for motorists and bus passengers. The pedestrian and cycle infrastructure upgrade has included provisions to separate and provide dedicated facilities for each of these user groups. This would improve safety and increase capacity of the active transport infrastructure.
- *Accessible services*, the proposal would reduce travel times along Mulgoa Road, which would improve accessibility to Penrith CBD and the M4 Motorway, and in doing so, would improve accessibility with the Greater Sydney region.
- *Sustainability*, the proposal would reduce the traffic congestion currently experienced on Mulgoa Road, and in doing so, this supports the vision of sustainable living, namely having access to jobs, education and services within 30 minutes of where people live.

2.1.5 Building Momentum: State Infrastructure Strategy 2018-2038

The State Infrastructure Strategy was delivered in 2012. It comprised a 20-year investment plan that provided recommendations on how to best-grow the State’s economy, enhance productivity and improve living standards. Updated this year, Building Momentum: State Infrastructure Strategy 2018-2038 focuses on continuing to strengthen infrastructure planning, procurement, management and performance to ensure the state’s assets are flexible, enduring and resilient. This current Strategy sets out a process and timeline for ensuring that all areas of state infrastructure investment are guided by coordinated plans. It recommends reforms, policies and projects that respond to the state’s changing economic, social, technological and environmental outlook.

The Strategy is designed to complement the Future Transport Strategy and Greater Sydney Region Plan and builds on the State Government’s major long-term infrastructure plans. It identifies the need for investing in well-targeted infrastructure that is integrated with land-use and planning, and improves travel-time efficiency and access. The proposal is consistent with this requirement as it would optimise the value of the existing road network by providing additional capacity and reducing congestion. Ultimately, this would improve the efficiency of the existing road network in the area.

2.1.6 Supporting strategies and policies

The proposal is also supported under the policies, goals, objectives, and targets of various other strategic transport-related planning documents as summarised in Table 2-1.

Table 2-1: Supporting strategies and policies

Strategy/policy	Relevance
Sydney’s Bus Future: Simpler, Faster, Better Bus Services	The proposal would provide bus infrastructure and priorities at key intersections to make buses a more attractive travel choice in the future consistent with the aims of this Plan.
Sydney’s Cycling Future: Cycling for Everyday Transport	The proposal would provide shared use facilities that would connect with the Penrith CBD to make cycling a more attractive travel choice in the future consistent with the aims of these Plans.

Strategy/policy	Relevance
NSW Bike Plan 2010	The proposal would improve connectivity for cyclists by supporting active transport use along the corridor and incorporating a shared zone for vehicles and cyclists along Hutchinson Crescent.
Sydney's Walking Future: Connecting People and Places	The proposal would provide pedestrian access throughout to make walking a more attractive travel choice in the future consistent with the aims of this Plan.
NSW Road Safety Strategy, 2012-21	The proposal has been designed to State and Australian engineering and road safety standards developed by Roads and Maritime and Austroads. It has also been subject to an independent safety review and audit consistent with the aims of this Strategy.
Government Architect New South Wales: Sydney Green Grid 7 West District, 2017	The proposal has been designed to help connect the urban environment through pedestrian and cycle access to nearby parklands in Western Sydney.

2.2 Existing infrastructure

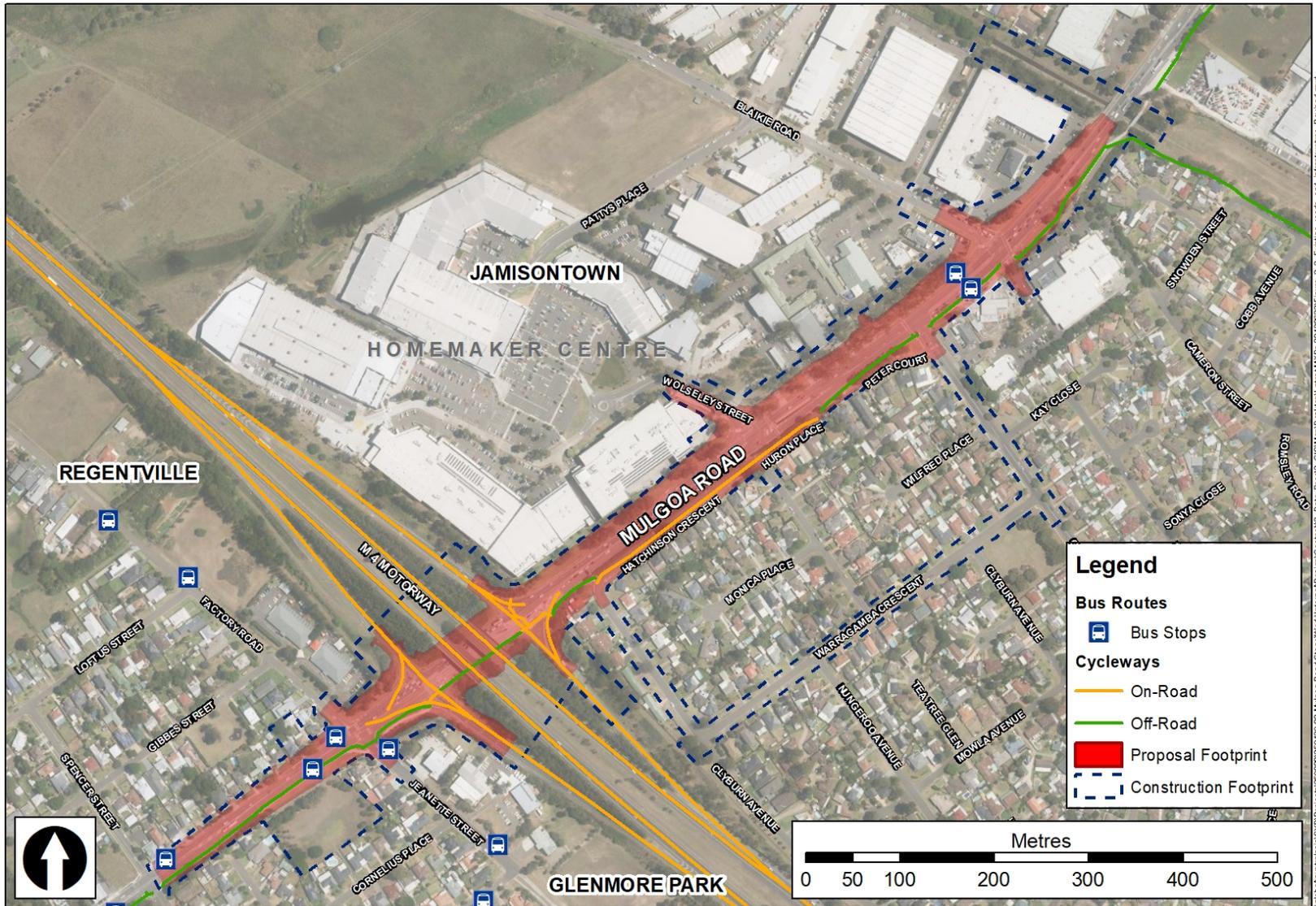
This section of Mulgoa Road is currently constrained and approaching capacity due to the limited number of lanes and the configuration of its key intersections. It also does not include adequate pedestrian or cyclist facilities throughout its length, and there is no provision for bus priority to help promote people using any of these alternative modes of transport. The key elements of the existing road network within and surrounding the proposal are summarised in Table 2-2 and shown in Figure 2-2 and Photo 2-1 to Photo 2-7. Section 6.1 provides more detail on the existing road infrastructure.

Table 2-2: Existing infrastructure

Key element	Description
Main roads	
Mulgoa Road	<ul style="list-style-type: none"> • About 1.3 kilometres long typically running north-south providing access between Penrith and the M4 Motorway • The corridor width varies along the proposal, comprising four lanes separated by a raised median and no shoulder. Footpath provision along the western side and a partial shared path along the eastern side. The road corridor includes sections of planted verge. • Flat with gradients not exceeding about 0.5 per cent. • Despite the 60 km/h posted speed limit average travel speeds in the morning and afternoon peak periods are between 20 km/h and 30 km/h • Two road bridges cross over Mulgoa Road (M4 Motorway) and Mulgoa Road bridges over Surveyors Creek. There is a single-lane underpass about 170 metres long, with about 75 metre of cover that provides dedicated southbound access from Mulgoa Road to Penrith Homemaker Centre • Up to 52,000 vehicles travel along this section of Mulgoa Road every day, of which, about 10 per cent are heavy vehicles • Connects with the National Freight Route.
M4 Motorway	<ul style="list-style-type: none"> • Urban motorway about 40 kilometres long connecting the Blue Mountains and Parramatta Road • Number of lanes in each direction varies between two and five with approval to install Smart Motorway technology (refer to section 3.2.3) • Posted speed limit along the motorway varies between 90 km/h and 110 km/h • Provides regional freight, recreational and commuter access between Sydney and the Blue Mountains • Up to 170,000 vehicles travel along the motorway every day, of which, about five per cent are heavy vehicles. • Forms part of the National Freight Route <p>Interchange with Mulgoa Road:</p> <ul style="list-style-type: none"> • Forms a diamond interchange with signalised intersections on the entry and exit ramps.
Other roads	
Factory Road	<ul style="list-style-type: none"> • Undivided two-lane road, one lane in each direction • Mainly provides east-west residential access between Regentville and Mulgoa Road. Also provides access to the Regentville Kids Academy. <p>Intersection with Mulgoa Road</p> <ul style="list-style-type: none"> • Un-signalised priority left-in/left-out T-intersection with Mulgoa Road.

Key element	Description
Jeanette Street	<ul style="list-style-type: none"> • Undivided two-lane road, one lane in each direction • Mainly provides east-west residential and commercial access between Regentville and Mulgoa Road. Also provides access to the Regentville Rural Fire Brigade and NSW Rural Fire Service on Jeanette Street • Emergency vehicle signage with flashing lights located on both the southbound and northbound approaches to Jeanette Street on Mulgoa Road to prioritise Fire and Rescue NSW access • Road line markings and static signage to prevent traffic queues on Mulgoa Road blocking the emergency services access to and from Jeanette Street <p>Intersection with Mulgoa Road</p> <ul style="list-style-type: none"> • Un-signalised priority left-in/left-out T-intersection with Mulgoa Road.
Wolseley Street	<ul style="list-style-type: none"> • Divided four-lane road, two lanes in each direction • Provides east-west access between Mulgoa Road and the Penrith Homemaker Centre • Mainly used by customers accessing the Penrith Homemaker Centre. <p>Intersection with Mulgoa Road:</p> <ul style="list-style-type: none"> • Forms a three-way at-grade signalised intersection with a grade-separated tunnel for southbound access from Mulgoa Road to Wolseley Street • Provides a northbound left-turn dedicated slip-lane on Mulgoa Road into Wolseley Street.
Hatchinson Crescent	<ul style="list-style-type: none"> • Undivided two-lane road, one lane in each direction • Provides residential access via Warragamba Crescent and Glenbrook Street • A pedestrian footpath is located on the eastern side of Hatchinson Crescent.
Huron Place, cul-de-sac	<ul style="list-style-type: none"> • One lane road (two-way traffic) • Provides residential access via Hatchinson Crescent • A pedestrian footpath is located on the eastern side of Huron Place • End of Huron Place connects with the shared path on the eastern side of Mulgoa Road.
Peter Court, cul-de-sac	<ul style="list-style-type: none"> • One lane road (two-way traffic) • Provides residential access via Glenbrook Street • Backs onto Huron Place, however there is no connecting vehicular access • Connecting shared path between Peter Court and Mulgoa Road.
Glenbrook Street	<ul style="list-style-type: none"> • Divided two-lane road, one lane in each direction • Provides east-west residential access between Jamisontown and Mulgoa Road • Left and right turn access to Peter Court from Glenbrook Street • Signalised pedestrian crossing at the intersection with Mulgoa Road. <p>Intersection with Mulgoa Road</p> <ul style="list-style-type: none"> • Signalised at-grade T-intersection with Mulgoa Road.

Key element	Description
Blaikie Road	<ul style="list-style-type: none"> • Undivided two-lane road, one lane in each direction • Provides access to commercial properties on the eastern and western side of the corridor in Jamisontown. <p>Intersection with Mulgoa Road</p> <ul style="list-style-type: none"> • Signalised at grade four-way intersection with Mulgoa Road that includes a southbound left slip lane to access commercial properties on Blaikie Road to the east and a southbound right turn to access Blaikie Road to the west.
Other key infrastructure	
Parking	<ul style="list-style-type: none"> • Time-restricted parking servicing the Penrith Homemaker Centre, Hungry Jacks, Pizza Hut and Toys'R'Us • Unmarked on-street parking provided on local roads in the area • No on-street parking provided on Mulgoa Road.
Active transport	<ul style="list-style-type: none"> • Active transport options currently available via a footpath on the western side of Mulgoa Road with signalised pedestrian crossings at key intersections • Shared cycle and pedestrian path, mainly off-road, on the eastern side of Mulgoa Road (See Figure 2-2).
Public transport	<ul style="list-style-type: none"> • Six bus routes use and stop along Mulgoa Road operated by Busways and the Blue Mountains Bus Company • Bus stops on both sides of the road in key locations.



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Source: Arup

Figure 2-2: Existing roads and infrastructure



Source: Arup 2018

Photo 2-1: Mulgoa Road facing east towards proposed compound location



Source: Arup 2018

Photo 2-2: Mulgoa Road facing north towards M4 Motorway overbridge (M4 westbound carriageway)



Source: Arup 2018

Photo 2-3: Mulgoa Road facing north towards Homemakers Centre to the west



Source: Arup 2018

Photo 2-4: Peter Court facing south towards Huron Place with shared path to the west



Source: Arup 2018

Photo 2-5: Mulgoa Road facing north towards grade separated tunnel access to Wolseley Street and Homemaker Centre



Source: Arup 2018

Photo 2-6: Mulgoa Road facing south towards M4 Motorway eastbound entry ramp



Source: Arup 2018

Photo 2-7: Mulgoa Road facing south towards M4 Motorway overbridge (eastbound carriageway)

Related projects

M4 Smart Motorway Project

In 2015, the NSW Government committed to installing intelligent ‘smart’ digital technology on the M4 Motorway between Pitt Street at Mays Hill and Russell Street at Lapstone. The project would see technology introduced to monitor traffic conditions, manage congestion and respond to incidents in real-time. Traffic signals and additional storage would be provided on both the westbound and eastbound entry ramps to the M4 Motorway interchange at Mulgoa Road.

Funding has been confirmed for providing additional storage by widening the exit ramps and this work is expected to be carried out in parallel with the Mulgoa Road upgrade. The installation of traffic signals and additional storage for the entry ramps at the M4 Motorway interchange would take place during the latter stages of the M4 Smart Motorway project, which currently do not have funding.

Jane Street/Mulgoa Road Infrastructure Upgrade

This project is being funded under the National Partnership Agreement on Land Transport Infrastructure Projects (refer to section 2.1.1). It involves widening Mulgoa Road and Castlereagh Road between Union Road and Museum Drive and upgrading the existing intersections at Jane Street/Mulgoa Road/Castlereagh Road and the Great Western Highway/Mulgoa Road/High Street. This project is located about 2.4 kilometres north of the limit of this proposal. It is planned to be operational by 2021.

2.3 Proposal objectives and development criteria

The following section describes the objectives and criteria that were adopted and used to develop options and select a preferred option. These objectives and criteria were selected, refined, tested, modified and updated to respond to each stage of the design process.

2.3.1 Proposal objectives

The objectives of developing the proposal included:

- Improving:
 - Amenity
 - Freight productivity
 - Road capacity to cater to population and employment growth
 - Road safety for all users
 - Goods and truck movements
 - Traffic efficiency
- Supporting:
 - Employment growth
 - Public transport use
 - Residential growth
- Encouraging active transport use
- Minimising environmental and community impacts.

2.3.2 Development criteria

Criteria were identified to develop the proposal to meet its objectives and used in the multi criteria analysis of options. The development criteria are described in Table 2-3.

Table 2-3: Development criteria

Criteria	Description
Travel efficiency	The performance of the option with reference to average travel speed, vehicle kilometres travelled, vehicle hours travelled, level of service.
Roads safety	The potential of the option to contribute to improved road safety or conversely any identified safety issues.
Environmental impacts	The potential impacts of the proposal on the environment having regard to biodiversity, waterways, heritage and other relevant aspects.
Utility impacts	The impact of the option on utilities and the extent of required relocation and/or protection.
Property impacts	The extent of property acquisition required for the option.
Future development and access	The ability of the option to accommodate access to future development.
Bus prioritisation	The ability of the option to accommodate bus prioritisation.
Alternative transport	The ability of the option to accommodate pedestrians and cyclists.
Design standards	The alignment of the option with contemporary design standards.
Urban design outcomes	The alignment of the option with the urban design objectives and principles set for the proposal.

2.3.3 Urban design objectives

The urban design objectives for the proposal were taken from Beyond the Pavement (2014a); the Roads and Maritime document setting out its urban design policy, requirements and principles.

The key urban design objectives for developing the proposal are summarised below:

- Reinforcing active transport potential along and across Mulgoa Road and providing a green link connecting open spaces
- Improving accessibility and connectivity
- Reinforcing this section of Mulgoa Road as the gateway to Penrith CBD through a strong green corridor
- Promoting, enhancing and framing views to distant significant landscapes and improving the aesthetic appeal of the corridor.

2.4 Alternatives and options considered

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

Development of the corridor

Following ministerial announcement to upgrade the Mulgoa Road/Castlereagh Road corridor in 2015, Roads and Maritime started investigating and developing several strategic corridor options. This process involved setting proposal and development objectives for upgrading the corridor, identifying potential options, and evaluating their relative value and benefits. A value management process was then used to compare more detailed section-specific widening options against development criteria set to help identify a preferred corridor option. These were based on the collection of site-specific information and input from key stakeholders. In April 2017, Roads and Maritime published its preferred option for widening the existing corridor between Glenmore Parkway, Glenmore Park and Andrews Road, Penrith.

Development of the upgrade of Mulgoa Road between Jeanette Street to Blaikie Road

Roads and Maritime then announced the prioritised Mulgoa Road upgrade between Jeanette Street and Blaikie Road due to the existing levels of congestion associated with the constrained operational performance of the M4 Motorway interchange.

2.4.1 Methodology for selection of preferred option

The selection of the preferred option involved six stages, each consisting of several steps as described below. The first two stages focused on selecting the preferred corridor option while the last four stages focussed on selecting the preferred proposal option. Table 2-4 lists the six stages, its purpose of each stage, and the method used for selecting the preferred option.

Table 2-4: Method for selecting the preferred option

Stage	Purpose	Methodology for selecting the preferred option
Corridor		
1	Develop and assess strategic corridor options.	Ability to meet the objectives and needs for developing the corridor

Stage	Purpose	Methodology for selecting the preferred option
2	Develop and confirm widening options within the corridor.	Multi-criteria analysis as informed through traffic modelling, preliminary environmental investigation, and findings from the following workshops: value management and options evaluation, risk management, constructability and health and safety in design.
Proposal		
3	Confirm the amount of capacity needed at the M4 Motorway interchange and Wolseley Street intersection.	Traffic modelling and analysis
4	Develop and assess options for the main intersections and service roads.	Ability to meet relevant objectives and needs for developing the proposal
5	Refine options for the shared transit and active transport provisions alongside the service roads.	Traffic modelling and analysis, and the ability to meet relevant objectives and needs for developing the proposal
6	Develop and assess options for the design of the intersections in the local area to supplement access and travel time improvements.	Traffic modelling and analysis and multi-criteria analysis.

2.4.2 Identified options

Table 2-5 lists the options that were identified and developed at each stage. Figures have been provided to assist with describing interchange and service road options where necessary.

Table 2-5: Identified options

Stage	Design element	Identified options
Whole corridor		
1	Strategic corridor options Six strategic options were identified to support meeting the objectives and needs of developing the corridor.	
	Whole corridor Glenmore Parkway to Andrews Road	<ul style="list-style-type: none"> • 1a: new road corridor • 1b: tidal flow along Mulgoa Road (see note 1) • 1c: widen both sides of Mulgoa Road • 1d: widen to the east along Mulgoa Road • 1e: widen to the west along Mulgoa Road • 1f: do-nothing
2	Widening options Mulgoa Road was divided into five sections to help define and analyse widening options. Two widening options were identified in each section; one to the west and one to the east. Following this stage, the corridor was divided into six priority areas which do not align with the initial five sections. As such, the proposal (Jeanette Street to Blaikie Road) spans former Sections A and B.	

Stage	Design element	Identified options
	Section A Glenmore Parkway to the M4 Motorway	<ul style="list-style-type: none"> • 2a: widen to the east • 2b: widen to the west
	Section B M4 Motorway to Preston Street	<ul style="list-style-type: none"> • 2c: widen to the east • 2d: widen to the west
	In addition to the 10 options, several design considerations were identified in each section. For section A and section B consideration was given to the arrangements and configuration of the Factory Road and Wolseley Street intersections and the M4 Motorway interchange. These were then developed into options under Stage 4.	
Proposal		
3	Capacity requirement options The following options were tested to confirm if the required lane configurations and lengths could be achieved to provide sufficient capacity for future traffic needs.	
	M4 Motorway	<ul style="list-style-type: none"> • 3a: provide three through-lanes southbound on Mulgoa Road • 3b: provide two through-lanes southbound on Mulgoa Road • 3c: provide three through-lanes northbound on Mulgoa Road • 3d: provide four lanes northbound on Mulgoa Road, including two through-lanes and two turning lanes
	Wolseley Street	<ul style="list-style-type: none"> • 3e: retain the tunnel access from Mulgoa Road to Wolseley Street • 3f: remove the tunnel access and provide signalised right-turn movements at the intersection •
4	Main intersection and service road options A total of 11 design and configuration options were considered at the four main intersections and two of the service roads running parallel to Mulgoa Road. Note: the preferred option for the Wolseley Road intersection was selected under Stage 3.	
	Factory Road (refer to Figure 2-3 for example of Factory Road arrangement)	<ul style="list-style-type: none"> • 4a: retain a left-in/left-out arrangement (do-nothing) • 4b: reduce access to a left-in arrangement • 4c: remove any access
	M4 Motorway (refer to Figure 2-4 for example of diverging diamond interchange)	<ul style="list-style-type: none"> • 4d: create a diverging diamond interchange (see note 2) • 4e: lengthen the M4 Motorway road bridges • 4f: reduce the embankment widths and install a retaining structure and widen outside of the piers

Stage	Design element	Identified options
	Huron Place and Peter Court (refer to Figure 2-5 for example of option 4h and <i>Source: Roads and Maritime</i> Figure 2-6 for an example of option 4i) <i>Source: Roads and Maritime</i>	<ul style="list-style-type: none"> 4g: remove the service roads, provide direct access onto Mulgoa Road, and do not include any active transport provisions 4h: retain the service roads and provide a separate footpath and cycleway 4i: create a shared zone for cyclists and cars to use and a separate footpath for pedestrians
	Blaikie Road (refer to <i>Source: Arup</i> Figure 2-7 for example of option 4j) <i>Source: Arup</i>	<ul style="list-style-type: none"> 4j: restricted bus-only access into Blaikie Road 4k: retain the ability for all traffic to turn left into Blaikie Road (do-nothing)
5	<p>Refined shared transit and active transport provision options</p> <p>Following further consultation with Penrith City Council and other stakeholders, Roads and Maritime identified eight more-specific active transport options for the service roads considered under Stage 4, but also including Hutchinson Crescent. Under all but one option (5e) the three roads would be connected.</p>	
	Huron Place, Peter Court and Hutchinson Crescent	<ul style="list-style-type: none"> 5a: two-way traffic flow and a shared use path on the eastern side 5b: one-way traffic flow and a shared use path on the eastern side 5c: two-way shared transit zone for use by cyclists and vehicles, passing restrictions and footpath 5d: consistent with 5b plus introduced speed restrictions 5e: retain the separate roads but include a connected shared use path on the eastern side 5f: consistent with 5c however include a rolled kerb to separate the shared transit zone and footpath 5g: consistent with 5c and 5f however including a narrower shared transit zone 5h: consistent with 5c, 5f and 5g however there would be no footpath and the shared transit zone would also be used by pedestrians
6	<p>Local access improvement options</p> <p>Following further consultation with Penrith City Council and other stakeholders, Roads and Maritime identified nine options for changes to secondary intersections in the local area to complement/supplement the options considered under Stage 4.</p>	
	Spencer Street/Gibb Street	<ul style="list-style-type: none"> 6a: install a roundabout in combination with 4a 6b: retain the give-way provisions in combination with 4c 6c: install a roundabout in combination with 4c 6d: retain the give-way provisions in combination with 4b 6e: install a roundabout in combination with 4b
	Pattys Place/Blaikie Road	<ul style="list-style-type: none"> 6f: retain the existing give-way arrangement (do-nothing) 6g: install a roundabout

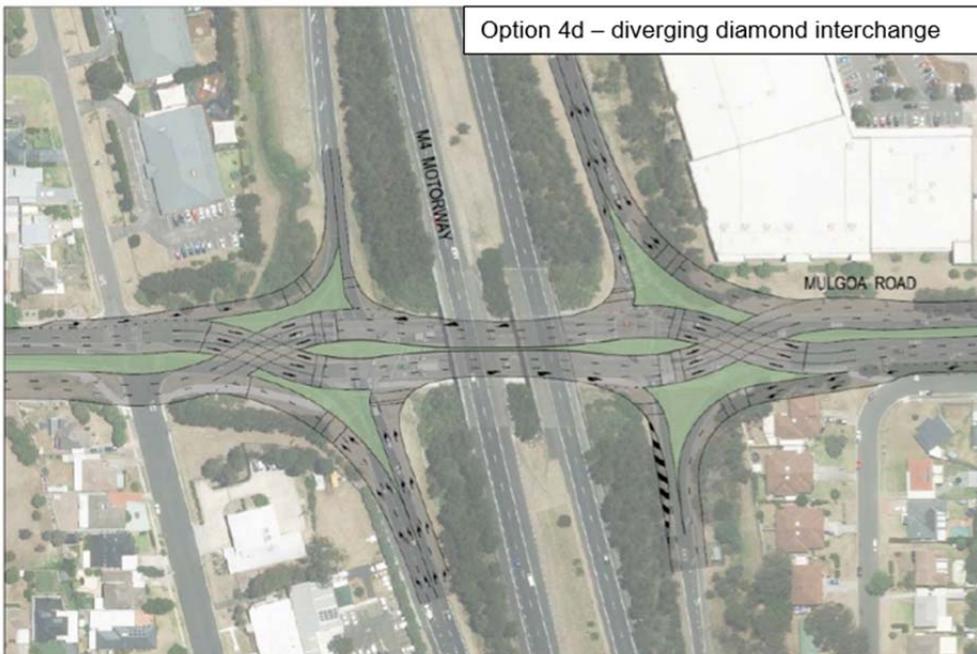
Stage	Design element	Identified options
	Glenbrook Street/ Warragamba Crescent	<ul style="list-style-type: none"> 6h: retain the existing give-way arrangement (do-nothing) 6i: install a roundabout

- (1) A tidal flow involves altering the direction of travel on central traffic lanes during peak periods
(2) The diamond arrangement reduces conflict points, provides better stopping sight distances and allows the phasing of the traffic signals to be simplified.



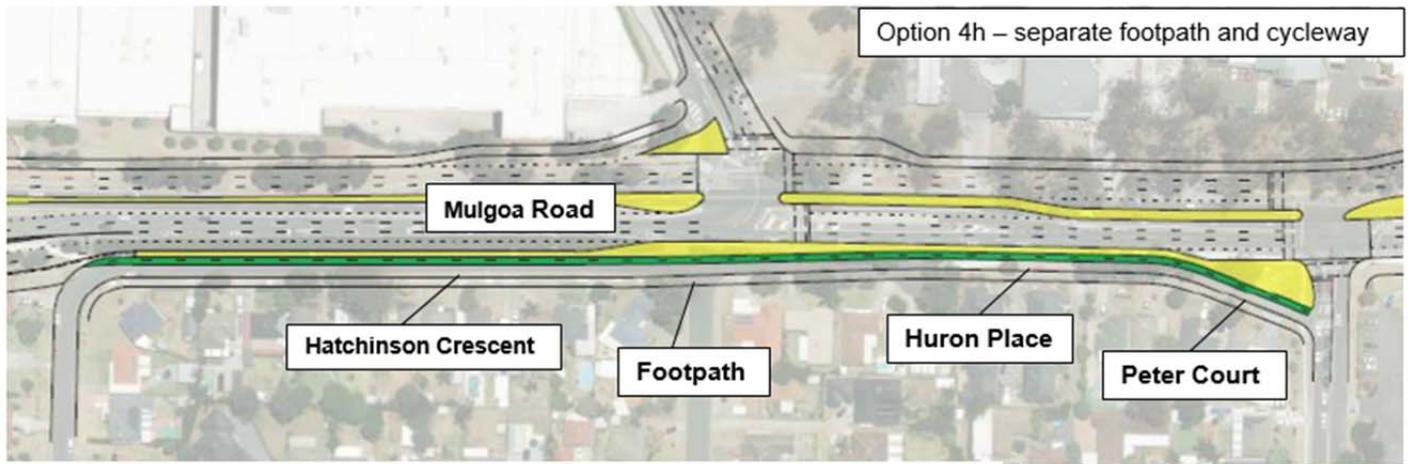
Source: Arup

Figure 2-3 Factory Road option 4a and option 4b



Source: Roads and Maritime

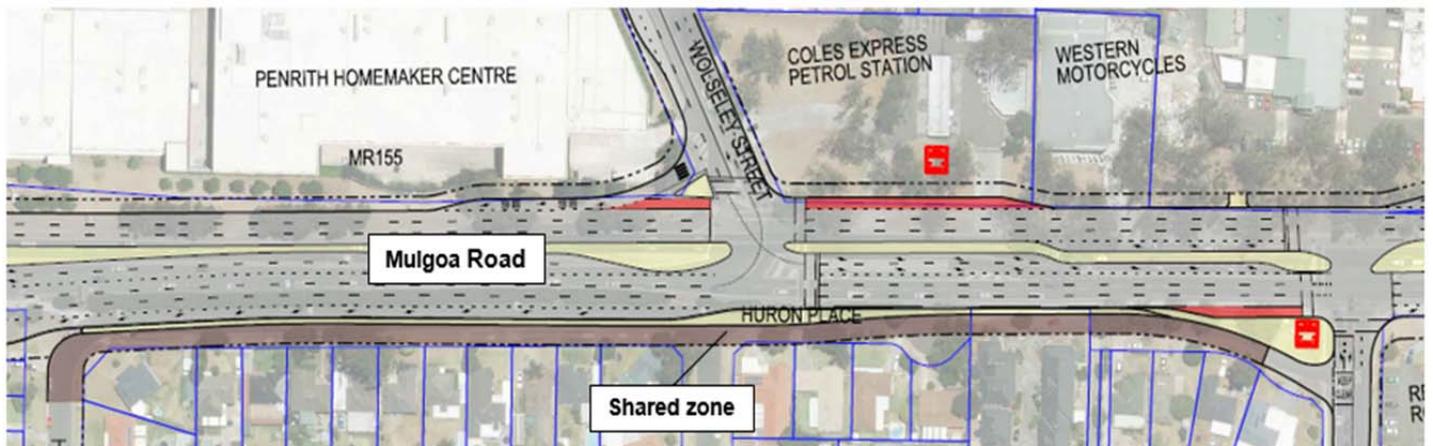
Figure 2-4 M4 Motorway option 4d



*Note: Green is shared path and yellow is median

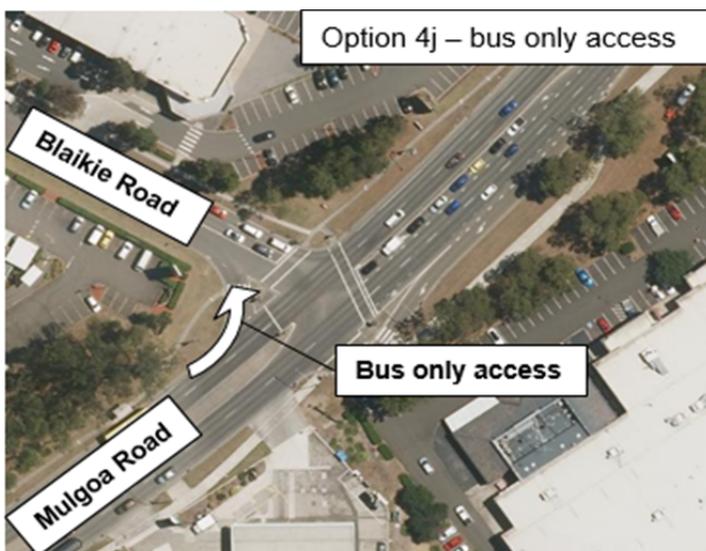
Source: Roads and Maritime

Figure 2-5 Huron Place and Peter Court option 4h



Source: Roads and Maritime

Figure 2-6 Huron Place and Peter Court option 4i



Source: Arup

Figure 2-7 Blaikie Road option 4j

2.4.3 Analysis of options

This section details the investigations and analysis carried out to choose, evaluate, compare and select the preferred option. It also discusses how each of the options satisfies (or otherwise) the need for the proposal, relevant objectives and development criteria.

Stage 1: strategic corridor options

The performance of each of the strategic corridor options was considered against the corresponding objectives described in section 2.3. Table 2-6 summarises the key advantages and disadvantages of each option.

Table 2-6: Analysis of the strategic corridor options

Option	Advantage	Disadvantage
1a: new road corridor	<ul style="list-style-type: none"> • Provides opportunity to increase capacity into the future beyond 40-years • Makes it easier for a new road to be designed to current standards over the challenges and constraints of upgrading an existing road • Provides an easier means to design the road with active and public transport provisions catered for throughout. 	<ul style="list-style-type: none"> • Cost-prohibitive and unnecessarily expensive to providing the needed capacity • Considerable property acquisition and expense • Has the greatest environmental, amenity and community impact • Would draw people away from the area and it may therefore not support employment and residential growth.
1b: tidal flow	<p>Minimises environmental, amenity and community impacts as the changes can be made within the existing corridor with limited widening.</p>	<ul style="list-style-type: none"> • Does not sufficient increase capacity as the volume of traffic in each direction during the peak periods is roughly balanced with little spare capacity to introduce tidal flows. As such, it would disadvantage traffic flow in the non-prioritised traffic direction • Does not support employment and residential growth as it would affect local access to the adjacent commercial properties by preventing right-turn movements across the tidal flow lanes • Introduces pinch-points and congestion at each end of the tidal flow • Introduces visual impacts through needing to install additional signage and gantries to operate the tidal-flow lane(s).

Option	Advantage	Disadvantage
1c: widening on both sides	<ul style="list-style-type: none"> • Consistent and comparable amongst the three options of providing a cost-effective solution of increasing capacity to service future population and employment growth (as confirmed through traffic modelling) • Ability and space to include the needed level of public and active transport provisions and road safety improvements • Does not compromise the movement of goods and trucks and therefore supports freight productivity. 	<ul style="list-style-type: none"> • Road widening would involve property acquisition, and bringing the road and traffic closer to residents, businesses and other sensitive land uses in the area • Involves vegetation and tree removal to widen the road which would have an amenity impact • Causes disruption and amenity impacts during construction, plus additional amenity impacts once the road is upgraded • Less opportunity to include effective continuous active and public transport provisions along the corridor due to narrow corridor near Hutchinson Crescent, Huron Place and Peter Court.
1d: widening to the east		
1e: widening to the west		
1f: do-nothing	<ul style="list-style-type: none"> • No capital expenditure • Removes environmental and community impacts during construction. 	<ul style="list-style-type: none"> • Road capacity is not provided to cater for population and employment growth • Does not promote public transport use • Does not improve traffic efficiency through reducing congestion and improving travel times • Does not support the movement of goods and trucks or improve freight productivity • Results in longer-term community and environmental impacts through increased congestion and stationary traffic on Mulgoa Road.

In summary, the do-nothing option (option 1f) was not taken forward as it would not meet the objectives or need for developing the corridor. It would only be preferred on cost grounds and avoiding construction-related environmental and community impacts. Equally, building a new alignment in a new corridor (option 1a) would be prohibitively and unnecessarily expensive as it would involve significant property acquisition and may not adequately reduce congestion to provide additional capacity along the existing road corridor to service future needs. The provision of tidal flow lanes (option 1c) is generally only considered as a last option as it presents safety concerns and design constraint issues by preventing right-turn movements across the tidal flow lanes. It would also be challenging in this location due to the need to reconfigure and redesign the intersections.

The do nothing, new corridor and tidal flow options (option 1f, option 1a and option 1c) discussed above fail to meet the objectives and criteria of the corridor and they were not carried forward. The three widening options (option 1c, option 1d and option 1e) were taken forward and developed at Stage 2 as they provide equal benefit against the objectives and need for developing the corridor and proposal, while having comparable constraints and disadvantages.

Stage 2: widening options

A value management workshop was held in October 2015 to evaluate the relative value of each option against the development criteria using a process of multi-criteria analysis discussed in section 2.3 . The workshop was attended by various specialists and stakeholders, each of whom brought experience in terms of engineering and urban design, property acquisition, community and stakeholder representation, and environmental management.

Table 2-7 summarises the differences in the evaluation of each of the four widening options relevant to the proposal footprint which covers part of corridor section A and section B (option 2a to option 2d). The evaluation compares the relative combined advantage and disadvantage of the two western and two eastern options. The table only shows where there is difference between the options.

Table 2-7: Comparison of the widening options associated with the proposal footprint

Development objective	Option 2a and Option 2c Widening to the east	Option 2b and Option 2d Widening to the west
Environmental impact	Strip acquisition along the frontage of the Council-owned reserve at 111 Mulgoa Road.	Loss of mature trees (Forest Red Gum vegetation).
Utility impact	Impacts on gas mains, telecommunications, overhead power lines and a waste water sewer (along the length of the corridor).	Impacts on telecommunications, overhead power lines and water main (along the length of the corridor).
Property impact	Full acquisition: 15 properties Partial acquisition: 2 properties	Full acquisition: 9 properties Partial acquisition: 5 properties
Future development and access	Removes service road access along Hutchinson Crescent, Huron Place and Peter Court.	Retains service road access along Hutchinson Crescent, Huron Place and Peter Court.

The participants at the workshop collectively agreed that there was no outright benefit from just widening on one side of the road. As such, the conclusion was to widen on both sides, as this would reduce the overall property acquisition, while also retaining the service road access to Hutchinson Crescent, Huron Place and Peter Court.

In terms of road safety, bus prioritisation, the inclusion of active transport provisions, the ability to promote a contemporary design, and the ability to provide an effective urban design outcome, all four options were of equal advantage and disadvantage. All four options were equally constrained by the design of the M4 Motorway as this would affect traffic performance.



Southern section

Source: Roads and Maritime (2017)

Figure 2-8 Impacts of widening (east vs west)



— Option 1 - Widening East
 — Option 2 - Widening West



Northern section

Source: Roads and Maritime (2017)

Figure 2-9 Impacts of widening (east vs west)

Stage 3: capacity requirement options

Before developing options for the main intersections, traffic analysis was used to determine what lane configurations and lengths would be needed at the most constrained points within the proposal footprint to provide additional capacity to cater for future population and employment growth. The result of the modelling confirmed:

- The need for three through-lanes southbound on Mulgoa Road to provide additional capacity to service future traffic needs, making option 3a the preferred option
- That providing four traffic lanes northbound on Mulgoa Road would over-service and over capitalise the road design, making option 3c the preferred option
- That removing the tunnel at Wolseley Street and replacing it with right-turn lanes at the intersection would provide an adequate level of service in the future for traffic while removing the safety issues associated with the tunnel, making option 3f the preferred option.

Stage 4: main intersections and service road options

The performance of each of the proposed options for the main intersections and service roads was considered against one or more of the proposal objectives described in section 2.3.

The priority for selecting the preferred option in each location was based on:

- A desired safety outcome at Factory Road, where only allowing left-in access would reduce the risk of road traffic accidents while maintaining some access making option 4b the preferred option. It was also concluded that motorists could still re-join Mulgoa Road via Spencer Street with little inconvenience.
- Capacity requirements at the M4 Motorway interchange, where providing a diverging diamond interchange was tested and would not improve traffic capacity compared with the other options considered. Of the two other options, it was concluded that there would be sufficient room to create three lanes each way on Mulgoa Road without the inconvenience, impact and expense of lengthening the road bridges. As such, this made option 4f the preferred option.
- Local access, safety and active transport requirements along Huron Place and Peter Court, where removing the service roads would affect and inconvenience residents. It would also present a safety issue for residents having to directly access Mulgoa Road. This option is also inconsistent with the objective of improving active transport. Providing a separate active transport corridor alongside the existing service roads would require additional property acquisition and it would have a greater impact on residents. Alternatively, to minimise property acquisition, the service roads would need to be narrowed and converted to a one-way traffic flow, which would also inconvenience residents. Also, there would be safety issues due to the conflict between turning vehicles entering and leaving adjacent properties, and the cyclists. Therefore, the ability to provide a shared transit zone offers the compromise of retaining local access, providing activity transport continuity along the corridor, and removing the conflicts between residents and cyclists. As such, option 4i was the preferred option
- A desired safety outcome and access considerations at Wolseley Street, where removing the tunnel from the middle of Mulgoa Road and providing a safer solution through dual right turn lanes to Wolseley Street. Decommissioning the tunnel would also remove the need and cost of maintaining the aging tunnel, and reduce property impacts, as retaining the tunnel would see the need to acquire property along Peter Court to provide a supporting service and access area. As such, option 4j is the preferred option.
- Local access requirements at Blaikie Road, whereby restricting left-turn access into Blaikie Road to buses-only would remove the only vehicle entry point into the customer car park for BCF, Barbeques Galore, Rashays Restaurant and Toys 'R' Us. As such, retaining the left turn identified in option 4k is the preferred option.

Stage 5: refined shared transit and active transport provision options

A technical note was prepared to analyse the refined options for the shared transit and active transport provisions alongside Huron Place and Peter Court. The principal aim of this analysis was to develop options that included more specific detail about the provisions along the service roads, and to test their performance against relevant proposal objectives.

The analysis also introduced measures to compare pedestrian and cyclists comfort and the level of property access of each option, consistent with the proposal objectives of encouraging active transport use, and delivering traffic efficiency. The analysis also considered the safety of each option, in terms of points of conflict between pedestrians, cyclists and vehicles, and the property acquisition needed to build each option.

While Stage 4 identified and justified the selection of a shared transit zone and separate footpath as being preferred (option 4i) at Stage 5 this was refined, with four more detailed shared transit zone options being identified. The performance of these options was analysed against four other options that reconsidered the potential and benefit of including a separate shared use path. As noted above, all options (except option 5e) included the proposal to join Hutchinson Crescent, Huron Place and Peter Court.

Table 2-8 shows the relative performance of each option against the adopted analysis criteria. A simple traffic light system is used to show where the option performs well against the criteria (green), partially performs against the criteria (amber), or does perform against the criteria (red).

Table 2-8: Active transport corridor options comparison

Stage	5a	5b	5c	5d	5e	5f	5g	5h
<i>Proposal objective: encouraging active transport use</i>								
<i>Development objective: support and accommodate pedestrians and cyclists</i>								
Pedestrian comfort level	●	●	●	●	●	●	●	●
Cycle comfort	●	●	●	●	●	●	●	●
<i>Proposal objective: travel efficiency</i>								
Property access (travel times)	●	●	●	●	●	●	●	●
<i>Proposal objective: road safety by reducing fatalities and serious injuries</i>								
<i>Development objective: making a positive contribution to road safety</i>								
Road safety	●	●	●	●	●	●	●	●
<i>Development objective: minimise the extent of property impacts</i>								
Property acquisition	●	●	●	●	●	●	●	●

As shown in Table 2-8 option 5f and option 5g performed best of the analysed options and would best support the objectives for encouraging active transport use, and were also supported by Penrith City Council. Option 5g was selected as the preferred option as the narrower shared transit zone would reduce the amount of property acquisitions while still maintaining an acceptable road width.

Stage 6: local access improvement options

The local access improvements covered under Stage 6 were investigated further using traffic modelling and analysis to consider if each option would result in a substantial improvement in network performance, journey travel times, and safety compared to the base case of doing nothing.

In all cases, the modelling and analysis concluded that there would be no appreciable improvement in network performance, travel times or safety (in terms of road user conflict or accident risks) either on Mulgoa Road or in the local area from modifying these three intersections. As such, the preferred option in each case was to do-nothing (eg option 6d, option 6f and option 6h). Roads and Maritime would continue to consult with Council to discuss access provisions in developing the detailed design.

2.4.4 Summary

Table 2-9 summarises the preferred option selected at each stage and the key reasons for this.

Table 2-9: Summary of the selected preferred option

Stage	Preferred option	Option reference	Key reason(s)
Stage 1 Strategic corridor options	Widening Mulgoa Road	Option 1c, 1d and 1e all being equally preferred	Provides the needed increase in capacity, access, public transport and active transport provisions in a cost-effective manner. While it would involve property acquisition and vegetation removal this would be less than building a new corridor.
Stage 2 Widening options	Widening on both sides between Jeanette Street and Blaikie Road	Composition of option 2a to 2d	As there was no clear benefit from widening on one side of the road throughout the proposal footprint the option to widen on both sides of the road was selected to reduce property acquisition and vegetation loss, while keeping the local services roads (Huron Place and Peter Court).
Stage 3 Capacity requirements	Providing three through-lanes in each direction on Mulgoa Road under the M4 Motorway	Option 3a and 3c	To provide the needed increase in capacity on Mulgoa Road to service future traffic needs three through-lanes would be needed in each direction under the M4 Motorway bridges.
	Removing the tunnel at the Wolseley Street intersection	Option 3f	The Wolseley Road intersection could continue to performance and service traffic in the future despite removing the tunnel and providing access at the intersection instead.
Stage 4 Main intersections and service roads	Providing left-in only access at the Factory Road intersection	Option 4b	Removing the left-out access at Factory Road would deliver a road safety benefit without compromising local access and travel times as traffic could still re-join Mulgoa Road via Spencer Street.
	Reducing the embankment widths under the M4 Motorway bridge and using retaining structures to create space for three through-lanes in each direction.	Option 4f	The three through-lanes could be most cost-effectively built by reducing the size of the supporting embankments and widening on the outside of the piers.

Stage	Preferred option	Option reference	Key reason(s)
	Creating a shared transit zone for use by cyclists and vehicles and building a separate footpath alongside Huron Place and Peter Court	Option 4i	Of the available options providing a separate shared use path would either require additional property acquisition or reduction the function and use of the service roads for residents. Having a shared transit space for vehicles and cyclists and a separate footpath offers a safe balance and compromise.
	Continuing to allow left-turn vehicle access into Blaikie Road (ie do-nothing)	Option 4k	Restricting vehicles entering Blaikie Road from Mulgoa Road would remove the only access to customer parking for several retail stores.
Stage 5 Refinement of the shared transport and active transport provisions	Providing a reduced width two-way shared transit zone and separate footpath with a rolled kerb and reducing the speed limit to 40km/h.	Option 5g	Would best support the objectives for encouraging active transport and could be built in a narrower corridor which would reduce the amount of property acquisitions.
Stage 6 Local access improvements	Retaining the existing intersection arrangements at Spencer Street/Gibb Street, Pattys Place/Blaikie Road, and Glenbrook Street/Warragamba Crescent (ie do-nothing)	Option 6d, 6f and 6h	There would be no demonstrated network performance, travel time or safety benefit from changing any of these intersections to address changes to local access.

2.5 Preferred option

As summarised in Table 2-9, the overall preferred option was to widen on both sides of Mulgoa Road between Jeanette Street to Blaikie Road. The other aspects of the preferred option were to:

- Widen the road from two-to-three lanes in each direction
- Create three through-lanes in each direction on Mulgoa Road at the M4 Motorway interchange by reducing the width of the supporting embankments, installing retaining structures, and widening on the outside of each bridge pier
- Remove the tunnel at the Wolseley Road intersection and provide two right-turn lanes at the intersection
- Modify the Factory Road intersection to only allow left-in access from Mulgoa Road
- Connect Hutchinson Crescent, Huron Place and Peter Court to provide a shared transit zone for vehicles and cyclists and a separate footpath for pedestrians.
- The preferred option would also involve not making any access changes at the Blaikie Road, Spencer Street/Gibb Street, Pattys Place/Blaikie Road, and Glenbrook Street/Warragamba Crescent intersections.

This preferred option achieves the objectives and needs for developing the corridor and proposal to provide the needed increase in capacity to support future employment and population growth in the area. It also allows public transport priorities to be set at the intersections, and it includes a solution that includes connected safe active transport provisions throughout.

2.6 Design refinements

The preferred option was further refined in the concept design to:

- Alter the access arrangements at Peter Court by making Peter Court left-in only access. The right-hand turn to Peter Court from Glenbrook Street and the left-out from Peter Court would be removed
- Include soil-nail shotcrete retaining structures to support the reduced embankments widths under M4 Motorway bridges as this would be an easy and cost-effective design solution that would minimise road traffic disruption
- Retain trees within the construction footprint where possible by incorporating tree protection zones.

3. Description of the proposal

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

3.1 The proposal

The proposal involves widening a 1.3-kilometre section of Mulgoa Road between Jeanette Street and Blaikie Road from four lanes to six lanes. Figure 1-3 shows the proposal.

Key features of the proposal would include:

- Upgrading 1.3-kilometres of existing road from two lanes to three lanes in each direction
- Extending the southbound left and right-turn slip lanes entering the M4 Motorway
- Interfacing with the M4 Smart Motorway project by providing an upgrade to the exit ramps
- Reducing the widths of the embankments supporting the M4 Motorway road bridges and installing retaining structures to create space for through-lanes on the outside of the piers
- Removing the tunnel access to the Penrith Homemakers Centre at Wolseley Street by providing dual right-turn lanes
- Making adjustments to lane widths and turning alignments at the Wolseley Street, Factory Road/Jeanette Street, Glenbrook Street, and Blaikie Road intersections
- Relocating the existing footpath along the western side of Mulgoa Road to widen the road
- Providing an active transport corridor along the eastern side of Mulgoa Road, including a 3.5-metre-wide shared use pedestrian and cyclist path
- Connecting Hutchinson Crescent, Huron Place and Peter Court to create a shared transit zone for vehicles and cyclists and providing an adjacent footpath
- Providing bus-priority measures at the Blaikie Road, Glenbrook Street, and Wolseley Street intersections in the form of bus queue jump lanes.

Other features of the proposal would include:

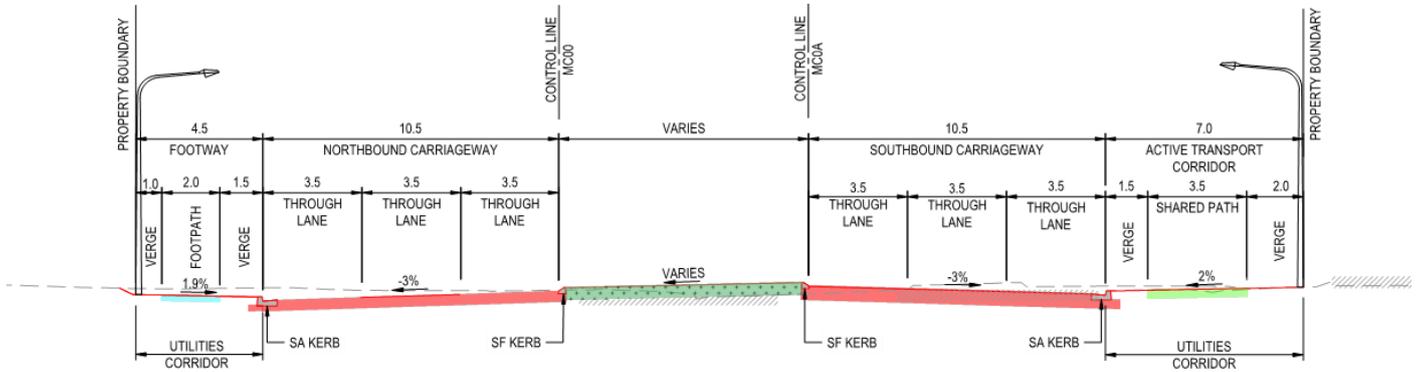
- Making drainage improvements to handle an increase in road runoff volumes and rates
- Installing an estimated 4.5 metre-high and 600-metre-long noise wall between Glenbrook Street and the M4 Motorway interchange along the eastern side of Mulgoa Road
- Diverting and adjusting the location of existing utilities and installing new utilities
- Introducing roadside amenity through tree planting to replace some of the canopy lost due to the road widening, landscaping and urban design provisions.

The proposal's engineered and urban design is consistent with the strategies developed for the wider Mulgoa Road/Castlereagh Road Corridor Upgrade. It also allows for Smart Motorway technology to be installed on the entry ramps to the M4 Motorway interchange in the future.

Roads and Maritime would need to acquire property alongside Mulgoa Road to accommodate the proposal footprint, while it would need to temporarily lease the Council-owned reserve at 111 Mulgoa Road to site the main construction compound (ancillary facility). This land is currently used as public open space.

3.2 Design

The design is described below. It would be further refined as result of ongoing design investigation and consideration of the environmental safeguards described in chapter 6. Figure 3-1 shows a typical cross section of Mulgoa Road once upgraded. Figure 3-2 shows a typical cross section of Mulgoa Road at the M4 once upgraded. Figure 3-3 shows a cross section of Mulgoa Road and Hutchinson Crescent once upgraded.



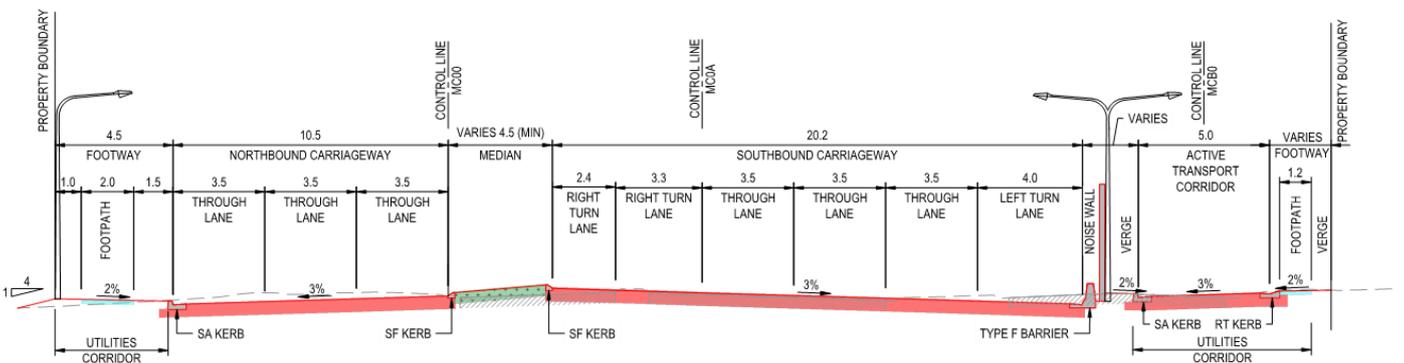
Source: Arup

Figure 3-1: Typical cross section of Mulgoa Road once upgraded



Source: Arup

Figure 3-2: Typical cross section of Mulgoa Road under M4 once upgraded



Source: Arup

Figure 3-3: Typical cross section of Mulgoa Road at Hutchinson Crescent once upgraded

3.2.1 Design criteria

The proposal has been designed to NSW and Australian engineering, road safety, environmental and transport planning standards developed by Roads and Maritime, Austroads and Standards Australia. These standards describe the criteria that should be adopted for specific road classifications and conditions. The criteria have been developed to ensure all roads are designed to be safe, effective, well-planned and easily maintained. Table 3-1 includes the design criteria adopted for the proposal’s design.

Table 3-1: Design criteria

Criteria	Typical specifications
Speed limits	<ul style="list-style-type: none"> Design speed limit: 70 km/h Posted speed limit: 60 km/h
Cross section (refer to Figure 3.2)	<ul style="list-style-type: none"> Lane width: 3.5 metres reducing to 3.3 metres at right-turn lanes Carriageway width: various Centreline/median width: 4.5 metres Active transport: western footpath, 2 metres, eastern shared use path, 3.5 metres Slopes of the cut batters: up to 1-in-4 along the western side, excluded on the eastern side
Stopping sight distance	83 metres to allow for a reaction time of 1.5 seconds at the 70 km/h design speed
Road surface type	Combination of rigid and flexible pavement surface (see note 1)
Design vehicle	<ul style="list-style-type: none"> Service vehicles up to 8.8 metres: Factory Road and Jeanette Street Trucks and buses up to 12.5 metres: Glenbrook Street and Blaikie Road (east) Semi-trailers up to 19 metres: Wolseley Street and Blaikie Road (west) B-double trucks up to 26 metres: Mulgoa Road (main alignment)
Grade	Up to 3 per cent on the road pavement surface
Clearance	Overhead structures (ie bridges): at least 5.3 metres clear of Mulgoa Road
Drainage	Refer to section 3.2.3.

(1) Flexible pavements are easy to maintain and are generally used except at the M4 Motorway interchange and the bus bays. Rigid pavements are used at the M4 Motorway interchange to replace the existing rigid pavement. Rigid pavement is also used at the bus bays to provide more durability.

3.2.2 Engineering constraints

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

Table 3-2: Engineering and development constraints

Constraint	Design provision
<i>M4 Motorway</i> : the limited space under the motorway overbridges and the need to work in a live traffic environment.	Installing a retained structure type, in the form of a soil nail wall, that can be constructed under live traffic conditions and provides the ability to widen the road to three lanes in each direction (refer to section 3.2.3).
<i>Existing utilities</i> : the presence of multiple existing utilities and services alongside and under Mulgoa Road and the intersecting road (refer to section 3.5).	Utilities would be relocated outside of the widening works corridor into new utility corridors (as shown on the footprint in Figure 3-9). Existing utilities have been identified, and discussion held with the service providers, to protect the assets while ensuring they can be accessed for scheduled maintenance and in an emergency during construction.
<i>Operational traffic</i> : the need to maintain access and operation of Mulgoa Road during construction.	Constructing most of the work offline and working under a traffic management plan that recognises the requirements for maintaining adjacent access, including emergency access, and traffic flow during peak periods.
<i>Limited space</i> : alongside Mulgoa Road to widen the road.	Maximising the space in the design, reducing the amount of property acquisition, and preserving the local amenity where feasible.

3.2.3 Major design features

This section describes the proposal's major design features.

Roadway

The road corridor would be widened to create three lanes in each direction and the number of turning lanes would be increased at key intersections (refer to the following section). A median, footways, footpath and shared use/transit zone would be provided along the carriageway. The horizontal alignment has been designed to provide an increase in capacity to deal with the predicted future traffic growth in the area, while also accommodating buses, trucks and semi-trailers. The vertical alignment would be largely unchanged due to the flat topography of the local area. This includes ensuring sufficient clearance for trucks, buses and other high-sided vehicles given the road's designation as a freight route (refer to section 6.1).

The proposal would tie into the existing sections of Mulgoa Road south of Jeanette Street and north of Blaikie Road.

Intersections

Table 3-3 describes how the arrangement of the seven intersections and accesses within the footprint would be altered under the proposal. Figure 3-4 shows a sequence of indicative illustrations showing the changes at these key intersections. Figure 3-5 shows an indicative illustration of the changes to the access arrangement at Glenbrook Street and Peter Court.

Table 3-3: Key intersections and areas

Intersection	Side	Proposed arrangement
Factory Road	West	Introduction of left-in only access to improve safety while maintaining left-out access via Gibbs Street and Spencer Street. Minor increases in travel time as discussed in section 6.1.
Jeanette Street	East	Introduction of a priority right-turn out of Jeanette Street and through access out to Factory Road for emergency vehicles via warning lights. 'Keep clear' road markings on Mulgoa Road would be retained.
M4 Motorway	East/West	Extension of both the southbound left-turn lane from Mulgoa Road to the M4 Motorway and the right-turn lanes from Mulgoa Road to cater for additional traffic growth and to support the future installation of additional storage for the M4 Motorway Smart Motorway project.
Wolseley Street	West	Removal of the dedicated southbound right-turn underpass (tunnel) and its replacement with dual right-turn lanes and a fully signalised intersection.
Glenbrook Street	East	Modification of the intersection to provide storage capacity at the intersection and to allow access to the shared transit zone at Hutchinson Crescent.
Blaikie Road	West	Extension of the northbound slip lane on the approach to Blaikie Road.
Hatchinson Crescent, Huron Place and Peter Court	East	Introduction of left-in only access from Glenbrook Street to improve safety. Removal of the right-turn exit from Peter Court onto Glenbrook Street.



Proposed changes at Factory Road



Proposed changes at the M4 Motorway interchange



Proposed changes at Wolseley Street



Proposed changes at Blaikie Road

Source: Roads and Maritime

Figure 3-4: Changes to key intersections



Source: Arup

Figure 3-5: Changes to Hatchinson Crescent, Huron Place and Peter Court

M4 Motorway interchange

The existing embankments supporting the M4 Motorway road bridges would be partially excavated to provide space for additional traffic lanes, the footpath and shared use zone on the outside of the bridge piers. A soil nail wall would be used to retain the excavated embankments.

Active transport and shared zones

Footpaths and cycleways

The existing footpath on the western side of Mulgoa Road would be relocated farther to the west to allow the road to be upgraded. It would continue to be separated from the kerb. Landscape planting would be provided between the traffic lanes and footpath.

A shared use path would be built along most of the eastern side of Mulgoa Road. This would comprise a widened paved area with line markings to designate areas for use by cyclists and pedestrians. The exception would be around Hatchinson Crescent, Huron Place and Peter Court. All three roads run alongside and parallel with Mulgoa Road, and provide local access for residents in these streets (refer to Table 2-2).

Shared transit zone

As noted in section 2.4.3, as Hutchinson Crescent, Huron Place and Peter Court run parallel to Mulgoa Road, there would be insufficient space to provide a full-width shared use path in this section while maintaining local vehicle access for residents. The proposed solution is to create a shared transit zone that would involve:

- Joining Hutchinson Crescent, Huron Place and Peter Court to create a continuous 430-metre-long road next to the southbound carriageway along Mulgoa Road
- Installing line markings, signage and other traffic calming measures to create a shared two-way transit zone for use by cyclists and vehicles
- Removing the right-turn entry from Glenbrook Street to Peter Court by installing a raised median
- Removing the right-turn exit from Peter Court to Glenbrook Street by providing a turning head for vehicles to manoeuvre back down and along Warragamba Crescent to access Glenbrook Street.

Local access

Access to all residential and commercial driveways along Mulgoa Road would be maintained; however, minor grade adjustments may be needed to tie into the final road levels and there may be modifications to some residential and commercial property accesses directly onto Mulgoa Road, which will be confirmed during detailed design. There may be the potential for vehicle circulation issues for the BP service station on the corner of Mulgoa Road and Blaikie Road due to the strip acquisition of this property (refer to Table 3-10), however changes to access have not yet been finalised.

Bus stops and bus priority measures

Bus stops

All six bus stops within the proposal footprint would need relocating to:

- Support the bus priority facilities
- Service 19-metre-long articulated buses along Mulgoa Road.

The street furniture, signage and other facilities to be provided at each bus stop would be discussed with Council and finalised as part of the detailed design.

Bus priority measures

Bus priority measures would be provided at the following intersections:

- Wolseley Street, northbound
- Glenbrook Street, southbound
- Blaikie Road, northbound.

The measures would include bus-priority lanes to tie-in with the existing or relocated bus stops on the departure lanes of the above intersections. This would prioritise buses at these signalised intersections to encourage more people to use public transport due to the intended improved journey reliability these measures provide.

Drainage

An average recurrence interval (ARI) of 1-in-10 years has been adopted for the design of pavement water drainage.

The drainage strategy is for the surface water to drain via pits and pipes and for the water to collect at a series of natural low points along Mulgoa Road, which is consistent with the existing drainage arrangement.

Despite the proposal to widen the road and increase the volume of surface runoff, it is expected that the existing cross drains are sufficient in number and size to handle the volume of runoff under the 1-in-10-year ARI. The existing longitudinal drains would need removing and new drains and inspection pits would be installed to allow for road widening. The existing cross drains would also be extended to tie into the longitudinal drains. The arrangement would continue to use the existing outfall and tie-in locations, namely:

- A piped network approaching School House Road that discharges into School House Creek, which in turn, discharges into the Nepean River
- An open channel next to westbound entry ramp of the M4 Motorway that adjoins School House Creek and discharges to the Nepean River
- An open channel next to the westbound exit ramp of the M4 Motorway that directs flow underneath Mulgoa Road into the open channel next to the westbound entry ramp described above
- Surveyors Creek, which joins with Peachtree Creek and then discharges to the Nepean River.

The predicted runoff volumes and rates associated with the above ARI mean that the attenuation or temporary storage of stormwater is not needed.

The existing culverts serving the M4 Motorway interchange fall within the proposal footprint and as such would be upgraded to convey the flows and channel them into existing drainage lines.

During construction, additional erosion and sediment controls may be needed (refer to section 6.5.4). Sediment and erosion control measures may also be included in the final drainage design once it is detailed.

Intelligent transport systems infrastructure

Intelligent transport system (ITS) infrastructure would be installed to improve the reliability, efficiency and safety of Mulgoa Road. This would likely comprise the following infrastructure:

- Closed-circuit television (CCTV) would be installed to cover the proposal footprint
- Conduits, cabinets, cableways, and inspection pits would be installed alongside Mulgoa Road to house the various communications and intelligent infrastructure. The specific location of the cabinets and inspection pits would be confirmed as the design is advanced.
- Variable Message Signage (VMS) would be installed on the approach to the M4 Motorway interchange. The specific location of the VMS would be confirmed as the design is advanced.

Retaining structures

The proposed soil nail wall would comprise galvanised steel bars in a thick reinforced shotcrete facing wall, after which a 'nail' is inserted into a pre-drilled hole. The created retaining structures would be designed to tie-in with the urban design requirements and improve the visual amenity (refer to Table 3-4) with the installation of concrete facing panels, designed in accordance with the proposal's urban design theme. Figure 3-6 shows an example soil nail wall installed under an existing bridge.



Source: Pinnacle design build

Figure 3-6: Example soil nail wall during construction

Supporting infrastructure

The specifics of the supporting road infrastructure, lighting, signage, and street furniture would be confirmed during the detailed design. It would likely include:

- Provision of lighting alongside Mulgoa Road, at the intersections and alongside Hatchinson Crescent, Huron Place and Peter Court. This would be designed in accordance with relevant guidelines and standards to minimise light spillage into residential and other adjacent properties and minimise the glare that could impact on driver visibility
- Appropriate signage and line markings
- Modification of existing safety barriers and provision of new safety barriers as required in accordance with relevant standards and guidelines to protect road users and various roadside equipment. This would include installing the necessary barriers to protect the piers supporting the two M4 Motorway road bridges and to protect road users along Hatchinson Crescent, Huron Place and Peter Court once they are connected and upgraded.

Urban design and landscaping

The current urban and landscape design strategy (refer to section 3 of Appendix H) responds to the objective of making Mulgoa Road a gateway to Penrith CBD and to improve the amenity and placemaking of the area. This includes safety and security provisions consistent with the Crime Prevention through Environmental Design (CPTED) principles.

Urban design

Section 2.3.3 describes the urban and landscape design objectives as adopted from Beyond the Pavement (Roads and Maritime, 2014a). Table 3-4 describes the key urban design features. These would be considered and included, as required, in developing the design.

Table 3-4: Key urban design features

Design feature	Urban design consideration
Retaining structures under the M4 Motorway	<ul style="list-style-type: none">• Tilt walls outwards to reduce the perceived height and provide a smooth top edge to structures in elevation• Ensure the bridge embankments and retaining structures either side provide a seamless integrated design• Use pre-cast concrete facing panels with a strong pattern/texture to reduce the visual scale of the structures and include an anti-graffiti coating treatments• Consider splaying the retaining structures in plan to provide planting to the base where feasible and reasonable.
Noise walls and shared transit zone	<ul style="list-style-type: none">• Use pre-cast concrete panels with similar patterns and curved lines to consider a consistent urban design for the corridor (refer to Figure 4 in Appendix H).

Landscape plan

Figure 3-7 to Figure 3-6 show the landscape concept plan for the proposal. This includes tree preservation where feasible and reasonable, new groundcover planting, and the use of high-canopy trees to allow clear visibility and passive surveillance. Drought and heat tolerant, low-maintenance plantings would be used, while new tree seedlings would be planted alongside the footpaths and shared use paths to provide shade and amenity for pedestrians and cyclists.

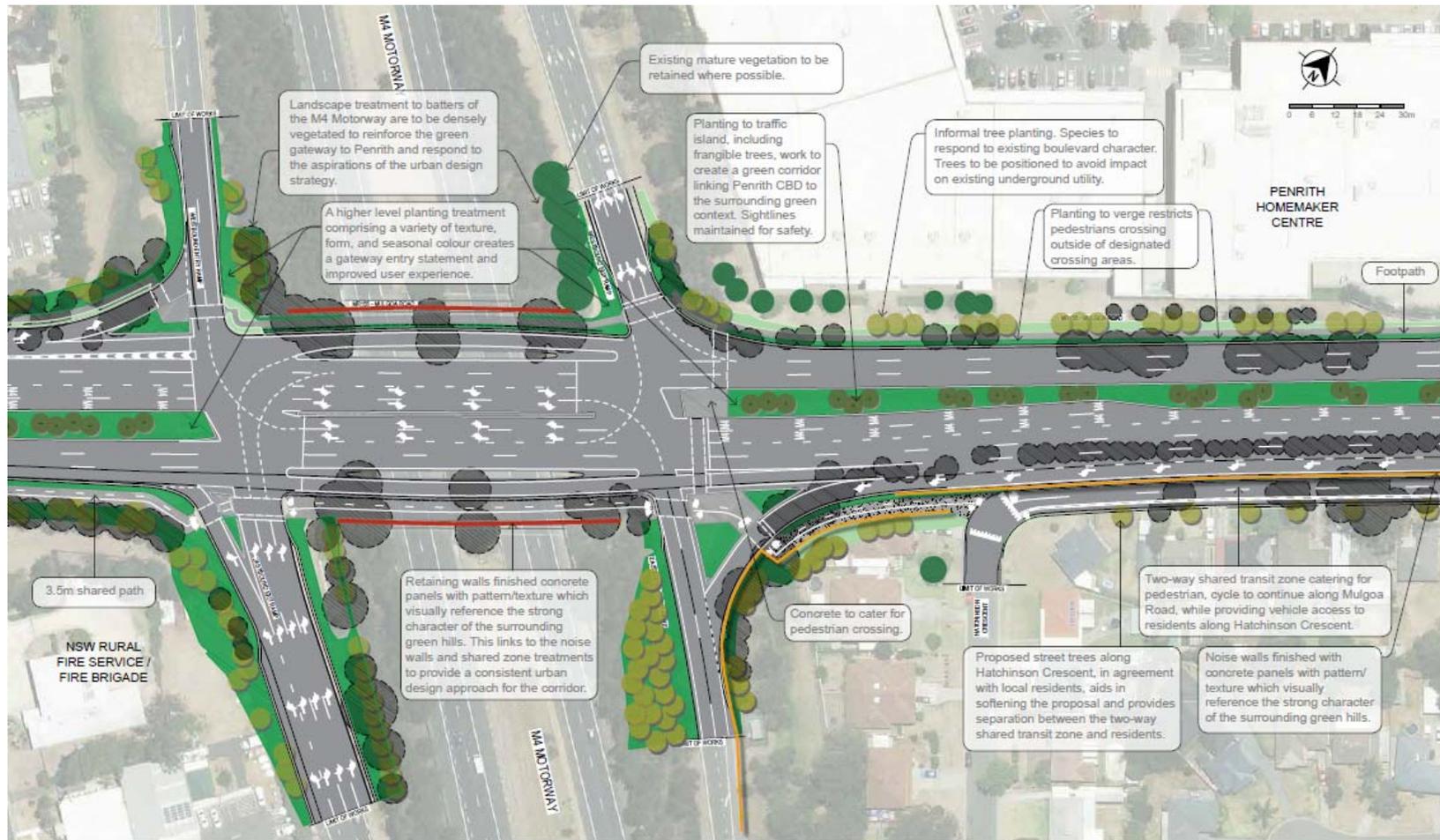


LEGEND

- | | | | |
|---|---|---|--|
|  | Proposed non-frangible tree planting (sightlines maintained) |  | Existing trees to be removed (shown indicatively, detailed survey is required to determine canopy extent and trees affected) |
|  | Proposed frangible tree planting (sightlines maintained & frangible species in clear zones) |  | Garden / Planting (sightlines maintained) |
|  | Existing trees to be maintained (where possible - arborist to be consulted) |  | Grass / Turf |



Southern section

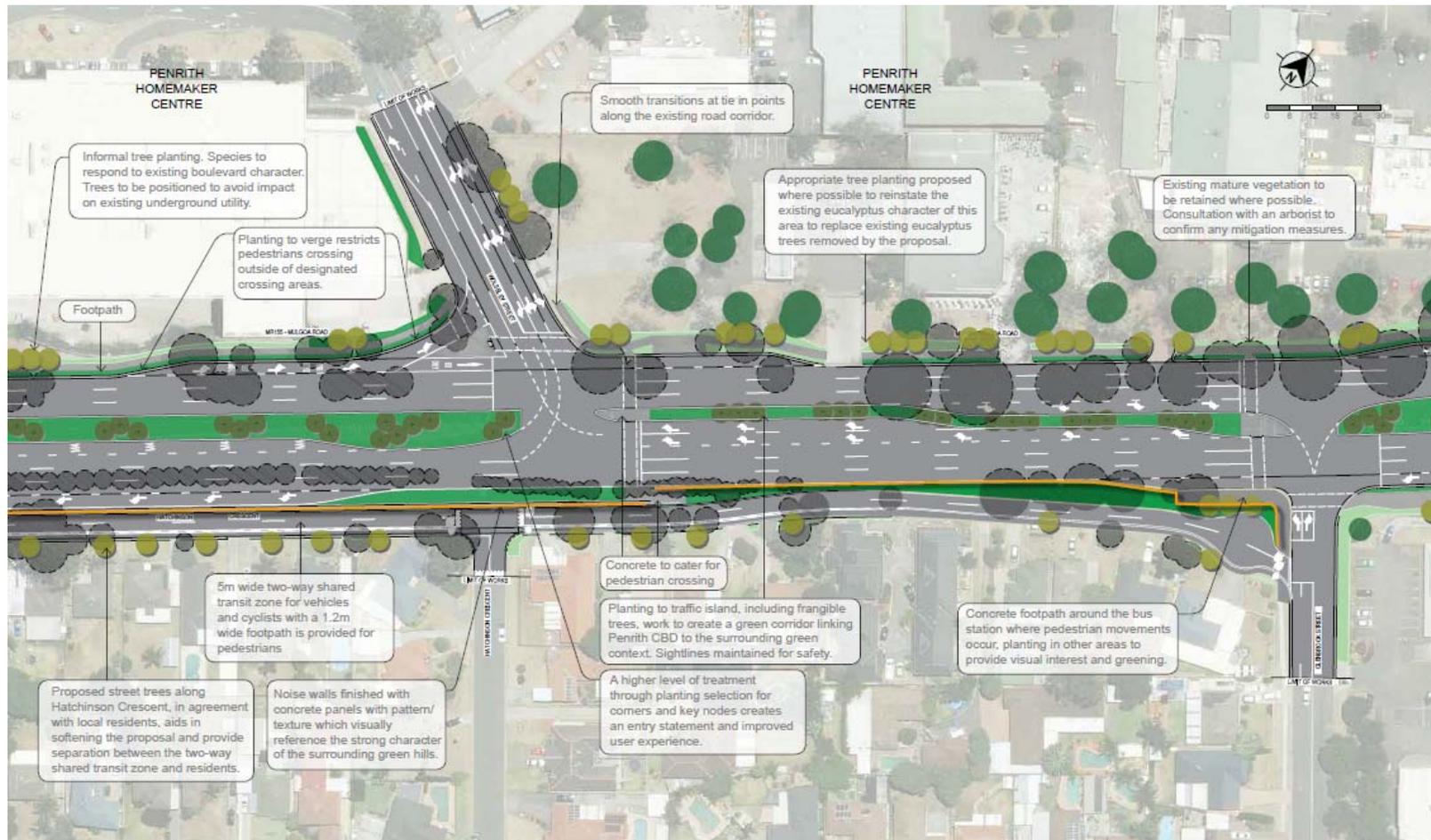


LEGEND

- | | | | | | |
|---|---|---|--|---|---------------------|
|  | Proposed non-frangible tree planting (sightlines maintained) |  | Existing trees to be removed (shown indicatively, detailed survey is required to determine canopy extent and trees affected) |  | Noise wall location |
|  | Proposed frangible tree planting (sightlines maintained & frangible species in clear zones) |  | Garden / Planting (sightlines maintained) |  | Retaining walls |
|  | Existing trees to be maintained (where possible - arborist to be consulted) |  | Grass / Turf | | |



M4 Motorway Interchange



LEGEND

- Proposed non-frangible tree planting (sightlines maintained)
- Proposed frangible tree planting (sightlines maintained & frangible species in clear zones)
- Existing trees to be maintained (where possible - arborist to be consulted)
- Existing trees to be removed (shown indicatively, detailed survey is required to determine canopy extent and trees affected)
- Garden / Planting (sightlines maintained)
- Grass / Turf
- Noise wall location
- Retaining walls



Wolesey Street interchange and shared transit zone

3.3 Construction activities

This section describes how the proposal would be constructed, including the likely method, staging, work hours, plant and equipment, and associated activities. For this REF, an indicative construction method is provided. The detailed construction staging plans and methods would be determined by the contractor after completion of the detailed design. The actual method may vary from the description in this chapter due to:

- Identification and location of underground utilities and services
- Onsite conditions identified during pre-construction activities
- Ongoing refinement of the design
- Outcomes of community consultation including submissions on the REF.

To construct the proposal, additional land would be temporarily needed to provide construction equipment access, sufficient clearance to install equipment and to temporarily store equipment, materials and excavated soil. This is referred to as the construction footprint which is shown in Figure 1-3.

3.3.1 Work methodology

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

Staging

The proposal would be likely built in several stages to reflect contractor requirements and material and equipment availability. The staging process would also allow for effective site and environmental management from the point of not placing too much demand on the ancillary facilities, haul routes, and local community. It is also possible that certain stages would be built at the same time.

Various physical and operational constraints would also affect how the proposal is built and the construction staging. Key constraints to constructing the proposal are the need to:

- Work in a live traffic environment
- Maintain operational traffic flows, access and speeds on a congested road; especially during peak periods, including emergency vehicle access
- Avoid damaging or needing to temporarily cut off the supply of the complex arrangement of services and utilities that would need relocating and protecting
- Carry out tunnel demolition at the Wolseley Street intersection
- Reduce the width of the embankments supporting the M4 Motorway road bridges and install soil nail walls.

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

Early work

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

- Obtain leases and licences (refer to section 7.3)

- Complete the property acquisition and arrange the temporary access and lease arrangements (refer to section 3.6)
- Notify the public, businesses, public transport companies, Council and other stakeholders before work starts
- Carry-out ecological pre-clearance inspections, geotechnical investigations, road dilapidation surveys, pre-condition surveys, and other investigation work as needed (refer to chapter 7)
- Set out, demark and fence the site to establish routes, accesses, and no-go zones
- Clear land (vegetation removal, clearing, grubbing and mulching), undertake building demolition work, and make property adjustments
- Possible key utility relocations where feasible and reasonable.

Temporary work

Temporary work is typically carried out as part of the early work package however it typically remains in place for the whole construction program. The temporary work expected to take place under the proposal would be the implementation of:

- Environmental management controls, including noise barriers, erosion and sedimentation and drainage provisions, and temporary screenings. Where possible, the proposed permanent noise barriers alongside Hutchinson Crescent would be installed ahead of construction (refer to section 3.1)
- Traffic and speed management controls and diversions (refer to section 3.3.6).

Main work

The proposed staging of the main work would likely involve:

- Stage 1: partially excavate the embankments and install the retaining structures on the M4 Motorway
- Stage 2: widen and upgrade Mulgoa Road and the supporting intersections
- Stage 3: upgrade the M4 Motorway interchange, including widening Mulgoa Road
- Stage 4: finalisation and handback.

Table 3-5 provides elements of the proposal that would be likely constructed under each stage.

Table 3-5: Proposed construction staging and activities

Stages	Typical activities
Stage 1: embankment earthworks and soil nail walls	<ul style="list-style-type: none"> • Earthworks, surface preparation and piling • Reinforcement work and shotcreting • Drilling, nail installation and grouting • Utility installation and tie ins • Drainage adjustments and installation • Subsurface infrastructure installation including conduits, pits and cables • Earthworks and new pavement installation • Traffic switching and the reconstruction/repair of the existing road • Footpath and shared use path installation/relocation.

Stages	Typical activities
Stage 2: main alignment work	<ul style="list-style-type: none"> • Utility installation and tie ins • Drainage adjustments and installation • Subsurface infrastructure installation including conduits, pits and cables • Earthworks, surface preparation, and new pavement installation • Traffic switching and the reconstruction/repair of the existing road • Footpath and shared use path installation/relocation • Landscape planting.
Stage 3: M4 Motorway interchange	<ul style="list-style-type: none"> • Utility installation and tie ins • Drainage adjustments and installation • Subsurface infrastructure installation including conduits, pits and cables • Earthworks and new pavement installation • Traffic switching and the reconstruction/repair of the existing road • Footpath and shared use path installation/relocation.
Stage 4: finalisation and handback	<ul style="list-style-type: none"> • Power supplies and cabinets, traffic signals and signs, safety barriers, and street lighting • Final levelling, compaction, rehabilitation, and landscape planting • Final tie-ins, safety barriers, kerbs, gutters and verges • Final side road adjustments, line markings and guide posts • Temporary facility decommissioning • Site clean-up, handback and recycling/disposal of surplus material.

Workforce

While about 200 people would be needed to carry out the main construction activities, it is expected that there would be about 50 people onsite at any time. Should several stages of the proposal be built at the same time then this number would increase proportionally.

3.3.2 Construction hours and duration

Start date and length of construction

Construction is expected to start in early-2020 and it would take up to two-years to complete the work, subject to any external unforeseen delays.

Working hours

Construction would be largely carried out during standard work hours:

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

To minimise disruption to daily traffic, surrounding residents and businesses, and to reduce the construction program, the following weekend, evening and night work is anticipated:

- Relocation of existing utilities and services
- Pavement work on active and constrained sections of Mulgoa Road where there is not the ability to provide a temporary pavement or effective traffic diversions
- Various work at the M4 Motorway interchange.

Any work taking place outside of the standard work hours would be in accordance with the Interim Construction Noise Guideline (ICNG, DECC, 2009) and the Construction Noise and Vibration Guideline (CNVG, Roads and Maritime, 2016a). This is to ensure that feasible and reasonable work practices are introduced to manage noise, including limiting certain activities or the use of key equipment at night, notifying the community before starting work, introducing permissible noise limits, monitoring noise, and ensuring there is an effective complaints-handling and response process. Section 6.2.5 describes the detail of these controls.

3.3.3 Plant and equipment

The plant and equipment needed to build the proposal would be typical to any major road construction site. It would vary depending on the construction activity. Table 3-6 indicates the plant and equipment that would be likely used to build the proposal however this would be finalised by the contractor and it is not exhaustive.

Table 3-6: Indicative plant and equipment

Construction phase	Plant and equipment	
Enabling work	<ul style="list-style-type: none"> • Concrete saw • Crane • Dozer and excavator • Front-end loader • Grader 	<ul style="list-style-type: none"> • Hydraulic hammer • Light vehicles • Semi-trailer • Trucks
Temporary work	<ul style="list-style-type: none"> • Concrete truck and pump • Concrete vibrator • Crane • Daymaker • Excavator • Front-end loader • Grader • Light vehicles 	<ul style="list-style-type: none"> • Line marker • Power generator • Scissor lift • Semi-trailer • Trucks • Vibratory Roller • Water cart
Main work		
Earthworks	<ul style="list-style-type: none"> • Compactor • Excavator • Grader 	<ul style="list-style-type: none"> • Scraper • Semi-trailer

Construction phase	Plant and equipment	
Drainage and utility work	<ul style="list-style-type: none"> • Compactor • Concrete truck • Crane • Excavator 	<ul style="list-style-type: none"> • Scraper • Truck • Vibratory roller
Retaining structure	<ul style="list-style-type: none"> • Air track drill • Bored piling rig • Concrete pump • Concrete vibrator 	<ul style="list-style-type: none"> • Crane • Excavator • Power generator • Welding equipment
Pavement work	<ul style="list-style-type: none"> • Asphalt truck • Concrete saw • Concrete truck • Daymaker • Dump truck 	<ul style="list-style-type: none"> • Grader • Pavement layer • Roller and profiler • Semi-trailer
Signage and road furniture	<ul style="list-style-type: none"> • Crane • Scissor lift 	<ul style="list-style-type: none"> • Truck
Revegetation	<ul style="list-style-type: none"> • Light vehicles 	<ul style="list-style-type: none"> • Water cart
Finalisation	<ul style="list-style-type: none"> • Asphalt truck • Daymaker • Front end loader 	<ul style="list-style-type: none"> • Pavement layer • Roller and profiler • Trailer

3.3.4 Earthworks

The extent of earthworks needed to build the proposal would be limited to those needed to support road widening, reduce the M4 Motorway road bridge embankments, relocate and install utilities and carry out some minor batter and embankment shaping work. Earthworks generally involve the removal and temporary stockpiling of suitable material for fill and grading work elsewhere. It also involves the segregation, testing, sorting and the disposal of material that is either unsuitable chemically or physically. In summary, it is estimated that about:

- 11,000 m³ of existing road material (pavement asphalt, and sub base) would be removed
- 5,500 m³ of 'fill material' would be needed for foundation, backfill and pavement materials.

It is expected that up to 40 per cent (4,400 m³) of the excavated materials may be unsuitable to reuse as engineering fill. This material would be either reused or disposed offsite in accordance with the following hierarchy

- Reuse as engineering fill onsite
- Transfer to another Roads and Maritime project for use as engineering fill
- Storage at a Roads and Maritime stockpile site to allow for its future reuse
- Transfer to another construction site for use as engineering fill
- Transfer to a licenced waste recovery site where reasonable

- Disposal at a licenced facility.

If the required fill cannot be provided from the excess of cut (excavated) material, imported fill may be needed. Preferentially, this would be obtained from other local construction projects and suppliers in the region where there is the supply availability.

Any excavated materials reused onsite, or imported to site from another project, would be subject to testing and waste classification exemption provisions in accordance with the Waste Classification Guidelines (EPA, 2014). Should the material be classified as a controlled or restricted waste, or found to contain contaminants of concern at elevated concentrations, it would not be classified for exemption and reuse. It would be stored in a contained separate location onsite before being transported offsite to a licenced facility.

In addition, water would be needed onsite to control dust and provide ablutions for staff. Roads and Maritime has an exemption for obtaining water for use during construction. The amount of water would be confirmed by the contractor and would depend on the final construction methods. It is proposed that water would be obtained from the local water supply network. The contractor would need to include mitigations for obtaining water from local supplies.

Reusable topsoil and subsoil would be stored in designated and suitable locations. This would ensure the stockpiled material was located away from sensitive areas and flood-prone land, where feasible and reasonable, consistent with Roads and Maritime guidelines (refer to section 6.4). It would also provide the ability to install controls to manage any leaching, erosion, sediment dispersion and dust dispersion risks and impacts.

3.3.5 Source and quantity of materials

Various standard construction materials that are readily available across Sydney would be needed to build the proposal. This would include prefabricated units ready for installation, or the materials that would be held at the site compound or any temporary laydown areas (refer to section 3.4). The main material needed to build the proposal, would comprise:

- Topsoil and subsoil, including mulch, general and select fill
- Stone, aggregates and quarried materials for the road base and sub-base
- Cement, fly ash, bitumen, asphalt, sand and spray seals for the road pavement
- Precast concrete units and infrastructure for drainage infrastructure (pits and pipes), barriers, noise wall, kerbs, gutters, paving and signage footings
- Steel for barrier railings, pipework, soil nail walls and concrete reinforcement
- Prefabricated steel infrastructure in the form of light posts, signage, fencing, and street furniture
- Prefabricated plastics cables, conduits, pits, gas mains and other utilities material
- Hard and soft landscaping materials including trees, seedlings, mulch, chippings and turf
- Additional materials such as relatively small quantities of paint, oils, and fuels.

The accuracy of estimation for the amount of fill material required is subject to variations in bulking factors, the relative compaction achieved for placed material, and the volume of usable material once it has been excavated. This would be refined during detailed design.

All road material would be purchased from Roads and Maritime registered suppliers according to specifications for the proposal. In sourcing materials, Roads and Maritime would require the contractor to use local suppliers as a priority, provided the materials sourced meet the required engineering specifications. The materials needed for the utilities are also likely to be sourced, or provided, by the corresponding companies to meet their own specifications. Overall, given the proposal's location, it is likely

that material supply and haulage could be minimised. Table 3-7 indicates the material volume estimates of the key construction materials.

Table 3-7: Indicative material quantities

Material	Volume or tonnage estimate
Fill material: total (m ³)	5,500
Road base (m ³)	10,000
Aggregate (m ³)	260
Asphalt (tonnes)	60
Concrete (m ³)	2,800
Steel (tonnes)	15

3.3.6 Traffic management and access

Traffic management and access controls would be developed during the detailed design and implemented under a construction traffic management plan.

Staging and traffic management

The purpose of building the proposal in stages is to allow Mulgoa Road and the surrounding roads to remain open to traffic, pedestrians and cyclists during construction. Certain work activities would take place at night to minimise any traffic-related impacts (refer to section 6.1.3), while traffic management controls may be relaxed during peak periods.

A traffic management plan would be prepared in accordance with the Traffic Control at Work Sites Manual Version 4 (RTA, 2010, refer to section 6.1.4) and approved by Roads and Maritime before implementation. The plan would provide details of the traffic management controls to be implemented during construction to ensure traffic flow on the surrounding network is maintained where possible.

Property access

Property accesses would be maintained as far as possible throughout construction.

Construction and delivery traffic and workforce vehicles

Heavy vehicle traffic: construction machinery and major deliveries

The proposal would generate heavy vehicle movements at regular intervals during construction, mainly associated with:

- Construction material deliveries
- Activities around the site compound
- Spoil and waste removal
- Delivery and removal of construction equipment and machinery.

Overall, is expected that up to 100 heavy vehicle movements would occur onsite on a typical day, potentially increasing to 200 during peak construction. This would include a composition of rigid trucks and semi-trailers. The rigid trailers would deliver most of the materials described in section 3.3.5, while also

removing waste from site. Semi-trailers would only be used to deliver oversized, prefabricated, precast and larger materials such as steels.

Heavy vehicle deliveries would use approved heavy vehicle routes, which may include Mulgoa Road, Castlereagh Road, The Northern Road, M4 Motorway and Great Western Highway. Specific access routes within the construction footprint would also be established to control the movement of heavy vehicles onsite. Heavy vehicle movements on local roads would be minimised as far as possible and restricted to designated transport haulage routes.

Light vehicles: workforce traffic and deliveries

Up to an additional 100 light-vehicle-movements would occur onsite on a typical day increasing to 200 during peak construction, in the form of workforce traffic. The workforce is likely to arrive and leave site on the fringes of the peak periods. Additional occasional vans and small trucks are also likely to arrive and leave site over the course of the day, making small deliveries.

Staff parking would be provided at the main construction compound site at 111 Mulgoa Road or at pre-arranged designated places within the construction footprint.

Traffic management controls

Specific controls would need implementing for most of the construction program, while others would be temporary to allow a specific work activity to safely take place. The main controls that would be introduced are likely to include:

- Night time and weekend lane closures, speed restrictions, and potentially, very occasional night time carriageway closures on Mulgoa Road
- Use of temporary lights, speed restrictions, and stop-go signs at the tie-in points
- Introduction of temporary side road access restrictions and one-way operations on the intersecting roads
- Introduction of left-in and left-out entry and exit provisions to the site compound.

Table 3-8 lists an additional five specific controls that would be needed to construct the proposal.

Table 3-8: Specific traffic management controls

Location/aspect	Control
Penrith Homemaker Centre: 301-335 Mulgoa Road, Jamisontown	Access to the Homemaker Centre during decommissioning of the Wolseley Street tunnel would be provided temporarily by using the median between Glenbrook Street and Wolseley Street as a temporary right-turn lane into Wolseley Street.
Shell service station: 221 Wolseley Street, Jamisontown	A temporary northbound traffic lane would be provided at the Wolseley Street intersection while it is being upgraded to maintain access to the Shell service station.
Regentville fire and rescue station and Regentville rural fire brigade: 8-12/20 Jeanette Street, Regentville	Temporary emergency northbound and southbound access to and from Mulgoa Road to Jeanette Street would be provided and maintained throughout to service Fire & Rescue NSW and the Rural Fire Service. The final design of the access would be discussed in consultation with these stakeholders and developed to support the detailed design.

Location/aspect	Control
Resident and business access: Mulgoa Road	Temporary property access would be provided for all residents and businesses along Mulgoa Road. However, at times, some of these accesses may be traffic controlled either through using stop-go signs or temporary traffic lights.
Public transport, pedestrian and cycle connectivity Mulgoa Road	<p>Bus stops would be temporarily relocated in consultation with the operators and local community. This would consider any implication for commuters. The relocations would be advertised before construction starts.</p> <p>Footpaths and cycle provisions would be maintained, or temporary alternatives provided on the local road network. In general, there is sufficient space within the existing road verges and adjacent to the proposed work to accommodate existing or temporary pedestrian and cycle facilities.</p>

3.4 Ancillary facilities

Ancillary facilities cover additional infrastructure, areas and facilities needed to construct the proposal such as laydown areas, site compounds and stockpile sites. They form part of the temporary work described in section 3.3.1. The final location of the compound, stockpile and storage sites and access arrangements would be identified during detailed design and/or construction. Once the contractor has a preferred location, they would consult with Roads and Maritime's Environmental Officer before any work in those locations to identify if any additional environmental assessment is required.

3.4.1 Site compound

A single main site compound at 111 Mulgoa Road would be used to service constructing the proposal. This is on Council reserve land. This site would be used to store the equipment, machinery and vehicles needed to build the proposal. The site compound facilities would include portable buildings with amenities, such as lunch facilities and toilets, secure and bunded storage areas for certain site materials including fuel and chemicals, office space, and associated parking.

Alternate sites were considered, however, were discounted due to the following reasons:

- Vacant land owned by private landowners which may affect the viability of the use, and of the proximity of the adjoining land use
- Vacant community land which could be dedicated for planned emergency events
- Increased construction vehicle traffic on the local road network
- Were within flood affected lands.

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

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

The construction compound would be secured with construction fencing and gates and would be provided with power for lighting and communications. Erosion and sediment control measures would be installed to ensure the site meets all contractual requirements. Signage would be erected advising the public of access restrictions. Upon completion of construction, the site compound and associated work areas would be removed, the site cleared of all rubbish and materials and rehabilitated. It is recognised that the proposed compound would be located directly next to residents in Regentville, which is unavoidable due to the lack of suitable alternatives nearby. To account for this, chapter 7 discusses the standard measures that would be adopted to minimise traffic disruption and manage amenity-related impacts.

3.4.2 Stockpile sites

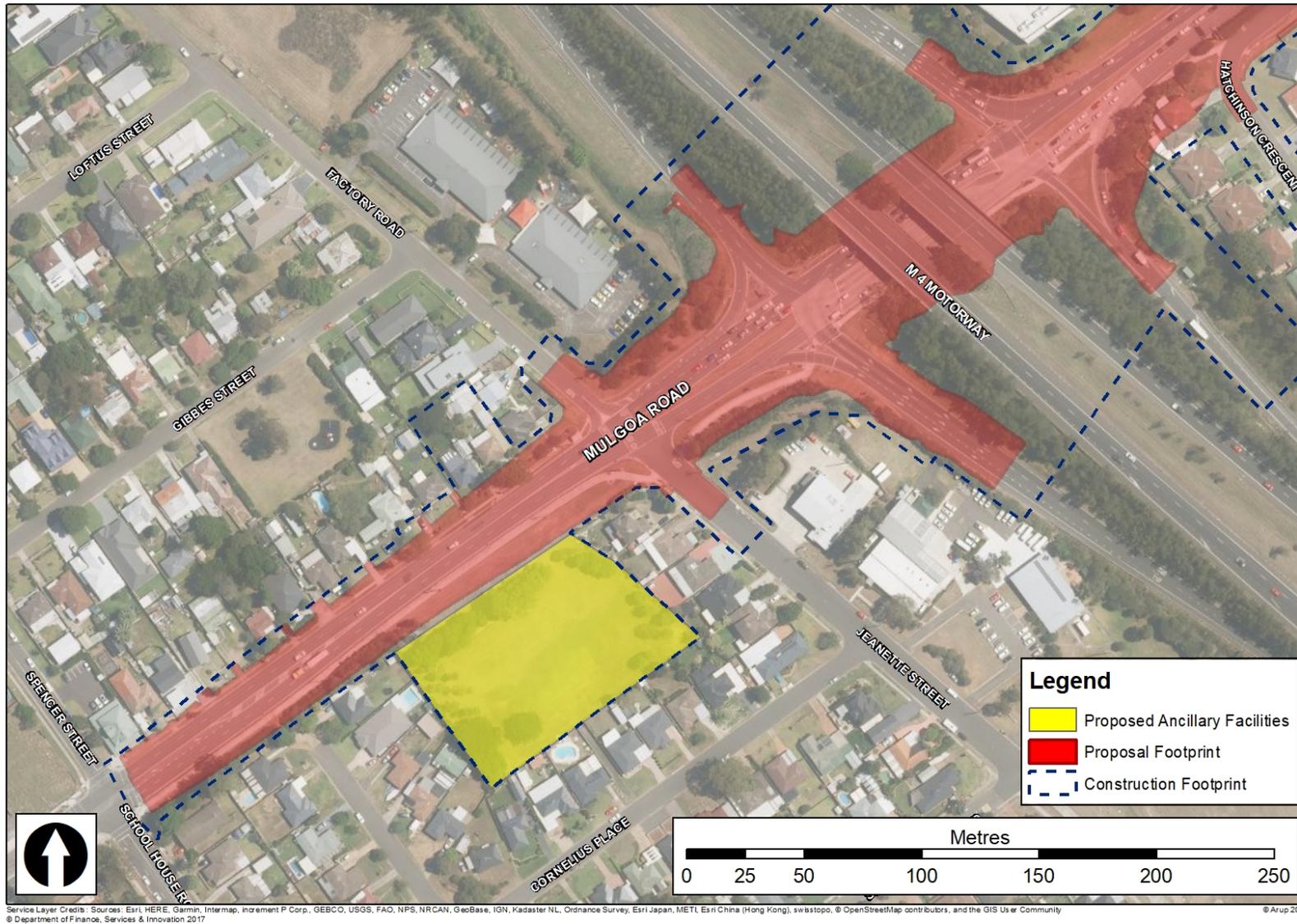
Excavated materials are to be stockpiled in designated areas within the construction footprint or at the site compound. Stockpiles would be managed in accordance with the Stockpile Site Management Procedure (RTA, 2011) and QA specification R44-Earthworks - IC-QA-R44 (Roads and Maritime, 2011a).

Stockpile sites would be chosen to best respond to the above criteria.

3.4.3 Vehicle and equipment storage areas

Given the multiple construction stages, construction plant and equipment would be likely parked up within designated areas in the construction footprint, and secured at the site compound. It would only be allowed to enter and leave site during off-peak periods.

Figure 3-8 shows the location of confirmed ancillary facilities. In terms of specific or designated stockpile sites and vehicle and equipment storage areas, these would be identified by the contractor and agreed with Roads and Maritime before (a) construction (stage) starts.



Source: Arup

Figure 3-8: Proposed location of ancillary facilities

3.4.4 Waste management

While there is a preference to minimise waste through employing the hierarchy of reduction, reuse and recycling over disposal, there would still be an amount of site-generated waste that would either be temporarily stored onsite until it was effective to arrange a pick-up, or otherwise collected and transported offsite at the end of each day. Where needed, waste materials, including suspected contaminated materials, would be segregated and stored before being tested and classified in accordance with the Waste Classification Guidelines (EPA, 2014). Any controlled, restricted, or contaminated waste would be stored in a contained separate location onsite before being transported offsite to a licenced facility.

3.5 Public utility adjustment

Given the urban character of the local area, there are a substantial number of above and below ground utilities, which include:

- Stormwater drains
- Sewerage and water supply pipes
- Electrical cables, conduits and pits, including street lighting
- High pressure gas mains
- Telecommunications cable and optic fibre.

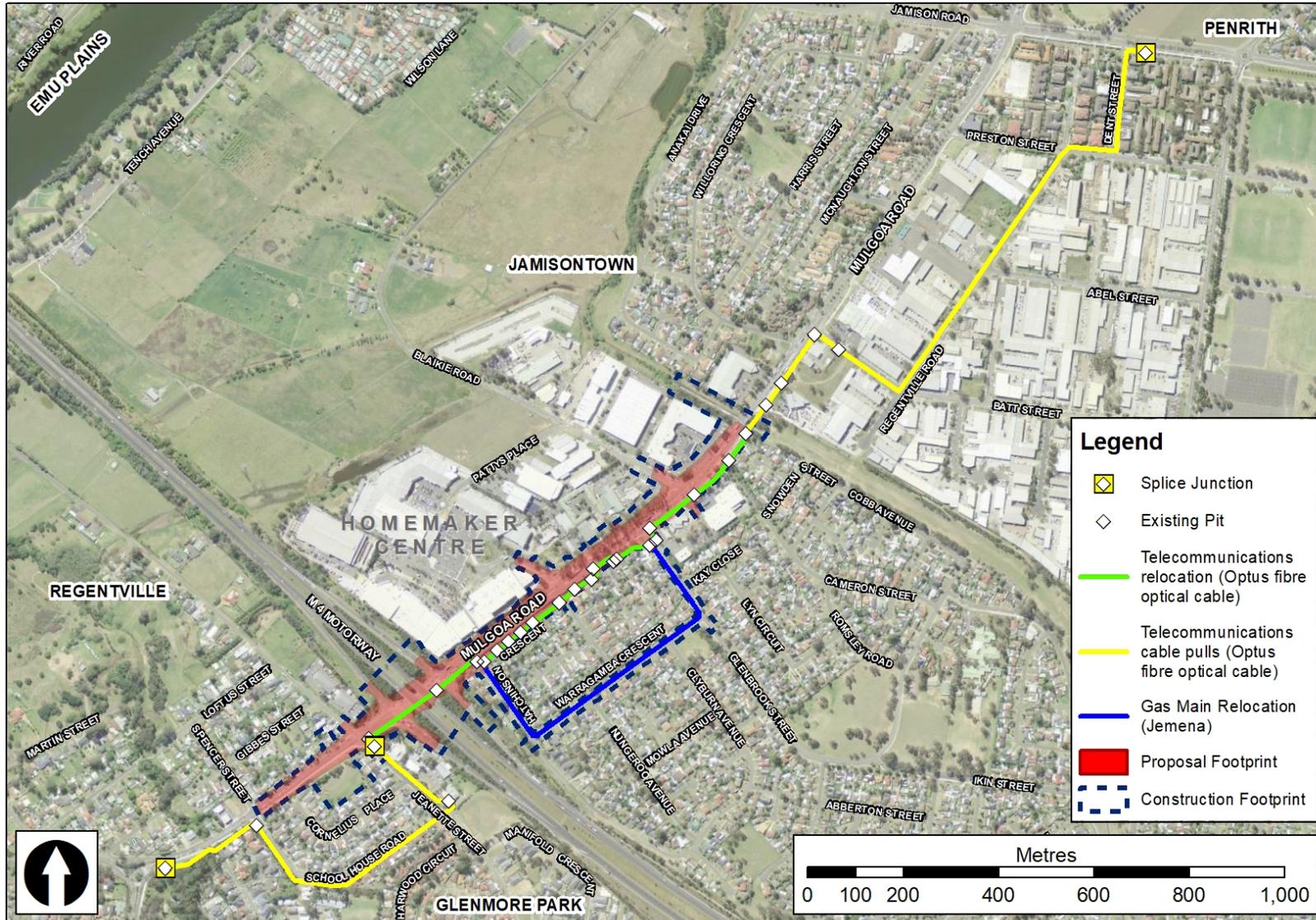
Initial public-utility company consultation has been carried out to identify and locate existing utilities (refer to chapter 5). Table 3-9 provides the detail of the main utility adjustments, relocations and installations needed to build the proposal. References (in metres) are provided in the table that relate to the length of utility adjustment or relocation. Final utility adjustments and relocations would be confirmed as the design is developed.

As part of the Optus fibre optic cable relocations, cables may need to be pulled through existing pits outside of the proposal footprint to reach existing connection points (splice junction) as shown in Figure 3-9. This work would be non-intrusive and would occur within the existing road corridor via existing manholes. Figure 3-9 also shows the gas main relocation along Warragamba Crescent within the construction footprint.

Table 3-9: Indicative utility adjustments, relocations and installations

Location	Utility	Work	Length (m)
Mulgoa Road to Warragamba Crescent	Jemena secondary (high pressure) gas main	Relocation	860
	Jemena medium pressure gas main	Relocation	1,150
Mulgoa Road to Mulgoa Road (including Hatchinson Crescent / Huron Place / Peter Court)	Optus optical fibre cable	Relocation	1,500
	Telstra	Relocation	1,600
	Sydney Water - water main	Relocation	600
	Sydney Water - sewer pressure main	Relocation	2,000

Location	Utility	Work	Length (m)
	Overhead electrical assets	Relocation	400
	Underground electrical assets	Relocation	2,400



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Figure 3-9 Optus fibre optic cable and Jemena gas main relocations

3.6 Property acquisition

About 8,150 m² (0.815 hectares) of privately owned land would need to be permanently acquired to build the proposal. Roads and Maritime would also need to temporarily lease, make informal arrangements and agree on access to land for construction. While the final land purchase, adjustments and leasing agreements would be confirmed during the detailed design, they would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, the supporting NSW Government Land Acquisition Reform 2016 and the Land Acquisition Guide and Policy (Roads and Maritime, 2012a and 2012b). Table 3-10 and Figure 3-10 shows the property acquisition needed for the proposal footprint.

As a result of acquisition, the following land uses may be lost or impacted:

- Three buildings/four residential properties would be purchased and demolished
- Potential loss of customer parking at the commercial complexes at the Penrith Trade Centre, the Homemakers Centre and the Grey Gum Hotel Complex, on the western side of Mulgoa Road
- Narrow strips of land on fronting properties, mainly residences on the western side of Mulgoa Road, which would reduce the size of their gardens.

Further refinement of the design would be considered to identify opportunities to minimise the above property impacts as described in chapter 7.

Table 3-10: Proposed property acquisition

Area ID	Description	Total area (m ²)	Acquisition type	Land Owner	Lot and DP	Land use (LEP)
1	Private residence	3	Partial	Private	11/C/DP1687	R2: low-density residential
2	Private residence	12	Partial	Private	10/C/DP1687	R2: low-density residential
3	Private residence	22	Partial	Private	9/C/DP1687	R2: low-density residential
4	Private residence	33	Partial	Private	8/C/DP1687	R2: low-density residential
5	Private residence	45	Partial	Private	7/C/DP1687	R2: low-density residential
6	Private residence	56	Partial	Private	6/C/DP1687	R2: low-density residential
7	Private residence	69	Partial	Private	5/C/DP1687	R2: low-density residential
8	Private residence	698	Full	Private	4/C/DP1687	R2: low-density residential

Area ID	Description	Total area (m ²)	Acquisition type	Land Owner	Lot and DP	Land use (LEP)
9	Private residence	698	Full	Private	3/C/DP1687	R2: low-density residential
10	Private residence	103	Partial	Private	2/C/DP1687	R2: low-density residential
11	Private residence	100	Partial	Private	1/C/DP1687	R2: low-density residential
12	Commercial properties	780	Partial	Homemakers Centre	SP72448	B5: business development
13	Commercial properties	924	Partial	Coles Express Service Station	221/DP828240	B5: business development
14	Commercial properties	436	Partial	Western Motorcycles	2223/DP852657	B5: business development
15	Commercial properties	1941	Partial	Grey Gums Hotel	1/DP884114	B5: business development
16	Commercial properties	871	Partial	Amart/Pizza Hut	123/DP778162	B5: business development
17	Private residence	429	Full	Private	1/DP829539	R2: low-density residential
18	Private residence	416	Full	Private	2/DP829539	R2: low-density residential
19	Private residence	328	Partial	Private	SP63101	R2: low-density residential
20	Commercial properties	190	Partial	Red Rooster	23/DP844394	B5: business development
21	Commercial properties	207	Partial	BP Service Station	21/DP844394	B5: business development
22	Council	N/A	Temporary Lease	Council Reserve	111/DP260265	RE1: public recreation



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Southern section

Source: Arup

Figure 3-10: Proposed property acquisition

4. Statutory and planning framework

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

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

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

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

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

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

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

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

Equivalent to a SEPP, this state regional environmental plan (SREP) covers the rivers and creeks of the Hawkesbury-Nepean catchment including Surveyors Creek and School House Creek, respectively located at the north end and to the south of the proposal footprint. The SREP includes the controls that Roads and Maritime needed to consider in developing the proposal:

- Avoid aquatic plant areas, significant fauna and wetland habitat (refer to section 6.3.4)
- Re-establish and replant impacted riparian flora and fauna habitat (refer to section 6.3.4)
- Work under an erosion and sediment control plan (refer to section 6.4.4)
- Work under a vegetation management plan (refer to section 6.3.4).

4.1.2 Local environmental plans

Penrith Local Environmental Plan 2010

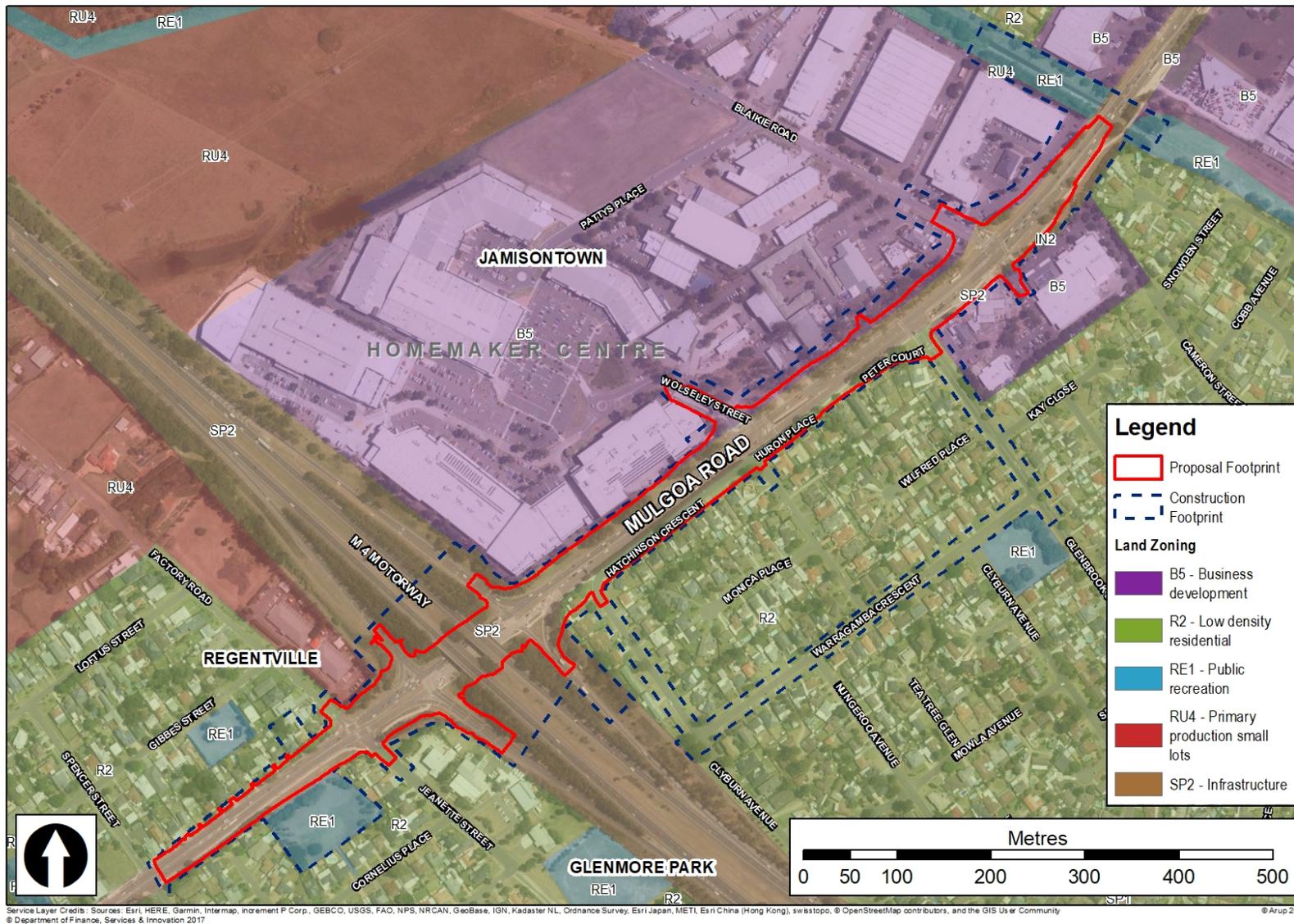
The proposal footprint is located within Penrith City Council local government area (LGA). Local development control, land use zoning and planning in the LGA is governed under the respective local environmental plan (LEP) and supporting development controls plans (DCPs).

As development without consent, the proposal is not subject to local environmental planning policy or development control. However, the NAP does consider the proposal's consistency with relevant local planning objectives and land use zoning policies of the LEP as described in Table 4-1. Figure 4-1 shows the land use zoning provisions of the proposal footprint and local area.

Table 4-1: Relevant Penrith City Council LEP land use zoning policies

Objective	Proposal consistency
SP2 infrastructure Applies to the existing Mulgoa Road and M4 Motorway corridors	
<ul style="list-style-type: none"> • Provide infrastructure and related uses • Prevent development that is not compatible with, or that may detract from, the provision of infrastructure. 	The proposal would involve the upgrade of existing transport infrastructure, the form and function of which is compatible with the existing infrastructure provisions.
B5 business development Applies to the commercial areas including the Homemaker Centre, Shell service station, Western Motorcycles, Grey Gums Hotel, Hungry Jacks, Red Rooster, and BP service station.	
<ul style="list-style-type: none"> • Enable a mix of business and warehouse uses, and bulky goods premises • Maintain economic strength of business development centres. 	The proposal would involve limited land take from within this zone, centred on the removal of outside space such as planted vegetation areas and customer car parking. It would therefore allow the land to remain viable and available for business development. The acquisition is needed to build the proposal which in turn supports future growth and demand generated in this zone by providing additional capacity, while encouraging existing and future employees to walk, cycle or travel to work using public transport.
R2 low density residential Applies to residential areas including Regentville and Jamisontown	
<ul style="list-style-type: none"> • Provide low-density housing • Enable other land uses that support day-to-day residential needs • Promote desired future low-density residential urban character and a high amenity level. 	<p>The proposal would result in the loss of about 2,700 m² (0.27 hectares) of sub-optimal residential land alongside Mulgoa Road (refer to section 3.6) except for the acquisition and demolition of four residential properties.</p> <p>The proposal would impact on residents that overlook Mulgoa Road, however this is in the context of an area that is undergoing change and development.</p> <p>Importantly, the proposal would not impact on the area's overall residential use or function. For affected tenants and owners Roads and Maritime has continued to consult and engage with them as the design has progressed, while the acquisition would be carried out under the terms of the guidelines and laws described in section 3.6.</p>

Objective	Proposal consistency
RE1 public recreation Applies to the main site compound at 111 Mulgoa Road and the area surrounding Surveyors Creek.	
<ul style="list-style-type: none"> • Enable land to be used for public open space or recreational purposes • Provide a range of recreational settings and activities, compatible land uses and protect and enhance the natural environment • Ensure development is secondary and complements/enhances public use and access. 	<p>The proposal would result in the temporary loss of recreational land along the margins of Mulgoa Road (refer section 3.6). The area used for the site compound would be reinstated once the proposal is built.</p>



Source: Penrith City Council
 Figure 4-1: Land zoning in the surrounding area

4.2 Other relevant NSW legislation

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

Table 4-2: Other relevant NSW legislation

Legislation and application	Relevance to the proposal and further requirements
<p>National Parks and Wildlife Act 1974: provides for the protection of Aboriginal heritage values, national parks and ecological values. The Act makes it an offence to harm Aboriginal objects, places or sites without permission.</p>	<p>While there are 11 recorded Aboriginal heritage sites locally (refer to section 6.8), the assessment and site walkover carried out to support the proposal did not identify any Aboriginal sites, objects or potential deposits in the proposal or construction footprint. As such, no permit under Part 6 of this Act would be needed. Nonetheless, precaution would be adopted through implementing a procedure to prevent any damage to any unexpected finds (refer to section 6.8.4).</p>
<p>Heritage Act 1977: provides for the protection of conservation of buildings, works, maritime heritage (wrecks), archaeological relics and places of heritage value through their listing on various State and local registers. The Act makes it an offence to harm any non-Aboriginal heritage values without permission.</p>	<p>The proposal would have no significant impact on any items of local or State heritage value (refer to section 6.10) and is unlikely to potentially impact on undiscovered archaeology given the disturbed nature of the local area. Approval for the proposal under the <i>Heritage Act 1977</i> is therefore not needed. Nonetheless, precaution would be adopted through implementing a procedure to prevent any damage to any unexpected finds (refer to section 6.10).</p>
<p>Roads Act 1993: provides for the construction and maintenance of public roads. Requires consent to dig up, erect a structure or carry out work in, on or over a road</p>	<p>The proposal would require work on several existing roads in the local area. Accordingly, an occupancy licence would be needed to carry out certain construction activities (refer to section 7.3).</p>

Legislation and application	Relevance to the proposal and further requirements
<p>Fisheries Management Act 1994: provides for the protection of fishery resources and values for current and future generations. Makes it an offence to harm fisheries and resources without an appropriate assessment, inclusion of safeguards and/or the appropriate permissions to carry out certain work.</p>	<p>The entire proposal footprint is located within the Hawkesbury-Nepean River catchment (refer to section 6.5).</p> <p>While this is the case, the proposal would not result in a significant impact on critical aquatic flora and fauna habitat, or aquatic threatened species, populations and ecological communities and their habitat, thus a species impact statement (SIS) is not needed, as per section 221 of this Act.</p> <p>While the proposal crosses Surveyors Creek, it is not classified as a key fish habitat, as described in section 6.3.2 thus avoiding the need to adhere to any of the associated requirements of this Act. Also, none of the construction activities would involve work requiring approval under this Act. Regardless, safeguards would be implemented to prevent any indirect impact on the wider catchment values associated with Surveyors Creek and the Hawkesbury-Nepean River as described in section 6.6.</p>
<p>Protection of the Environment Operations Act 1997: focuses on environmental protection and provisions for the reduction of water, noise and air pollution and the storage, treatment and disposal of waste. Introduces licencing provisions for scheduled activities that are of a nature and scale that have a potential to cause environmental pollution. Also includes measures to limit pollution and manage waste.</p>	<p>As the proposal would not require the excavation of more than 30,000 tonnes of material or involve the upgrade of more than three kilometres of road it would not involve an activity listed in Schedule 1 of this Act. An environmental protection licence (EPL) is therefore not needed for the proposal.</p> <p>The Act still requires Roads and Maritime and its contractors to notify the EPA and the supporting authorities when a pollution incident occurs that causes or threatens material environmental harm either during construction or operation. In accordance with the intent of the Act, pollution prevention and waste controls are proposed to manage the constructing and operating the proposal (refer to section 6.10). The safeguards are aligned with the waste hierarchy of avoidance, recovery and recycling over disposal as defined under the <i>Waste Avoidance and Resource Recovery Act 2001</i>.</p>
<p>Water Management Act 2000: provides for the management of surface and groundwater.</p>	<p>The relevant provisions of the Act relate to the need for Roads and Maritime to obtain approval from the water division of the Department of Primary Industry (DPI Water) to use any groundwater extracted (dewatered) during constructing, as the proposal footprint is in a water sharing plan area. As the work is unlikely to require any dewatering and the proposal is to use water from the public water supply, approval from DPI Water is not required.</p>
<p>Biosecurity Act 2015: provides for the control of noxious weeds and other plant and pathogen species. It places a responsibility on land owners to control, remove and eradicate noxious weeds</p>	<p>Five priority weeds listed under this Act were recorded within the construction footprint. Four of these are also listed as weeds of national significance (WONS). Roads and Maritime have included safeguards to manage and prevent their spread as described in section 6.3.4.</p>

Legislation and application	Relevance to the proposal and further requirements
<p>Biodiversity Conservation Act 2016: includes provisions to maintain a healthy, productive, and resilient environment for the community, now and in the future consistent with the principles of ecologically sustainable development (ESD).</p>	<p>This Act requires that a test of significance (five-part test) is carried out if there is the potential for the proposal to have a significant impact on any threatened species, population or ecological community protected under the Act. Additional approval is needed if a significant impact is likely.</p> <p>The proposal would result in the loss of about 0.81 ha of River-flat Eucalypt Forest on Coastal Floodplains; a threatened ecological community listed and protected under this Act. Despite this, the community was assessed and classified as being disturbed in its character and nature, and as such, it was concluded that there would be no significant ecological impact on its values. Section 6.3.3 describes this in more detail.</p> <p>The only locally-recorded threatened species is the grey-headed flying fox, which is listed as vulnerable under the Act. Despite this, the proposal footprint contains no primary foraging habitat or hibernacula. As such, it was concluded that there would be no significant ecological impact on this species' values.</p>

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

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

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

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

Findings – matters of national environmental significance

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

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

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant

matters of national environmental significance. Section 6.3.4 of the REF describes the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

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

5. Consultation

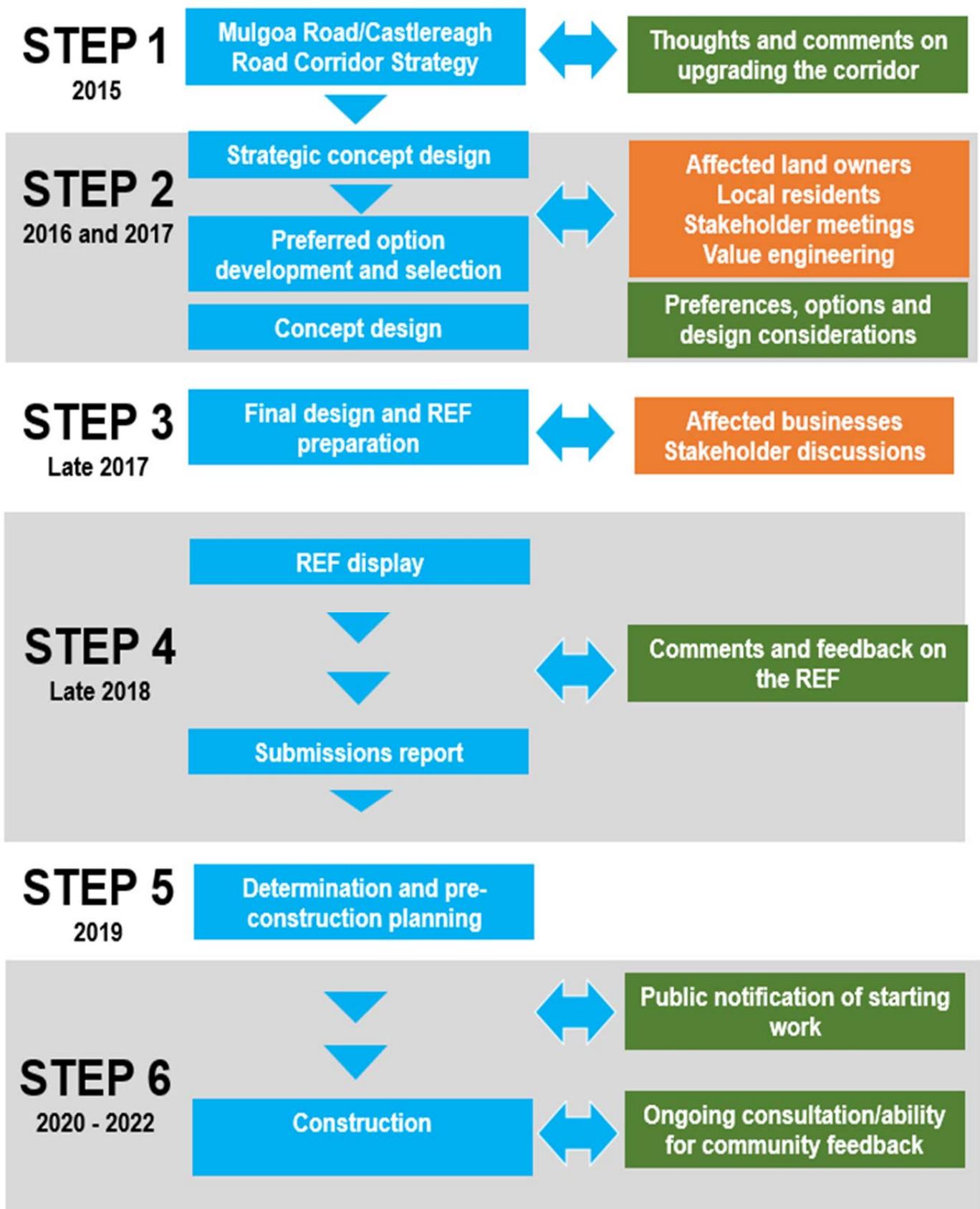
This chapter discusses the consultation carried out to date for the proposal and the consultation proposed in the future.

5.1 Consultation strategy

Roads and Maritime has prepared a community consultation and stakeholder engagement plan for the proposal. The plan's objectives are to:

- Build a positive working relationship with the local community and key stakeholders
- Advise directly-affected stakeholders and the community about the proposal, its potential impacts, and how they can obtain further information
- Brief parties affected by any temporary traffic management controls and access restrictions
- Promptly investigate and, where possible, resolve issues affecting the community and stakeholders
- Ensure issues relating to the proposal are identified and effectively managed
- Identify local issues to ensure the proposal aligns with community needs
- Inform and consult with impacted and interested stakeholder groups and businesses
- Involve key Government agencies and stakeholders.

Figure 5-1 shows the six main steps of the consultation process. The orange shaded boxes show where external stakeholders and Government agencies have been consulted and engaged with, while the green shaded boxes show where community consultation has taken place.



Source: Arup

Figure 5-1: Consultation process

5.2 Community involvement

Mulgoa Road/Castlereagh Corridor Upgrade

The proposal to upgrade the Mulgoa Road/Castlereagh Corridor was announced in August 2015 by issuing a community update to 13,000 residents and businesses and inviting people to submit their comments. In total, Roads and Maritime received 22 submissions covering a range of topics. It responded to each submission and relevant comments and concerns were taken into consideration in developing the preferred strategic concept design for the corridor.

Preferred strategic corridor and widening option

The preferred option for the upgrade of the Mulgoa Road/Castlereagh Corridor was published in April 2017 and a follow-up community update was issued to 16,000 residents and businesses inviting comment and feedback. This was supported by four community information sessions attended by 93 people, a media release, the publication of newspaper advertisements, use of static displays, doorknocking and consulting with affected stakeholders, email communications with interested parties, briefings, and online updates.

These activities resulted in 34 people providing comments and feedback. Penrith City Council also provided feedback and comments. While the range of comments and feedback was varied, several areas of concern were common as described in Table 5-1. Section 5.5 describes the feedback provided by Council and the subsequent consultation.

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

Group	Issue raised	Response/where addressed in REF
Common issues		
Residents and businesses	Amenity loss during construction through noise generation and access adjustments.	<p>The noise assessment (refer to section 6.2) identifies that certain construction activities would generate noise at levels that would have the potential to affect amenity for people that live, work, and/or use the facilities and services in the local area. The predicted levels of construction noise are consistent and typical of road work that takes place in an urban environment. Accordingly, Roads and Maritime would introduce a plan that includes standard safeguards and controls that are proven effective in managing and monitoring construction noise to acceptable levels.</p> <p>All access to and from Mulgoa Road would be maintained during construction. Various temporary traffic management controls would be introduced to complete the work to ensure a safe working environment while best maintaining access and minimising travel disruption (refer to section 6.1.4).</p>

Group	Issue raised	Response/where addressed in REF
	Operational access changes or loss to and from Mulgoa Road through the inclusion of active transport provisions, bus priority measures, and intersection modifications.	Despite the inclusion of public and active transport provisions, all access to and from Mulgoa Road would be maintained. Also, the increased capacity along Mulgoa Road would help improve the road's level of service and better-manage congestion now and in the future (refer to section 6.1).
	Amenity loss during operation due to an increase in road traffic noise exposure.	The noise assessment (refer to section 6.2) predicts that there would be a negligible increase in noise at most of the receivers in the area. However, widening the road around Hutchinson Crescent is predicted to result in an increase in noise where treatment measures would be needed to reduce the change in exposure. Appropriate treatment measures have been proposed in the form of a noise barrier (refer to section 6.2.5).
	Vegetation and tree loss along Mulgoa Road to accommodate widening.	The biodiversity assessment (refer to section 6.3) identified that most of the vegetation locally is disturbed, forming planted vegetation communities. The remainder, while native, is planted. Under the proposal, about 3.51 ha of this vegetation would be removed to widen the road. This would include up to 41 of the hollow bearing recorded in the construction footprint. While the vegetation is assessed as having limited ecological value, the removed trees would result in an amenity loss along the corridor. A landscape and urban design plan has been developed to reduce this loss, which includes refining the detailed design of the road to reduce the tree removal (refer to section 6.7.4).
	Offering solutions based on public transport improvements over widening the road	As described in section 2.1.6, State policy realises the need to provide people with travel choices. While a main objective of widening Mulgoa Road is to provide the increase in capacity needed to develop the area in the short-term, it is balanced by other objectives to encourage people to use alternative modes of transport by including bus-priority controls at the intersections and active transport provisions along the road (refer to section 2.3.1).
	Concern about emergency vehicle access and reliability during construction.	Emergency vehicle access along Mulgoa Road and to Jeanette Street would be maintained during construction (refer to Table 3-8).

Group	Issue raised	Response/where addressed in REF
	Objection to the introduction of more traffic lights on Mulgoa Road as this would affect traffic flow and journey times	The proposal does not include any additional signals (traffic lights) along Mulgoa Road. The phasing (timing) of the existing traffic lights would be optimised under the proposal to improve traffic flow and access at each intersection.
	Access provision for future development along Mulgoa Road including the Penrith Panthers Stadium due to the traffic and operational network changes	The proposed upgrade has been designed to provide an increase in capacity along Mulgoa Road needed to support the predicted additional traffic growth in the area, including the Penrith Panthers Stadium (refer to section 6.1). Roads and Maritime is also committed to consulting and collaborating with Penrith City Council as the proposal's detailed design is progressed ensure it continues to support development in the area.
Other issues		
Residents and businesses	Amenity loss due to an increased exposure to operational road-traffic pollutants.	The air quality locally is well within the health-based limits (refer to section 6.10). While the road alignment would bring traffic closer to property frontage, leading to reduced air quality, an increase in capacity and the associated improved traffic flows would reduce idling, leading to air quality improvements. Overall however, the extent of any changes would not be sufficient to have any associated amenity or health-impacts. Standard safeguards would be introduced to manage construction dust and other vehicle and equipment emissions. These controls are proven to be effective at avoiding and managing air quality impacts during construction.
	Concern about land and property value impacts from widening the road and bringing it closer to property frontages.	The needed property acquisition and residual evaluations are being considered in accordance with boundary adjustments and leasing arrangements in accordance with the equitable provisions of the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> , the supporting NSW Government Land Acquisition Reform 2016 and the Land Acquisition Guide and Policy (Roads and Maritime, 2012a and 2012b, refer to section 6.1

Group	Issue raised	Response/where addressed in REF
	Safety concerns about joining Hutchinson Crescent, Huron Place and Peter Court as this may encourage its use by more traffic.	The proposal, including the changes at Hutchinson Crescent, Huron Place and Peter Court, has been developed to recognised safety standards. The design has also been subject to an independent safety audit and design review to ensure it would present no risk for residents and road users. In terms of future traffic volumes, the proposal has been designed to accommodate traffic growth into the future (refer to section 6.1).
	Parking loss with introduction of bus lanes, active transport links and other Infrastructure	There is currently no on-street parking available on Mulgoa Road. The only parking that may potentially be affected would be customer and staff parking spaces at commercial properties on the western side of Mulgoa Road, while on-street parking restrictions may be introduced along Hutchinson Crescent, Huron Place and Peter Court. Roads and Maritime continues to consult with the commercial property owners and residents to identify opportunities to reduce the loss as the detail of the design is developed.
	Safety concerns from widening the road, upgrading the intersections and bringing traffic closer to residents	As described above, the proposal has been developed to recognised safety standards and subject to an independent safety audit and design review.

5.3 Aboriginal community involvement

Aboriginal heritage impacts have been considered under the first two stages of the four-stage Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI, Roads and Maritime, 2011c).

Table 5-2: Summary of Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial Roads and Maritime assessment
Stage 2	Site survey and further assessment
Stage 3	Formal consultation and preparation of a cultural heritage assessment report
Stage 4	Implement environmental impact assessment recommendations

The PACHCI stage two site survey was carried out in 2017 with a representative of the Deerubbin local Aboriginal land council (LALC) in attendance to assess the proposal’s potential to harm cultural heritage and values, and to determine whether formal Aboriginal community consultation and a cultural heritage assessment report was needed.

The conclusion of the site survey was that there was no Aboriginal heritage value or identified potential within the proposal footprint or local area. The LALC identified no additional concerns or issues that would warrant further assessment or consultation. Section 6.8 describes the detail of the Aboriginal heritage consultation and investigation carried out to support the proposal.

5.4 ISEPP consultation

Clause 94 of the ISEPP states that “development on behalf of a public authority for the purpose of a road or road infrastructure facilities may be carried out without consent” providing that certain key parties are consulted and/or notified about the work. Accordingly, Penrith City Council was consulted about the proposal as per the requirements of clause 13 of the ISEPP. This consultation is needed because the proposal is to connect and discharge into the Council’s stormwater system, and it would also likely cause disruption to existing pedestrian and vehicle accesses during construction.

Roads and Maritime notified Council under the above provisions in May 2018, building on the ongoing consultation that has taken place since 2015, as described in section 5.5. Council responded on 8 June 2018. Table 5-3 summarises the key issues raised by Council in relation to stormwater discharge and temporary loss of vehicle and pedestrian access during construction.

Table 5-3: Issues raised through ISEPP consultation with Penrith City Council

Issue raised	Response/where addressed in REF
Request that the assessment of construction traffic impacts is provided to Council by issuing the traffic management plan. Note that this assessment should include, but not be limited to an assessment of redistributed traffic, potential changes to patterns and an increase in vehicles on the network, including heavy vehicles.	Section 6.1 and Appendix C assess the proposal’s construction traffic impacts including the issues described by Council. Roads and Maritime would also continue to consult with Council and the local community about traffic management controls and impacts during construction, using the methods and provisions described in chapter 7.
Request that the above plan identifies how vulnerable users such as pedestrians and cyclists would be displaced on the local network during construction.	Section 6.1 and Appendix C describe the impact on pedestrians and cyclists and how this would be managed during construction using temporary diversions. Any temporary diversions would be as close to the original routes as possible so as not to displace, inconvenience or unnecessarily lengthen people’s journeys.
Request that consideration is given to possible intersection changes in the local area to provide access.	Section 2.4.3 describes the assessment and analyse of the Council’s recommendations to modify three intersections outside of the proposal footprint. In all cases, it was concluded that there would be no appreciable improvement in network performance, travel times or safety (in terms of road user conflict or accident risks) either on Mulgoa Road or in the local area from modifying these three intersections.

5.5 Government agency and stakeholder involvement

Various government agencies and stakeholders were consulted about the corridor and proposal shortly after it was announced. Table 5-4 summarises the consultation timeline and purpose of the consultation.

Table 5-4: Government agency and key stakeholder consultation timeline

Agency/stakeholder	Purpose
March 2017	
Penrith Homemaker Centre Penrith City Council	Meeting to discuss the implications of a development application from the Homemakers Centre to adjust the Wolseley Road access to allow an underground detention basin to be installed onsite.
June 2017	
Penrith City Council	Initial consultation to discuss design milestones and address unresolved issues that Council identified in responding to the Mulgoa Road/Castlereagh Corridor strategic corridor design (refer to Table 5-5).
September 2017	
Penrith City Council	Meeting to discuss the local and side road access strategy to inform the proposal's intersection design.
NSW Fire and Rescue Regentville Rural Fire Service Penrith Homemaker Centre Kids Academy Regentville BP Service Station Grey Gums Hotel Motel Western Motorcycles Regentville Public School Penrith City Council – Community and Planning Department	Direct engagement to obtain feedback and input to the development of the concept design.
December 2017	
Penrith City Council	Meeting to discuss and review the concept design and seek feedback.
Penrith City Council	Meeting to discuss the urban design treatments and consistency between the proposal and the local upgrades on the Northern Road and at the Jane Street intersection.
February 2018	
Penrith City Council	Second meeting to discuss the proposal's urban design treatment and planting strategy.
March 2018	
Penrith City Council	Meeting to discuss the preferred outcome for the proposal's active transport provisions and wider access strategy.

Table 5-5 lists the key relevant issues raised in the above consultation.

Table 5-5: Issues raised through stakeholder consultation

Agency	Issue raised	Response/where addressed in REF
Penrith City Council	Raised concerns with the safety of widening under the M4 Motorway bridge and the width of footpaths and the shared user path.	As noted in Table 3-2, the proposal has been designed to current safety standards and subject to an independent review to ensure there would be no risk to road users, pedestrians or cyclists. Through this process, specific safety measures have been included to the M4 Motorway bridge retaining structures and embankments with pier protection included.
	Concerns with tree planting being limited and not aligning with the principles of a green corridor, shade and cooling and the removal of trees in general.	As described in section 3.2.3, the landscape and urban design strategy includes sustainable measures to cater for pedestrian amenity and safety, consistent with the climate change adaption provisions. This includes a strategy that supports passive cooling and shade provisions within the design by replanting vegetation, proposed in the urban design strategy. The plan is also committed to reducing tree loss as the detailed design is developed.
	Suggested several design modifications to the proposed intersection arrangements and the road's median.	Roads and Maritime has considered the future capacity that the proposal needs to service in the future and accordingly intersection and median arrangements that balance the proposal's objectives, provide a safe design and deliver value for money. At this stage, the proposed intersection designs are considered to provide a safety-compliant design that provides the needed increase in capacity to support future growth and development. Nonetheless, Roads and Maritime is committed to continuing to consult and work with Council to improve and optimise the design. It continues to welcome suggestions and would introduce any that are feasible and reasonable.
	Removing access to the Shell service station on Mulgoa Road	Access provisions to the service station, including the entry and exit from Mulgoa Road are being retained.
	Raised concerns with reducing the speed limit in the shared transit zone to less than 40 km/h.	Following received submissions, the speed limit for the shared transit zone has been set to 40 km/h.
	Questioning if 20 customer car parking spaces be reinstated in the Amart carpark.	It is noted that several existing staff and customer parking spaces would be removed to accommodate road widening. The car park would be reconfigured to minimise the loss where feasible and efforts would be made to keep the same number of parking spaces where possible. This would be carried out in consultation with the business owner.
	Request graffiti removal solutions for the proposed noise wall.	Graffiti removal and vandal-proof design measures are considered as standard. This includes the proposed design of the noise barrier and retaining structures, and would be developed in the detailed design.

Agency	Issue raised	Response/where addressed in REF
	<p>Proposed road upgrade should consider the road standards required for the flood evacuation and include in the design. Roads and Maritime should consult with NSW SES to identify hydraulic/hydrologic standards required for flood evacuation.</p>	<p>Adequate flood immunity, consistent with current standards, has been provided in the design of the road levels and drainage which has accounted for the altered pavement area, and corresponding increased stormwater and runoff rates. Roads and Maritime has committed to further considering flood immunity and evaluation provisions as part of the detailed design as described in section 6.5.4.</p>
	<p>Request Roads and Maritime to consider roundabouts at three local intersections to address impacts on traffic flow: Spencer Street/Gibbs Street Pattys Place/Blaikie Road Glenbrook Street/ Warragamba Crescent</p>	<p>In developing the preferred option, consideration was given to providing the required level of service at each intersection to address changes to access (refer to section 2.4.3). It was concluded that the existing intersection design would largely provide the required level of service needed in the future, without the need for major design changes.</p>
<p>NSW Fire and Rescue Regentville Rural Fire Service</p>	<p>Request to ensure that there is a maintained right-turn provision out of Jeanette Street northbound to Mulgoa Road that can be accessed at all time.</p>	<p>Access for emergency vehicles and exiting and entering Jeanette Street would be maintained during construction and operation (refer to section 6.1).</p>
	<p>Request to ensure the necessary signage and marking are provided to ensure access, critically including peak bushfire season.</p>	<p>All existing signage including keep-clear road markings and warning lights would be maintained during construction and operation (refer to section 6.1).</p>
<p>Kids Academy Regentville</p>	<p>Requirement to maintain safe pedestrian and vehicle access to the academy and adequate parking at the academy under the proposal.</p>	<p>As mentioned in this table, the proposal has been designed to current safety standards and has been subject to an independent safety audit and review to ensure that all road users, including pedestrians and vehicles can enter the Kids Academy. Parking at the Kids Academy would not be impacted by the proposal.</p>
<p>BP service station</p>	<p>As the limit of property acquisition is close to the service station's underground fuel storage tanks there is concern that construction may result in the loss of this storage.</p>	<p>The proposal requires about 191 m² of land to be acquired from the BP service station (refer to Table 3-10). Roads and Maritime is consulting with the business owners to identify any operational impact on the service station, and has committed to carrying out further investigation and adjusting the design to limit any impacts, where possible. Roads and Maritime will then refine the design, working closely with the owners.</p>

Agency	Issue raised	Response/where addressed in REF
	Concern that the construction work may result in the closure of one or more of the pumps, which would affect business.	The above investigation and consultation would also be used to develop a construction work program that would minimise any impact on the service station's operations (refer to section 3.3).
Grey Gums Hotel Motel	Concern about access loss for hotel patrons.	As described in the table, the proposal's operational design would see access to all properties maintained, including the Grey Gums Hotel (refer to section 6.9). While traffic management controls would be temporarily introduced during construction, hotel guests would still have access (refer to section 6.1).
	Concern about a loss of user enjoyment while the proposal is being built for hotel patrons.	Safeguards would be introduced to minimise amenity-related impacts when building the proposal relating to the management of construction traffic, noise, visual amenity and air quality impacts (refer to chapter 7). Additional urban and noise amenity measures also form part of the proposal's operational design (refer to section 6.2.3). These have considered the permanent impact on the future amenity of hotel guests as described in chapter 7.
Western Motorcycles	Concern that the property acquisition would reduce the available space outside for the display frontage, which would affect business.	The design would be refined to reduce the area of property acquisition as far as practical and limit the amount of display frontage removed. Roads and Maritime would consult with the Western Motorcycles during detailed design to investigate where such refinements could be made.
	Concern about access loss for customers.	As described in the table, the proposal's operational design would see access to all properties maintained, including the Western Motorcycles (refer to section 6.9). While traffic management controls would be temporarily introduced during construction, customers would still have access (refer to section 6.1).
Regentville Public School	Concern from parents about it being safe for children to walk, cycle or take public transport to school.	Roads and Maritime has ensured the proposal is designed to current safety standards for all road users, including pedestrians and cyclists. Also, proposed bus priority measures are supported by ensuring the bus stops are moved to safe locations. These measures have been subject to an independent Road Safety Audit (RSA) and design review. The same review process would take place on the final detailed design. Roads and Maritime would also continue to work with the school and Council to understand their proposals to encourage parents to allow children to use alternative means to travel to and from school (refer to section 6.1).
	Request that more access opportunities and priorities are provided for school buses along Mulgoa Road, while aiming to reduce the number of cars on the road.	Priority measures such as queue jump facilities would be provided to improve the reliability of bus services and traffic flow (refer to section 6.1). Roads and Maritime is also in consultation with the bus operators and school to refine and detail the final bus arrangements (refer to section 6.9), which could include a focus on school bus services and access requirements.

5.6 Ongoing or future consultation

Roads and Maritime will continue to seek feedback from businesses, the local community, Penrith City Council, residents, and other key stakeholders as the design progresses. The REF will be displayed for comment. Roads and Maritime will also hold three community information sessions during this period. Following the public display period, Roads and Maritime will collate and consider the submissions received by preparing a submissions report, and responding to all issues raised. Roads and Maritime will then determine whether the proposal should proceed as described in the REF, or whether any changes are required. The submissions report will then be published on the project website. Roads and Maritime will notify those who made submissions and distribute a community update. The update will summarise the submissions report and the actions Roads and Maritime took to address comments. Subject to project determination, Roads and Maritime will continue to inform the community during construction.

6. Environmental assessment

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

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

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

6.1 Traffic and transport

This section describes the traffic and transport impacts that are predicted to occur from building and operating the proposal. This section summarises the Traffic and Transport Assessment prepared by Arup included in Appendix C.

6.1.1 Methodology

The purpose of the traffic and transport assessment was to evaluate:

- Temporary construction-related traffic and transport impacts
- Network performance changes in the future when the key projects in the area that are defining the need for the proposal (refer to section 2.1) would be fully developed
- Operational safety impacts and benefits
- Operational property access, public transport, and pedestrian and cyclist impacts and benefits.

Existing traffic and transport movements and network performance within and local to the proposal footprint were identified by using; published information, traffic count data collected in 2015, predictive traffic modelling outputs prepared for the wider corridor in 2017; and historic and future growth data, including information published by Transport for NSW.

It was important to consider how traffic growth along Mulgoa Road and in the local area would increase over the proposal's operational design life. As such, Roads and Maritime considered two alternative growth scenarios. The first was based on the data provided by Transport for NSW for the Mulgoa Road/Castlereagh Road corridor, Penrith Lakes, Thornton and Penrith Panthers areas, while the second considered an alternative of accelerated growth across the same areas as for scenario 1. The Transport for NSW data were selected by Roads and Maritime as being the more realistic growth scenario for the future as they were based on a continued stable growth rate of 1.2 per cent per year as has happened over the past 25 years.

Construction impacts were assessed using the information in section 3.3, including vehicle volumes, schedules and haulage routes, along with the effects of introducing temporary traffic management, access controls, and diversions on the road network.

Predicted changes to operational traffic in the future both with and without the proposal in place were identified using micro-simulation traffic modelling. Appendix C provides details of the collection of the traffic count data and modelling.

6.1.2 Existing environment

Road network

Road network surrounding Mulgoa Road

Mulgoa Road is a four-lane divided major arterial road. The proposal runs north-to-south for 1.3 kilometres connecting Jeanette Street and Blaikie Road. It also provides an important access to and from the M4 Motorway and Penrith CBD. It is part of the NSW heavy vehicle network, and therefore supports B-Double vehicles.

The section of Mulgoa Road that would be upgraded under this proposal operates with a 60 km/h posted speed limit. The M4 Motorway and five other roads intersect Mulgoa Road within the proposal footprint.

- Jeanette Street/Factory Road is a four-way intersection with Mulgoa Road, with only left-in left-out movements permitted. Except for emergency vehicles, no right-turn movement onto Mulgoa Road is allowed from Jeanette Street. Jeanette Street provides access to the Regentville Fire and Rescue Service, the Regentville Rural Fire Service and residents. Factory Road provides access to the Kids Academy and residents.
- M4 Motorway is a six-lane 40-kilometre motorway that connects the Sydney Metropolitan area to the Blue Mountains. It intersects with Mulgoa Road as a fully grade-separated interchange, which is partially signalised. In 2015, Roads and Maritime approved and committed to installing 'smart' technology on the motorway to better-manage traffic flow. This would involve installing traffic lights and extra lanes on each entry ramp to control, regulate and monitor traffic flows onto motorway, termed ramp-metering.
- Wolseley Street is a local road that provides access to the Penrith Homemaker Centre and other retail land uses. It forms a signalised intersection with Mulgoa Road. Traffic turning right from Mulgoa Road to Wolseley Street does so via a tunnel.
- Glenbrook Street is a two-lane collector road that provides access for residents living in Jamisontown between the M4 Motorway and Surveyors Creek. It forms a signalised three-way intersection with Mulgoa Road.
- Blaikie Road is a two-lane collector road that provides access for residents and to the commercial and retail land uses off Mulgoa Road, including Amart Furniture, Hungry Jacks and Western Motorcycles. It forms a signalised four-way intersection with Mulgoa Road.

Figure 2-2 shows the existing road network.

Traffic volumes and travel times

The 2015 traffic count data on Mulgoa Road (refer to section 3.3 of Appendix C) confirms that:

- Traffic volumes during the week are typically up to seven per cent higher than at the weekend
- The average typical daily traffic volume is up to 52,000
- About 10 per cent of the traffic is heavy vehicles
- The road is typically congested between 7am and 9am in the morning and 4pm and 6pm in the evening during the week as described further under the next heading. These are the peak periods. The most congested section of Mulgoa Road within the limits of the proposal footprint during the peak periods is the M4 Motorway interchange, which is approaching capacity
- Traffic volumes have increased by about 1.2 per cent every year since 1993; the extent of the available data
- Currently, the average time taken to travel through the proposal footprint is about three minutes in the morning and afternoon peak periods. For buses, this is higher at around four minutes. While the

posted speed limit is 60 km/h, traffic is travelling at between 20 km/h and 30 km/h during peak periods due to the congestion on the local road network.

Network performance

Performance is measured by the time it takes for a vehicle to travel through an intersection, termed the average delay per vehicle. In turn, this leads to the intersection providing a level of service (LoS) for the traffic that uses it. Correspondingly, LoS and delay are the terms used to measure congestion. There are six LoS', from 'A', excellent with delays of less than 15 seconds, to 'F', unacceptable with delays of more than 70 seconds. Typically, a road is considered congested where the LoS is 'D' or worse. Table 6-1 summarises the LoS at the intersections/interchange described in the previous section. It confirms that the M4 Motorway is the only intersection/interchange with a LoS that is approaching unacceptable.

Table 6-1: Average intersection delay and level of service in 2015 during the peak periods

Intersection/Interchange	2015 baseline			
	Morning peak period		Afternoon peak period	
	Average delay (s)	LoS	Average delay (s)	LoS
M4 Motorway interchange westbound	48	D	21	B
M4 Motorway interchange eastbound	25	B	36	C
Wolseley Street	10	A	18	B
Glenbrook Street	23	B	17	B
Blaikie Road	12	A	24	B

Crash statistics

Since 2012 while there have been 76 crashes on this section of Mulgoa Road no one was killed and 35 people were injured. Most of the crashes happened at intersections during peak periods. This suggests that congestion and driver error were contributing factors.

Public transport services and infrastructure

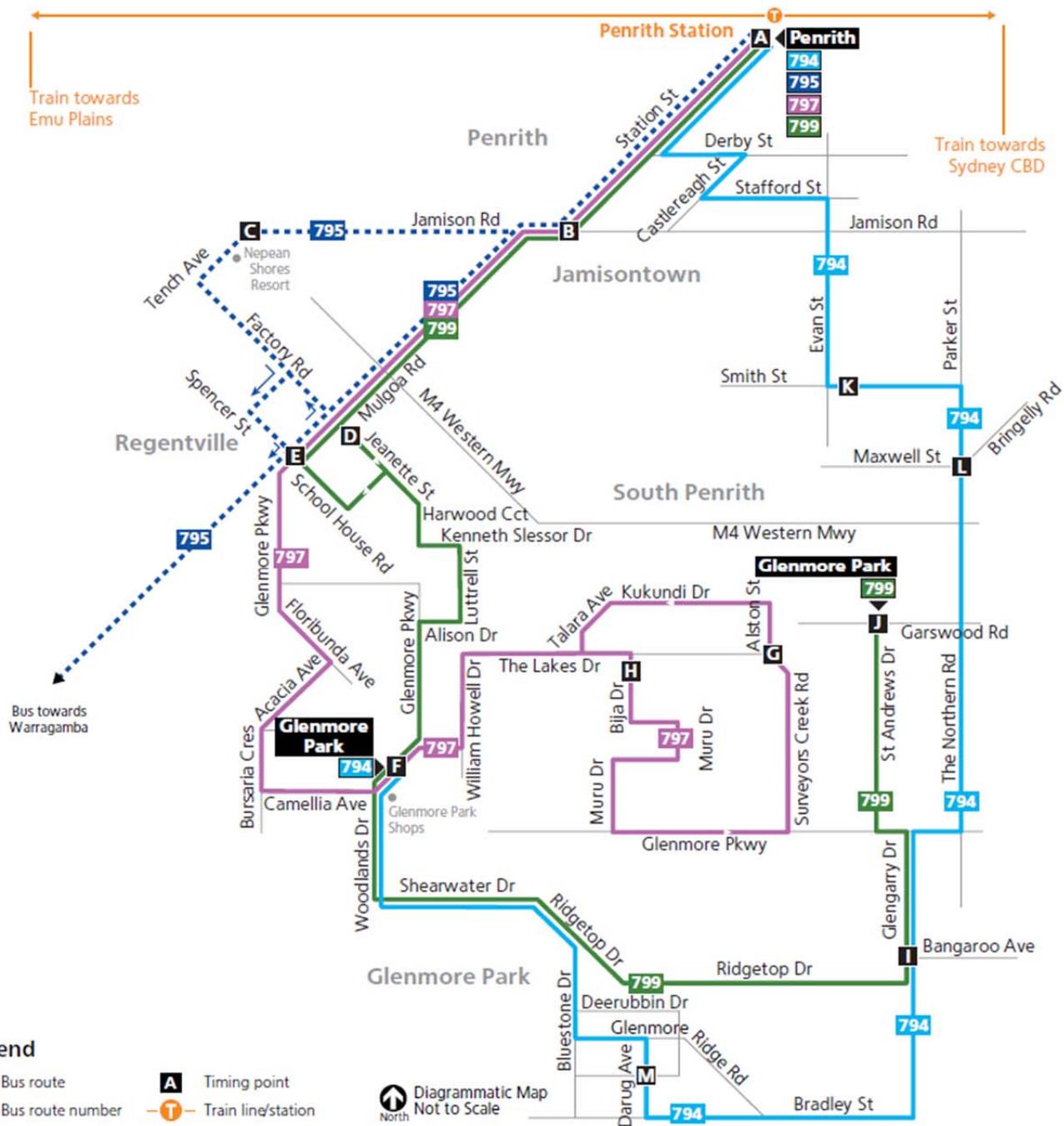
Bus services

Four Busways services operate along Mulgoa Road between the Penrith Transport Interchange on Belmore Street to various suburbs to the south of the M4 Motorway (781, 795, 797 and 799). In combination, these routes service Mulgoa Road with one bus operating every half hour on average during the peak periods. These services are shown in Figure 6-1.

Two Blue Mountains Bus Company services also travel along Mulgoa Road between the Great Western Highway and High Street, the Penrith Transport Interchange, and then onto M4 Motorway via Ransley Street (690P and 691). In combination, these routes service Mulgoa Road with one bus operating every half hour on average during the peak periods.

There are six bus stops within the proposal footprint servicing the above routes.

Figure 6-1 shows the bus routes and services through the proposal footprint.

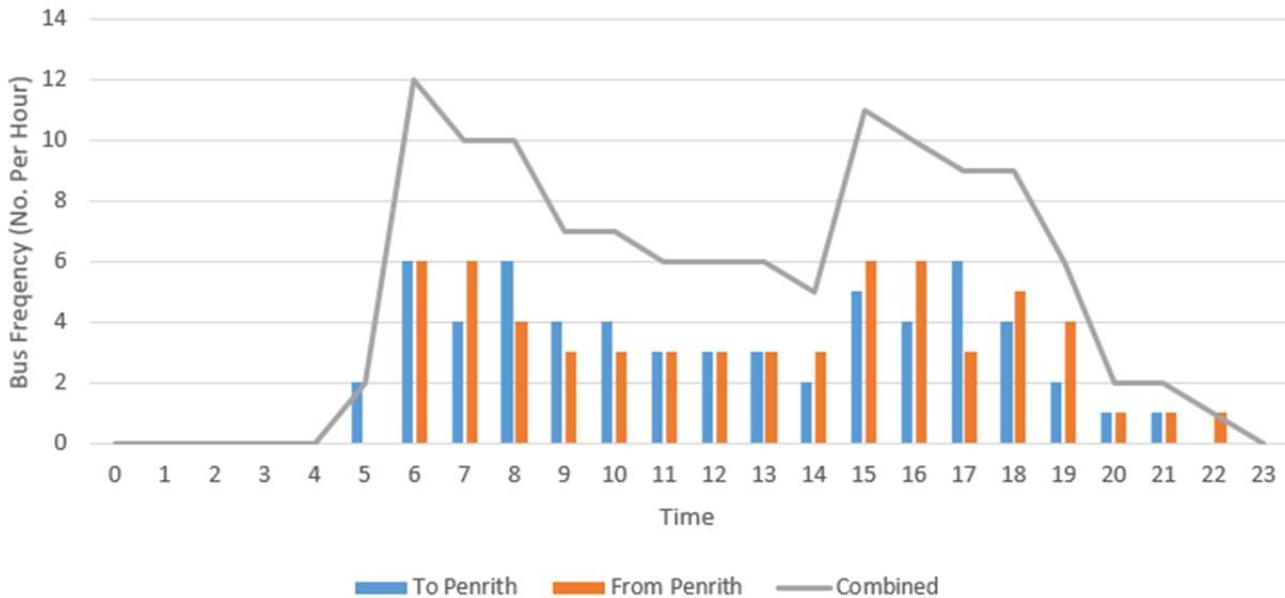


Source: Busways and Blue Mountains Bus Company

Figure 6-1: Existing bus routes and services along Mulgoa Road

Bus Frequency on Mulgoa Road (2018)

Between Jeanette St and Blaikie Rd



Source: Busways and Blue Mountains Bus Company

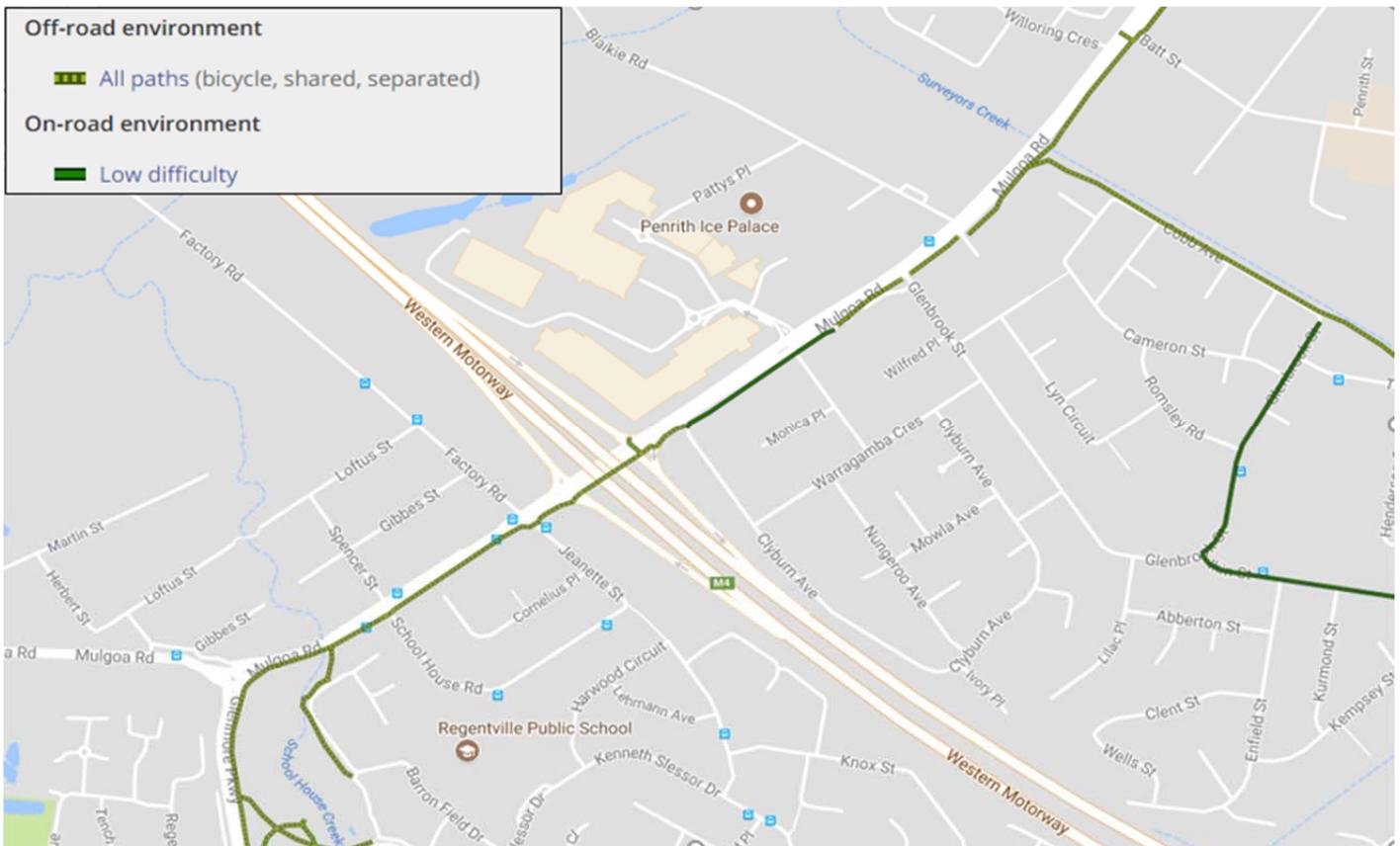
Figure 6-2: Daily bus operations and service frequency

Train services

Penrith train station is about three kilometres north of the proposal footprint. It operates services on the T1 Western Line. It is also serviced by the Blue Mountains intercity line. There are about five services per hour in each direction, increasing in frequency to about a ten-minute service interval during peak periods. About 7,500 passengers use the station during a weekday. The station is mainly used by commuters.

Active transport provisions

There are active transport facilities local to Mulgoa Road that provide dedicated off-road cycling lanes as well as cycle friendly roads. Figure 6-3 shows the local cycle network, which includes the existing off-road shared use facilities along the eastern side Mulgoa Road and the on-road facilities alongside Hutchinson Crescent, Huron Place and Peter Court. There is a footpath along the western side of Mulgoa Road within the extent of the proposal footprint. Each main intersection is signalised and includes pedestrian/cycle crossings.



Source: Cycleway finder

Figure 6-3: Existing cycling facilities locally

Usage

Figure 6-4 shows the Strava cycling and walking heat maps in the local area. The yellow and orange routes show more usage compared to the darker routes. As can be seen, the active transport provisions on Mulgoa Road appear to be well used; however, the highest (near white) walking and cycling activity takes place alongside the Nepean River. The data are only indicative as not all walkers and cyclists use Strava.



Source: Strava

Figure 6-4: Walking and cycling heat maps

Existing travel characteristics

In 2016, about 88 per cent of residents living in the area travelled to and from work by car while about 95 per cent of workers in the area travelled by car.

Table 6-3 shows the range of transport modes that people living and working in the area used to travel to and from work. Most residents in the area work in the Greater Western Sydney region, with only eight per cent working in Penrith. The highest proportion of residents that work in the Greater Western Sydney region, 25 per cent, live in Glenmore Park and Jamisontown.

The high car use suggests that the existing active transport infrastructure and bus stops within the proposal footprint are not well-used by commuters.

Table 6-2: Journey to work patterns

Intersection/Interchange	Car	Train	Bus	Walk	Cycle	Other
How residents in the area travel to work	87.7	10.0	1.0	1.1	0.2	-
How workers in the area travel to work	94.7	1.3	1.0	2.2	0.4	0.3

Source: 2016 Census, Travel to Work Data

6.1.3 Potential impacts

Construction

As discussed in section 3.3, the proposal would generate heavy vehicle movements at regular intervals during construction, while workers would travel to and from site on the fringes of the peak periods. Traffic management controls in the form of speed and lane restrictions, and occasional lane/road closures would also be introduced, which would temporarily affect travel times and journey reliability along Mulgoa Road for up to two years while the proposal is being built. Table 6-3 summarises the likely impacts associated with these construction activities and controls.

Table 6-3: Proposal impact during construction

Category	Impact
Road	<p>There would be the need to transport equipment and materials to site and remove waste from site on a routine basis. There would also be the regular movement of construction traffic onsite every day, including to and from the construction compound and materials storage area (refer to section 3.3.6).</p> <p>Based on the scale and nature of the proposal, it is predicted that there would be about 200 heavy vehicle movements throughout the day, or roughly 20 per hour. This would be less than a one per cent increase in traffic on Mulgoa Road at any point during construction. This would have a negligible impact on road network performance in the area.</p> <p>Various forms of traffic management would be needed along Mulgoa Road during construction (refer to section 3.3.6). While the specific details would be confirmed by the contractor, it is assumed that individual lane or full road closure would be needed along Mulgoa Road at certain times to undertake certain work activities. Roads and Maritime would seek to program work activities requiring lane and road closures to periods of reduced traffic volumes such as school holidays, weekends and at night to minimise impacts on the road users. The night work program would be confirmed with Council and others, and agreed under the terms of a road occupancy licence (ROL, refer to section 7.3). The ROL would outline permitted lane closures and diversions at specific times and days. This would extend to agreeing specific lane closures and diversions.</p> <p>Speed restrictions and traffic control zones are also likely to be set up and remain in place for most of the work program. This would allow construction traffic to enter and leave sections of the construction and proposal footprints.</p> <p>Collectively, these controls are likely to result in some marginal temporary travel time delays resulting to inconvenience road users. This would be greatest for the people that routinely travel along Mulgoa Road and the intersecting roads. The delays are likely to be in the form of an increase of a few minutes. Any impacted adjacent properties along identified diversion routes would be identified and managed through the measures in section 6.1.4.</p> <p>The frequent movement of construction traffic and heavy vehicles may damage road surfaces over time. Roads and Maritime would limit this through provisions included in the contractors traffic management plan, including carrying out road-conditions surveys before starting and finishing work, and making good any damage, as described in section 6.1.4.</p>
Parking	<p>Construction worker parking would be at the site compound or at designated places within the construction footprint. This would include enough space for some 200 vehicles, equivalent to the expected maximum number of people working onsite at any one time (refer to section 3.3). Staff would not be allowed to park on public roads in the area. The current on-street parking provisions along Hutchinson Crescent, Huron Place and Peter Court may be restricted while this section is being upgraded. However, there is sufficient alternative on-street parking on local roads and private driveway parking for the impacts to be limited to the minor inconvenience and disruption caused.</p>

Category	Impact
Local access	Access to all properties and businesses would be maintained throughout, however there may be instances where traffic is controlled into and out of properties on safety grounds. This may inconvenience residents, customers, workers, and delivery vehicles. Businesses with direct access onto Mulgoa Road are likely to temporarily experience some access changes during construction. Construction work would be planned and staged to minimise any local road access impacts where possible, and again agreed under the ROL and implemented under a traffic management plan. This would be done in consultation with each affected business and/or resident.
Bus	Bus travel times through the proposal footprint are likely to be temporarily affected through the introduced traffic management controls. All services would still operate, with Roads and Maritime working with the bus operators to confirm final arrangements. Some existing bus stops in the proposal footprint would also be temporarily relocated to carry out certain work. This may inconvenience passengers who have a longer walk to and from the temporary stops, while for others they may have a shorter distance to walk.
Pedestrians	Footpaths would remain open and accessible during construction. Occasional temporary footpath and pedestrian diversions may be needed to maintain access while allowing construction to take place. This may inconvenience people and it may take longer for people to walk to their destinations. There may also be some frustration for people who work on Mulgoa Road, as their access to commercial frontages may be occasionally restricted during construction. Roads and Maritime would prioritise making these diversions as direct wherever possible with fewest crossing points.
Cyclists	Cycle paths would remain open and accessible during construction. As above, Roads and Maritime would prioritise making any temporary diversions as direct as possible with the fewest crossing points. Again, this would inconvenience the cycle community through introduced delays and detours and the possible need to stop more frequently at intersections.

Operation

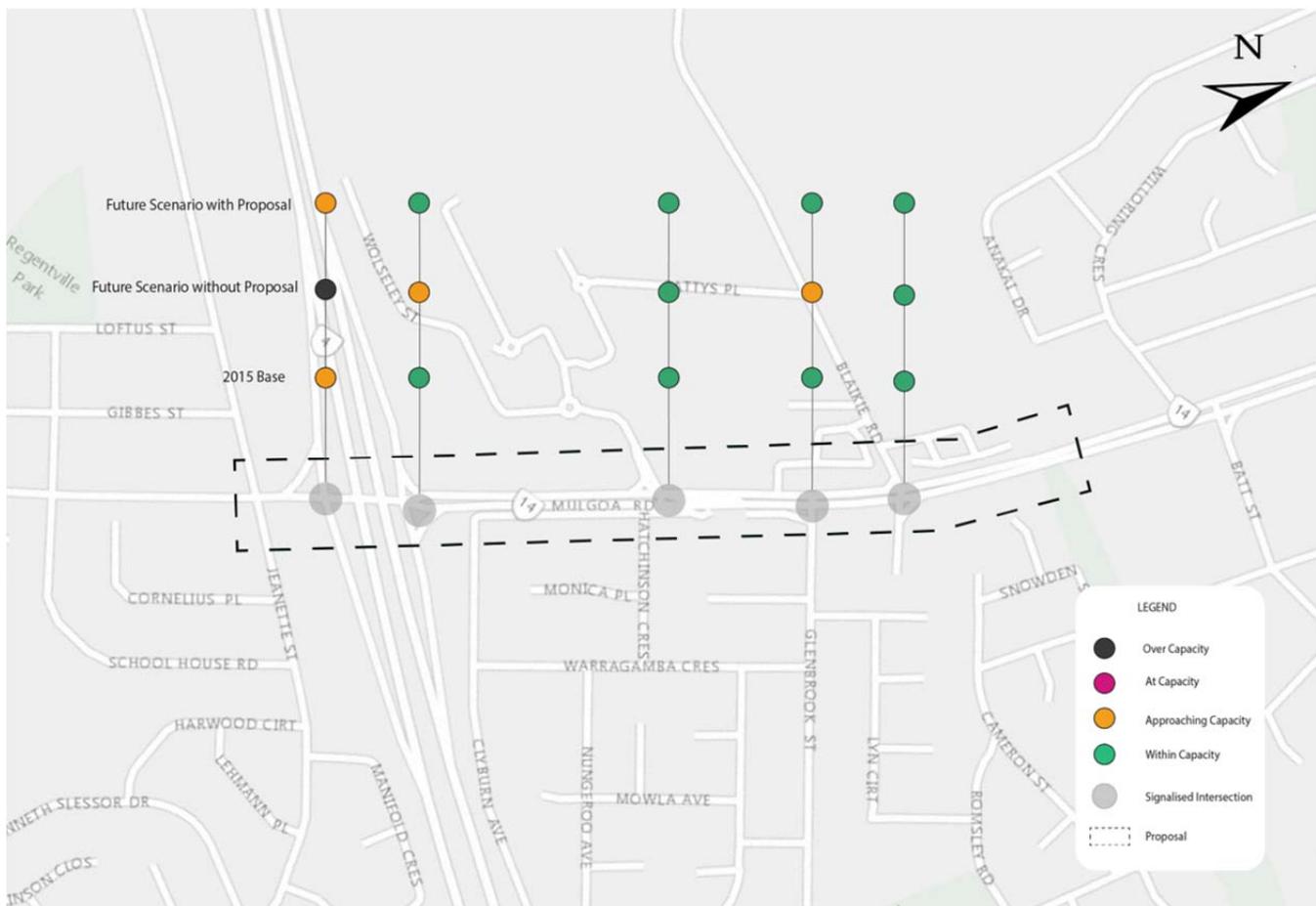
Overall, the proposal would have several positive traffic and transport impacts including:

- Travel-time saving benefits from providing additional capacity and improving the network arrangements
- Road user safety benefits by improving connectivity and reducing congestion
- Road network reliability improvements.

Traffic network performance improvements

Figure 6-5 and Figure 6-6 show the model-predicted intersection performance in the future with and without the proposal. Table 6.4 and Table 6.5 show the predicted LoS and delays in the morning and afternoon peak periods in the same year.

The model predicts that without the proposal in place the M4 Motorway interchange and the Blaikie Road intersection would be operating over capacity (LoS F), where traffic would be delayed for longer than 100 seconds. The other intersections in the proposal footprint would operate within capacity (LoS C). In comparison, by building the proposal all intersections would provide additional capacity in the future to service the road traffic (LoS A or LoS B), while the M4 Motorway interchange would be approaching capacity (LoS C). The added capacity would therefore reduce delays and improve travel times along Mulgoa Road, therefore meeting two key objectives of the proposal referred to in section 2.3.

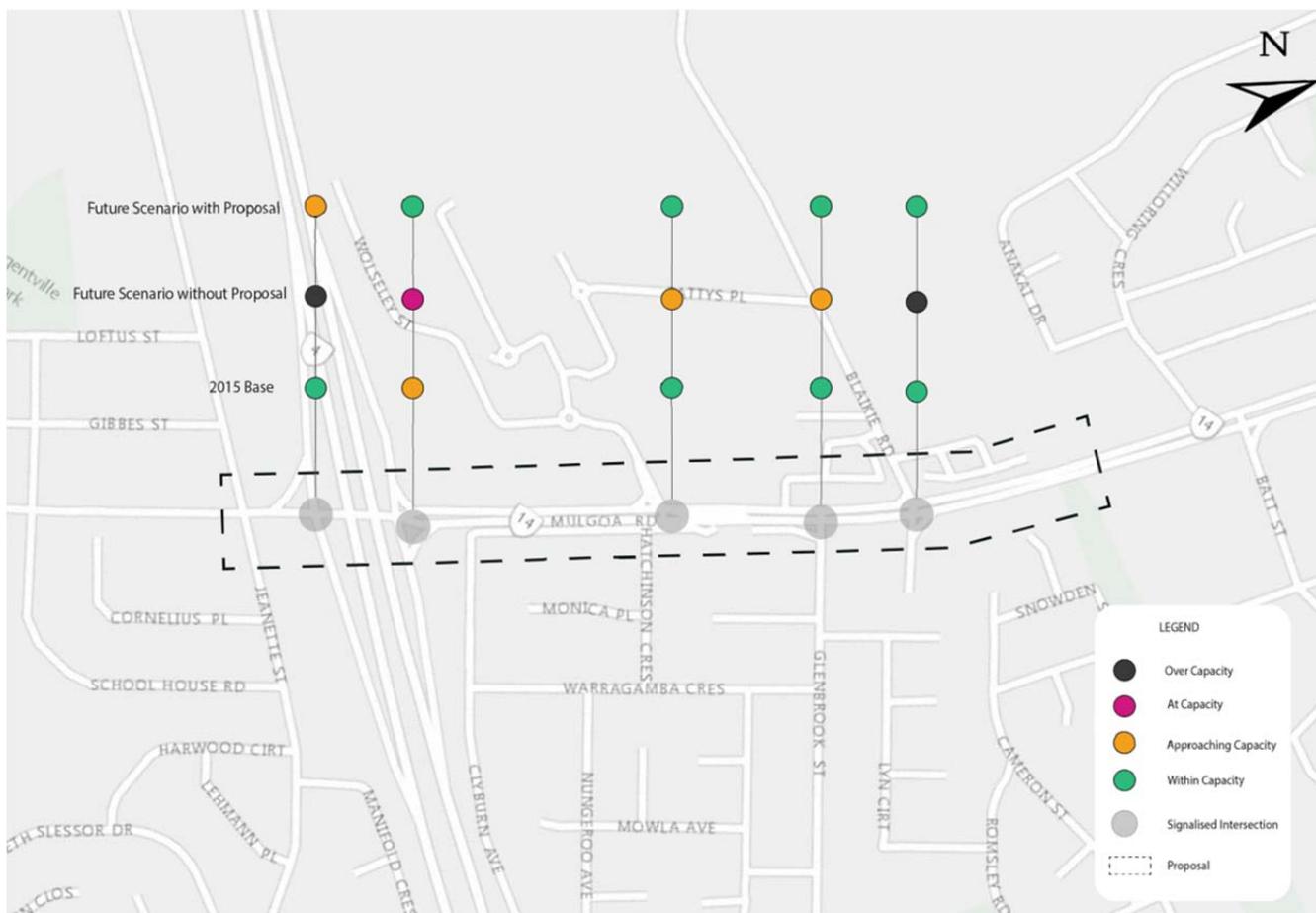


Source: Arup

Figure 6-5: Morning peak intersection performance in the future

Table 6-4: Morning peak average intersection delay and level of service in the future

Intersection	Without proposal		With proposal	
	Average delay (s)	LoS	Average delay (s)	LoS
M4 Motorway interchange westbound	178	F	39	C
M4 Motorway interchange eastbound	40	C	26	B
Wolseley Street	20	B	10	A
Glenbrook Street	36	C	19	B
Blaikie Road	10	A	17	B



Source: Arup

Figure 6-6: Afternoon peak intersection performance in the future

Table 6-5: Afternoon peak average intersection delay and level of service in the future

Intersection	Without proposal		With proposal	
	Average delay (s)	LoS	Average delay (s)	LoS
M4 Motorway interchange westbound	162	F	36	C
M4 Motorway interchange eastbound	60	E	25	B
Wolseley Street	34	C	10	A
Glenbrook Street	42	C	20	B
Blaikie Road	115	F	19	B

Travel time savings

In future, without upgrading Mulgoa Road, it is likely to take up to seven minutes for most vehicles to travel through the proposal footprint, increasing to nine minutes for stopping bus services. Comparatively, with the proposal built, this is significantly reduced, with most vehicles travel times reduced to less than three minutes and, the now prioritised, bus journeys taking around 3.5 minutes.

Road access changes

There may be some modifications to some residential and commercial property accesses directly onto Mulgoa Road, which will be confirmed during detailed design. There would also be the following intersection modifications under the proposal:

- The left-out access from Factory Road on to Mulgoa Road would be removed to improve safety with road users accessing Mulgoa Road via Spencer Street
- Increasing the lane capacity on the eastbound and westbound exit ramps from the M4 Motorway
- Removing the Wolseley Street tunnel, which provides access to the Penrith Homemakers Centre, and replacing it with two dedicated right-turn lanes at the Wolseley Street intersection
- Creating a designated left-turn lane into Glenbrook Street from Mulgoa Road
- Creating a designated right-turn lane into Blaikie Road from Mulgoa Road.

These access changes are proposed to improve intersection performance and result in the network improvements described in the previous section. The only negative impact would be the inconvenience and minor increase in travel times for road users who are used to having right turn access from Mulgoa Road to properties on the western side, south of Factory Road. The installation of a raised median would prevent this right turn movement and residents would have to use the roundabout further south at Glenmore Parkway to return to their driveway.

The traffic analysis that was carried out to test the suitability of this change (refer to chapter 2) confirmed that this change would not affect the network performance or level of service on Spencer Street. The predicted increase in traffic would also be insufficient to have any material operational noise impact on adjacent receivers to the extent of needing to consider installing mitigation treatments (refer to section 6.2.4 and section 6.2.5).

Public transport

Bus priority lanes would be provided on the southbound approach at the Wolseley Street and Glenbrook Street intersections and the northbound approach at the Blaikie Road intersection.

The bus priorities would improve journey and travel-time reliability potentially up to 5.5 minutes (refer to the previous section) for the six services that operate along Mulgoa Road (781, 795, 797, 799, 690P and 691). This would benefit existing and future passengers. It may also encourage more people to travel by public transport, while it would allow for the introduction of additional bus services to support the area's expansion and development.

Several bus stops would also be need relocating to better support the predicted changes in traffic and the inclusion of the bus priorities. The exact positioning of bus stops during the operational phase would be further investigated during the detailed design in consultation with the bus operators.

Active transport

The retention of footpaths and crossing provisions along Mulgoa Road and its intersecting roads would be supplemented through the inclusion of a separated active transport corridor along the eastern side and the relocation of the footpath along the western side, which would also be separated from the main traffic lanes. Hutchinson Crescent, Huron Place and Peter Court would be connected and converted to a shared transit zone marked for use by vehicles and cyclists. The footpath along the western kerb would also be retained as show in Figure 6-3.

While these provisions would ensure existing and future pedestrians and cyclists are catered for, the separation from the main traffic lanes would also improve user amenity. This would be supplemented by the shading provided by proposed landscape planting strategy (refer to section 3.2.3). Additional changes to vehicle access arrangements from Glenbrook Street to Peter Court are also proposed to create a safer user environment for pedestrians and cyclists. Overall, the aim is to make the active transport provisions a more attractive travel choice for people to use.

6.1.4 Safeguards and management measures

Table 6-6 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix C contains further details on the specifics of the safeguards and management measures.

Table 6-6: Environmental safeguards for 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 Roads and Maritime Traffic Control at Work Sites Manual (RTA, 2010) and QA Specification G10 Control of Traffic (RTA, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • Confirmed haulage routes • Confirmed temporary diversion routes and management provisions • Road condition and dilapidation surveys pre-and-post construction plus repair commitments • 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 	Contractor	Detailed design/pre-construction	<p>TT1</p> <p>Section 4.8 of QA G36 <i>Environment Protection</i></p>

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>mechanisms</p> <ul style="list-style-type: none"> Stipulated parking restrictions including not allowing staff, contractors or delivery vehicles to park on public roads. 			
Traffic and transport	<p>Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the RTA's Community Involvement and Communications Resource Manual (RTA, 2008a). Consultation will include but not limited to door knocks, newsletters or letter box drops providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.</p>	Roads and Maritime project manager	Detailed design/pre-construction	TT2
Traffic and transport	<p>Business needs, including peak customer periods, would be considered within the TMP where feasible and reasonable.</p>	Contractor	Pre-construction	TT3
Access	<p>Requirements for any changes to local access arrangements will be confirmed during detailed design in consultation with the local road authority and any affected landowners.</p>	Roads and Maritime project manager	Construction	TT4
Access	<p>Disruptions to property access and traffic will be notified to landowners at least five days in accordance with the relevant community consultation processes outlined in the TMP.</p>	Contractor	Construction	TT5
Pedestrian and cyclists	<p>Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.</p>	Contractor	Construction	TT6
Public transport and school buses	<p>Access for public transport services, including school bus services, will be maintained. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community.</p>	Contractor	Construction	TT7

6.2 Noise and vibration

This section describes the noise and vibration impacts that are predicted to occur from building and operating the proposal. This section summarises the Noise and Vibration assessment prepared by Arup included in Appendix D.

6.2.1 Methodology

This section describes the noise and vibration monitoring, modelling and assessment methods. The overall assessment method involved:

- Identifying the noise and vibration assessment study area and associated sensitive receivers
- Describing the existing noise environment
- Defining the criteria adopted to assess the proposal's noise and vibration impacts
- Presenting the predicted construction noise and vibration levels associated with building the proposal
- Presenting the predicted operational road traffic noise levels at identified sensitive receivers
- Presenting the feasible and reasonable safeguards and management measures that should be introduced to mitigate noise and vibration impacts when building and operating the proposal.

The noise and vibration assessment was carried out in accordance with:

- Environmental Noise Management Manual (ENMM, RTA, 2001)
- Assessing Vibration, A Technical Guideline (EPA, 2006)
- Interim Construction Noise Guideline (ICNG, EPA (DECC), 2009)
- Road Noise Policy (RNP, EPA (DECC), 2011)
- Procedure: Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2014c)
- Noise Criteria Guideline (NCG, Roads and Maritime, 2015a)
- Noise Mitigation Guideline (NMG, Roads and Maritime, 2015b)
- Noise Model Validation Guideline (NMVG, Roads and Maritime, 2016c)
- Construction Noise and Vibration Guidelines (CNVG, Roads and Maritime, 2016a)
- Noise Policy for Industry (NPI, EPA, 2017).

Noise monitoring and analysis

Existing ambient noise levels were determined by carrying out attended and unattended monitoring at two locations in October 2017. These locations were considered to represent a collection of commercial, residential and educational receivers in the local area that would be similarly affected by the proposal. Termed noise catchment areas (NCAs), Table 6-7 details what they represent and Figure 6-7 shows the monitoring locations and the extent of the two defined NCAs.

The measured ambient noise levels were used to establish construction noise management levels (NMLs) in accordance with the CNVG. These NMLs form the criteria that the proposal's noise and vibration construction impacts were assessed against (refer to section 6.2.3).

The noise monitoring results were also used to measure the existing road traffic noise levels at sensitive receivers. This was used for the assessment of operational impacts.



Source: Arup

Figure 6-7: Noise measurement locations and sensitive receivers

Table 6-7: Noise catchment areas and monitoring locations

NCA	Description	Measurement location address	Minimum distance to the proposal and description
NCA1	Mainly single-storey residential receivers on the eastern side of Mulgoa Road. Also includes the BP service station and Red Rooster. The western side of Mulgoa Road in this NCA mainly comprises commercial property and includes the Penrith Homemakers Centre and other retail facilities. Ambient noise levels in the area are dominated by road traffic.	Logger 1 1 Huron Place, Jamisontown	30 metres Located on the eastern side of Mulgoa Road at the Huron Place intersection
NCA2	Mainly residential receivers comprising single and multi-storey properties either side of the road. Also includes educational, childcare and commercial properties. Again, ambient noise in the area is dominated by road traffic.	Logger 2 24 Mulgoa Road, Regentsville	25 metres Located on the western side of Mulgoa Road about 60 metres north of the Spencer Street intersection.

Construction noise and vibration

The construction assessment reviewed how the proposed activities, methods and scheduling described in section 3.3 would affect sensitive receivers in the local area. The assessment was completed in accordance with the CNVG. The CNVG defines the assessment methods and suggests noise management measures based on the length of the work, the number of people affected, and the time the work would take place, including works outside of standard hours.

Modelling was used to predict the noise levels that would be generated from carrying out construction work, including use of equipment associated with the proposal. Various inputs and parameters were used in the model, such as prevailing weather conditions, topography, existing buildings, structures and barriers, as they affect how noise disperses.

A qualitative method based on adopting safe working distances was used to assess the potential vibration impacts on buildings and people in the area.

Operational noise

The proposal would affect travel times and network performance on Mulgoa Road in the future (refer to section 6.1). This would also affect road traffic noise levels locally, the impact of which was assessed using modelling methods carried out in accordance with the NCG. The assessment considered the difference in noise levels between building and not building the proposal. The assessment considered the impact of the proposed 2022 opening year and then a 2032 design year.

Section 4 of Appendix D outlines the modelling approach, methods and assumptions as relevant to the NCG. It also describes the approach that was taken to validating the modelling, consistent with the approach and requirements of the NMVG.

6.2.2 Existing environment

Ambient and background noise levels

The existing environment in the area is mainly dominated by road traffic noise, including heavy vehicles, from Mulgoa Road and the high traffic volumes on the M4 Motorway.

Table 6-8 provides the background monitored noise levels across the local area. The reported data show the rating background levels (RBL) which were used to define the NMLs.

The table also shows the average ambient noise levels during the day (15-hour averaging period) and at night (nine-hour averaging period) and the highest average noise levels (one-hour averaging period) defined under policy. These were used to assess operational road traffic noise impacts (refer to section 6.2.3 for further detail).

As is typical of most urban and suburban areas, the monitored noise levels are lower at night and during the evening than during the day due to a decrease in traffic; the dominant noise source. As monitoring location was slightly closer to Mulgoa Road in NCA 2 this reflects the higher monitored levels.

Table 6-8: Summary of unattended noise measurements

Noise Monitoring Location	Monitoring period	Noise Levels dB(A)						
		RBL			RNP defined time periods ²			
		<i>Used to assess construction noise impacts</i>			<i>Used to assess operational noise impacts</i>			
		Day	Evening	Night	Day $L_{Aeq(15hour)}$	Night $L_{Aeq(9hour)}$	Day $L_{Aeq(1hour)}$	Night $L_{Aeq(1hour)}$
NCA 1	Weekday ³	50	45	32	66	61	67	66
	Full week	50	45	32	65	61	66	66
NCA 2	Weekday ³	59	54	39	68	64	68	69
	Full week	59	54	38	68	64	68	68

(1) ICNG Assessment Periods – Day: 7am to 6pm Monday to Saturday, 8am to 6pm Sunday; Evening: 6pm to 10pm; Night: 10pm to 7am Monday to Saturday, 10pm to 8am Sunday.

(2) RNP Assessment Time Periods – Day: 7am to 10pm; Night: 10pm to 7am (weekly data).

(3) Appendix B1 of the RNP states average weekday volumes are preferable for road traffic noise assessments and have been used in this assessment. To validate predictions based on weekday volumes, weekday measurement results are presented.

Sensitive receivers

Noise and vibration has the potential to affect a range of sensitive receivers in the local area as described below. This may be in the form of a noise improvement for certain receivers and impacts for other receivers.

Most of the receivers in the NCAs comprise residential properties, which classify as suburban receivers under policy, meaning they are characterised as being exposed to decreasing noise levels during the evening and at night. Table 6-9 lists the specific educational and commercial receivers located in both NCAs that are shown on Figure 6-7.

Table 6-9: Educational and commercial sensitive receivers

Receiver type	Receiver	Location
Educational	Kids Academy Regentville (pre-school/childcare facility)	1 Factory Rd, Regentville
	Regentville Public School	28-34 School House Rd, Regentville
Commercial	Penrith Homemaker Centre	Lot 2 Pattys Place, Penrith
	Nepean Food Services, NSW Rural Fire Service & Fire Brigade.	8-20 Jeanette Street, Regentville
	7-Eleven	36 Mulgoa Rd, Regentville
	Jim Aitken & Partners	30 Mulgoa Rd, Regentville

6.2.3 Criteria

This section outlines the construction and operational noise assessment criteria used in this assessment.

Construction

Noise management levels

Noise assessment criteria used in this assessment comprise threshold exceedance levels and residential NMLs developed from the monitored noise levels in each NCA. Table 6-10 details the criteria used for deriving the residential NMLs and threshold exceedance levels. Table 6-11 summarises residential NMLs and sleep disturbance levels.

Table 6-10: Construction noise criteria for residential receivers

Aspect	Criteria	Standard	
Work activity noise Note: measured externally	Relative increase criteria (noise management levels)		
	Residents: standard hours <i>Noise affected</i>	Rating background level (RBL) + 10 dB $L_{eq(15\ min)}$	Note 1 and 2
	Residents: out of hours <i>Noise affected</i>	RBL + 5 dB $L_{eq(15\ min)}$	
	Residents: sleep disturbance	RBL + 15dB L_{Amax}	
	Threshold exceedance limits		
	Residents: standard hours <i>Highly noise affected</i>	75 dB (A) $L_{eq(15\ min)}$	Note 1 and 2
	Education institutions (internal)	45 dB (A) $L_{eq(15\ min)}$	
	Commercial properties	70 dB (A) $L_{eq(15\ min)}$	

(1) Construction Noise and Vibration Guidelines (CNVG, Roads and Maritime, 2016a)

(2) Interim Construction Noise Guidelines (ICNG, DECC, 2009).

Table 6-11: Residential noise management levels

NCA	Standard hours: $L_{eq(15\ min)}$	Out of hours: $L_{eq15min}$			Sleep disturbance: L_{Amax}
	Daytime	Daytime	Evening	Night-time	Night
NCA 1	60	55	50	37	47
NCA 2	69	64	59	43	53

Construction traffic

An initial screening test has been provided in the CNVG that states the following: “For Roads and Maritime projects an initial screening test should first be applied by evaluating whether noise levels will increase by more than 2 dB due to construction traffic or a temporary detour due to a road closure. Where increases are 2 dB or less then no further assessment is required. Where noise levels increase by more than 2 dB (less than 2.1 dB) further assessment is required using Roads and Maritimes Criteria Guideline.”

Accordingly, where exceedances due to construction traffic were determined, corresponding noise mitigation as outlined in Appendix B and Appendix C of CNVG and the supporting application notes was considered.

Sleep disturbance

The ICNG discusses the method for assessing and managing sleep disturbance. It also refers to the criteria included in the RNP. The RNP indicates that people may potentially wake up where internal building noise levels are above 50 dBA to 55 dBA. The RNP also realises that noise levels can decrease by up to 10 dB from the outside to the inside of a building. Sleep disturbance can therefore occur where the maximum

external noise levels (L_{max}) are above 65 dBA, at which point feasible and reasonable noise treatments should be considered.

Vibration

Cosmetic building damage and amenity-related impacts

The use of vibration generating equipment during construction such as piling rigs and hammer drills can cause two impacts:

- Cosmetic building damage in the form of things like hairline cracks and plaster loss
- Amenity based (human comfort) impacts.

As there are no Australian Standards or guidelines for assessing cosmetic building damage Part 3 of German Standard DIN 4150 on the Effects of Vibration on Structures is often used. This measures the risk and potential for cosmetic building damage in terms of vibration velocities. Amenity based impacts are measured using the vibration dose values set out in Assessing Vibration: A Technical Guideline (EPA, 2006). The guideline also sets out preferred and maximum values for continuous and impulsive vibration measured in terms of acceleration levels and peak particle velocities.

The CNVG has translated the above in to a series of safe working distances developed by Transport for NSW in 2012 (refer to Table 6-12). These are set for nominated construction plant to minimise the impacts of cosmetic building damage and amenity-based comfort impacts. They are indicative and based on the impact from a continuous vibration source.

Table 6-12: Recommended safe working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance	
		Cosmetic damage ^{1,3,4}	Human response ²
Vibratory roller	< 50 kN (Typically 1-2 tonnes)	5 metres	15 metres to 20 metres
	< 100 kN (Typically 2-4 tonnes)	6 metres	20 metres
	< 200 kN (Typically 4-6 tonnes)	12 metres	40 metres
	< 300 kN (Typically 7-13 tonnes)	15 metres	100 metres
	> 300 kN (Typically 13-18 tonnes)	20 metres	100 metres
	> 300 kN (> 18 tonnes)	25 metres	100 metres
Hydraulic hammer	(300 kg - 5 to 12t excavator)	2 metres	7 metres
	(900 kg – 12 to 18t excavator)	7 metres	23 metres
	(1600 kg – 18 to 34t excavator)	22 metres	73 metres
Pile boring	≤ 800 mm	2 metres (nominal)	4 metres
Jackhammer	Hand held	1 metre (nominal)	Avoid surface contact

(1) Referenced from British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2

(2) Referenced from EPA's Assessing Vibration: a technical guideline (EPA, 2006)

(3) Referred to 15 mm/s vibration limit

(4) More stringent conditions may apply to vibration sensitive structures

Operation

The NCG define a range of assessment criteria that are to be considered when assessing road traffic noise impacts. Receivers identified to exceed these criteria are considered eligible for noise treatment in accordance with the NMG. The NCG classifies different criteria for new roads, redeveloped roads and transition zones. Section 4.3 in Appendix D provides a definition for each of these roads and confirms the classification of the roads in the local area.

The NCG details the implementation of the RNP assessment criteria for sensitive receivers affected by road traffic noise. For receivers that are not buildings (ie sports fields) then the noise criteria apply at the property/facility boundary.

Threshold criteria

The criteria in Table 6-13 were applied to assess operational road traffic noise impacts. The criteria represent the average levels of noise that occur over a 15-hour period during the day and a nine-hour period at night.

Table 6-13: Road traffic noise assessment criteria for residential and non-residential land uses

Road category	Road classification	Assessment criteria dBA	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/sub-arterial/collector ¹ roads	Redevelopment of an existing road ²	60 dBA $L_{eq}(15hr)$	55 dBA $L_{eq}(9hr)$
	New roads	55 dBA $L_{eq}(15hr)$	50 dBA $L_{eq}(9hr)$
	Transitional areas	55 to 60 dBA $L_{eq}(15hr)$	50 to 55 dBA $L_{eq}(9hr)$
All roads	School classroom (internal): <i>when in use</i>	40 L_{Aeq} , (1 hour)	-

(1) Collector roads are considered the same category as sub-arterial roads in the NCG

(2) Redevelopment includes an increase in carrying capacity, an increase in heavy vehicle numbers or instances where the road is not significantly realigned.

The criteria in Table 6-14 supplement the above criteria. They provide an allowable increase above the existing road traffic noise levels for residential receivers. These relative increase criteria (RIC) are intended to protect residential amenity from an excessive increase in noise from developing existing roads and building new roads. The criteria apply to all roads that are either built or redeveloped under the proposal.

Table 6-14: Relative increase criteria for residential land use

Road Category	Type of project/land use	Total traffic noise level increase dBA	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/sub-arterial/collector roads	Redevelopment of an existing road	Existing traffic $L_{Aeq}(15hr) +12$ dB	Existing traffic $L_{Aeq}(9hr) +12$ dB

6.2.4 Potential impacts

Construction

Activity based noise

Appendix D provides a list of the noise generating plant and equipment that was assessed as part of the construction assessment, which is consistent with the information in Table 3-6.

Table 6-15 summarises the overall sound power level of each of the key noise-generating activities that would be carried out during construction (refer to section 3.3). The table also shows when these activities are likely to take place.

Table 6-15: Summary of construction activities

Stage	Activities	Timing	Sound power level dB(A)
Enabling works	Survey/site establishment, sediment and erosion control, temporary barriers and structures	Day	100 - 105
	Trenching, relocation of critical utilities, bulk earthworks, compound establishment and stockpile, reconstruction	Day	116 – 120
Temporary work	Temporary traffic control measures	Night	106 – 110
Main work	Emergency cross overs/access, installation of road furniture, revegetation, signage	Day	106 - 110
	Strip topsoil, drainage	Day	111 - 115
	*Demolition and excavation work and *building retaining structures	Day	121 – 122
	*Pavement tie-in and asphalt laying	Night	121 - 122

(1) *loud construction activities

The loudest proposed construction activities would be:

- Demolition and excavation work carried out in the day to widen the road corridor
- Building the retaining structures during the day, despite these activities taking place some distance from the identified sensitive receivers
- Pavement tie-ins and asphalt laying at night.

While building the retaining structures would be the loudest activity (refer to section 5.1.2 of Appendix D), the highest noise levels would be limited to the very occasional use (less than five minutes at one time) of an air track drill, with a sound power level of 124 dBA. This means that for most of the time, construction of the retaining structures would have a similar noise level to more routine activities such as stripping topsoil or earthworks. As such, the use of the air drill could be controlled and restricted to very specific times during the day to the point of having no appreciable impact.

The assessment of construction noise assessed two scenarios; the potential impact associated with the loud construction activities, including the use of the key associated noise-generating equipment over short-periods of time, and the potential impact of typical construction activities, which are likely to be more consistent across the construction phase.

Loud activities

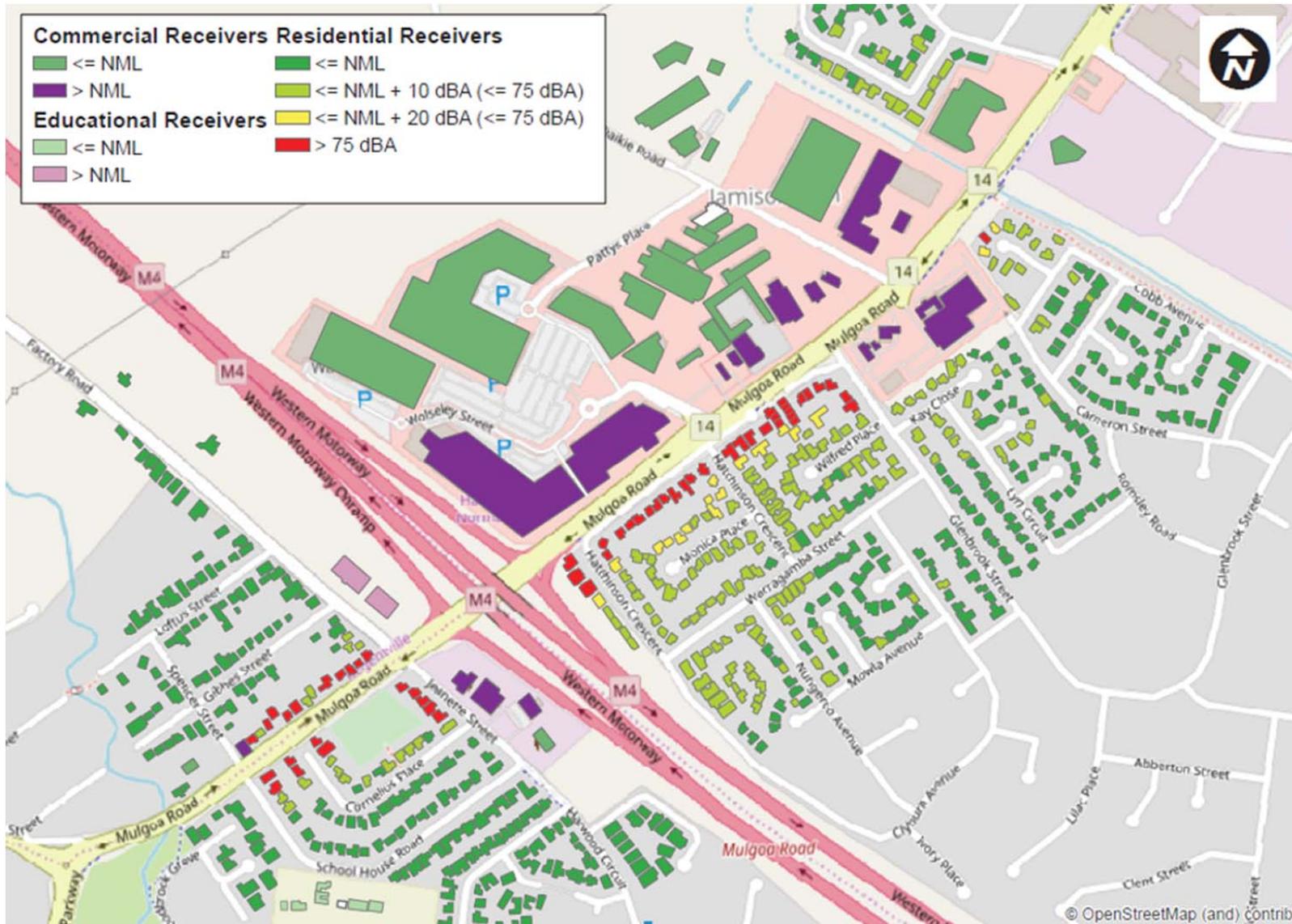
Table 6-16 shows the maximum predicted noise level at receivers affected by the loudest construction activities described above. The modelling predicts that 83 residential properties (out of 660 or about 13 per cent) would be 'highly affected' by demolition and excavation work.

Up to 219 receivers (about 33 per cent) may be impacted at some point from loud construction activities taking place during standard work hours, while all receivers may be affected by any out-of-hours work activities. At present, as noted in Table 6-15, pavement tie-in and asphalt laying is the only loud activity that is expected to take place out-of-hours. This would last for a short duration across the two-year construction program.

Table 6-16 show the number of affect receivers and the degree to which they would be impacted relative to management levels. Those receivers that are highly affected are also shown in Figure 6-8 and Figure 6-9. Maps showing those receivers identified as being affected during out-of-hours work are shown in Appendix C of Appendix D. Section 6.2.5 outlines the management measures to minimise potential noise impacts during the construction.

Table 6-16: Summary of residential receivers exceeding NMLs for loud construction activities

Loud construction activities (ie demolition and excavation and pavement tie-in and laying of asphalt)	No. of receivers	Percentage of receivers assessed (%)
Work on the western side of Mulgoa Road		
<i>Maximum predicted noise level dB(A) at receiver</i>		<i>87</i>
Number of 'highly affected' residences (> 75dB(A))	31	5
Exceeds NML (Standard hours)	219	33
Exceeds NML (Out of hours - daytime)	365	55
Exceeds NML (Out of hours - evening)	507	77
Exceeds NML (Out of hours - night)	660	100
Work on the eastern side of Mulgoa Road		
<i>Maximum predicted noise level dB(A) at receiver</i>		<i>87</i>
Number of 'highly affected' residences (> 75dB(A))	52	8
Exceeds NML (Standard hours)	220	33
Exceeds NML (Out of hours - daytime)	347	53
Exceeds NML (Out of hours - evening)	495	75
Exceeds NML (Out of hours - night)	660	100



Source: Arup

Figure 6-8: Predicted impact at receivers from loud construction activities happening on the western side of the proposal



Source: Arup

Figure 6-9: Predicted impact at receivers from loud construction activities happening on the eastern side of the proposal

Typical routine activities

Table 6-17 shows the maximum predicted noise level at receivers associated with typical construction activities, namely those activities in Table 6.15 not identified as being loud construction activities.

The modelling predicted that 30 properties (out of 660 or less than one per cent) would be 'highly affected' by stripping topsoil and carrying out the drainage work.

Up to 92 receivers (about 14 per cent) may be impacted at some point from routine activities being carried out during standard working hours, while all receivers would be affected by any out-of-hours work. While these types of activities are likely to occur during standard work hour, the assessment considered the potential for any of these to also take place out-of-hours. This was to assess a worst-case scenario and to understand the potential risks and impacts of any construction program changes in the future. At present, as noted in Table 6-15, the temporary traffic controls and operation of the site compound are the only typical activities that are expected to take place out-of-hours.

Table 6-17 shows those receivers predicted to exceed the NML, as well as the magnitude of exceedance, because of typical construction activities being carried out on the western and eastern side of the proposal respectively during standard hours.

Table 6-17: Summary of residential receivers exceeding NMLs for typical construction activities

Typical construction activities (ie stripping topsoil and drainage works)	No. of receivers	Percentage of receivers assessed (%)
Work on the western side of Mulgoa Road		
<i>Maximum predicted noise level dB(A) at receiver</i>	80	
Number of 'highly affected' residences (> 75dB(A))	6	1
Exceeds NML (Standard hours)	69	10
Exceeds NML (Out of hours - daytime)	147	22
Exceeds NML (Out of hours - evening)	264	40
Exceeds NML (Out of hours - night)	660	100
Work on the eastern side of Mulgoa Road		
<i>Maximum predicted noise level dB(A) at receiver</i>	80	
Number of 'highly affected' residences (> 75dB(A))	24	4
Exceeds NML (Standard hours)	92	14
Exceeds NML (Out of hours - daytime)	156	24
Exceeds NML (Out of hours - evening)	262	40
Exceeds NML (Out of hours - night)	660	100

Sleep disturbance

As noted in section 6.2.3, there is the potential risk for sleep disturbance where the noise level is above L_{max} 65 dBA. As shown by the construction noise impact assessment above, there are likely to be some receivers whose sleep would be disturbed where any night-time work takes place, including operation of the site compound. It is anticipated that the site compound would be used during the night no matter where the

work takes place along the proposal. Typical activities that would take place at the site compound during the night include:

- Delivery and movement of spoil
- Car parking
- Generator use for lighting
- Office use.

The loudest of these activities would be the delivery and movement of soil which may involve excavators, bobcats, front end loaders and trucks. Residential receivers are located directly next to the site compound and as such, site compound activities are likely to result in sleep disturbance at nearby receivers with predicted L_{eq} noise levels of up to 84 dBA. The intermittent nature of construction noise and the distance from the main works would mean that cumulative noise from the main works are unlikely to increase noise levels at the site compound.

The actual potential for sleep disturbance would however depend on final construction schedules and the length of time the noisiest equipment was in use. By limiting night-work activities and introducing other notification and standard controlling processes consistent with the CVNG, the potential for sleep disturbance would be greatly reduced. Accordingly, section 6.2.5 describes the safeguards and management measures that would be adopted to minimise sleep disturbance impacts.

Traffic related noise

Section 3.3 indicates that there would be some 200 construction vehicles and an additional 200 employee vehicle movements generated by the proposal every day on average. Typically, a change in traffic noise level of more than 2 dB requires an increase in total traffic volume of more than 60 per cent. As described in section 6.1.3, the construction phase would temporarily add less than one per cent to the traffic volumes on Mulgoa Road and the other roads in the area, even accounting for the concentration of vehicle movements at the start and end of the working day. This equates to a predicted increase of about 0.2 dB, which is notably below the above screening criterion.

Vibration

The main vibration sources would occur from using equipment when carrying out:

- Excavation work
- Grading of existing roadways
- Compacting of new road surfaces.

An exercise was carried out to determine the number of receivers that could be potentially affected by vibration. This was determined by identifying the number of receivers (people and buildings) within the recommended minimum safe working distances for each piece of equipment shown in Table 6-12. The assessment considered the minimum separation distance between the proposal footprint and sensitive receivers. Table 6-18 shows that by careful equipment selection, vibration effects could be limited to a potential amenity impact on 30 receivers using a smaller capacity vibratory roller (as denoted by the black box in the following table).

Table 6-18: Number of receivers potentially affected by vibration

Plant item	Rating/description	Cosmetic Damage		Human response	
		Minimum working distance	Receivers within the minimum distance	Minimum working distance	Receivers potentially within the minimum distance
Vibratory roller	< 50 kN	5 metres	0	15 to 20 metres	9 to 30
	< 100 kN	6 metres	0	20 metres	30
	< 200 kN	12 metres	2	40 metres	140
	< 300 kN	15 metres	9	100 metres	293
	> 300 kN	20 metres	30	100 metres	293
	> 300 kN	25 metres	57	100 metres	293
Hydraulic hammer	(300 kg)	2 metres	0	7 metres	0
	(900 kg)	7 metres	0	23 metres	46
	(1600 kg)	22 metres	46	73 metres	207
Pile boring	≤ 800 mm	2 metres (nominal)	0	4 metres	0
Jackhammer	Hand held	1 metre (nominal)	0	Avoid surface contact	-

Operation

Road traffic noise

Road traffic noise predictions with and without the proposal in place were determined for all receivers as described in Appendix D. The modelling predicted that there would be a negligible increase in road traffic noise under the proposal and that noise treatment need not be considered.

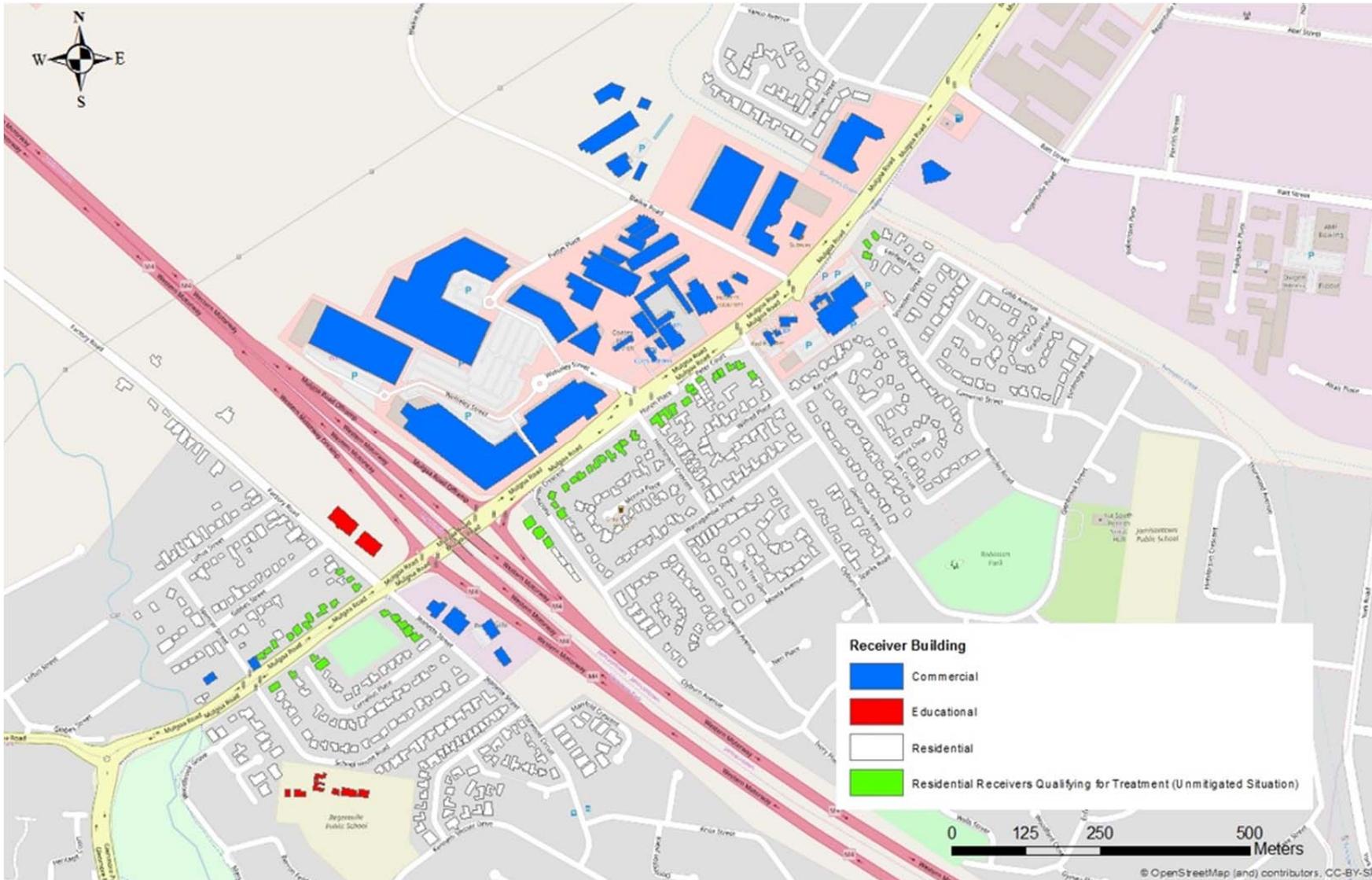
However, 60 of the receivers (52 residential receivers and eight educational receivers, about nine per cent of receivers assessed) would be considered for treatment measures. Figure 6-10 shows the location of these receivers. The majority of these receivers would be considered for noise treatment as they experience 'acute' noise levels over the criteria (65dBA during the day or 60 dBA during the night). One receiver is also predicted to experience a relative increase in road traffic noise along Mulgoa Road. The impacted receivers are all located alongside Mulgoa Road, close to the M4 Motorway.

Sleep disturbance

Section 6.7 of Appendix D reviews the existing maximum night-time noise levels relative to ambient noise levels. It compares these against the changes that are predicted to occur because of the proposal. The

review confirmed that people's sleep is already likely disturbed up to 12 times every night due to heavy vehicle movement on Mulgoa Road.

Under the proposal, maximum night time noise levels are predicted not to change to the extent of increasing or decreasing the potential for either the number of people at risk of sleep disturbance or the intensity of exposure for those people who are already at risk of sleep disturbance. In fact, the eligibility for the consideration of noise treatment at 52 residential receivers would indirectly reduce the existing night time noise levels therefore providing some sleep disturbance benefit to those receivers where noise treatment is implemented.



Source: Arup

Figure 6-10: Residential and educational receivers qualifying for consideration of additional treatment (NOTE: Only the Residential homes indicated in green and the educational buildings indicated in red would qualify for consideration for additional treatment)

6.2.5 Safeguards and management measures

The preferred order of mitigation in line with the NMG is as follows:

- Road design and traffic management measures, which include the consideration of shielding the road with the natural landscape features, minimising the need for compression release engine braking, such as by reducing the number of signalised intersections, and signage
- Quieter road pavement surfaces, which includes consideration of different types of asphalt mixes that can reduce noise levels by up to 5dB
- Noise barriers in the form of walls and mounds
- At property treatments including architectural upgrades such as sealing windows and mechanical ventilation or localised screening.

Roads design and quieter pavement

In considering road design and traffic management measures it was concluded that there were no additional measures that could be effectively, feasibly or reasonably implemented to reduce noise.

The use of quieter surfaces is only noise-effective for roads with posted speed limits above 70 km/h, making it an unreasonable option in this location due to its 60km/h posted speed limit.

Noise barrier treatment

Of the remaining feasible and reasonable mitigation measures it was determined that a noise wall could be included along the eastern side of Mulgoa Road to the north of the M4 Motorway interchange as this would be effective in treating the group of noise-affected receivers in this location.

Appendix D describes the approach to confirming the length and height required in accordance with the Roads and Maritime Noise Mitigation Guideline (NMG, Roads and Maritime, 2015b). Consideration is then made as to the practical height of building a noise wall. Through this process it was concluded that building a noise wall about 4.5 metres high alongside Hutchinson Crescent, Huron Place, Peter Court and Glenbrook Street would provide treatment to 25 properties (96 per cent). Figure 6-11 shows the extent of the proposed noise wall.

At-property treatment

The remaining receivers could not be reasonably treated using noise walls as they are isolated from one another. However, these receivers could be reasonably treated using at-property architectural treatments (refer to Figure 6-12).

The final noise wall design and number of receivers requiring at-property treatment would be refined and confirmed after approval of the proposal is granted.

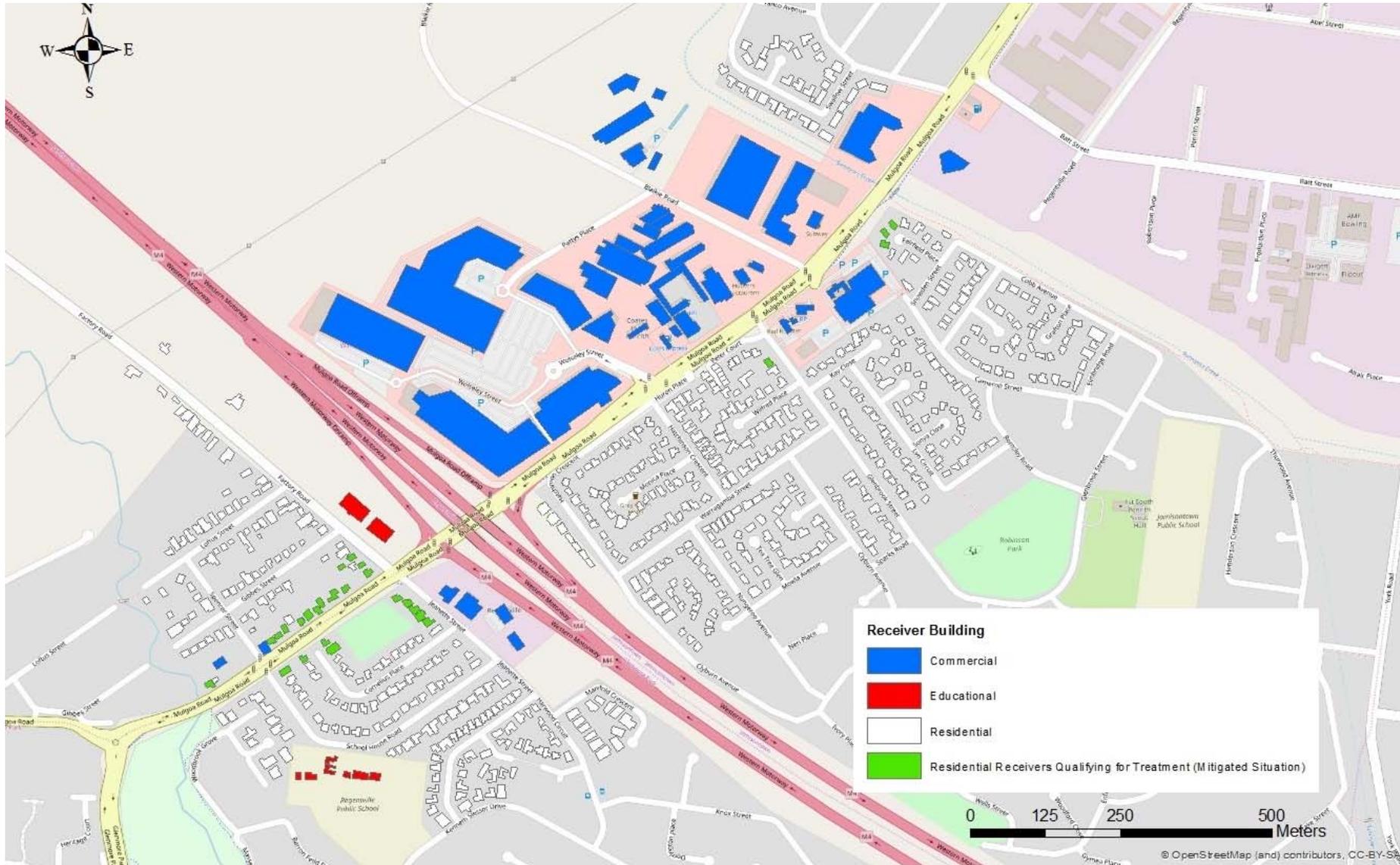


Service Layer Credits : © Department of Finance, Services & Innovation 2017

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Source: Arup

Figure 6-11: Extent of the proposed noise wall



Source: Arup

Figure 6-12: Receivers qualifying for consideration of property mitigation measures

Safeguards and management measures

Table 6-19 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix D contains further details on the specifics of the safeguards and management measures.

Table 6-19: Noise and vibration safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim Construction Noise Guideline (ICNG, DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account Beyond the Pavement: urban design policy, process and principles (Roads and Maritime, 2014a) • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. 	Contactator	Detailed design/pre-construction	NV1 Section 4.6 of QA G36 <i>Environment Protection</i>
Noise and vibration	Any variations to the standard construction hours will follow the approach in the RMS Construction Noise and Vibration Guideline (CNVG) and/or the RTA Environmental Facts Sheet - Noise Management and Night Works, including consultation with the affected local community.	Contractor	Pre-construction/ construction	NV3

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	A sleep disturbance assessment would be carried out before the planned out-of-hours work. The assessment would consider the absolute noise level of the activity, exceedances above the existing ambient noise level, and the number of individual noisy events likely to occur per night.	Contractor	Pre-construction/ construction	NV4
Noise and vibration	Where feasible and reasonable, the permanent noise wall will be built as part of the early work and before the main work.	Contactora	Pre-construction Construction	NV5
Noise and vibration	All sensitive receivers (eg schools, residents) likely to be affected will be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification would provide details of: <ul style="list-style-type: none"> • The proposal • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contactora	Pre-construction	NV6
Noise and vibration	All personnel working on site will receive training to ensure awareness of requirements of the CNVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction	NV7

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>The following controls would be included in the NVMP:</p> <ul style="list-style-type: none"> • Where practical, the layout and positioning of noise-producing plant and activities at each work site would be optimised to minimise noise emission levels • Where practical, at the site compound, locate spoil mounds towards the north-west of the site and noisy stationary plant (ie. generators) behind site offices, hoarding/screens or other spoil mounds to shield receivers • Where practical, equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate noise control equipment and be in good working order • Where possible, non-beeper reversing movement alarms would be used such as broadband (non-tonal) alarms or ambient noise-sensing alarms. Work sites would also be designed to reduce the need for reversing, potentially minimising the use of reversing beepers • Vehicles, plant and equipment would be regularly inspected and maintained to avoid increased noise levels from rattling hatches, loose fittings etc • All vehicles, plant and equipment would be shut off when not in use • Resilient damping material would be fitted on bin trucks to minimise noise impacts from loading materials • Where feasible and reasonable, localised temporary acoustic hoardings/screens would be installed near high noise-generating activities. Hoardings/screens would be located as close to the noise source as possible, and would be an appropriate height as structurally feasible to minimise noise emissions • Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, 	Contractor	Construction	NV8

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	Consistent with any specific requirements of the approved NVMP a monitoring program will be implemented during construction for six months or otherwise directed by Roads and Maritime to assess effective implementation of noise and vibration safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements.	Contactor	Construction	NV9
Noise and vibration	After considering the outcomes and recommendations arising from the monitoring program, and any other relevant information that becomes available during construction, appropriate measures will be implemented to address identified deficiencies or undertake actions needed to address noise and vibration impacts. If necessary, the NVMP will be reviewed and updated to include any additional measures	Contactor	Construction	NV10
Noise and vibration	Ensure the use of vibratory rollers <100kN (typically two to four tonnes) and hydraulic hammers 300kg (five to 12 tonne excavator) are used during construction. Where this is not feasible or reasonable, carry out additional vibration impact assessment and/or pre-conditional surveys on the potentially affected buildings and affected receivers within the associated safe working distances. Carry out additional vibration monitoring during construction as needed to respond to any received complaints, and if needed carry out post-conditional surveys on the potentially affected buildings.	Contactor	Construction	NV11
Noise and vibration	Construction respite periods would be implemented as per the RMS Construction Noise and Vibration Guideline (CNVG). In addition, for the key noise-impacting activities, this would be scheduled to be ideally carried out during standard work hours otherwise these activities would be carried out before midnight. Where feasible, these activities should only restart after 7am the next day.	Contactor	Construction	NV12

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	<p>Within six months of the project becoming operational a noise review will be undertaken in accordance with Roads and Maritime's Preparing a Post Construction Noise Assessment Brief. The review will generally follow the approach provided in the RMS Construction Noise and Vibration Guideline (CNVG) and will:</p> <ul style="list-style-type: none"> Assess actual noise performance compared to predicted noise performance Assess the performance and effectiveness of noise and vibration mitigation measures Where deficiencies in performance are identified, provide recommendations for additional feasible and reasonable measures in accordance with the NMG 	Roads and Maritime project manager	Post-construction/operation	NV13
Noise and vibration	<p>After considering the outcomes and recommendations arising from the operational noise review, and any other relevant available information (including consultation with sensitive receivers), additional measures may be implemented to ensure adequate management of operational noise impacts.</p>	Roads and Maritime project manager	Post-construction/operation	NV14

6.3 Biodiversity

This section describes the biodiversity impacts that are predicted to occur from building and operating the proposal. This section summarises the biodiversity assessment report (BAR) prepared by EPS included in Appendix E.

6.3.1 Methodology

The BAR was completed to:

- Describe the existing biodiversity environment
- Identify and assess threatened biodiversity listed under BC Act, FM Act, and EPBC Act
- Identify ecological constraints within the study area
- Assess the proposal's predicted impact on biodiversity values in the local area
- Set out the safeguards and management measures to either avoid or reduce the proposal's impacts

- Assess the significance of any biodiversity impacts and confirm the need for any supplementary approvals
- Identify if there is the need to offset any of the impacts.

A desktop search was carried out in 2017 to identify threatened flora, fauna, populations and ecological communities, Commonwealth listed migratory species or critical habitat previously recorded or predicted to potentially occur within or near the survey area. These results helped plan the field survey and identify the ecological groups likely to occur. The database searches included.

- A 10-kilometre buffer search centred on the proposal footprint of:
 - BioNet Atlas of NSW Wildlife (OEH, 2017b)
 - NSW PlantNet (The Royal Botanical Gardens and Domain trust, 2017)
 - Threatened Species Conservation Act critical habitat register (OEH, 2017d)
 - NSW vegetation types database (OEH, 2017c)
 - Vegetation Information System (VIS) and the Vegetation Types Database for Plant Community Types (PCTs) in the Bioregion (OEH, 2017e).
 - NSW SEPP (coastal management) spatial database (Department of Planning and Environment, 2017)
 - NSW weed wise database (NSW Department of Primary Industries, NSW DPI, 2017b)
 - Database for aquatic biodiversity (NSW Department of Primary Industries, NSW DPI, 2017a)
 - Protected matters search tool (Department of Planning and Environment, 2017b)
 - Atlas of Groundwater Dependent Ecosystems (Australian Bureau of Meteorology, 2017)
 - Directory of Important Wetlands (Department of Environment and Energy, DEE, 2017a)
 - Weeds of national significance (Department of Planning and Environment, 2017)

The above searches were supplemented by reviewing existing reports prepared to define and support the wider strategic development and design of the Mulgoa Road/Castlereagh Road Corridor upgrade. The habitat assessment helped identify the appropriate targeted surveys that were subsequently carried out.

Targeted field surveys were carried out in September 2017 and April 2018 to ground-truth the results of the background research and habitat assessment and identify any additional ecological values. They involved:

- Surveying the composition and condition of vegetation to identify and classify native vegetation into PCTs and mapped areas of non-native vegetation
- Recording all incidental sighting of flora and fauna
- Carrying out targeted surveys for the presence of Cumberland Plain land snail and hollow-bearing trees
- Completing one plot in accordance with the Biodiversity Assessment Methodology (BAM, OEH, 2017)
- Visual inspecting the aquatic habitat.

The assessment was guided by Environmental Impact Assessment Practice Note: Biodiversity Assessment (EIA-N06, RTA, 2011b) and the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011a).

Figure 6-13 shows the biodiversity study area and BAM plot.



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Source: EPS

Figure 6-13: Biodiversity study area and BAM plot location

6.3.2 Existing environment

As an overview, the study area is located within a highly urbanised environment and vegetation generally consists of planted roadside and amenity communities, except for an area of forest red gum woodland between Wolseley Street and Blaikie Road along the western side of Mulgoa Road. Mulgoa Road also crosses over Surveyors Creek, which is part of the wider Hawkesbury-Nepean River catchment.

The proposal footprint is located within the following key areas:

- Sydney Basin bioregion
- Greater Sydney local land services area
- Nepean Rivers catchment management authority sub-region
- Hawkesbury-Nepean channels and floodplains of the Mitchell Landscape
- Penrith LGA priority (weeds) control area.

Vegetation and plant community types

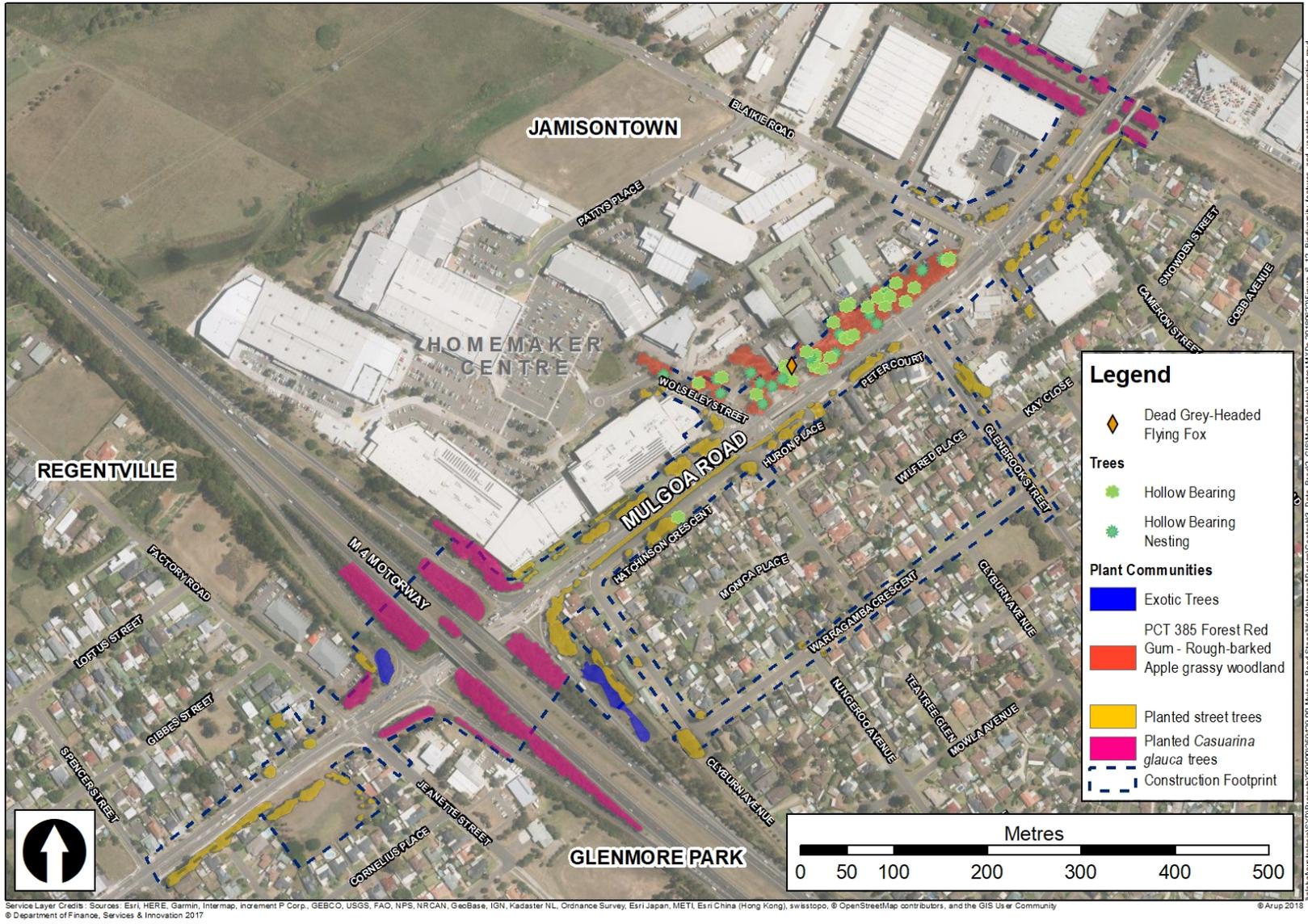
Table 6-20 outlines the four vegetation communities that were recorded in the field, the surveyed extent of which is shown on Figure 6-13. Due to the highly urbanised condition of the existing environment, only a small proportion of the proposal footprint was recorded as vegetation community, of which about 23 per cent classified as native.

One of the communities classifies as forest red gum: rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835), referred to as 'forest red gum' below for simplicity. While this PCT is also a threatened ecological community (TEC) protected under the BC Act (as shown in Table 6-20, it occurs as a remnant patch that has been isolated from the higher-quality forest red gum community in the local area. The fragmentation has likely caused the observed loss of quality and biodiversity value over time. Evaluation of the condition and character of the TEC under the methods described in section 2.5.2 of Appendix E, confirmed the community to be in an ecologically 'poor condition'.

Table 6-20: Recorded vegetation

Plant community type (PCT) or Modified Vegetation type	Vegetation formation	Vegetation class	Location in the survey area	Description	Condition class	BC Act/FM Act status	EPBC Act status	Area within study area (ha)	Area within construction footprint (ha)
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	Western side of Mulgoa Road between Wolseley Street and Blaikie Road	Comprising 50 red forest gum trees of varying age (refer to Figure 6-13). There is about 40 per cent tree cover, including five per cent small tree cover, as well as about five per cent groundcover. Notably, 45 of the trees were classified as hollow bearing (refer to Figure 6-15). These trees are likely to have been planted, and some are likely to be over 50 years old. The understorey consists of garden plantings with a managed/mown grassland dominated by kikuyu (<i>Cenchrus clandestinus</i>). This community is interspersed by concrete driveways and footpaths and the understorey and ground layer is generally mown and/or contains regularly maintained landscaping.	Moderate to good – poor condition	Endangered: River-flat Eucalypt Forest on Coastal Floodplains	Not listed	0.93	0.81
Planted kikuyu trees	-	-	M4 Motorway entry and exit ramps and the Surveyors Creek corridor	M4 Motorway: the ground layer was generally absent under the kikuyu, with the edges and open areas of the entry and exit ramps containing exotic grasses and herbs. Surveyors Creek: more open ground layer which also contained some native ground layer and shrub species.	-	Not listed	Not listed	1.76	1.33

Plant community type (PCT) or Modified Vegetation type	Vegetation formation	Vegetation class	Location in the survey area	Description	Condition class	BC Act/FM Act status	EPBC Act status	Area within study area (ha)	Area within construction footprint (ha)
Planted street trees	-	-	Occur across the length of the proposal on both sides of Mulgoa Road ad adjoining local roads	Scattered planted trees providing 10 per cent cover, dominated by native tree species. The ground layer comprises garden beds and managed kerbside/parkland grasses dominated by kikuyu. No understorey was present with the ground layer. A hedge is located between Mulgoa Road and Huron Place.	-	Not listed	Not listed	1.46	1.24
Exotic vegetation	-	-	M4 Motorway entry ramps	Westbound entry ramp: exotic vegetation comprising a canopy of exotic trees and shrubs. The understorey was sparse and dominated by goosegrass (<i>Galium aparine</i>) and other exotic herbaceous species. Eastbound entry ramp: exotic vegetation, trees and shrubs which adjoined the box culvert north of the entry ramp.	-	Not listed	Not listed	0.18	0.13
Total								4.33	3.51



Source: EPS

Figure 6-14 Biodiversity features and vegetation communities in the study area

Aquatic habitat

The artificial drainage channel located alongside the M4 Motorway westbound entry ramp (linking with School House Creek) and the concrete lined Surveyors Creek provide low-quality low-value aquatic habitat that is likely unsuitable for threatened species.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes depend on an available groundwater source. Drainage lines, including School House Creek, are identified as GDE in the Bureau of Meteorology Groundwater Atlas. No GDEs that are likely to have any terrestrial value were identified within or near the proposal footprint.

Threatened flora species

No threatened flora species were recorded during the field surveys, reflecting the highly-disturbed and modified character of the study area. Further, no threatened flora species are considered to have a moderate-to-high likelihood of occurring locally.

Threatened fauna species

One threatened species of bat was recorded in the field, the grey-headed flying fox *Pteropus poliocephalus* (refer to Table 6-21). This species is listed as vulnerable under both the BC Act and EPBC Act. The grey-headed flying fox is known to forage over the Sydney Metropolitan area.

Any of the trees in the study area would provide foraging habitat for the grey-headed flying fox, however more favourable habitat to the west in the Blue Mountains would offer better foraging and is within the natural range of this species. No breeding camps or hibernacula were observed or are likely to occur locally.

Based on the habitat characteristics of the area, a further six threatened bat species are considered to have a moderate likelihood of occurring locally (refer to Table 6-21).

Table 6-21: Threatened fauna likely within the survey area

Common name	BC Act status	EPBC Act status	Likelihood of occurrence
Microchiropteran bats <ul style="list-style-type: none">Large-eared pied batEastern bentwing-batSouthern myotis	Vulnerable	Not listed	Moderate: foraging potential over the study area and roosting and breeding potential associated with the M4 Motorway and Surveyors Creek road bridges.
Microchiropteran bats <ul style="list-style-type: none">Eastern false pipistrelleEastern freetail-batGreater broad-nosed bat	Vulnerable	Not listed	Moderate: foraging, nesting and roosting potential within the existing vegetation and the hollow-bearing trees.
Grey-headed flying-fox	Vulnerable	Vulnerable	Recorded: foraging potential within the existing vegetation.

Migratory species listed under the EPBC Act

While nine migratory species listed under the EPBC Act were identified as having the potential to occur in the area their presence in the locally is considered unlikely due to the disturbed and fragmented nature of the habitat. No migratory species or associated habitat were observed in the field.

Biosecurity species

The following five priority weeds listed under the BC Act were recorded in the field, African olive, velvet tree pear, lantana, blackberry and firewood. The Department of Industries specifies a 'regional recommended measure' for African olive, which means that plants or parts of the plant cannot be traded, carried, grown or released into the environment. The other weeds are listed as having 'prohibition on dealings', which means they must not be imported into the state or sold. The four species of weed marked with an asterisk are also declared as weeds of national significance (WONS).

No pest or pathogen species were recorded in the area or are likely to be present given the vegetation and habitat type.

Other

There are no world or national heritage places or wetlands of international importance within or surrounding the survey area. There is also no critical habitat, wildlife corridors, potential koala habitat, littoral forests, coastal wetlands, or coastal protection areas locally. The Greater Blue Mountains world heritage site is removed from the proposal footprint and located about 2.5 kilometres to the west at its closest point.

Overall, 74 flora species and 10 fauna species were recorded in the field. About 30 per cent of recorded flora species were native, albeit largely planted, and the rest were planted exotic species. The exotic and native trees locally also provide foraging, nesting and roosting habitat for common native and exotic bird and arboreal mammal species.

6.3.3 Potential impacts

Chapter 4 of Appendix E details the potential impacts of the proposal on biodiversity. The main impacts are summarised below.

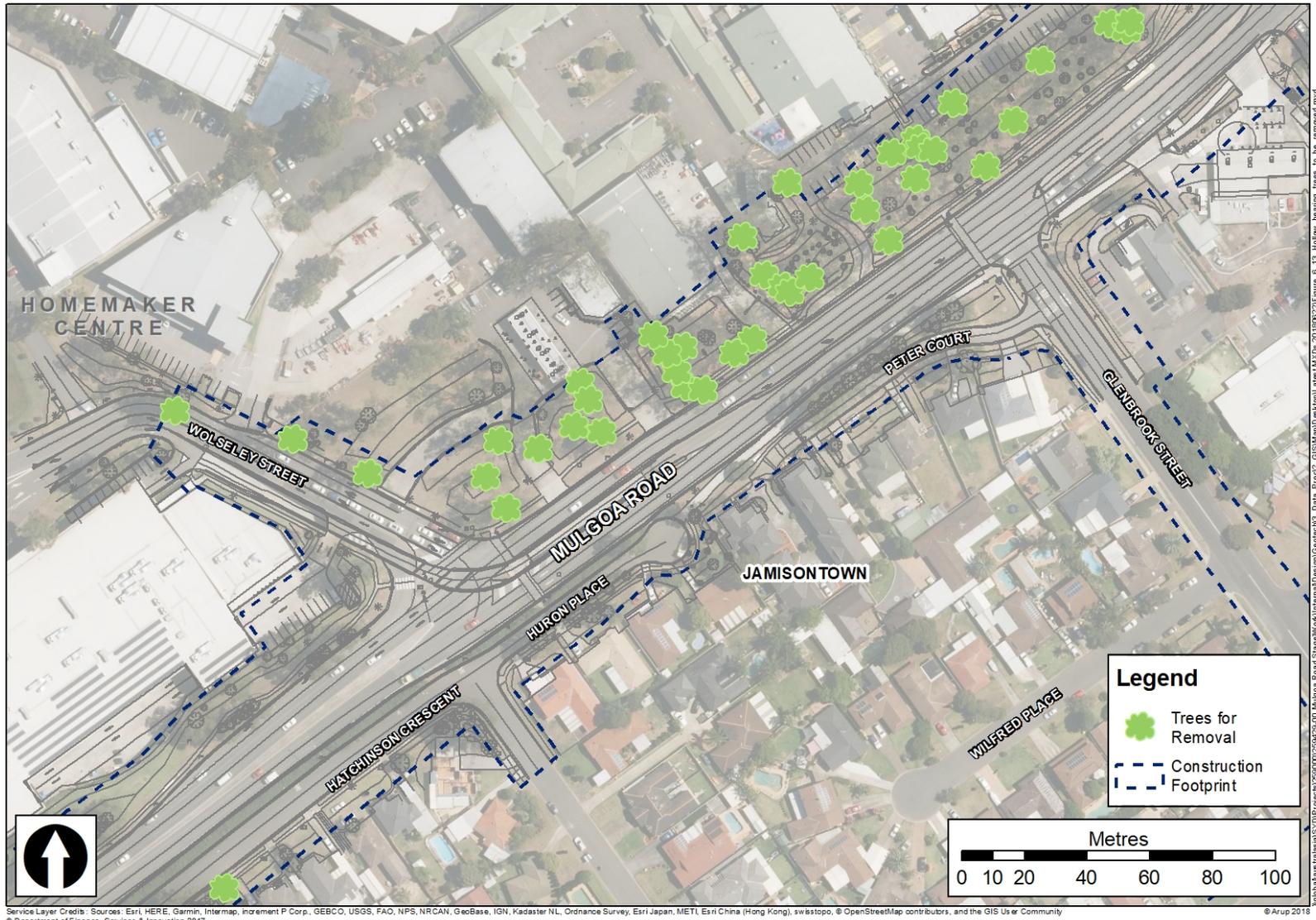
Construction

Table 6-22 outlines the environmental values lost to the proposal, direct impacts, plus the other potential impacts that may occur during construction.

Table 6-22: Construction-related biodiversity impacts

Impact description	Type of native and/or threatened fauna likely affected
Direct impacts	
<p>Removal of above 3.51 hectares of vegetation to accommodate the proposal footprints as shown in Table 6-20, of which about 0.81 hectares (23 per cent) is native and a TEC and 2.70 hectares (77 per cent) forms miscellaneous ecosystems of exotic and planted vegetation.</p>	<p>Native plant community that are aligned with TEC under the BC Act namely PCT 835 forest red gum - rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney basin bioregion.</p>
<p>Loss of associated (threatened) fauna habitat through vegetation clearance from the proposal footprint. Loss of low-value foraging habitat for the grey-headed flying fox through the removal of 3.51 hectares of vegetation; the majority of which comprises native and non-native trees. Loss of available foraging, nesting and roosting habitat for bat species, common native and exotic blossom-feeding, hollow-dependent and large predatory birds, and arboreal mammal species.</p>	<ul style="list-style-type: none"> • Migratory and/or nomadic blossom-feeding birds • Hollow-dependent birds • Large predatory birds with extensive home ranges • Microchiropteran and megachiropteran bats.
<p>Removal of threatened micro-bat fauna due to the loss of the following habitat: Up to 41 hollow bearing trees (refer to Figure 6-15)</p> <ul style="list-style-type: none"> • Modifications to the form and fabric of the M4 Motorway • Dead wood and trees scattered throughout. <p>The degree of impact would depend on the range of each species and their reliance of this vegetation for their survival.</p>	<ul style="list-style-type: none"> • Migratory and/or nomadic blossom-feeding birds • Hollow-dependent birds • Large predatory birds with extensive home ranges • Microchiropteran and megachiropteran bats • Arboreal and ground-dwelling mammals and reptiles.
<p>Fauna injury and mortality during construction through:</p> <ul style="list-style-type: none"> • Removal of mature trees with hollows • Removal of understorey, groundcover and topsoil • Machinery/plant and vehicle movements during construction. <p>Implementation of the safeguards in section 6.3.4 is expected to minimise, but not eliminate, the potential for this impact.</p>	<ul style="list-style-type: none"> • Migratory and/or nomadic blossom-feeding birds • Hollow-dependent birds • Large predatory birds with extensive home ranges • Microchiropteran and megachiropteran bats • Arboreal and ground-dwelling mammals and reptiles

Impact description	Type of native and/or threatened fauna likely affected
Indirect impacts	
<p>Increased edge effects relating to vegetation removal along Mulgoa Road and around the intersections leading to:</p> <ul style="list-style-type: none"> • Increased noise and vibration due to construction equipment and methods • Soil moisture changes • Altered light conditions (artificial lighting) during construction. 	<ul style="list-style-type: none"> • All bird species • Microchiropteran bats • Arboreal and ground-dwelling mammals and reptiles • Native plants
<p>Invasion and spread of pests and pathogens, including the spread of weed, associated with movement of vehicles and import of materials into the area. The introduction of a biosecurity management measures would mean that any related impacts would be avoided and/or appropriately mitigated.</p>	All
<p>Accidental spills affecting soil and habitat quality. While this is a potential risk, the introduction of standard safeguards and management measures as described in section 6.3.4 would mean that any related impacts would be avoided and/or appropriately mitigated.</p>	All



Source: EPS

Figure 6-15: Hollow bearing trees to be removed

Operation

Table 6-23 outlines the main biodiversity impacts likely to be associated with operation of the proposal.

Table 6-23: Main operation impacts on biodiversity

Description of impact	Types of native and/or threatened flora and fauna likely to be affected
<p>Fauna injury and mortality from roadkill. This would mainly affect ground-dwelling species, meaning the risk of any impact on threatened fauna is low given that most locally-occurring species are birds. Nonetheless, as some scavenging bird species often feed on roadkill there is still the risk of vehicle strikes. Overall, the proposal is unlikely to result in significant levels of fauna injury and mortality from roadkill, with a negligible impact compared to risk of impacts on similar roads.</p>	<ul style="list-style-type: none"> • Migratory and/or nomadic blossom-feeding birds • Hollow-dependent birds • Large predatory birds with extensive home ranges • Microchiropteran and megachiropteran bats • Arboreal and ground-dwelling mammals and reptiles
<p>Increased edge effects on adjacent native vegetation and habitat including:</p> <ul style="list-style-type: none"> • Noise and vibration from passing vehicles • Altered light conditions from artificial lighting, shading or reduced shading • Chemical spills from road traffic accidents or maintenance activities • Weed invasion from soil disturbance and roadside littering. 	<ul style="list-style-type: none"> • All bird species • Microchiropteran bats • Arboreal and ground-dwelling mammals and reptiles • Native plants

Conclusion on significance of impacts

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

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

6.3.4 Safeguards and management measures

Table 6-24 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix E contains further details on the specifics of the safeguards and management measures.

Table 6-24: Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>A Flora and Fauna Management Plan (FFMP) will be prepared in accordance with Roads and Maritime's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011) and implemented as part of the CEMP. It would include, but not be limited to:</p> <ul style="list-style-type: none"> • Vegetation management plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the Landscape Guideline (RTA, 2008b) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Procedures addressing relevant matters specified in the Policy and guidelines for fish habitat conservation and management (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens • Habitat replacement and reinstatement • Handling injured fauna consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects 	Roads and Maritime project manager /contractor	Detailed design/pre-construction	B1 Section 4.8 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>Measures to further avoid and minimise the construction footprint and native vegetation (including aquatic plant areas, significant fauna, and wetland habitat) or habitat removal would be investigated during detailed design and implemented where practicable and feasible. Measures to avoid and minimise impacts should be prioritised in the following order:</p> <ul style="list-style-type: none"> • Critical habitat • Threatened species, endangered ecological communities or their habitat • Native vegetation and habitat supporting flora and fauna connectivity and/or that supports other • Environmental objectives such as protecting water quality, hydrology or erosion and sediment controls • Native vegetation of higher quality condition • Other native vegetation 	Roads and Maritime project manager /contractor	Detailed design/pre-construction	B2 State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997, 1997c)
Biodiversity	All personnel working on site will receive training to ensure awareness of requirements of the FFMP and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of areas of identified biodiversity value that are to be protected.	Contractor	Pre-construction/ construction	B3
Biodiversity	A pre-construction check of native flora and fauna species and habitat would be carried out in accordance with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects. Biodiversity management measures identified during the pre-construction check would be included in the FFMP.	Contractor	Pre-construction	B4
Biodiversity	Consistent with the 'Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects', and any specific requirements of the approved FFMP, an unexpected finds procedure would be implemented in the event that a threatened species or ecological community that had not been identified and assessed by the REF are unexpectedly encountered during the construction process.	Contractor	Construction	B5

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>Consistent with the approved FFMP:</p> <ul style="list-style-type: none"> The limits of clearing within the construction site will be delineated using appropriate signage and barriers, identified on site construction drawings and during construction staff induction Vegetation and habitat features to be retained, such as hollow-bearing trees, will be clearly identified and protected by suitable fencing, signage or markings Identified areas containing habitat for hollow-dependent species will not be cleared during the breeding season May to September 	Contractor	Construction	B6
Weeds and pathogens	<p>Declared noxious weeds and potential pests and pathogens are to be managed according to requirements under the <i>Biosecurity Act 2015</i> and Guide 6 (Weed Management) of the Roads and Maritime Services Biodiversity Guidelines 2011 and Guide 7: Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011a). Topsoil from the site that contains or potentially contains weed species or propagules:</p> <ul style="list-style-type: none"> Will not be reused for future rehabilitation or revegetation works Will be removed from the construction site and disposed of at an appropriately licensed facility Will be stockpiled and managed in accordance with the RTA Stockpile Site Management Guideline. 	Contractor	Construction	B7
Biodiversity	<p>Consistent with any specific requirements of the FFMP, a monitoring program will be implemented during construction to ensure effective implementation of the safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements to the safeguards. A register of inspections will be established.</p>	Contractor	Construction	B8

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	After considering the outcomes and any recommendations arising from the monitoring program, and any other relevant information that becomes available during construction, additional measures may be implemented to ensure adequate protection of native flora and fauna. If necessary, the Flora and Fauna Management Plan will be reviewed and updated to include any additional measures.	Contractor	Construction	B9
Biodiversity	The above safeguards would be developed in accordance with the provisions State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997) that are aimed at protected catchment values. Therefore, the mitigation would specifically consider the need to: <ul style="list-style-type: none"> • Avoid aquatic plant areas, significant fauna and wetland habitat • Re-establish and replant impacted riparian flora and fauna habitat 	Contractor	Construction	B10 State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997, 1997c)

6.4 Soils, geology and contamination

This section describes the soil, geology and contamination impacts that are predicted to occur from building and operating the proposal. This section summarises elements of the surface and groundwater assessment prepared by Arup included in Appendix F and the preliminary site investigation prepared by Coffey Environment included in Appendix G.

6.4.1 Methodology

The preliminary site investigation reviewed the development history of the area to identify potential historical contamination sources. This included a review of the following resources:

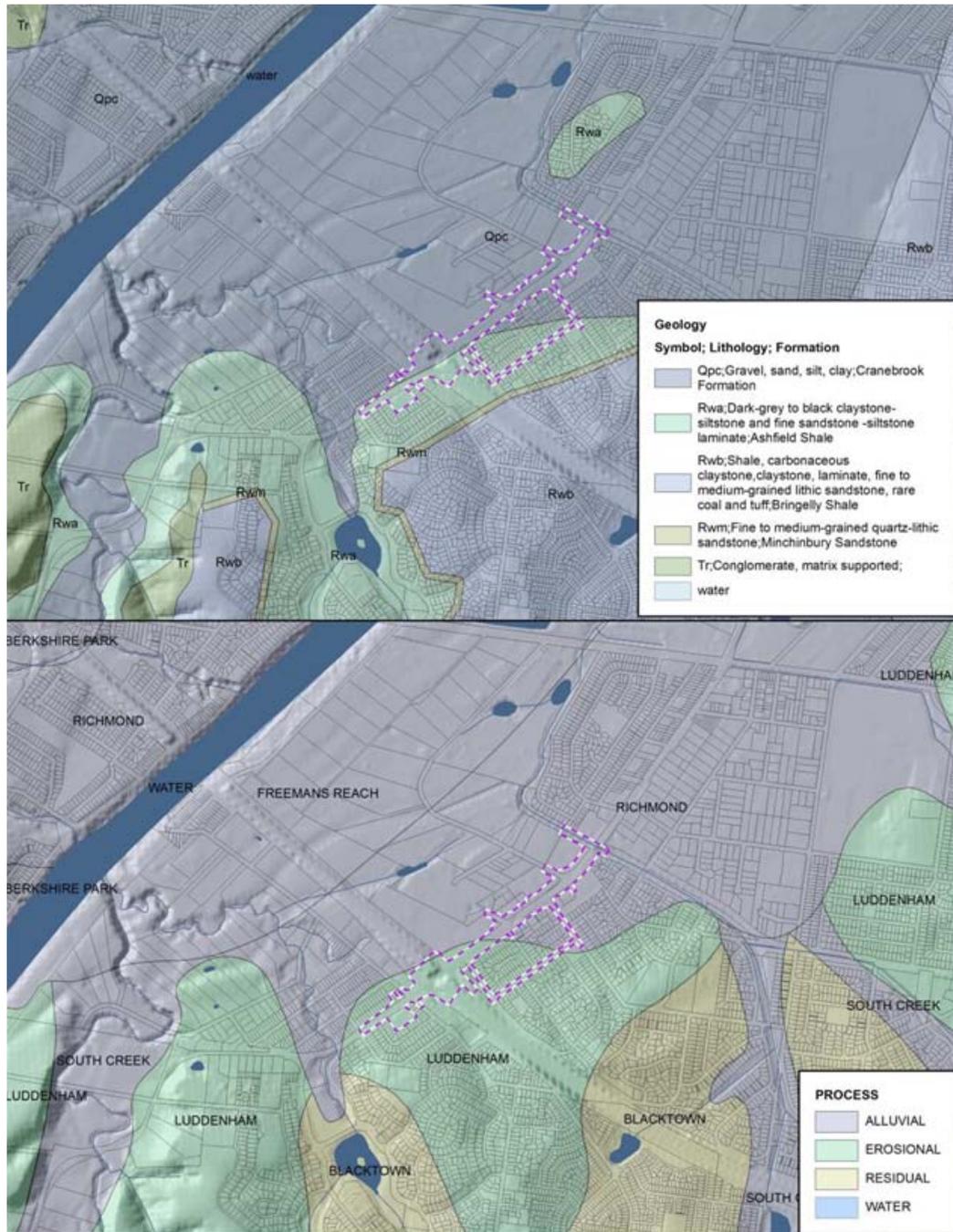
- Historical aerial photographs
- Topographic, acid sulfate soil (ASS) risk, salinity, soil landscape and geological maps
- Registered contaminated land and notifications issued under the *Protection of the Environment Operations Act 1997* (POEO Act)
- Groundwater registered bores.

A site inspection was carried out to ground-truth the results of the background research and identify any additional constraints or issues. This was then used to develop a site conceptual model to confirm if there are feasible exposure pathways for contamination sources to impact on local and remote values and receivers.

6.4.2 Existing environment

Geology and soils

Broadly, the southern section of the proposal footprint is underlain by Ashfield Shale, a laminate of claystone-siltstone and sandstone-siltstone, with the northern section underlain by the Cranebrook Formation, a fluvial deposit of gravel, sand, silt and clay. Figure 6-16 shows the extent of each deposit. Both formations overlay a base geology of Hawkesbury sandstone, which extend across the entire Sydney Basin.



Source: Kelleher Nightingale: Note: the dotted-purple line shows the combined construction and proposal footprint

Figure 6-16: Subsurface geology and soils

The soil landscape reflects the geological landscape. Luddenham soils underlay the southern end of the proposal footprint, while Richmond soils underlay the northern end. Figure 6-16 shows the extent of both

soil landscapes. Luddenham soils are sandstone, siltstone and mudstone derived and contain forest-derived organic material (podzols) and are typically saline (solodic), while Richmond soils comprise loams, clays and sands, with occasional ironstone nodules. Both soil types are highly erosive while Richmond soils are also subject to localised flooding.

Soil chemistry

While the proposal is not located in an acid sulphate soil risk area (Naylor *et al*, 1998) it is underlain by an area of moderate-to-high potential for soil salinity (Department of Infrastructure, Planning and Natural Resources, 2003). Saline soils are typically sensitive to groundwater changes as this can result in salt mobilisation and/or washout. In turn, this can affect soil quality and structure, water quality, and impact on flora and fauna.

Potential contamination sources

The local area was first developed commercially and industrially in the mid-1970s. Before then it was largely used for agricultural grazing or as orchards. The area has continued to develop over time to its current mixed use. Table 1 and Table 2 of Appendix G identify potential sources of contamination that exist within the corridor, which generally relate to:

- Current and former fuel service stations
- Areas of infill and vacant land
- Vehicle workshops and services areas
- Industrial premises
- The Sydney Water treatment compound, which also houses an electrical substation
- Road-related contaminants and runoff
- Wider, more diffuse sources associated with older buildings, which contain lead-based paint and asbestos, electrical transformer boxes, and old asbestos services pipes and pits.

Searches of the record of contaminated land and public register of notifications, licences and applications under the POEO Act, identified one contaminated and two potentially-contaminated sites locally as listed in Table 6-25. There were no records on the public register of notifications, licences and applications.

Table 6-25: Contaminated and potentially contaminated sites

Licence holder	Address	Activity	Status	Approximate location from proposal footprint
Regulated contaminated sites				
7-Eleven service station	92 Mulgoa Road	Petrol service station	Declared as significantly contaminated in 2012 due to the presence of various hydrocarbons and petroleum bi-products in the soil and groundwater. The site has been remediated however it remains regulated.	170 m to the north of the proposal footprint on the eastern side of the Mulgoa Road
Potentially contaminated sites				
BP service station	124-128 Mulgoa Road	Petrol service station	Potential presence of hydrocarbons and petroleum bi-	Immediately to the east

Licence holder	Address	Activity	Status	Approximate location from proposal footprint
Caltex service station (former)	229-231 Mulgoa Road		products in the soil and groundwater.	100 m to the north of the proposal footprint on the western side of Mulgoa Road.

Table 6-26 summarises the potential contamination sources within the study area.

Table 6-26: Potential sources of contamination

Potential contamination source	Contaminant source	Potential contaminants of concern ¹
Service stations	Fuel storage	TRH, BTEX, PAH and lead
Fill material and vacant land	Imported unknown and dumped materials	Unknown but typically including heavy metals, TRH, BTEX, PAHs and asbestos
Vehicle workshops and service areas	Chemical and lubricant use and storage	TRH, BTEX, PAH, VHCs and heavy metals (mainly lead)
Industrial areas	Cement batching, dairy processing, former factories, and metal manufacturing	Alkanes, heavy metals, surfactants, semi-volatile organic compounds, hydrocarbons, VHCs, and asbestos
Sydney Water treatment compound	Water treatment chemicals	Pathogens, hydrocarbons, alkaline/acid regulators and agents, nutrients
Electrical substations and transformer boxes	Transformer oils	TRH, BTEX, heavy metals, PAHs, phenols and PCBs.
Old buildings and utilities and services	Form and fabric of buildings and pipes	Heavy metals (mainly lead) and asbestos
Existing roads	Vehicle emissions, road bitumen and vegetation management	BTEX, TRH, PAHs, heavy metals, heavy metals, OCPs, OPPs, herbicides.
Agricultural land	Pesticides to maintain the land	Pesticides and herbicides

(1) Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), volatile halogenated compounds (VHCs), volatile organic compound (VOCs), organochlorine pesticides (OCPs) and organophosphate pesticides (OPPs).

Exposure pathways and potential receptors

Based on the potential contaminants and identified receptors there are the following potential exposure pathways:

- Direct contact with, or ingestion of, impacted surface or near surface soils by workers during construction or maintenance
- Leaching during the temporary stockpiling and storage of (contaminated) spoil

- Inhalation of dust, vapour or fibres by workers or members of the public during the construction or maintenance

Migration of contaminants and pollutants into Surveyors Creek, the nearby drainage lines or the underlying groundwater.

The potential for direct contact exposure would be managed by any staff working onsite under stringent health and safety controls. These safeguards would be used to avoid and minimise impacts to acceptable levels. The potential for the public to be exposed to dust or fibres, or the risk of coming into direct contact with soil, would also be managed by adopting stringent health and safety controls.

Section 6.6 specifically assesses the potential for surface and groundwater impacts.

6.4.3 Potential impacts

Construction

Soil quality and erosion

Under the proposal, the expected earthwork volumes would be about 11,000 m³ of cut material and about 5,500 m³ of fill material (refer to section 3.3.5). This would involve temporary stockpiling of topsoil and subsoil at its point of excavation and its longer-term storage in specific designated locations onsite (refer to section 3.3). Vegetation clearing, tree removal, mulching and other earthwork activities would also be required during construction. These activities would potentially lead to:

- Washout, erosion and sediment discharge of exposed soils
- Dust generation
- Loss of soil quality and condition during stockpiling
- Associated soil quality impacts through accidental spills caused by:
 - Use of chemicals outside of the contained areas
 - Traffic accidents, including loading and unloading risks
 - Leaks and drips from poorly maintained vehicles, machinery and equipment
 - Inadequate management of spoil and waste (leading to leaching).

The controls to manage sediment and erosion risks are standard and proven to be effective. Providing they are correctly implemented the impacts would be avoided or appropriately mitigated.

Contamination

The preliminary site investigation suggests that while encountering extensive contamination within the construction footprint is unlikely, the potential for encountering localised or unexpected contamination cannot be discounted (refer to Appendix G). Based on the area's development and land use history, current site uses, contaminated land and public notice records and the site investigation, the service stations along Mulgoa Road are considered to present the highest risk of encountering contamination due to hydrocarbons and petroleum bi-products.

Despite there being the presence of one significantly contaminated sites and two potentially contaminated sites locally, all these locations are either located far enough away from the proposal for there not to be a feasible exposure pathway or they have been remediated and/or are being managed to a point of not presenting a risk to workers and the public via the exposure pathways described above. The only other potential is exposing asbestos containing materials during excavation or demolition work.

Construction activities, if not properly managed, may result in soil contamination through accidental fuel and/or chemical spills or leaks. During construction, there would be a need to store small quantities of such

materials onsite. Standard management measures that are commonly applied to construction work for the storage and handling of hazardous materials and operation of machinery would be implemented. As these are proven to be effective in minimising the likelihood and potential for spills and leaks, providing that they are correctly implemented then the impacts would be avoided or appropriately mitigated.

Operation

The following impacts are typical of any operational road and may result in some contamination impact to the soils and geology of the surrounding area:

- Chemical and fuel spillage from road traffic, maintenance or accidents
- Runoff of oils, greases and hydrocarbons from the road.

The road would be operated and maintained under emergency and environmental management response processes that are adopted state-wide to limit any impact from the above.

6.4.4 Safeguards and management measures

Table 6-27 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix F and Appendix G contain further details on the specifics of the safeguards and management measures.

Table 6-27: Soil, geology and contaminated land safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction.	Contractor	Detailed design/pre-construction	SW1 Section 2.1 of QA G38 Soil and Water Management
Soil and water	A site-specific Erosion and Sediment Control Plan (ESCP) would be prepared and implemented as part of the SWMP. The Plan would include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design/pre-construction	SW2 Section 2.2 of QA G38 Soil and Water Management State Regional Environmental Plan No.20 (Hawkesbury -Nepean River, No.2 1997, 1997c)

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	<p>A Contaminated Land Management Plan (CLMP) would be prepared in accordance with the Guideline for the Management of Contamination (Roads and Maritime, 2013) and implemented as part of the CEMP. The Plan would include, but not be limited to:</p> <p>Capture and management of any surface runoff contaminated by exposure to the contaminated land</p> <p>Further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2)</p> <p>Management of the remediation and subsequent validation of the contaminated land, including any certification required</p> <p>Measures to ensure the safety of site personnel and local communities during construction.</p>	Contractor	Detailed design/pre-construction	<p>SW3</p> <p>Section 4.2 of QA G36 Environment Protection</p>
Contaminated land	<p>If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. This may include but not be limited to:</p> <ul style="list-style-type: none"> • Diversion of surface runoff • Capture of any contaminated runoff • Temporary capping. <p>All other works that may impact on the contaminated area would cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.</p>	Contractor	Detailed design/pre-construction	<p>SW4</p> <p>Section 4.2 of QA G36 Environment Protection</p>

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas. The Spill Management Plan will address, but not necessarily be limited to: management of chemicals and potentially polluting materials; any bunding requirements; maintenance of plant and equipment; and emergency management, including notification, response and clean-up procedures.	Contractor	Pre-construction/ construction	SW5
Asbestos	An Asbestos Management Plan will be developed and implemented. The plan will include: <ul style="list-style-type: none"> • Identification of potential asbestos on site • Procedures to manage and handle any asbestos • Mitigation measures if asbestos is encountered during construction • Procedures for disposal of asbestos in accordance with NSW EPA guidelines, Australian Standards and relevant industry codes of practice. 	Contractor	Pre-construction/ construction	SW6
Soil and water	All stockpiles will be designed, established, managed and decommissioned in accordance with the Stockpile Site Management Procedure (RTA, 2011e).	Contractor	Pre-construction/ construction	SW7
Soil and water	In addition to the implementation of general erosion, sediment and water quality control safeguards (above), any sediment basins, stockpiles, washdowns, batch plants, refuelling and chemical storage sites will be lined and/or bunded.	Contractor	Construction	SW8

6.5 Hydrology and flooding

This section describes the hydrology and flooding impacts that are predicted to occur from building and operating the proposal. This section summarises the surface and groundwater assessment prepared by Arup included in Appendix F.

6.5.1 Methodology

Modelling the drainage catchments and network allowed the existing stormwater characteristics and flood patterns to be replicated. It then allowed the hydrology and flooding changes to be modelled under the proposal to predict what the associated impacts would be. Two sets of modelling were used to assess the hydrological and flooding impacts:

- Hydrological modelling (DRAINS) to confirm the stormwater design and capacity
- Hydraulic flood modelling (TUFLOW) to confirm the operational impact on flood pattern and risks.

The assessment considered the impact of:

- Altering the volume of stormwater runoff due to widening the road, modifying the gradients and increasing the pavement area
- Flooding and afflux changes across the area through widening the road, increasing runoff, altering drainage patterns and revising the stormwater infrastructure.

Chapter 3 of Appendix F describes the modelling method and inputs.

6.5.2 Existing environment

Hydrology

Catchments and waterways

The proposal footprint is located within the Hawkesbury-Nepean catchment about 1.3 kilometres to the south-east of the Nepean River on the edge of the main floodplain. The two key creeks local to the proposal are:

- Surveyors Creek, which crosses the proposal footprint just to the north of Blaikie Road. It discharges into Peach Tree Creek about 800 metres from where it crosses Mulgoa Road, with Peach Tree Creek discharging into the Nepean River about 2.5 kilometres to the north
- School House Creek, which crosses Mulgoa Road just past the southern limit of the proposal footprint just to the north of the Glenmore Parkway intersection. It discharges to Mulgoa Creek just before discharging to the Nepean River about 1.25 kilometres to the west.

Additional drainage lines and culverts cross and run parallel to Mulgoa Road.

Figure 6-17 shows the two main creeks and their relationship to the proposal footprint.



Source: Arup: Note: the red line shows the combined construction and proposal footprint, the two creek lines are shown in blue

Figure 6-17 Key surface water features and drainage lines

The Hawkesbury-Nepean catchment falls under a WaterNSW plan that focusses on the management of sewage, runoff, river flow, stream bank repair, groundwater, water quality and pollution. The following management values are attached to the catchment:

- Aquatic ecosystem protection
- Primary (ie swimming) and secondary (ie kayaking) contact protection
- Drinking, irrigation and primary industry water quality maintenance.

Local drainage and catchments

As described in section 3.2.2, Mulgoa Road currently discharges via a series of gravity-fed cross and longitudinal drains and pits that discharge unattenuated to, School House Creek, Surveyors Creek, and alongside the M4 Motorway. All these discharge points eventually discharge to the Nepean River.

While all runoff from Mulgoa Road is discharged into the Nepean River, the above collection points also receive stormwater runoff from a wide area including the surrounding residential suburbs and commercial properties. This is supplemented by other regulated and un-regulated discharges into the Nepean River, including additional stormwater runoff and agricultural and mining discharges. This has affected the Nepean River's water quality as described in section 6.6.

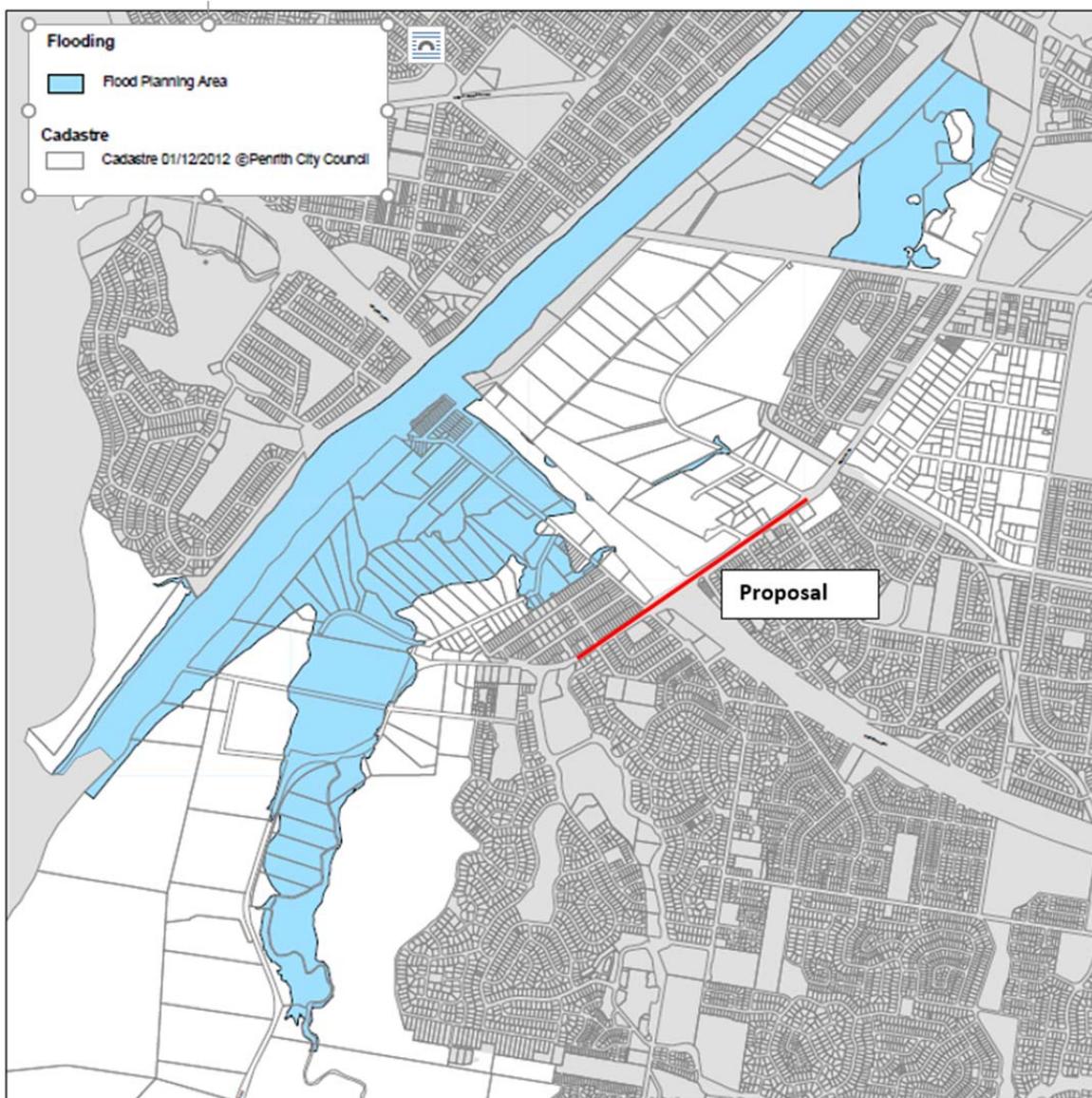
Flooding

The Penrith City Council LEP shows the proposal to be outside of the modelled 1-in-100 ARI flood level. As such, it is not prone to regional large-scale major-event flooding. However, it is affected by flooding because of the drainage lines and creeks backing up during flood conditions and localised overland flooding resulting for the surcharge (backing up) of stormwater infrastructure during extreme rainfall.

Previous flooding assessments concluded that parts of the footprint currently experiences flooding, with existing flood depths between 0.10 to 0.30m during a 10 year flood and 0.30 to 0.50m during a 100 year

flood. These areas include residential premises to the south east of the Glenbrook Road intersection and commercial properties to the west of Surveyors Creek.

Groundwater is present in the underlying alluvial deposits (refer to section 6.6). Its depth is influenced by rainfall and seasonal conditions. The recorded and predicted minimum depth to groundwater is about five metres below the surface, which is too deep to have any material effect on flood characteristics and patterns. The surface geology also supports the rapid discharge of water into the ground, which again would prevent localised waterlogging during extreme weather.



Source: Penrith LEP

Figure 6-18: Existing flooding levels

6.5.3 Potential impacts

Construction

There are two potential flood risks when the proposal is being built:

- An increased surcharge (water backing-up) in the stormwater system due to temporarily altering the runoff rates, flow paths and the catchments, plus the accidental discharge of sediment (causing blockages)
- Localised ponding, pooling and flooding mainly on hardstand areas during and following heavy rainfall that could result in the destabilisation of stockpiled spoil or fill material, the collection of water in open excavations, and an associated safety risk for site workers and the public.

Site maintenance and the inspection of the stormwater system, further refinement in the temporary drainage design, and effective work staging, are the standard safeguards that would be put in place to reduce the flooding impacts. As such, while the above impacts could feasibly occur, they would be managed to remove any worker exposure or public risks. Also, the routine inspection and maintenance of the site would be used to prevent the build-up and discharge of sediment to minimise any associated impacts as described above. This would be supplemented by planning the work schedule around anticipated major weather events and allowing sufficient time to 'closedown' the site and make it safe. Providing these measures are put in place the residual impact would be negligible.

Operation

Increased road runoff

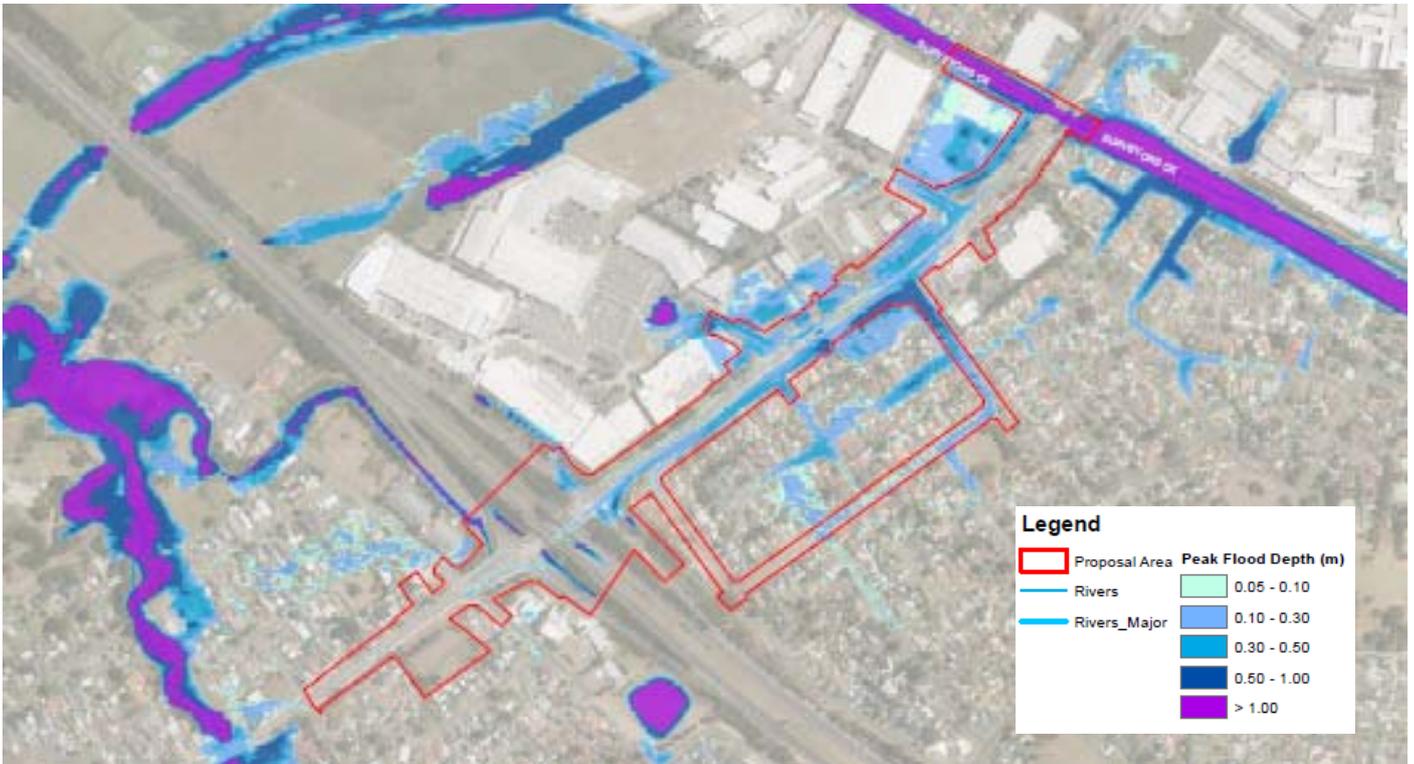
The pavement area along Mulgoa Road would increase by about one third from widening the road from four to six lanes. This would increase the volume of stormwater runoff entering the discharge points described in section 6.5.2. The small changes in road levels would also affect the runoff rates.

The modelling reported in Appendix F confirmed that under a range of scenarios and extreme flooding events the proposed road drainage would be able to cope to the same level as the current road despite the increased runoff volumes and rates without the risk of back-up and flooding along Mulgoa Road. The changes would also be insufficient to require the need to install attenuation controls to regulate the runoff.

Flooding impacts

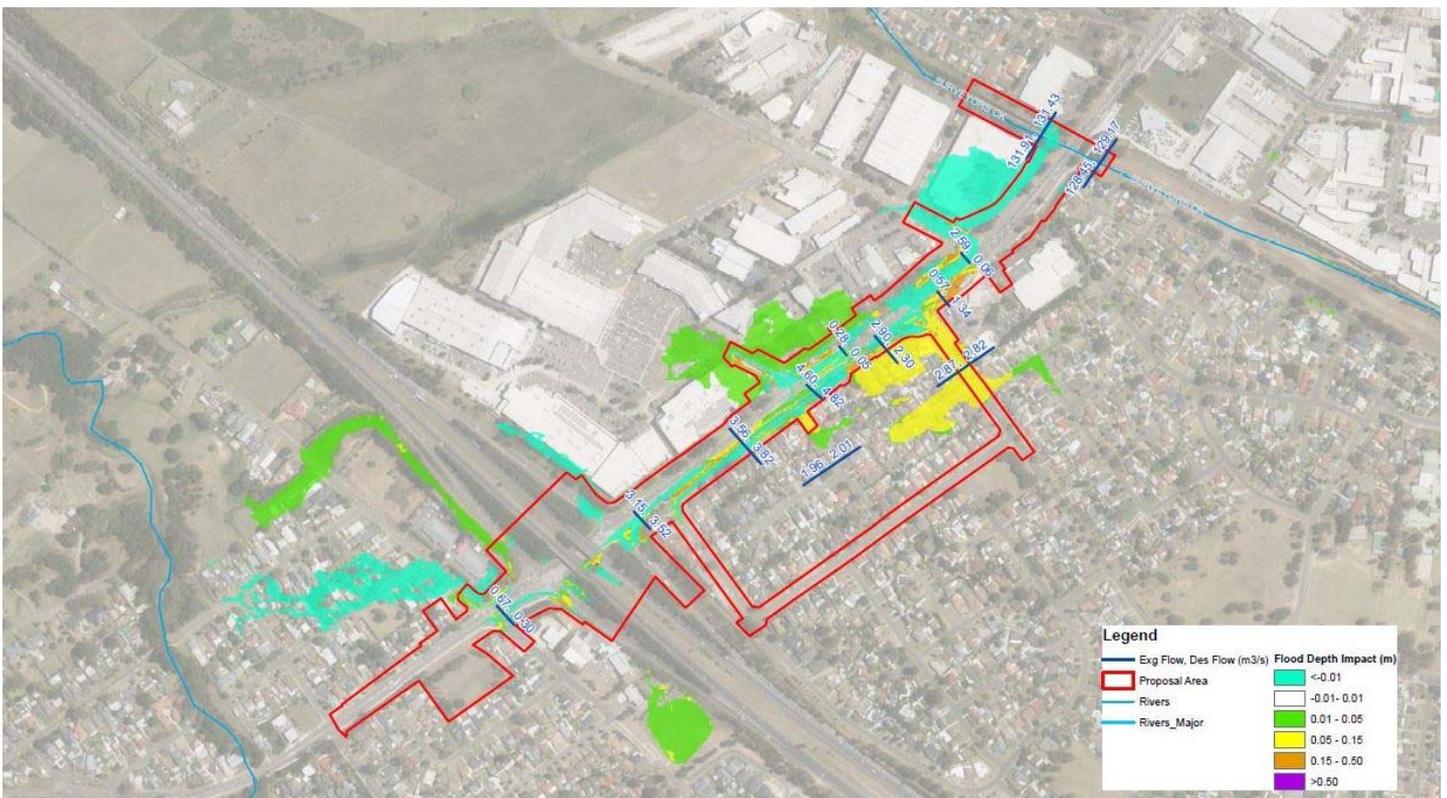
The DRAINS modelling reported in Appendix F confirmed that the land to the south east of the Glenbrook Road intersection, which includes local residences, would flood during a 10-year ARI event, while the land to the west of Surveyors Creek would flood during a 20-year ARI event. This would be due to afflux (flow) changes of between 0.05 meters and 0.07 metres in both locations introduced under the proposal as a result in the small changes in road levels in combination with increased road widths. The modelling does not predict that there would be any material change to flood risk or flood levels downstream of the proposed discharge points from the additional runoff.

The current modelling also predicts that Mulgoa Road would flood during a 100-year ARI event as shown on Figure 6-20. Importantly however Appendix F notes that this is likely due to the modelling not including the longitudinal drainage network. The report notes that further modelling would be carried out during the detailed design to address this limitation and confirm this. Existing flood impacts would not become worse due to the road widening. If Mulgoa Road is still shown to flood during an extreme event, additional design controls can be included to reduce impacts to acceptable levels.



Source: Arup

Figure 6-19: Model-predicted depth impacts over a 100-year ARI event in the existing case



Source: Arup

Figure 6-20: Model-predicted depth impacts over a 100-year ARI event incorporating proposed road design

6.5.4 Safeguards and management measures

Table 6-28 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix F contains further details on the specifics of the safeguards and management measures.

Table 6-28: Hydrology and flooding safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Hydrology and flooding	Prior to construction commencing, final flood and hydrology assessments will be undertaken to inform detail design measures to minimise risks to the environment, properties and the project. If Mulgoa Road is still shown to flood during an extreme event, additional design controls would be included to reduce impacts to acceptable levels	Roads and Maritime project manager	Detailed design	H1
Hydrology and flooding	A contingency and evacuation plan would be prepared for a potential flood event during construction. The plan would: Evaluate what flood event would trigger the plan Include evacuation procedures Include a map indicating the area that is flood prone and the locations where to evacuate.	Contractor	Pre-construction/ construction	H1

6.6 Surface and groundwater

This section describes the surface and groundwater impacts that are predicted to occur from building and operating the proposal. This section summarises the surface and groundwater assessment prepared by Arup included in Appendix F.

6.6.1 Methodology

Sub-catchment records, data and mapping were used to confirm the existing surface water quality conditions locally, while a review of the soil and geological characteristics, hydrogeological landscape, and borehole data were used to confirm the groundwater conditions locally.

The impact assessment considered if any construction activities or operational conditions would affect surface and groundwater quality in the context of the objectives and trigger values set out in the Australian Water Quality Guidelines for Fresh and Marine Waters (Australian and New Zealand Environment and Conservation Council, 2000, often referred to as the 'ANZECC Guidelines'). This was used to consider:

- Whether standard management measures would be sufficient to mitigate any construction-related water quality impacts
- The need, effectiveness and application of the principles set out in the Water Sensitive Urban Design Guideline (Roads and Maritime, 2015d).

6.6.2 Existing environment

Surface water quality

As noted in section 6.5.2, the proposal footprint is in the Hawkesbury-Nepean catchment. Water quality locally is affected by a mix of regulated and unregulated urban, agricultural and industrial runoff from an area extending from Richmond in the north to past Camden in the south (Hawkesbury Nepean River Health Strategy).

A nutrient management strategy is in place for this section of the Hawkesbury-Nepean catchment. It was introduced in 2010 in response to an increase in algal blooms and aquatic weed growth that had hampered recreational and commercial use of the river and affected its aquatic biodiversity. The focus of the strategy has been to manage the water quality of diffuse (eg urban and agricultural) and point (eg sewage treatment plant) discharges into this part of the catchment.

The above was supplemented by the implementation of a water sharing management plan for the Lower Nepean that focusses on maintaining the river's water quality to allow for its future viable use commercially and agriculturally.

Groundwater

The proposal footprint is located on the Richmond Lowlands hydrogeological landscape, which is characterised by groundwater infiltration and vertical and lateral flows. This means that unconfined aquifers form close to the surface, while groundwater flows horizontally at the point of intercepting more impermeable layers further belowground. The landscape also results in the formation of floodplains on low ground, which is evident along the banks of the Nepean River.

A review of 20 local borehole records (refer to section 2.4.9 of Appendix F) indicated that groundwater occurs between five and 10 metres belowground within the alluvial deposits. The exact depth to groundwater also varies seasonally and following heavy rainfall given the hydrogeological landscape character.

The groundwater quality of the Richmond Lowlands hydrogeological landscape is typically fresh-to-brackish because of the soil salinity locally (refer to section 6.4.2). While recorded salinity levels are generally below ANZECC Guideline trigger values set for lowland rivers, there are monitored instances where concentrations exceed the trigger values by 100 per cent (refer to section 2.4.9.1 in Appendix F and Table 3.3.3 in Volume 1 of the ANZECC Guidelines).

Table 6-29 summarises the available limited groundwater chemistry data recorded locally as compared against the recreational water quality guideline values of the ANZECC Guidelines. The bolded text highlights the recorded exceedances of the guideline trigger values. These exceedances are consistent with, and reflective of, the wider poor water quality across the Nepean River sub-catchment.

Table 6-29: Groundwater chemistry

Location	Groundwater depth (metres)	pH	Chloride (µg/L)	Sulphate (µg/L)	Iron (µg/L)
Western corner of the M4 Motorway interchange	11.1	7.0	3,700,000	230,000	<50
Eastern corner of the M4 Motorway interchange	9.6	7.4	74,000	44,000	1,100
Recreational water quality guideline values:		6.5 to 8.5	400,000	400,000	300

The groundwater is currently abstracted under licence for domestic and stock use at 12 locations within one kilometre of the proposal footprint (NSW Department of Primary Industries: Water, 2018).

6.6.3 Potential impacts

Construction

The proposed earthworks and resulting soil exposure has the potential to disturb and mobilise sediment and any associated contaminants, while the vegetation clearance and subsequent mulching, may result in leaching of organic contaminants. There is also a potential for poor site management practices relating to spoil transfer and management, soil/mulch stockpiling, and accidental chemical, fuel and hazardous spills, to impact on surface and groundwater quality through uncontrolled runoff.

In all cases, providing standard safeguards are implemented and effective, any impacts would be avoided and/or appropriately mitigated. This includes specific controls for working over Surveyors Creek, near any existing stormwater drains, and close to the existing drainage lines to avoid impacts. It would also include the installation of temporary erosion and scour protection around any discharge points and the separation of and diversion of offsite water flow.

The closure, decommissioning and backfilling of the Wolseley Street tunnel may affect groundwater flow locally. The scale of any change is unlikely to have any wide scale impact on regional groundwater patterns; however, it may alter soil moisture content locally due to improved flows from the removed barrier effect. This may reduce ground saturation on the up-gradient side of the tunnel and increase saturation on the down-gradient side of the tunnel.

Operation

While stormwater volumes and rates would be affected under the proposal, runoff quality is likely to largely remain unaffected. Over time, there is expected to be 1.2 per cent more traffic using Mulgoa Road every year on average (refer to section 6.1). While this would add to the soluble and sediment-bound pollutant discharge from the road, the increased stormwater volumes would dilute the runoff prior to discharge. Regardless, even if there was a change in road runoff chemistry locally this would never be at a scale to have any material effect on the water quality of the wider sub-catchment due to its size. As such, there is no need to treat or abate the runoff prior to discharge, including the need for any of the principles set out in the Water Sensitive Urban Design Guidelines (Roads and Maritime, 2015d).

In terms of the altered runoff rates, this would be investigated further, and if needed, the drainage design would be revised to include scour and erosion protection provisions at the discharge points to prevent any associated impacts. The potential for pollutant runoff from road traffic accidents is minimised by ensuring the upgrade is designed to current safety standards, and operating the road under environmental management and emergency response processes that are adopted state-wide.

Any maintenance work involving earthworks, vegetation clearance and/or the use of polluting chemicals carries some potential for mobilising sediment or accidental spillages. However, the adoption of standard safeguards would be used avoid and/or minimise any impacts.

6.6.4 Safeguards and management measures

The safeguards and management measures proposed in section 6.4.4 and section 6.5.4 would be introduced manage the predicted impacts described above.

6.7 Landscape character and visual impacts

This section describes the landscape character and visual impacts that are predicted to occur from building and operating the proposal. This section summarises the landscape character, visual impact and urban design assessment prepared by Arup included in Appendix H.

6.7.1 Methodology

The assessment was carried out in accordance with the Environmental Impact Assessment Practice Note: Guidelines for Landscape Character and Visual Impact Assessment (EIA-N04, Roads and Maritime, 2013a) and the Roads and Maritime urban design guideline Beyond the Pavement (Roads and Maritime, 2014a). It involved a desktop analysis and site visit. The assessment focussed on the temporary visual amenity impacts during construction and the long-term visual impacts on selected viewpoints due to changes in the landscape character introduced under the proposal.

The landscape assessment considered the area's built, natural and cultural character as well as sense of place. It measured impacts as a combination of the area's sensitivity and the magnitude of change introduced under the proposal. The visual assessment was based on assessing the impact on specific viewpoints by considering how sensitive the viewer would be to the magnitude of change in the landscape introduced under the proposal. Both assessments rated the scale of the impacts using a matrix as described in Appendix H. In summary:

Sensitivity to change considered factors such as:

- Existing land use
- Landscape patterns and scales
- Visual openness of the landscape and distribution of viewers
- Value placed on the landscape.

Magnitude of change considered factors such as:

- Existing built form in the landscape and how closely the development matches its bulk, scale and form
- Scale or degree of change to the landscape
- Nature of and duration of change.

6.7.2 Existing environment

Regional landscape context

The proposal footprint is located within the developed urban environment of western Sydney. It is characterised by a low-scale built form, including a residential mix of well-spaced housing and lower-density commercial and industrial activity. This provides a feeling of openness within distinct suburban areas. Each area is divided and contained by a network of main roads or other key features such as drainage and creek lines. The area's strong vegetation component is a feature of the landscape that helps provide distinction and character for locals, road users and other visitors to the area

Mulgoa Road frames and contains the commercial area to the west and the residential areas to the east and south of the M4 Motorway. The area's relatively flat topography contains the landscape and form along the road corridor and affords localised views for road users. Occasional views to the Blue Mountains are however afforded throughout the landscape, which provide key distinct view and reference points in the landscape.

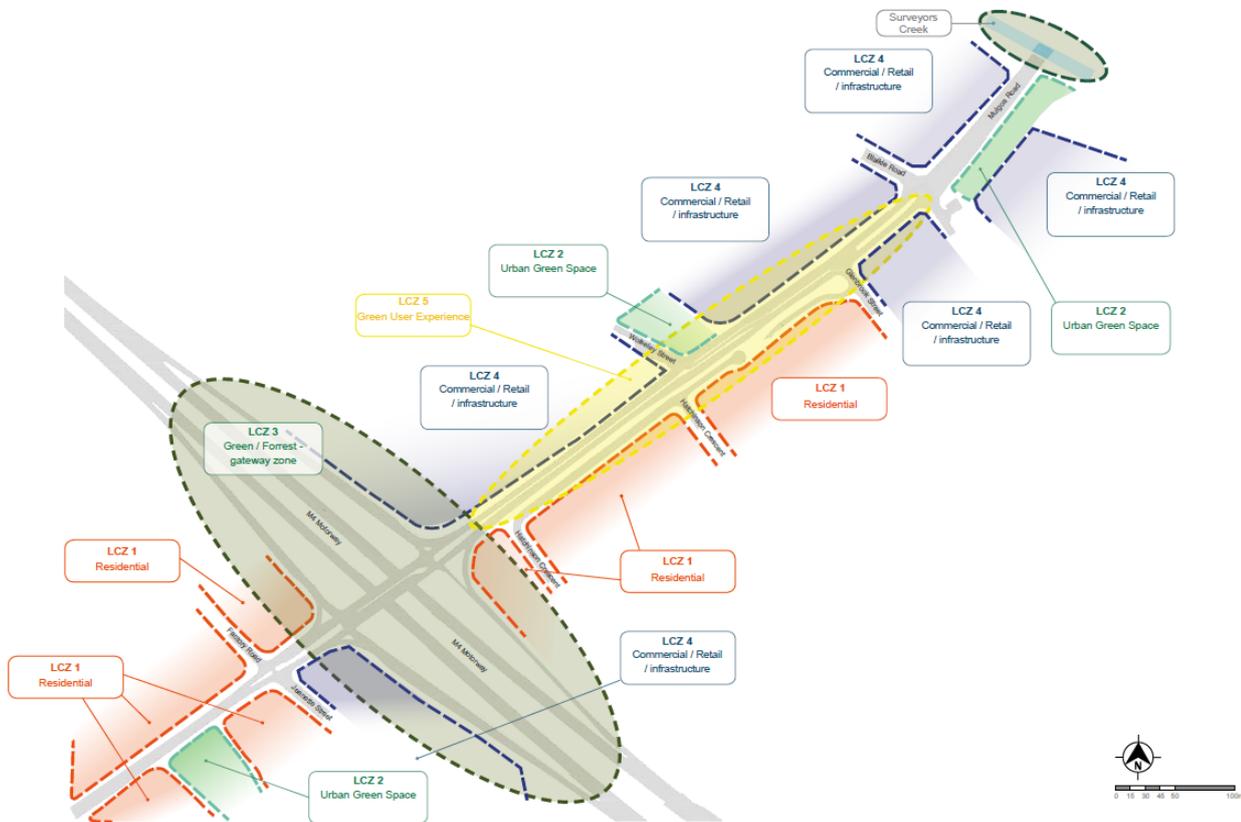
Landscape character zones

To characterise the differences in the landscape it was divided into five distinct zones that have recognisable components and patterns. Table 6-30 describes each zone, its characteristics and its sensitivity to change. Figure 6-21 shows the location of each of the five landscape character zone (LCZ).

Table 6-30: Landscape character zones

Zone	Zone	Land use characteristics	Sensitivity to change
LCZ1	Residential: south of the M4 Motorway to the west and east of Mulgoa Road (Regentville) and north of the M4 Motorway to the east of Mulgoa Road (Jamisontown).	Low-scale residential development including: <ul style="list-style-type: none"> Densely-planted vegetation that provides screening Verge-side planting that softens the corridor and provides separation between land uses 	Moderate sensitivity: the area has some ability to accommodate change however this would depend on the ability to replant and screen the road. The changes would be more sensitive in the short-term before any replacement planting establishes and matures.
LCZ2	Urban green space: including the Council reserve located south of the M4 Motorway, the area next to Wolseley Street, and the area on the eastern side of Mulgoa Road north of Blaikie Road.	<ul style="list-style-type: none"> Offers informal recreation open green space for residents Provides relief to the hard built-elements along Mulgoa Road. 	Moderate sensitivity: assists in transitioning from the commercial area to the north and the rural character to the south. Contributes to the open road corridor character and supports the surrounding landscape.
LCZ3	Green forest gateway: covering the M4 Motorway interchange and approaches.	<ul style="list-style-type: none"> Mature native planting provides a vegetative gateway from the north along Mulgoa Road and regionally via the M4 Motorway Provides connections to surrounding green hills. 	Low sensitivity: provides a green edge around the M4 Motorway interchange, however the area is generally compromised and disturbed due to the high traffic volumes.
LCZ4	Commercial and retail: including north of the M4 Motorway on both sides of Mulgoa Road (Jamisontown), and the fire stations south of the M4 Motorway on the eastern side of Mulgoa Road.	<ul style="list-style-type: none"> Signage is present along Mulgoa Road for these premises that provides reference to the zone's use and presence Current verges that front these premises are large and contain vegetation including mature endemic trees. This provides a strong vegetated component in the landscape and separates Mulgoa Road from this zone. 	Low-moderate sensitivity: assists in transitioning from the commercial area to the north and the rural character to the south. Contributes to the open road corridor character and supports the surrounding landscape. Provides a distinct boundary between the commercial area and the road, which increases its sensitivity.

Zone	Zone	Land use characteristics	Sensitivity to change
LCZ5	Green user experience: covering the Mulgoa Road corridor north of the M4 Motorway.	<ul style="list-style-type: none"> • Mature trees provide a green corridor with visual connections to surrounding green hills • The trees provide shade and amenity benefits • Native vegetation on the ground supports the native trees. 	Low-moderate sensitivity: due to it providing a green edge extending along the road corridor. It therefore provides an important natural landscape features.



Source: Arup

Figure 6-21: Landscape character zones

Viewpoints and receivers

The proposal would see the widening of the existing road within a relatively contained corridor. This means the proposal’s visual envelope (ie the area over which the road is visible) is contained to a small area, focussed on the properties that immediately front Mulgoa Road, extending slightly back along each intersecting road as shown in Figure 6-22. Consequently, the proposal would have the potential to impact on the following receivers:

- Residents and workers alongside Mulgoa Road
- Users of the green and recreational spaces locally
- Shoppers and customers using the infrastructure alongside the road corridor
- Existing road users.

Eight private and public viewpoints were selected to represent the above receivers. Table 6-31 describes the character of each viewpoint and Figure 6-22 shows their location.



Source: Arup. Note: red shading shows the visual envelope and the numbers show the selected viewpoints

Figure 6-22: Visual envelope and representative viewpoints

Table 6-31: Visual receivers (viewpoints)

Viewpoint and location		Direction	Receiver representation and sensitivity
VP1	School House Road intersection	West/north	Residents: <i>moderate</i>
VP2	Local Park/Council Reserve	West/south	Recreational users: <i>moderate</i>
VP3	Factory Road: childcare centre	East/north-east	Children/workers: <i>moderate</i>
VP4	Hatchinson Crescent	West	Residents: <i>moderate</i>
VP5	Homemaker Centre	South-east	Customers/workers: <i>low</i>
VP6	Peter Court	North/north-west	Residents: <i>moderate</i>
VP7	Blaikie Road: shopping centre edge	East/south	Customers/workers/road users: <i>low</i>
VP8	Fairfield Place intersection	West/north	Residents: <i>moderate</i>

6.7.3 Potential impacts

Construction

Certain landscape character and visual impacts would first occur during construction because of:

- Vegetation clearance, earthworks and ground disturbance
- The introduction of equipment, work platforms, cranes and construction equipment along the road corridor.

This work would have the greatest impact on the values associated with the residential areas (LCZ1) and urban green space (LCZ2) where the effects would be:

- Loss of the composition of the landscape character and its setting
- Removal of green components and the visual separation this offers
- Temporary introduction of machinery and equipment into the landscape, affecting the overall amenity and setting.

The proposal's construction would temporarily affect the visual amenity of most the receivers in Table 6-31. This would be most notable for those residents overlooking the construction works (VP1, VP6 and VP8) who may be affected for up to two years. The magnitude of impact would depend on the stage of construction and proximity of the work. It is expected that the greatest amenity impacts would take place during the major earthworks phases when the existing vegetation is removed. Once this has taken place, and the construction work is complete, the impacted areas would be reinstated and landscaped. Over time, the impacts would lessen and the green and vegetated character of the corridor would (re) establish and mature.

The construction compound would be used outside of standard construction hours to support specific activities which would be carried out during the night. The operation of the construction compound at night has the potential to result visual impacts from light spill on neighbouring residents. Construction activities would be temporary in nature and night time works would be minimised as far as practical.

Operation

Landscape character assessment

Table 6-32 summarises the landscape character impact assessment, with more detail provided in Appendix H.

Table 6-32: Landscape character assessment

Zone	Description of changes to LCZ	Sensitivity	Magnitude	Impact
LCZ1 residential	Widening would encroach into the surrounding residential areas. Additional road infrastructure and street furniture would introduce new built-form elements into the landscape. The impacts would be greater in the short-term because of tree and vegetation removal, however the proposed planting strategy would serve to re-establish a screen and buffer between the road corridor and this zone.	Moderate	Moderate	Moderate

Zone	Description of changes to LCZ	Sensitivity	Magnitude	Impact
LCZ2 urban green space	The road widening would increase the dominance and presence of the road in relation to the character of this zone. The impacts would be initially greater because of the removal of roadside vegetation. However, the proposed planting strategy serve to re-establish a screen and buffer between the road corridor and this zone.	Moderate	Low	Low
LCZ3 green forest gateway	The upgrade of the interchange would be at a scale that it would have a limited impact on the character of the zone. This is supported by the need for limited vegetation clearance in this location to accommodate the proposal footprint, and the proposal to re-plant any disturbed areas.	Low	Low	Low
LCZ4 commercial and retail	The proposed widening would require the removal of a large extent of the mature trees that buffer and screen this zone from the road. The result would be the increased presence and dominance of the road from within this zone. The overall long-term impact would depend on the ability to refine the design and reduce the tree loss to sufficient an extent to maintain the natural character and provide a buffer.	Low- moderate	High	Moderate- high
LCZ5 green user experience	Like LCZ4, the proposed widening would require the removal of a large extent of the mature trees that buffer and screen this zone from the road. This would reduce the character and amenity of this zone. However, unlike LCZ4, there is more potential to replant where space allows. Also, the impacts would be reduced by refining the design to reduce the tree loss.	Low- moderate	High	Moderate- high

Overall, the proposal would have the greatest impact to the north of the M4 Motorway through the need to clear an extent of mature trees alongside the existing road corridor. This would remove the buffer, screening and amenity function provided to LCZ4 and LCZ5. There is also limited space to replant and replace the removed vegetation to mitigate the loss in character. Thus, the road is likely to become a more prominent and dominant feature in the landscape north of the motorway. Conversely, around the M4 Motorway interchange and to the south, the vegetation and tree loss would be far less, and there would be sufficient space to replant and introduce other urban design features to mitigate the impacts of widening the road corridor. As such, these zones (LCZ1 to LCZ3) have more ability to absorb the changes.

Visual impact assessment

Table 6-33 summarises the assessed visual impact at each viewpoint. Appendix H provides more detail of the impact assessment.

Table 6-33: Visual impact ratings

ID	Viewpoint location	Type of receiver	Sensitivity	Magnitude	Impact rating
VP1	School House Road intersection	Residents	Moderate	Low	Low-moderate
VP2	Local Park/Council Reserve	Recreational users	Moderate	Negligible	Negligible
VP3	Factory Road: childcare centre	Children/workers	Moderate	High	Moderate-high
VP4	Hatchinson Crescent	Residents	Moderate	High	Moderate-high
VP5	Homemaker Centre	Customers/workers	Low	High	Moderate
VP6	Peter Court	Residents	Moderate	High	Moderate-high
VP7	Blaikie Road: shopping centre edge	Customers/workers/road users	Low	Moderate	Low-moderate
VP8	Fairfield Place intersection	Residents	Moderate	Low	Low-moderate

Three viewpoints (VP3, VP4 and VP6) are predicted to be experience a moderate-high impact. These capture the residents living alongside Hatchinson Crescent and Peter Court and the children and workers at the Kids Academy on Factory Road. The removal of the vegetation buffer along Hatchinson Crescent and Peter Court and its replacement, in part, with a proposed noise wall (refer to section 6.2.5) along with the road's encroachment into private property would alter the views for the people that live there. For VP6, the removal of the mature trees, which define and support the landscape character of the area, would additionally add to the visual impact for the residents of Peter Court.

Despite the low-sensitivity of the customers and workers at the Penrith Homemakers Centre, the required removal of a large extent of the mature trees that buffer and screen this viewpoint from the road (VP7), would make the road become more visually dominant within the landscape leading to an increased visual impact. As described in

Table 6-32, the limited space means it would be not easy to introduce mitigative landscape planting.

For the rest of the viewpoints, the existing road infrastructure is already affecting the quality and amenity of people's views in these locations. Despite the proposal to widen the road, the remaining residents already accept the presence of the road. While it would become more dominant in their views, the inclusion of landscape planting and an effective urban design would limit the impacts.

6.7.4 Safeguards and management measures

Key treatments and mitigation measures

Section 3.2.3 describes the proposed urban design and treatment measures that would be used to minimise any change in landscape character values and reduce visual amenity impacts. Table 6-34 summarises the proposed mitigation at each viewpoint. This would also aim to minimise and ideally maintain the landscape character of each zone.

Table 6-34: Proposed mitigation at each viewpoint

ID	Viewpoint location	Impact rating	Mitigation
VP1	School House Road intersection	Low-moderate	Replace lost trees to create a boulevard treatment and amenity improvements (such as shading) for pedestrians. Use low-level planting to separate the road corridor and footpaths.

ID	Viewpoint location	Impact rating	Mitigation
VP2	Local Park/Council Reserve	Negligible	Consistent with VP1, plus plant trees in clumps to maintain views across the open space and turf and landscape all disturbed areas to improve the road's integration within the revised road corridor.
VP3	Factory Road: childcare centre	Moderate-high	Replace lost trees to create a gateway treatment, which would be supported by a densely planted understory to screen the childcare centre. Use low-level planting to separate the road corridor and footpaths, while planting the median to support the gateway/ arrival experience.
VP4	Hatchinson Crescent	Moderate-high	Replace lost trees focussing on screening views of the noise wall for residents. Use supplementary urban design treatments on the noise walls to soften their impact. Turf all disturbed areas to improve the road's integration within the revised road corridor.
VP5	Homemaker Centre	Moderate	Revise the design to retain the buffer and screening effect of the mature trees where feasible and reasonable. Replace any lost trees to improve the urban amenity and shade pedestrians. Plant at regular intervals to create a boulevard treatment consistent with the themes proposed for VP1. Also use clumped tree planting at specific locations to create a more natural character consistent with the existing vegetation in this location. Turf all disturbed areas to improve the road's integration while introducing median planting to continue the gateway/arrival experience theme proposed for VP3.
VP6	Peter Court	Moderate-high	Consistent with VP4, plus the use of additional planting around the bus stop to soften any impacts.
VP7	Blaikie Road: shopping centre edge	Low-moderate	Consistent with VP5
VP8	Fairfield Place intersection	Low-moderate	Consistent with VP1 plus turf all disturbed areas to improve the road's integration.

Safeguards and management measures

Table 6-35 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix H contains further details on the specifics of the safeguards and management measures.

Table 6-35: Landscape character and visual impact safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	<p>An Urban Design Plan (UDP) would be prepared to support the final detailed project design and implemented as part of the CEMP. The UDP would present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan would include design treatments for:</p> <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise walls • pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. <p>The UDP would be prepared in consultation with Council in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> • Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014a) • Landscape Guideline (RTA, 2008b) • Bridge Aesthetics (Roads and Maritime 2012) • Noise Wall Design Guidelines (RTA, 2006) • Shotcrete Design Guideline (RTA, 2005). 	Roads and Maritime project manager/contactor	Detailed design/pre-construction	LV1
Landscape character and visual impact	<p>Detailed design solutions to minimise the visual impacts of noise wall along the eastern side of Mulgoa Road will be developed in consultation with property owners, residents and Penrith City Council and implemented during construction. The design will be prepared in accordance with the RTA Noise wall design guideline.</p>	Roads and Maritime project manager	Detailed design	LV2

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	The Landscape Management Plan will be refined to ensure cost effective and consistent management of landscape works will be developed in consultation with property owners, residents and Penrith City Council and implemented during construction. The plan will be prepared in accordance with the RTA Landscape guideline (RTA, 2008b).	Roads and Maritime project manager	Detailed design	LV3
Lighting	A detailed lighting plan will be developed for the proposal in consultation with property owners, residents and Penrith City Council.	Roads and Maritime project manager	Detailed design	LV4
Landscape character and visual impact	Detailed design solutions to screen properties alongside Mulgoa Road will be developed in consultation with property owners, residents and Penrith City Council and implemented during construction.	Roads and Maritime project manager	Detailed design	LV5
Tree loss	Measures to reduce the tree loss alongside Mulgoa Road would be considered in developing the detailed design.	Roads and Maritime project manager	Detailed design	LV6
Landscape character and visual impact	Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials.	Contractor	Construction	LV7
Lighting impacts	Temporary site lighting will be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting.	Contractor	Pre-construction/ construction	LV8

6.8 Aboriginal heritage

This section describes the Aboriginal heritage impacts that are predicted to occur from building and operating the proposal. This section was informed by the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) Assessment that was prepared for the proposal by Kelleher Nightingale Consulting included in Appendix I.

6.8.1 Methodology

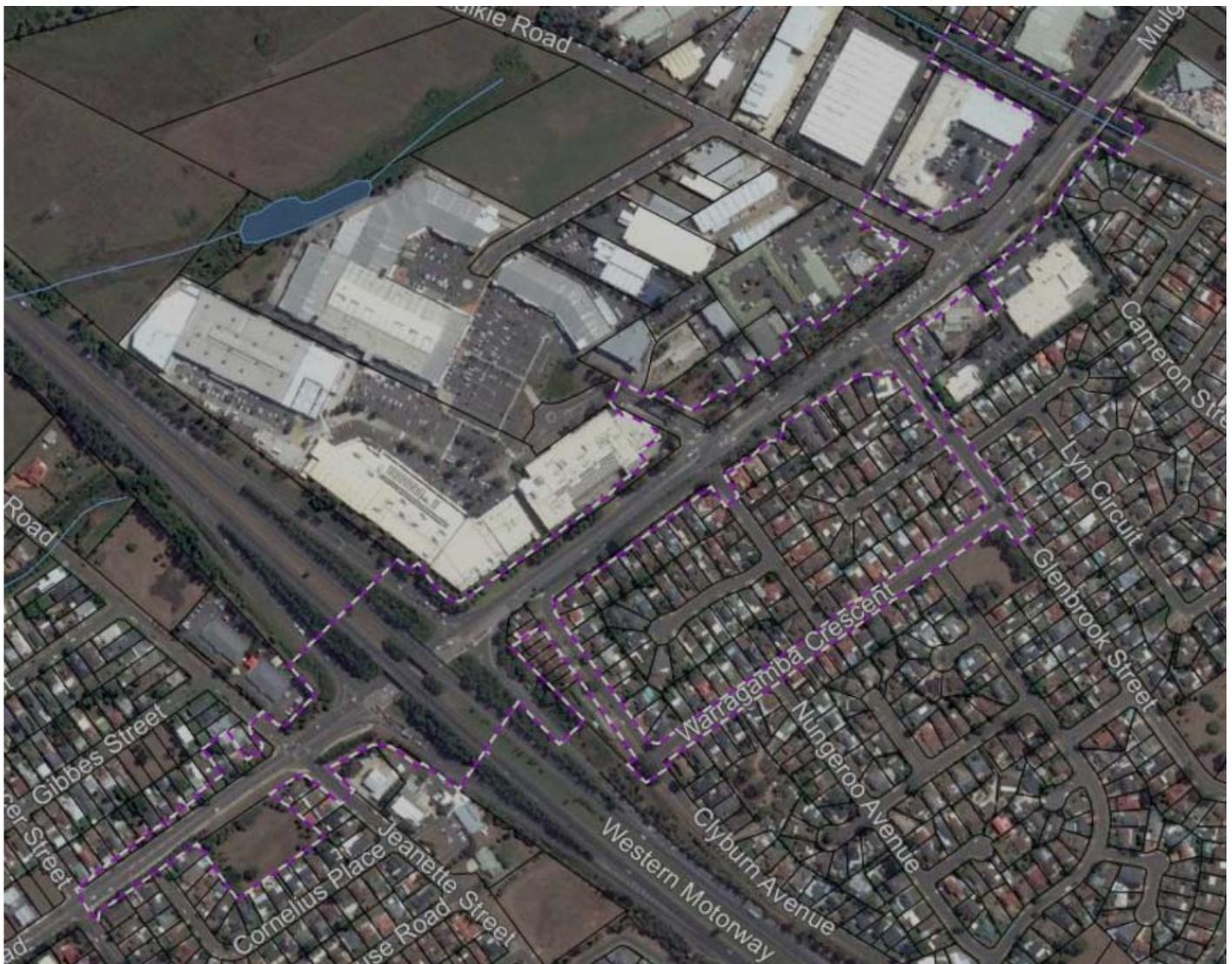
The assessment was carried out in accordance with:

- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW referred to as 'the Due Diligence guidelines' (OEH, 2011)

- Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW referred to as 'the Code of Practice' (DECCW, 2010)
- Stage one and two of the PACHCI (RTA, 2011).

A desktop search of the Aboriginal Heritage Information Management System (AHIMS) and Native Title Claims Register was carried out in 2017 to identify any previously recorded Aboriginal heritage objects, items or values locally. This was supplemented by reviewing statutory Commonwealth, State and local heritage lists, inventories and register, and previous studies in the local area as described in chapter 3 of Appendix I. This information was collectively used to determine a predictive model for the Aboriginal heritage value of the proposal footprint and local area.

This was followed by an archaeological field survey carried out in September 2017 by a qualified archaeologist and a representative from the Deerubbin Local Aboriginal Land Council. Standard archaeological field survey methods were adopted (Burke & Smith 2004), comprising a full pedestrian survey, as defined under the Code of Practice, and spot checks of areas of identified disturbed land. The aim of this survey was to identify and record objects or sites of Aboriginal heritage significance within the construction and proposal footprints, as well as any landforms likely to contain further archaeological deposits. Figure 6-23 shows the Aboriginal heritage study area.



Source: Kelleher Nightingale Consultancy

Figure 6-23: Aboriginal heritage study area.

6.8.2 Existing environment

Aboriginal history

The Aboriginal peoples that lived on the Cumberland Plain spoke the Darug dialect and used the land for its resources. As is well-documented, the British colonisation had a devastating effect on the Aboriginal population, including their ancestral displacement from their traditional lands. Despite these tensions on the Cumberland Plain, many Aboriginal families continued to live semitransitional lives alongside the settled Europeans in the area. Locally, the research suggests that Aboriginal peoples were more likely to avoid the floodplains of the Nepean River to the west, favouring the slightly higher land to the east of the proposal. Appendix I provides further information on the area's history and use.

Identified sites, records and previous studies

There are 11 recorded Aboriginal sites over a four square kilometre area centred on the proposal footprint. Nine remain while three others are recorded as destroyed. Of the remaining nine sites, all except one are located on the higher ground to the south east of the proposal footprint, and they are all characteristic of open camp sites. There are no other listed or registered Aboriginal heritage items of national, state or local value in the area recorded on the other databases. Table 6-36 describes the character of the three closest sites to the proposal footprint.

Table 6-36: Key AHIMS sites

AHIMS reference	Character	Location relative to the proposal
45-5-4569	Surface scatter comprising two mudstone flakes within a disturbed deposit of a gravel lag, with no archaeological potential.	160 metres south-west
45-5-0305	Surface scatter of four artefacts comprising two mudstone flakes and two mudstone, silcrete and quartz waste flakes.	150 metres south
45-5-0418	Surface scatter of 13 artefacts comprising one core.	240 metres south-east

While three previous studies covering the South Penrith Development Site (1981, 2001a and 2001b) and the M4 Motorway (1996) identified a range of Aboriginal heritage items locally, all are consistent in concluding that previous agricultural, quarrying and other land uses had caused sufficient disturbance to remove any archaeological potential or retained Aboriginal value.

Likelihood of Aboriginal sites within the construction footprint

Based on the landscape character, underlying soil and geology, topography, recorded finds, and extensive disturbance, the following Aboriginal heritage potential was predicted to occur in the study area:

- Reasonable potential for open artefact scatters and/or isolated artefacts on flat and slope landforms most likely comprising silcrete, with occasional occurrences of quartz, chert and siliceous tuff/mudstone
- Low potential for remnant native trees to include scars, limited due to the clearance of most of the original natural vegetation cover.

No other Aboriginal heritage values (eg isolated finds, burial sites) are predicted to occur locally.

Additional recorded value

The field survey was used to investigate the above predictions and archaeological potential within and local to the proposal footprint. Consistent with the wider area, the field survey did not identify any new objects, items, sites or potential archaeological deposits, concluding that the substantial ground disturbance provides no potential for natural ground surface or intact buried objects.

6.8.3 Potential impacts

Construction

As none of the sites on the AHIMS are within the construction or proposal footprints, and the area is confirmed to have no viable remaining Aboriginal value or potential, then there is not expected to be any heritage impact during construction.

Operation

No Aboriginal heritage impacts are expected once the proposal is operational.

6.8.4 Safeguards and management measures

Table 6-37 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix I contains further details on the specifics of the safeguards and management measures.

Table 6-37: Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015c) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction.	Contractor	Detailed design/ pre-construction	AH1

6.9 Socio-economic

This section describes the socio-economic, property and land use impacts that are predicted to occur from building and operating the proposal. This section was informed by the Social Assessment that was prepared for the proposal by Arup included in Appendix J.

6.9.1 Methodology

Socio-economic

A moderate level of assessment was carried out in accordance with Environmental Impact Assessment Practice Note: Socio-Economic Assessment (EIA-N05, Roads and Maritime, 2014). As such, it involved reviewing published 2016 Census data, records, literature, community and stakeholder feedback, and the

output from other assessments containing relevant socio-economic themes, namely traffic, noise and vibration, landscape character and visual impacts, and air quality.

The assessment considered the corresponding socio-economic impacts on:

- The local community in terms of its adoption or opposition to the proposal based on its characteristics and profile
- Social amenity and community infrastructure in the area
- The community's values
- Local and regional business.

Community values are those socio-economic aspects that people hold important to their quality of life and wellbeing. They include physical assets, such as parks, recreational areas and pedestrian connectivity, as well as social factors such as a sense of safety and wellbeing, belonging and community diversity. The community values were defined for the local area through consultation with the local community (refer to chapter 5).

The assessment mainly considered the socio-economic values within an area extending about one kilometre from the proposal footprint. This captured six of the smallest Census zones (SA1 zones) as described in section 1.6 of Appendix J. Additional socio-economic data within the LGA and occasionally across the state were used to supplement the study area data.

Property and land use

Land zoning maps and publicly available information were used to understand the current development zoning and land uses. The assessment considered:

- Property acquisition requirements
- Temporary and permanent public and private property impacts
- Conflict or inconsistency with land use zoning provisions in the area
- Severance impacts
- Loss of existing function or future viability.

6.9.2 Existing environment

Local community

Population

About 204,000 people were recorded as living in the LGA in 2016; an 11 per cent increase from 2011. By 2021, the population is expected to grow by another 20 per cent to around 240,000. Locally about 3,000 people were living in the study area in 2011, which may increase to 3,600 by 2021.

Social and demographic characteristics

The age and family profile locally is broadly consistent with state averages. Almost half the families in the area (46 per cent) are couples with children, while the average household size is 2.6. About one fifth (21 per cent) of the people in the area are children (14 years or younger) and about 15 per cent are over 65. Most of the people in the area, about 65 per cent, are of working age (15 to 64 years old).

Only about 11 per cent of the people living in the area were born overseas which was far lower than the state-average of 30 per cent. About four per cent of the people living in the area needed help with daily living, which is consistent with the wider LGA.

Employment, income, housing and socio-economic advantage/disadvantage

In the first quarter of 2017, unemployment stood at four per cent, which was lower than the state-average over the same period (5.1 per cent). Unemployment in the area had also continued to fall since 2015. There was no main employer or industry in the area.

The manufacturing, retail, healthcare, and education/training sectors each employed between 11 and 13 per cent of the people that work in the area. On average, each household locally had a weekly income of about \$1,550. This was consistent with the state-average but about \$100 less than the LGA average.

In terms of household ownership, about 40 per cent of the housing stock was owned outright and another 40 per cent was being purchased. The remaining 20 per cent was rented, which was lower than the LGA and state-average of about 30 per cent.

Average monthly home loan (mortgage) repayments were about \$2,350 in 2016, while average weekly rents were about \$250. As such, home loan repayments in 2016 were higher than the LGA and state averages of about \$2,000, but rents were slightly lower than the LGA and state average of \$360 and \$380 respectively.

This would suggest that there was (and continues to be) a degree of economic pressure for people with home loans in the area as they have a relatively high repayment compared their income. Despite this, the people living in the area are not considered socio-economically disadvantaged as can be concluded by looking at the corresponding Australian Bureau of Statistic dataset of relative advantage/disadvantage, which is based on a composition of socio-economic indicators including income, education, occupation, wealth and living conditions. This showed the people living in the area to be relatively advantaged socio-economically as described further in Appendix J.

Travel behavior

There is a clear dependency on private vehicle use and ownership, with this being the main method to travel to and from work (refer to section 6.1.2). As a result, in 2016, over 90 per cent of households owned a car, and about 50 per cent of households owned more than one car. The high level of car dependency, and the need for most people to travel between 10 kilometres and 40 kilometres to and from work every day has resulted in the congestion experienced on Mulgoa Road the result of which has been a notable drop in average speeds to about 20 km/h to 30 km/h in peak periods (refer to section 2.2). The limited public transport provisions and accessibility in the area had also resulted in the high dependency on private car travel.

Social infrastructure

Social infrastructure comprises the community services and facilities provided in an area that cater for residents and wider user groups. Table 6-38 summarises the key social infrastructure located within and alongside the proposal footprint. Figure 6-24 shows the location of these facilities.

Table 6-38: Key social infrastructure within and alongside the proposal

Infrastructure type	Services and facilities
Open space and amenity land	Public open green space: 111 Mulgoa Road Mature roadside amenity planting: alongside Mulgoa Road
Community facilities	Regentville Fire & Rescue: 8-12 Jeanette Street Regentville Rural Fire Service: 20 Jeanette Street Regentville Public School (Junior): School House Road Regentville Kids Academy: 1 Factory Road Regentville Hall: 16 Jeanette Street

Infrastructure type	Services and facilities
Places of community significance	These include the tourism and hospitality facilities described below under business, industry and tourism heading.



Source: Arup

Figure 6-24: Key social infrastructure

Community values

The points of value raised in the community consultation (refer to chapter 5) echo the outcomes the local community is keen to see delivered in the LGA, as reported in the Penrith City Council’s Community Plan, namely:

- A regional City that is the focus of a sustainable and prosperous region
- Access to facilities and services
- Active, healthy lifestyles
- Choice of quality housing
- A safe, resilient, welcoming and creative community
- To protect and conserve a healthy natural environment, including the Nepean River
- Safe roads, including shared pathways for cyclists and pedestrians
- Neighbourhoods people can be proud of.

Business, industry and tourism

There were nearly 13,000 businesses registered in the LGA in 2016, which collectively added about \$7.8 billion to the State economy. This equated to about 1.6 per cent of the State’s gross sale product.

Business composition and type in the LGA echoes the key employment sectors. The main sectors generating gross regional product are manufacturing (13 per cent), health care (10 per cent), public administration (10 per cent), education (10 per cent) and construction (10 per cent).

The closest businesses to the proposal footprint that are all serviced by Mulgoa Road as summarised in Table 6-39 and shown on Figure 6-25.

Table 6-39: Key local businesses alongside the proposal footprint

Business	Detail
Penrith Homemaker Centre	Comprise 23 specialty shops including several flagship chain stores. About 125,000 people visit the centre each month. While the centre operates typical opening hours, the highest custom is on Saturday morning and in the lead up to the festive period and end of financial year sales.
BP service station: 124 to 128 Mulgoa Road	Operates 24-hours per day.
Shell service station: 221 Mulgoa Road	Operates from early morning to late evening.
Penrith trade centre: 241 Mulgoa Road	Bulky goods retailer that has a capacity for over 100 parking spaces.
Quality Inn, Grey Gums Hotel: 261 Mulgoa Road	A 55-bedroom hotel, licenced bar, bottle shop, restaurant and gaming facility. While the hotel operates from late morning to early the following morning, peak custom is typically during the evening.
Western Motorcycles: 283 Mulgoa Road	A major showroom and retail outlet stocking about 300 bikes, along with a service and maintenance centre that employs over 20 people. While it operates standard typical trading hours, peak custom is on Saturday morning and in the lead up to the festive period and end of financial year sales.
Nepean Animal Hospital: 50 Mulgoa Road	A veterinary service that operates 24-hours per day accessed via Mulgoa Road. The next nearest 24-hour service is over 25 kilometres away in Blacktown.

Business	Detail	
Hungry Jacks: Blaikie Road intersection	A fast food restaurant that operates from early morning to midnight each day. Peak custom is during the breakfast, lunch and dinner periods. Up to 80 per cent of its custom is via the drive-through facility accessed from Blaikie Road.	
Penrith Panthers Precinct: 123 Mulgoa Road	While this is about two kilometres from the proposal footprint it provides an important and essential function in the community and is a key business that relies on Mulgoa Road. Planning is underway to upgrade the precinct.	
Other businesses on Mulgoa Road (refer to Figure 6-25)	<ul style="list-style-type: none"> • YMCA Penrith: community centre • Penrith Tyres and Mechanical Repairs: mechanics • Penrith Ice Palace: ice-rink • Hooters: restaurant • GPC Electronics: retail 	<ul style="list-style-type: none"> • Toys'R'Us and Babies'R'us: retail • Barbeques Galore: retail • Rashays: restaurant • Pool & Spa Warehouse: retail • Rudolph's Christmas Centre: retail

The tourism and hospitality sectors also made a notable contribution to Penrith's economy; about \$320 million in 2015-16. There are several key tourist attractions that support the local economy, which comprise:

General tourist attractions

- Bents Basin State Conservation Area
- Caleys Lookout Track
- Greater Blue Mountains drive
- Mount Schoenstatt Shire
- Rock Lookout
- WSU Penrith Observatory

Museum and galleries

- Arms of Australia Inn Museum
- Model Park
- Museum of Fire
- Penrith Regional Gallery and The Lewers Bequest

Sports and recreation facilities

- Foot Golf Werrington
- iFLY Downunder
- Luddenham Raceway
- Penrith Golf and Recreation Club
- Penrith Skatel
- Penrith Slot Car and Bobby Centre
- Penrith Whitewater Stadium
- Cables Wake Park
- Twin Creeks Golf and Country Club

Property and land use

Existing and future land uses

Section 4.1.2 discusses the land use zoning provisions of the proposal footprint and surrounds. In general, the land to the north of the M4 Motorway to the west of Mulgoa Road is zoned for business development (B5) while most of the remaining land fronting Mulgoa Road is zoned for low-density residential use (R2). Figure 4-1 shows the land use zoning relative to the proposal footprint.

The area's development is consistent with the zoning and land uses described above. It comprises:

- Low-density housing in Regentville and Jamisontown
- Commerce to the west of Mulgoa Road north of the M4 Motorway centred on the Homemaker Centre
- The transport infrastructure of Mulgoa Road and the M4 Motorway
- Remnant natural land uses including Surveyors Creek and School House Creek.

There are several key (re)development plans locally, including Glenmore Park Stage 2, a residential development to the south of the proposal footprint, and a campus style office development at the Penrith Panthers precinct. These developments are giving rise to the estimated 1.2 per cent increase in traffic over the coming years discussed in section 6.1. It is not anticipated that the land use of the proposal footprint would significantly change because of these developments or any other proposals that may occur soon.

Property

Most of the proposal footprint falls within the extent of the existing road reserve and is on public land that is either Council or state-owned. However, to widen the road would involve the strip acquisition of 17 private properties fronting Mulgoa Road, and the full acquisition of four residential properties. The strip acquisition would be from 10 residential properties and seven commercial properties as described in Table 6-41.

6.9.3 Potential impacts

Construction

Local community and social infrastructure

The proposal's construction would not be of a scale to have any material impact on the local population, its age structure, its social and demographic profile, and/or housing costs or availability. It would also be unlikely to result in any change in social advantage or disadvantage. However, there would be a range of temporary construction traffic and amenity-related impacts that would inconvenience, frustrate and potentially disadvantage residents, commuters and other road users. Conversely, the proposal would directly employ up to 200 people over a two-year period, and it would see the purchase of goods and services locally from a range of suppliers in the area.

Several temporary social impacts would occur during construction due to possible changes in travel behavior and patterns. Such impacts are typical and common to urban road development projects, and are caused from introducing traffic management controls in the area (refer to section 6.1.3). They comprise:

- Travel delays for residents, shoppers, tourists, sports fans, and commuters and the possibility of a temporary increase in traffic on low-volume side roads from people choosing alternative routes to avoid Mulgoa Road. This may affect the amenity of the area for its residents
- Reduced or delayed access to key properties that front Mulgoa Road including the community and tourist facilities identified in the previous section, key to which would be the school and Kids Academy. It would also affect access to the commercial and residential properties locally. Access to

the fire services would be maintained along with emergency access throughout the proposal footprint (refer to section 6.1.4)

- Removal of on-street parking along Hutchinson Crescent, Huron Place and Peter Court (permanent)
- Enjoyment and amenity loss for people using the public open spaces along Mulgoa Road. The largest impact would be the temporary loss of the recreational use of the Council reserve to site the construction compound (refer to section 3.3)
- Noise disturbance for school pupils, especially during key periods such as exams
- Reduced bus service reliability and increased journey times along Mulgoa Road, plus possible added inconvenience from having to use temporary bus stops
- Frustration and inconvenience from having to navigate temporary footpath and cycle diversions.

Community values

There would be a temporary amenity loss in the area, which is likely to affect local community values. This would be caused by:

- Landscape character and visual amenity loss from general construction activities, vegetation and amenity planting removal and associated earthworks, key of which would be the removal of the mature roadside planting along Mulgoa Road
- An increase in noise and the vibration generated from carrying out a range of construction activities
- Possible dust dispersion from carrying out earthworks and stockpiling operations
- Reduced access and increased travel times through introducing traffic management controls.

This may result in a perceived or actual temporary impact on the following community values:

- A perceived loss in safety due to traffic management controls, potential changes in traffic patterns, and temporary pedestrian and cycle diversions
- A perceived loss of access to facilities and services through traffic management controls, access restrictions, and the introduction of a perceived barrier to movement along and across Mulgoa Road
- Reduce community pride through the visual amenity impacts associated with construction activities taking place along Mulgoa Road in combination with the removal of roadside vegetation.

Business, industry and tourism

The capital investment needed to build the proposal is likely to deliver local and regional economic benefit through the creation of construction jobs and purchase materials from local manufacturing and construction businesses. There is also likely to be secondary spending by construction workers. This would benefit retail businesses locally, potentially including the service stations and hotel.

Offsetting these benefits would be the perceived and actual economic and business impacts from introducing traffic management controls and access restrictions in the local area. While Roads and Maritime is maintaining access to all businesses along Mulgoa Road, customers may be delayed or frustrated in accessing or leaving key properties. They therefore may be temporarily deterred from shopping in the area.

There are also specific construction activities that may have a short-term impact on access to key businesses. These include: the relocation of service station infrastructure and making access changes, and the temporary loss of frontage space to allow the road to be widened, which would either reduce the number of available parking spaces (Super Amart Centre, Hunger Jacks and Homemakers Centre), affect outside use (displaying motorcycles at Western Motorcycles), and/or result in the loss of roadside signage (Hungry Jacks).

While the construction work may temporarily affect the user enjoyment and amenity for hotel patrons at the Grey Gums Hotels, as well as for other customers shopping in the area, the scale of impact is predicted to

be limited. This is because the area’s existing amenity is already impacted by the high traffic volumes on Mulgoa Road.

The timing of construction work activities also has the potential to affect businesses differently. While traffic management controls would be relaxed where feasible and reasonable during peak travel periods, these differ from the peak custom times identified in Table 6-39. As this peak custom time varies across the day, throughout the week and across the seasons, detailed consideration of the traffic management planning would be needed to minimise any impacts.

Property and land use

While the property acquisition would take place as part of the early construction work, its impacts are assessed in the following section. This acquisition would be supplemented by the need to lease and agree access to certain additional areas to support construction and house the ancillary facilities (refer to section 3.3). Table 6-40 describes the temporary loss of functional viability and land use that would be impacted during construction.

Table 6-40: Land use impacts: construction footprint

Construction activity	Land use	Functional loss
Construction access	Super Amart Centre, Hunger Jaks, and Homemakers Centre	Temporary removal of customer parking spaces.
Main site compound	Council reserve	Temporary loss of recreational use of Council-reserve.
Widening of the road corridor	Commercial	Partial frontage loss of commercial properties including some display areas.
Widening of the road corridor	Residential	Partial loss of front gardens/outdoor areas.

Operation

Local community and social infrastructure

The proposal would provide the needed increase in capacity on Mulgoa Road to cope with the expected future traffic growth generated because of commercial and residential development in the area (refer to chapter 2.1). It would also maintain and even improve travel times along Mulgoa Road (refer to section 6.1.3). This would therefore indirectly benefit and support population growth, job creation and employment in the area. The proposal may also help increase the area’s attractiveness as a place to live and work, which may further improve the socio-economic advantage of the area. Adversely however, any demographic changes and social uplift, may place more pressure on future home owners and existing tenants in terms of housing affordability or rental costs.

An intent of the proposal would be to encourage a change in travel behavior by increasing the attractiveness of alternatives to car use through the planned public and active transport improvements. The investment in alternative travel choices would be supplemented by amenity improvements for these user groups, and by improved access and connectivity to travel nodes (eg Penrith Train Station) and the wider pedestrian and cycle network. Any active transport shift would have associated health benefits. However, secondary incentive and educational measures outside of the scope of this proposal would be needed to maximise these changes in habit and the associated benefits.

Access to all existing properties along Mulgoa Road would be maintained and provisioned under the proposal, even accounting for the planned intersection alterations. As such, community facilities and places of community significance would be unaffected. Section 3.2.3 describes the access arrangement changes that would be introduced under the proposal. This may affect staff and users of the Kids Academy and residents of Peter Court in terms of minor inconvenience due to a slight increase in travel times.

The amenity of residents along Hutchinson Crescent, Huron Place and Peter Court would be affected through the creation of the shared transit zone, vegetation removal, the loss of on-street parking, and the construction of a noise wall. As described in section 6.7.3 this would result in a moderate-to-high adverse impact. As such, specific landscape planting and urban design treatments are proposed (refer to Table 6-34) to reduce the adverse impact of these impacts.

Community values

The introduced road capacity, bus priorities and active transport provisions would deliver community value benefit in terms of helping the area to prosper and develop by maintaining and improving access to facilities and services. Also, by ensuring the road is designed to current safety standards, including integrated active transport provisions, and delivering effective urban design and landscape planting strategy based on creating boulevard and gateway (refer to Table 6-35), the aim would be to encourage people to walk and cycle. As noted above, this should help promote active and health lifestyles in a safe, resilient and welcoming environment that the local neighbourhoods can be proud of.

However, to achieve these benefits, the proposal would involve vegetation removal and property loss along Mulgoa Road. While these impacts are unavoidable if the proposal is to progress, they are less notable than the alternative options described in Table 2-6. While the proposed solution would impact on the natural environment, it would not result in the loss of key or critical values associated with the Nepean River, which are valued by the community. Also, there is opportunity to improve the detail of the design to further reduce impacts.

Business, industry and tourism

There would be no direct operational impact on business, industry or tourism in the area. There may however be indirect benefit from providing additional capacity on Mulgoa Road to cater for the future expected development described in section 6.1. This would be offset by the indirect impacts resulting from the partial property acquisition of seven commercial properties as described in the following section.

In instances where the acquisition would affect the functional use of the site, Roads and Maritime has either purchased the property or included design provisions, such as access alterations, to prevent any operational impact. The strip acquisition would however reduce the frontage area of these commercial properties. This may have a range of indirect impacts such as the loss of customer parking or a reduction in the functional use of the outdoor space as described below.

Property and land use

The introduced proposal would support the area’s future land use development in accordance with the strategy and policies discussed in chapter 2. It would also have no fundamental conflict with any land use zoning provisions and local development controls. However, in widening the road there would be strip acquisition in 17 locations and full acquisition in four locations. Table 6-41 describes current use of the land that would be acquired under the proposal and how this may affect the corresponding use. Refer to Figure 3-10 for location of property acquisition.

Table 6-41: Land use impacts: property acquisition

ID	Description	Total area (m ²)	Acquisition type	Functional loss
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ID	Description	Total area (m ²)	Acquisition type	Functional loss
1	Private residence	3	Partial	Part of front garden
2	Private residence	12	Partial	Part of front garden
3	Private residence	22	Partial	Part of front garden
4	Private residence	33	Partial	Part of front garden
5	Private residence	45	Partial	Part of front garden
6	Private residence	56	Partial	Part of front garden
7	Private residence	69	Partial	Part of front garden
8	Private residence	698	Full	House and outdoor areas
9	Private residence	698	Full	House and outdoor areas
10	Private residence	103	Partial	Part of front garden
11	Private residence	100	Partial	Part of front garden
12	Commercial property Homemakers Centre	780	Partial	Part of frontage on the western side of Mulgoa Road, including parking spaces
13	Commercial property Shell service station	924	Partial	Part of frontage on the western side of Mulgoa Road and change to access
14	Commercial property Western Motorcycles	436	Partial	Part of frontage on the western side of Mulgoa Road used to display goods
15	Commercial property Grey Gums Hotel	1941	Partial	Part of frontage, including signage, on the western side of Mulgoa Road and parking spaces within the commercial property complex (Hungry Jacks)
16	Commercial property Pizza Hut	871	Partial	Partial loss of frontage and some customer and staff parking spaces
17	Private residence	429	Full	House and outdoor areas

ID	Description	Total area (m ²)	Acquisition type	Functional loss
18	Private residence	416	Full	House and outdoor areas
19	Private residence	328	Partial	Outdoor area between Mulgoa Road and front wall of property
20	Commercial property Red Rooster	190	Partial	Partial loss of frontage
21	Commercial property BP service station	207	Partial	Partial loss of frontage

Tree removal

As discussed above, the proposal would remove an extent of the mature trees alongside Mulgoa Road. Several of these trees include hollows, which hold an ecological value (refer to section 6.3.2), while they all provide amenity value (refer to section 6.7.3). The current proposal footprint would see the need for all the trees to be removed based on the concept design. However, the detail of the design would be refined under the guidance of an arborist to develop solutions to reduce the tree loss where feasible and reasonable. This would be supplemented by the introduction of landscape planting and urban design treatments to reduce the amenity impacts, as described in section 6.7.4.

6.9.4 Safeguards and management measures

Table 6-42 describes the proposed safeguards that would be introduced to manage the predicted impacts described above. Appendix J contains further details on the specifics of the safeguards and management measures.

Table 6-42: Socio-economic, property and land use safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic	A Communication Plan (CP) would be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP would include (as a minimum): Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints. The CP would be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008a).	Roads and Maritime project manager/contractor	Detailed design/pre-construction	SE1

Impact	Environmental safeguards	Responsibility	Timing	Reference
Tree loss	An arborist will be engaged to carry out a detailed tree survey in accordance with AS4970: 2009: Protection of Trees on Development Sites (Standards Australia, 2009). This information would be used to inform the detailed design and reduce tree loss where feasible and reasonable.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	SE2
Property acquisition	All property acquisition would be carried out in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2014 , the supporting NSW Government Land Acquisition Reform 2016, and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Roads and Maritime project manager	Pre-construction. construction	SE3
Socio-economic	Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the RTA's Community Involvement and Communications Resource Manual (RTA, 2008a). Consultation will include but not limited to door knocks, newsletters or letter box drops providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	SE4
Socio-economic	Consultation will be undertaken with all affected property owners during detailed design and construction to develop and implement measures to mitigate impacts on land use viability, infrastructure and severance. This would include but not be limited to the Public School and Penrith City Council about school bus services, access requirements, and any key calendar periods (ie exams), and the Rural Fire Service and Fire & Rescue to ensure emergency access to and from Jeanette Street.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	SE5

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic	Consultation will occur with the commercial properties alongside Mulgoa Road to identify appropriate management strategies to avoid or minimise impacts on parking, access and operations, especially during peak customer periods. This will include consideration of measures such as additional signage and alternative access arrangements.	Roads and Maritime project manager/contractor	Pre-construction/construction	SE6
Tree loss	An arborist will carry out a pre-construction check of the site to confirm that all preserved trees are clearly and effectively marked and suitable protection zones are in place to prevent any impact on the canopy or root zones.	Roads and Maritime project manager/contractor	Pre-construction/construction	SE7
Socio-economic	A complaints handling procedure and register will be included in the CEMP.	Contractor	Construction	SE8
Access	Disruptions to property access and traffic will be notified to landowners at least five days in accordance with the relevant community consultation processes outlined in the TMP.	Contractor	Construction	SE9
Socio-economic	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.	Contractor	Construction	SE10
Access	Access for emergency vehicles would be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.	Contractor	Construction	SE11

6.10 Other impacts

This section describes the range of common and typical impacts associated with building and operating roads. Importantly, their impacts can be safeguarded against and managed through adopting effective standard safeguards and management measures.

6.10.1 Existing environment and potential impacts

Table 6-43 describes the other potential impacts that may occur from building and operating the proposal.

Table 6-43: Other environmental aspects

Environmental factor	Existing environment	Potential impacts
Air quality	<p>The local air quality is classified as good for Sydney’s west (OEH, 2017). Last year, the associated health-based air quality standards were achieved except on less than 15 days during the bushfire season. There are also no registered pollutant sources within the local airshed (National Pollution Inventory, 2017).</p> <p>Some areas in Regentville and Jamisontown, next to the main roads, will currently experience a reduced local air quality due to the high-traffic volumes and associated generated emissions. This is likely to be most notable during peak congestion. The same noise-sensitive receivers in the area (refer to Figure 6-7) are also considered sensitive to air pollution. The most sensitive of these are the pupils at the public school, and the children at the Kids Academy.</p>	<p>Temporary amenity impacts from dust generation (during vegetation clearance, earthworks, and material transportation and stockpiling), construction vehicle and equipment emissions, and possible odour releases (from asphalt and bitumen batching and pavement laying and line-marking work) would occur during construction.</p> <p>There would be a decrease in the air quality for those people currently living and working alongside Mulgoa Road from by widening the road and reducing the separation distance between traffic and receivers. Conversely, there would be an improvement in air quality by reducing congestion, increasing traffic flows and therefore improving engine performance and reducing idling.</p>
Non-Aboriginal heritage	<p>There are no recorded or heritage-listed buildings, sites or cultural heritage values local to the proposal footprint. As described in section 6.8, the heavy disturbance throughout local area reduces the potential for any undiscovered finds, to the point that any impacts are considered negligible.</p>	<p>The only potential is discovering, and impacting on, an unexpected find during construction.</p>

Environmental factor	Existing environment	Potential impacts
Waste and resource use	<p>Waste management is driven by Roads and Maritime policy and State legislation and guidance that focusses on reducing resource consumption, minimising waste, and recovering and recycling materials. Section 3.3.5 describes the resources that would be used to build the proposal, and the intended waste management provisions. While the specifics of these would be defined during the detailed design, the key wastes generated during construction would be:</p> <ul style="list-style-type: none"> • Residual road material (concrete, asphalt, aggregate) • Surplus building material (fencing, scrap material) • Packing materials (pallets, crates, plastics) • Food waste and general site waste and litter • Wastewater from facilities, vehicle wash down and dust suppression • Residual chemical (oils, lubricants, waste fuels, batteries) • Green waste (trees and other vegetation). <p>The operation of the proposal is unlikely to result any change in roadside litter.</p>	<p>The generation of waste would have the potential to impact the local environment if not correctly managed. Potential impacts would include:</p> <ul style="list-style-type: none"> • Ground contamination from spillages or runoff and waste transfer especially if there is stockpile mismanagement or poor waste storage • Amenity impacts from littering and potential increased attraction of vermin and pest species • Excessive waste being diverted to landfill. <p>Minimal amounts of resources would be needed to maintain and operate the road. These requirements would be consistent with the operation of all other classified and main roads in the State. Opportunities would be taken where feasible to (re)use:</p> <ul style="list-style-type: none"> • Durable materials to limit replacement frequency • Repurposed infrastructure such as signposts and lighting posts • Recyclable and low-embodied energy materials.

Environmental factor	Existing environment	Potential impacts
Greenhouse gas and climate change	<p>The existing climate in Sydney is characterised by warm summers and mild winters with rainfall throughout the year. Climate change generally refers to the warming temperatures and altered climate conditions associated with the increased concentration of greenhouse gases in the atmosphere. It is now accepted that the release of certain gases intensifies climate change. These gases are collectively referred to as 'greenhouse gases' and there are a number of industrial facilities locally that emit greenhouse gases. This is supplemented by existing road-traffic generated greenhouse gas emissions. Over time, it is expected that Sydney will experience more extreme weather because of greenhouse gas emissions and climate change. This will include stronger winds, heavier rainfall, and hotter temperatures.</p>	<p>Building the proposal would result in minor greenhouse gases emissions through material consumption, including the embodied emissions in the production of materials, and the use of plants and equipment. Operationally, the proposal provides the needed increase in capacity to handle an increase in traffic in the future generated by development in the area. By improving traffic flow and reducing congestion, this would improve engine performance and reduce idling, which may reduce the level of greenhouse gas emissions compared to not building the proposal. Operationally, the proposal has been designed to account for climate change adaptation. This includes making additional allowances in the drainage design for increased rainfall, including shading provisions in the urban design, and improving the specification and durability of the design to handle more extreme weather.</p>

6.10.2 Safeguards and management measures

Table 6-44 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-44: Other safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	<p>An Air Quality Management Plan (AQMP) would be prepared and implemented as part of the CEMP. The AQMP would 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 OEH guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces. 	Contractor	Detailed design/pre-construction	AQ1 Section 4.4 of QA G36 Environment Protection
Air quality	<p>All sensitive receivers (eg schools, residents) likely to be affected would be notified at least five days prior to commencement of any works associated with the activity that may have an adverse impact on local air quality. The notification would provide details of:</p> <ul style="list-style-type: none"> • The proposal • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting <p>How to obtain further information.</p>	Contractor	Pre-construction/construction	AQ2
Air quality	All personnel working on site will receive training to ensure awareness of requirements of the AQMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction/construction	AQ3
Air quality	Consistent with the approved AQMP, mitigation and suppression measures will be implemented to protect local air quality.	Contractor	Construction	AQ4

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	No burning of timber or other materials will occur, other than vegetation debris that is unsuitable for any other purpose, and subject to any necessary approval of Penrith City Council and/or EPA, and provision of any required notification to the Rural Fire Service. No burns will be undertaken during total fire bans.	Contractor	Construction	AQ5
Non-Aboriginal heritage	The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015c) 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.	Contacto	Detailed design/pre-construction	NA1 Section 4.10 of QA G36 <i>Environment Protection</i>
Waste	<p>A Waste Management Plan (WMP) would be prepared and implemented as part of the CEMP. The WMP would 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 would be prepared taking into account the Environmental Procedure - Management of Wastes on Roads and Maritime Services Land (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.</p>	Contacto	Detailed design/pre-construction	W1 Section 4.2 of QA G36 <i>Environment Protection</i>
Waste	Prior to land being used for ancillary construction purposes (compounds, storage, parking, etc) a pre-construction land assessment will be undertaken to identify the presence of any pre-existing wastes. The assessment will be prepared in accordance with the RMS Environmental Procedure - Management of Wastes on Roads and Maritime Services Land. Where the land is privately owned, a copy of the assessment will be provided to the landowner.	Contractor	Pre-construction	W2

Impact	Environmental safeguards	Responsibility	Timing	Reference
Waste	Waste materials (such as soils and aggregates) obtained from the project and to be exported to a non-road construction site or project will be sampled and managed in accordance with relevant Roads and Maritime Waste Fact Sheets.	Contractor	Construction	W3
Waste	Any removed trees would be reused as millable timber wherever feasible and reasonable. Other removed vegetated material would be mulched and reused onsite for landscaping or rehabilitation purposes if consistent with the approved FFMP. Weed species, or vegetation not considered appropriate for reuse onsite, would be removed and disposed of to an appropriately licenced facility.	Contractor	Construction	W4
Waste	A post-construction land assessment would be carried out on land used for ancillary construction purposes (compounds, storage, parking, etc) to determine the suitability for hand-back to the landowner. The assessment would be prepared in accordance with the RMS Environmental Procedure - Management of Wastes on Roads and Maritime Services Land. Where the land is privately owned, a copy of the assessment will be provided to the landowner.	Roads and Maritime project manager/ contractor	Post-construction	W5
Resources (utilities)	<p>Prior to the commencement of works:</p> <ul style="list-style-type: none"> The location of existing utilities and relocation details would be confirmed following consultation with the affected utility owners <p>If the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment would be undertaken.</p>	Contractor	Detailed design/pre-construction	W6

Impact	Environmental safeguards	Responsibility	Timing	Reference
Greenhouse gas and climate change	<p>Specific measures would be outlined in the CEMP to ensure that construction minimises any potential impacts on or from climate change including:</p> <ul style="list-style-type: none"> • Energy efficiency and related carbon emissions would be considered during the development of construction methodologies, procurement of low carbon alternatives and the selection of efficient plant vehicles, and equipment. • Plant, vehicles and machinery must be operated efficiently in accordance with the manufacturers guidelines to ensure optimal performance and be switched off when not in use <p>Procedures would be set out for the management of extreme events including flooding, heatwaves and bushfires.</p>	Contractor	Pre-construction/ construction	GH1

6.11 Cumulative impacts

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

6.11.1 Study area

The study area was defined by considering other projects within Western Sydney that have the potential to contribute to cumulative impacts with the proposal. The timing of the construction is expected to be from 2020 to 2022 subject to external factors. This assessment includes regional projects of similar scale and function and excluded local residential developments or minor road works for local council roads.

6.11.2 Broader program of work

The Mulgoa Road/Castlereagh Road Corridor Upgrade includes improvements over 6.5 kilometres that would be delivered in several stages. It is also supported by the upgrade of the Jane Street/Mulgoa Road/Castlereagh Road and the Great Western Highway/Mulgoa Road/High Street and the commitment to install Smart Motorway technology on the entry and exit ramps of the M4 Motorway (refer to section 2.2). This work (would) include(s) proposals to widen the road corridor and improve the intersections to either mainly add capacity or improve traffic flow. The corridor upgrade would also see additional active and public transport improvements.

The above program of work would/will have a similar impacts and benefits to those described in this REF associated with the proposal.

6.11.3 Other projects and developments

There are a range of other specific and precinct committed and approved developments in the area that have the potential to contribute to cumulative impacts with the proposal. The reported impacts are a summary of available information in the public domain. Overall Penrith City Council has released several precinct development plans since 2009. The two of relevance of the proposal are Glenmore Park Stage 2 Precinct and the Nepean River Precinct. Both are approved and the associated land use planning, zoning and development control provisions are defined. The land is currently being released for development. As such, Table 6-45 only lists those key projects local to the proposal within the precincts that have a development application submitted or approved.

Table 6-45: Past, present and future projects nearby to the proposal

Project	Construction impacts	Operational impacts
<p>Penrith Panthers Entertainment Precinct: <i>amenity development</i>:</p> <p><i>Specification:</i> 68 hectares zoned for mixed uses. Stage 1 includes a community centre, conference facility, new civic domain and urban amenity. Stage 2 includes a hotel and retail precinct. Stage 3 includes serviced apartments and exhibition space</p> <p><i>Location:</i> 123 Mulgoa Road about 1 kilometre north of the proposal footprint.</p> <p><i>Construction date:</i> no committed date</p> <p><i>Planning status:</i> stage application approved, stage 1 partially approved</p>	<p>Job creation during construction</p> <p>Temporary amenity and construction-related impacts from noise generation and traffic management controls</p>	<p>Traffic circulation and car park noise impacting on the local community</p> <p>Job creation during operation</p> <p>Contribution to the community infrastructure and facilities</p> <p>Visual and amenity change perceived to be an improvement in urban amenity.</p> <p>Voluntary planning agreement in place to amend local road access to support the site.</p> <p>Information on land based impacts including biodiversity, heritage and contamination impacts unavailable.</p>
<p>ESQ1818: residential (part of the above site)</p> <p><i>Specification:</i> 850 residential apartments</p> <p><i>Location:</i> About 1.5 kilometres north of the proposal footprint.</p> <p><i>Construction date:</i> unconfirmed</p> <p><i>Planning status:</i> approved not built</p>	<p>Temporary amenity and construction-related impacts from noise generation and traffic management controls</p> <p>Loss of a locally heritage listed building (Willow Cottage) to allow construction</p>	<p>No adverse operational traffic impacts of this proposal in the context of Stage 1</p> <p>Penrith City Council’s concern in application was the oversupply of residential units for demand and privacy, noise and social impacts. Issues however addressed to the satisfaction of Council.</p>
<p>Penrith Lakes: mixed use development</p> <p><i>Specification:</i> 700 hectares of Lakeland, 800 hectares of recreational space, 410 hectares for mixed use development. However currently comprises remediation application</p> <p><i>Location:</i> About 4 kilometres north of the proposal footprint</p> <p><i>Construction date:</i> mixed use development date unconfirmed, remediation and infill expansion 2018-19</p> <p><i>Planning status:</i> unapproved: original mixed-use application withdrawn. Continued use applications made to infill, extract and remediate.</p>	<p>No construction impacts due to the nature of the work</p>	<p>Import of clear fill with low risk of contaminated fill</p> <p>Increase of 400 trucks per day (over multiple applications and modifications) with low impact on local road capacity</p> <p>Low noise impact along haulage routes</p> <p>Increased dust from infilling activities however low impact of air quality impacts</p>

Project	Construction impacts	Operational impacts
<p>Thornton: residential development</p> <p>Specification: 0.55-hectare commercial project plus 550 apartments.</p> <p>Location: Penrith City Centre about 3 kilometres north of the proposal footprint.</p> <p>Construction date: near completion</p> <p>Planning status: approved</p>	<p>Temporary amenity and construction-related impacts from noise generation and traffic management controls</p>	<p>Urban amenity and land use impact in centre Penrith</p> <p>Increased traffic contribution from urban densification.</p>
<p>Nepean Hospital Complex (Penrith Hospital): hospital facility</p> <p>Specification: Stage 1 57 hectares of car park and new hospital extension</p> <p>Location: About 4 kilometres north-east from the proposal footprint</p> <p>Construction date: Under construction Stage 1 carpark</p> <p>Planning status: approved</p>	<p>Dealing with legacy contamination in the area due to storage tanks and other associated historic uses</p> <p>No other impacts are described in the application for assessment requirements made to the Department of Planning and Environment.</p>	<p>12 story building which may visually impact on the local area</p> <p>Increased traffic from the additional provision of hospital infrastructure.</p>

6.11.4 Potential impacts

Table 6-46 lists the potential cumulative impacts that have the potential to occur from the proposal being built and operating at the same time as the broader program of work and other projects and development in the area.

Table 6-46: Potential cumulative impacts of the proposal and other developments in the area

Environmental factor	Construction	Operation
Traffic and transport	<p>Potential for increased traffic management controls across a wider footprint and over a longer period than assessed in the REF. This scale or impact would depend on the proposed construction start and end dates of the above projects. This may either cumulatively add to people's journey times over a wide area or people may become fatigued from the overlap of the construction projects impacting on their amenity.</p>	<p>Section 6.1 has assessed the operational impact of traffic on Mulgoa Road assuming a 1.2 per cent growth each year. This accounts for the traffic generated on the range of proposal above and demonstrates that there would still be a benefit compared to not building the proposal. The assessment does not include the additional benefit introduced on the traffic network from the broader program of work described in section 6.11.2. This has the potential to further increased capacity and network performance over a wider area.</p>

Environmental factor	Construction	Operation
Noise and vibration	There are no sensitive receivers impacted by the proposal that would also be impacted by the above development. If any of the above projects and developments are built at the same time as the proposal, then it is unlikely that there would be close to the 60 per cent increase in traffic on Mulgoa Road or in the local area needed to result in a 2dB change, the implications of which are described in section 6.2.3.	There are no receivers within the proposal's two NCAs that would also be affected by operation noise from the above proposals. In all planning and development applications, the conditions of approval state that any new residential development in the area is to provide adequate at-property treatment to prevent operational noise impacts. As this proposal would improve traffic flows over the wide network, it is unlikely to either cause any additional operational impacts in combination with other development or require future noise treatment controls at undeveloped properties to be supplemented.
Biodiversity	There is insufficient information in the public domain to confirm the cumulative ecological impact of the other developments in combination with the proposal. However, the proposal would have a negligible impact on protected ecological values in the area. This means the proposal is unlikely to have a cumulative impact in combination with any other committed or approved development	The proposal would include replacement of vegetation where reasonable and feasible to address the loss of canopy cover.
Landscape character and visual impacts	Individual receivers within the visual envelope of the proposal would be unlikely to have a view of any other proposed development under construction at the same time except at the interface points of the broader program of work (ie the M4 Motorway and the adjoining sections of the upgrade of Mulgoa Road). The staging of these works would mean that people's visual amenity would be affected by construction work for longer than additively due to the overlap and extension of construction work beyond 2020.	The proposal would contribute to the area's overall redevelopment. The other proposals and developments commit to a mix of balanced development, but would involve land take from existing natural and low-intensity uses for their conversion to urban development. Therefore, the proposal would cumulatively contribute to the urban intensification in the area and its transformation. This would be likely received subjectively for people living and working in the area.

Environmental factor	Construction	Operation
Socio-economic	<p>The proposal would cumulatively contribute to the job creation opportunities regionally in the construction, transportation, manufacture, and distribution sectors. The proposal may therefore offer longer-term sustainable employment.</p> <p>Adversely, the proposal in combination with other development may lead to impact fatigue in terms of an overall amenity loss and wider frustration from longer-term traffic and public infrastructure disruption, or increase visual impacts than assessed for this proposal.</p>	<p>The road upgrade is being proposed to provide the additional capacity on Mulgoa Road needed to support future development in the area. It therefore supports the employment and residential development provided by the other projects described above. As such, there would be an additive and synergistic cumulative benefit from the road upgrade supporting the other development in the area.</p> <p>The community impacted by this proposal is unlikely to be additively or synergistically impacted by the other projects in the area as they are located too far away.</p>

6.11.5 Safeguards and management measures

Table 6-47 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-47: Safeguards and management measures for cumulative impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative impacts	Consultation would take with other developers in the area to coordinate traffic management in the wider area, especially during peak periods.	Roads and Maritime	Pre-construction/ construction	CI1
Cumulative impacts	All environmental management plans would be prepared to consider other developments in the area.	Contractor	Pre-construction	CI2

7. Environmental management

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

7.1 Environmental management plans (or system)

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

A Project Environmental Management Plan (PEMP) and a Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The PEMP and CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The PEMP and CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Roads and Maritime Environment Officer, Western Sydney Project Office, prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP and PEMP would be developed in accordance with the specifications set out in the 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
General					
GEN1	General - minimise environmental impacts during construction	<p>A CEMP would be prepared and submitted for review and endorsement of the Roads and Maritime Environment Manager prior to commencement of the activity. As a minimum, the CEMP would address the following:</p> <ul style="list-style-type: none"> • Any requirements associated with statutory approvals • Details of how the project would 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 would be implemented during the undertaking of the activity.</p>	Contractor/ Roads and Maritime project manager	Detailed design pre-construction	-
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity would be notified at least five days prior to commencement of the activity. The notification will include details of: the project; construction period and construction hours; contact information for project management staff; complaint and incident reporting; and how to obtain further information.	Contractor/ Roads and Maritime project manager	Pre-construction	-
GEN3	General – environmental awareness	All personnel working onsite would receive training to ensure awareness of environment protection requirements to be implemented during the project. This would include up-front site induction and regular "toolbox" style briefings. Site-specific training would be provided to personnel engaged in activities or areas of higher risk.	Contractor/ Roads and Maritime project manager	Detailed design/pre- construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport					
TT1	Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Roads and Maritime Traffic Control at Work Sites Manual (RTA, 2010) and QA Specification G10 Control of Traffic (Roads and Maritime, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • Confirmed haulage routes • Confirmed temporary diversion routes • Road condition and dilapidation surveys pre-and-post construction plus repair commitments • 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 • Stipulated parking restrictions including not allowing staff, contractors or delivery vehicles to park on public roads. 	Contractor	Detailed design/pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>
TT2	Traffic and transport	Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the RTA's Community Involvement and Communications Resource Manual (RTA, 2008a). Consultation will include but not limited to door knocks, newsletters or letter box drops providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.	Roads and Maritime project manager	Detailed design/pre-construction	-
TT3	Traffic and transport	Business needs, including peak customer periods, would be considered within the TMP where feasible and reasonable.	Contractor	Pre-construction	-
TT4	Access	Requirements for any changes to local access arrangements will be confirmed during detailed design in consultation with the local road authority and any affected landowners.	Roads and Maritime project manager	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
TT5	Access	Disruptions to property access and traffic will be notified to landowners at least five days in accordance with the relevant community consultation processes outlined in the TMP.	Contractor	Construction	
TT6	Pedestrian and cyclists	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Contractor	Construction	
TT7	Public transport and school buses	Access for public transport services, including school bus services, will be maintained. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community.	Contractor	Construction	
Noise and vibration					
NV1	Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the Interim Construction Noise Guideline (ICNG, DECC, 2009) and identify:</p> <ul style="list-style-type: none"> All potential significant noise and vibration generating activities associated with the activity Feasible and reasonable mitigation measures to be implemented, taking into account Beyond the Pavement: urban design policy, process and principles (Roads and Maritime, 2014a) A monitoring program to assess performance against relevant noise and vibration criteria Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. 	Contractor	Detailed design/pre-construction	Section 4.6 of QA G36 <i>Environment Protection</i>
NV2	Noise and vibration	<p>Work would be carried out during normal hours:</p> <ul style="list-style-type: none"> 7am to 6pm Monday to Friday 8am to 1pm Saturdays No construction on Sundays or Public Holidays. 	Contractor	Construction	-
NV3	Noise and vibration	Any variations to the standard construction hours will follow the approach in Practice Note VII of the RTA Environmental Noise Management Manual and/or the RTA Environmental Facts Sheet - Noise Management and Night Works, including consultation with the affected local community.	Contractor	Pre-construction/construction	-
NV4	Noise and vibration	A sleep disturbance assessment would be carried out before the planned out-of-hours work. The assessment would consider the absolute noise level of the activity, exceedances above the existing ambient noise level, and the number of individual noisy events likely to occur per night.	Contractor	Pre-construction/construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV5	Noise and vibration	Where feasible and reasonable, the permanent noise wall would be built as part of the early work and before the main work.	Contactora	Pre-construction Construction	-
NV6	Noise and vibration	All sensitive receivers (eg schools, residents) likely to be affected would be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification would provide details of: <ul style="list-style-type: none"> • The proposal • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contactora	Pre-construction	-
NV7	Noise and vibration	All personnel working on site will receive training to ensure awareness of requirements of the CNVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV8	Noise and vibration	<p>The following controls would be included in the NVMP:</p> <ul style="list-style-type: none"> • Where practical, the layout and positioning of noise-producing plant and activities at each work site would be optimised to minimise noise emission levels • Where practical, at the site compound, locate spoil mounds towards the north-west of the site and noisy stationary plant (ie. generators) behind site offices, hoarding/screens or other spoil mounds to shield receivers • Where practical, equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate noise control equipment and be in good working order • Where possible, non-beeper reversing movement alarms would be used such as broadband (non-tonal) alarms or ambient noise-sensing alarms. Work sites would also be designed to reduce the need for reversing, potentially minimising the use of reversing beepers • Vehicles, plant and equipment would be regularly inspected and maintained to avoid increased noise levels from rattling hatches, loose fittings etc • All vehicles, plant and equipment would be shut off when not in use • Resilient damping material would be fitted on bin trucks to minimise noise impacts from loading materials • Where feasible and reasonable, localised temporary acoustic hoardings/screens would be installed near high noise-generating activities. Hoardings/screens would be located as close to the noise source as possible, and would be an appropriate height as structurally feasible to minimise noise emissions. 	Contactator	Construction	-
NV9	Noise and vibration	Consistent with any specific requirements of the approved NVMP a monitoring program will be implemented during construction for six months or otherwise directed by Roads and Maritime to assess effective implementation of noise and vibration safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements.	Contactator	Construction	-
NV10	Noise and vibration	After considering the outcomes and recommendations arising from the monitoring program, and any other relevant information that becomes available during construction, appropriate measures will be implemented to address identified deficiencies or undertake actions needed to address noise and vibration impacts. If necessary, the NVMP will be reviewed and updated to include any additional measures.	Contactator	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV11	Noise and vibration	Ensure the use of vibratory rollers <100kN (typically two to four tonnes) and hydraulic hammers 300kg (five to 12 tonne excavator) are used during construction. Where this is not feasible or reasonable, carry out additional vibration impact assessment and/or pre-conditional surveys on the potentially affected buildings and affected receivers within the associated safe working distances. Carry out additional vibration monitoring during construction as needed to respond to any received complaints, and if needed carry out post-conditional surveys on the potentially affected buildings.	Contactora	Construction	-
NV12	Noise and vibration	Construction respite periods would be implemented as per Appendix C of the NVMP. In addition, for the key noise-impacting activities, this would be scheduled to be ideally carried out during standard work hours otherwise these activities would be carried out before midnight. Where feasible, these activities should only restart after 7am the next day.	Contactora	Construction	-
NV13	Noise and vibration	Within six months of the project becoming operational a noise review will be undertaken in accordance with Roads and Maritime's Preparing a Post Construction Noise Assessment Brief. The review will generally follow the approach provided in Practice Note VIII of the RTA Environmental Noise Management Manual, and will: <ul style="list-style-type: none"> Assess actual noise performance compared to predicted noise performance Assess the performance and effectiveness of noise and vibration mitigation measures Where deficiencies in performance are identified, provide recommendations for additional feasible and reasonable measures in accordance with the NMG 	Roads and Maritime project manager	Post-construction/operation	-
NV14	Noise and vibration	After considering the outcomes and recommendations arising from the operational noise review, and any other relevant available information (including consultation with sensitive receivers), additional measures may be implemented to ensure adequate management of operational noise impacts.	Roads and Maritime project manager	Post-construction/operation	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity					
B1	Biodiversity	<p>A Flora and Fauna Management Plan (FFMP) would be prepared in accordance with Roads and Maritime's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011a) and implemented as part of the CEMP. It would include, but not be limited to:</p> <ul style="list-style-type: none"> • Vegetation management plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the Landscape Guideline (RTA, 2008b) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Procedures addressing relevant matters specified in the Policy and guidelines for fish habitat conservation and management (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens • Habitat replacement and reinstatement • Handling injured fauna. 	Roads and Maritime project manager /contractor	Detailed design/pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>
B2	Biodiversity	<p>Measures to further avoid and minimise the construction footprint and native vegetation (including aquatic plant areas, significant fauna, and wetland habitat) or habitat removal would be investigated during detailed design and implemented where practicable and feasible. Measures to avoid and minimise impacts should be prioritised in the following order:</p> <ul style="list-style-type: none"> • Critical habitat • Threatened species, endangered ecological communities or their habitat • Native vegetation and habitat supporting flora and fauna connectivity and/or that supports other • Environmental objectives such as protecting water quality, hydrology or erosion and sediment controls • Native vegetation of higher quality condition • Other native vegetation 	Roads and Maritime project manager /contractor	Detailed design/pre-construction	State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997, 1997c)
B3	Biodiversity	All personnel working on site will receive training to ensure awareness of requirements of the FFMP and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of areas of identified biodiversity value that are to be protected.	Contractor	Pre-construction/construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B4	Biodiversity	A pre-construction check of native flora and fauna species and habitat would be carried out in accordance with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects. Biodiversity management measures identified during the pre-construction check would be included in the FFMP.	Contacteur	Pre-construction	-
B5	Biodiversity	Consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects, and any specific requirements of the approved FFMP, an unexpected finds procedure would be implemented in the event that a threatened species or ecological community that had not been identified and assessed by the REF are unexpectedly encountered during the construction process.	Contractor	Construction	-
B6	Biodiversity	Consistent with the approved FFMP: <ul style="list-style-type: none"> The limits of clearing within the construction site will be delineated using appropriate signage and barriers, identified on site construction drawings and during construction staff induction Vegetation and habitat features to be retained, such as hollow-bearing trees, will be clearly identified and protected by suitable fencing, signage or markings Identified areas containing habitat for hollow-dependent species will not be cleared during the breeding season May to September 	Contractor	Construction	-
B7	Weeds and pathogens	Declared noxious weeds and potential pests and pathogens are to be managed according to requirements under the <i>Biosecurity Act 2015</i> and Guide 6 (Weed Management) of the Roads and Maritime Services Biodiversity Guidelines 2011 and Guide 7: Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011a). Topsoil from the site that contains or potentially contains weed species or propagules: <ul style="list-style-type: none"> Will not be reused for future rehabilitation or revegetation works Will be removed from the construction site and disposed of at an appropriately licensed facility Until removal occurs, will be stockpiled in cleared or disturbed areas and managed in accordance with the RTA Stockpile Site Management Guideline. 	Contractor	Construction	-
B8	Biodiversity	Consistent with any specific requirements of the FFMP, a monitoring program will be implemented during construction to ensure effective implementation of the safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements to the safeguards. A register of inspections will be established.	Contractor	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B9	Biodiversity	After considering the outcomes and any recommendations arising from the monitoring program, and any other relevant information that becomes available during construction, additional measures may be implemented to ensure adequate protection of native flora and fauna. If necessary, the Flora and Fauna Management Plan will be reviewed and updated to include any additional measures.	Contractor	Construction	-
B10	Biodiversity	The above safeguards would be developed in accordance with the provisions State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997) that are aimed at protected catchment values. Therefore, the mitigation would specifically consider the need to: <ul style="list-style-type: none"> • Avoid aquatic plant areas, significant fauna and wetland habitat • Re-establish and replant impacted riparian flora and fauna habitat 	Contractor	Construction	State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997, 1997c)
Soils, geology and contamination					
SW1	Soil and water	A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction.	Contractor	Detailed design/pre-construction	Section 2.1 of QA G38 Soil and Water Management
SW2	Soil and water	A site-specific Erosion and Sediment Control Plan (ESCP) would be prepared and implemented as part of the SWMP. The Plan would include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design/pre-construction	Section 2.2 of QA G38 Soil and Water Management State Regional Environmental Plan No.20 (Hawkesbury-Nepean River, No.2 1997, 1997c)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SW3	Contaminated land	<p>A Contaminated Land Management Plan (CLMP) would be prepared in accordance with the Guideline for the Management of Contamination (Roads and Maritime, 2013) and implemented as part of the CEMP. The Plan would 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/pre-construction	Section 4.2 of QA G36 Environment Protection
SW4	Contaminated land	<p>If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. This may include but not be limited to:</p> <ul style="list-style-type: none"> • Diversion of surface runoff • Capture of any contaminated runoff • Temporary capping. <p>All other works that may impact on the contaminated area would cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.</p>	Contractor	Detailed design/pre-construction	Section 4.2 of QA G36 Environment Protection
SW5	Asbestos	<p>An Asbestos Management Plan will be developed and implemented. The plan will include:</p> <ul style="list-style-type: none"> • Identification of potential asbestos on site • Procedures to manage and handle any asbestos • Mitigation measures if asbestos is encountered during construction <p>Procedures for disposal of asbestos in accordance with NSW EPA guidelines, Australian Standards and relevant industry codes of practice.</p>	Contractor	Pre-construction/construction	-
SW6	Soil and water	<p>A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas. The Spill Management Plan will address, but not necessarily be limited to: management of chemicals and potentially polluting materials; any bunding requirements; maintenance of plant and equipment; and emergency management, including notification, response and clean-up procedures</p>	Contractor	Pre-construction/construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SW7	Soil and water	All stockpiles will be designed, established, managed and decommissioned in accordance with the Stockpile Site Management Procedure (RTA, 2011e).	Contractor	Pre-construction/ construction	-
SW8	Soil and water	In addition to the implementation of general erosion, sediment and water quality control safeguards (above), any sediment basins, stockpiles, washdowns, batch plants, refuelling and chemical storage sites will be lined and/or bunded.	Contractor	Construction	-
Hydrology and flooding					
H1	Hydrology and flooding	Prior to construction commencing, final flood and hydrology assessments will be undertaken to inform detail design measures to minimise risks to the environment, properties and the project. If Mulgoa Road is still shown to flood during an extreme event, additional design controls would be included to reduce impacts to acceptable levels	Roads and Maritime project manager	Detailed design	-
H2	Hydrology and flooding	A contingency and evacuation plan would be prepared for a potential flood event during construction. The plan would: <ul style="list-style-type: none"> Evaluate what flood event would trigger the plan Include evacuation procedures Include a map indicating the area that is flood prone and the locations where to evacuate. 	Contractor	Pre-construction/ construction	-
Surface and groundwater					
-	Soil and water	Refer to SW1 to SW8	-	-	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impacts					
LV1	Landscape character and visual impact	<p>An Urban Design Plan (UDP) would be prepared to support the final detailed project design and implemented as part of the CEMP. The UDP would present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan would include design treatments for:</p> <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise walls • pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. <p>The UDP would be prepared in consultation with Council in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> • Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014a) • Landscape Guideline (RTA, 2008b) • Bridge Aesthetics (Roads and Maritime 2012) • Noise Wall Design Guidelines (RTA, 2006) • Shotcrete Design Guideline (RTA, 2005). 	Roads and Maritime project manager/contactor	Detailed design/pre-construction	-
LV2	Landscape character and visual impact	Detailed design solutions to minimise the visual impacts of noise wall along the eastern side of Mulgoa Road will be developed in consultation with property owners, residents and Penrith City Council and implemented during construction. The design will be prepared in accordance with the RTA Noise wall design guideline.	Roads and Maritime project manager	Detailed design	-
LV3	Landscape character and visual impact	The Landscape Management Plan will be refined to ensure cost effective and consistent management of landscape works will be developed in consultation with property owners, residents and Penrith City Council and implemented during construction. The plan will be prepared in accordance with the RTA Landscape guideline (RTA, 2008b).	Roads and Maritime project manager	Detailed design	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
LV4	Lighting	A detailed lighting plan will be developed for the proposal in consultation with property owners, residents and Penrith City Council.	Roads and Maritime project manager	Detailed design	-
LV5	Landscape character and visual impact	Detailed design solutions to screen properties alongside Mulgoa Road will be developed in consultation with property owners, residents and Penrith City Council and implemented during construction.	Roads and Maritime project manager	Detailed design	-
LV6	Tree loss	Measures to reduce the tree loss alongside Mulgoa Road would be considered in developing the detailed design.	Roads and Maritime project manager	Detailed design	-
LV7	Landscape character and visual impact	Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials.	Contractor	Construction	-
LV8	Lighting impacts	Temporary site lighting will be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting.	Contractor	Pre-construction/ construction	-
Aboriginal heritage					
AH1	Aboriginal heritage	The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015c) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contacto	Detailed design/pre-construction	Section 4.9 of QA G36 <i>Environment Protection</i>
Socio-economic					
SE1	Socio-economic	A Communication Plan (CP) would be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP would include (as a minimum): Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints. The CP would be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008a).	Roads and Maritime project manager/ contractor	Detailed design/pre-construction	-
SE2	Tree loss	An arborist will be engaged to carry out a detailed tree survey in accordance with AS4970: 2009: Protection of Trees on Development Sites (Standards Australia, 2009). This information would be used to inform the detailed design and reduce tree loss where feasible and reasonable.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SE3	Property acquisition	All property acquisition would be carried out in accordance with the <i>Land Acquisition Information Guide</i> (Roads and Maritime, 2014), the supporting NSW Government Land Acquisition Reform 2016, and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Roads and Maritime project manager	Pre-construction. construction	-
SE4	Socio-economic	Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the RTA's Community Involvement and Communications Resource Manual (RTA, 2008a). Consultation will include but not limited to door knocks, newsletters or letter box drops providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	-
SE5	Socio-economic	Consultation will be undertaken with all affected property owners during detailed design and construction to develop and implement measures to mitigate impacts on land use viability, infrastructure and severance. This would include but not be limited to the Public School and Penrith City Council about school bus services, access requirements, and any key calendar periods (ie exams), and the Rural Fire Service and Fire & Rescue to ensure emergency access to and from Jeanette Street.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	-
SE6	Socio-economic	Consultation will occur with the commercial properties alongside Mulgoa Road to identify appropriate management strategies to avoid or minimise impacts on access and operations, especially during peak customer periods. This will include consideration of measures such as additional signage and alternative access arrangements.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	-
SE7	Tree loss	An arborist will carry out a pre-construction check of the site to confirm that all preserved trees are clearly and effectively marked and suitable protection zones are in place to prevent any impact on the canopy or root zones.	Roads and Maritime project manager/ contractor	Pre-construction/ construction	-
SE7	Socio-economic	A complaints handling procedure and register will be included in the CEMP.	Contractor	Construction	-
SE8	Access	Disruptions to property access and traffic will be notified to landowners at least five days in accordance with the relevant community consultation processes outlined in the TMP.	Contractor	Construction	-
SE9	Socio-economic	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.	Contractor	Construction	-
SE10	Access	Access for emergency vehicles would be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.	Contractor	Construction	-
SE11	Tree loss	Any tree removal or pruning would be carried out by a qualified specialist and in accordance with AS4970: 2009: Protection of Trees on Development Sites (Standards Australia, 2009) and AS4373:2007: Pruning of Amenity Trees and WorkCover Amenity Tree Industry Code of Practice 1998	Contractor	Construction	-

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality					
AQ1	Air quality	An Air Quality Management Plan (AQMP) would be prepared and implemented as part of the CEMP. The AQMP would include, but not be limited to: <ul style="list-style-type: none"> • Potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces. 	Contractor	Detailed design/pre-construction	Section 4.4 of QA G36 <i>Environment Protection</i>
AQ2	Air quality	All sensitive receivers (eg schools, residents) likely to be affected would be notified at least five days prior to commencement of any works associated with the activity that may have an adverse impact on local air quality. The notification would provide details of: <ul style="list-style-type: none"> • The proposal • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contractor	Pre-construction/construction	-
AQ3	Air quality	All personnel working on site will receive training to ensure awareness of requirements of the AQMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction/construction	-
AQ4	Air quality	Consistent with the approved AQMP, mitigation and suppression measures will be implemented to protect local air quality.	Contractor	Construction	-
AQ5	Air quality	No burning of timber or other materials will occur, other than vegetation debris that is unsuitable for any other purpose, and subject to any necessary approval of Penrith City Council and/or EPA, and provision of any required notification to the Rural Fire Service. No burns will be undertaken during total fire bans.	Contractor	Construction	-
Non-Aboriginal heritage					
NA1	Non-Aboriginal heritage	The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015c) 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.	Contractor	Detailed design/pre-construction	Section 4.10 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Waste and resource use					
W1	Waste	<p>A Waste Management Plan (WMP) would be prepared and implemented as part of the CEMP. The WMP would 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 would be prepared taking into account the <i>Environmental Procedure - Management of Wastes on Roads and Maritime Services Land</i> (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.</p>	Contractor	Detailed design/pre-construction	Section 4.2 of QA G36 <i>Environment Protection</i>
W2	Waste	<p>Prior to land being used for ancillary construction purposes (compounds, storage, parking, etc) a pre-construction land assessment will be undertaken to identify the presence of any pre-existing wastes. The assessment will be prepared in accordance with the RMS Environmental Procedure - Management of Wastes on Roads and Maritime Services Land. Where the land is privately owned, a copy of the assessment will be provided to the landowner.</p>	Contractor	Pre-construction	-
W3	Waste	<p>Waste materials (such as soils and aggregates) obtained from the project and to be exported to a non-road construction site or project will be sampled and managed in accordance with relevant Roads and Maritime Waste Fact Sheets.</p>	Contractor	Construction	-
W4	Waste	<p>Any removed trees would be reused as millable timber wherever feasible and reasonable. Other removed vegetated material would be mulched and reused onsite for landscaping or rehabilitation purposes if consistent with the approved FFMP. Weed species, or vegetation not considered appropriate for reuse onsite, would be removed and disposed of to an appropriately licenced facility.</p>	Contractor	Construction	-
W5	Waste	<p>A post-construction land assessment would be carried out on land used for ancillary construction purposes (compounds, storage, parking, etc) to determine the suitability for hand-back to the landowner. The assessment would be prepared in accordance with the RMS Environmental Procedure - Management of Wastes on Roads and Maritime Services Land. Where the land is privately owned, a copy of the assessment will be provided to the landowner.</p>	Roads and Maritime project manager/contractor	Post-construction	-

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 would 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 would be undertaken. 	Contractor	Detailed design/pre-construction	-
Greenhouse gas and climate change					
GHG1	Greenhouse gas and climate change	<p>Specific measures would be outlined in the CEMP to ensure that construction minimises any potential impacts on or from climate change including:</p> <ul style="list-style-type: none"> Energy efficiency and related carbon emissions would be considered during the development of construction methodologies, procurement of low carbon alternatives and the selection of efficient plant vehicles, and equipment. Plant, vehicles and machinery must be operated efficiently in accordance with the manufacturers guidelines to ensure optimal performance and be switched off when not in use Procedures would be set out for the management of extreme events including flooding, heatwaves and bushfires. 	Contractor	Pre-construction/construction	-
Cumulative impacts					
C1	Cumulative impacts	Consultation would take with other developers in the area to coordinate traffic management in the wider area, especially during peak periods.	Roads and Maritime project manager/contractor	Detailed design/per-construction	-
CI2	Cumulative impacts	All environmental management plans would be prepared to consider other developments in the area.	Contractor	Pre-construction	CI2

7.3 Licensing and approvals

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

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
<i>Roads Act 1993</i>	Licence from Penrith City Council and the Transport Management Centre to occupy roads during construction	Prior to the start of the activity

8. Conclusion

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

8.1 Justification

This proposal along with the Jane Street Penrith upgrade are the first schemes to be progressed as part of the wider 6.5 kilometre upgrade of the Mulgoa Road/Castlereagh Road corridor between Glenmore Parkway and Andrews Road. The proposal is to widen 1.3-kilometre section between Jeanette Street and Blaikie Road.

The proposal forms part of the WSPGR. This plan aims to progressively upgrade five major arterial roads in Western Sydney to deliver a more-efficient, reliable network that meets future community and economic needs. The plan supports an integrated transport solution for the region to capitalise on Western Sydney Airport and the Western Sydney Priority Growth Area.

Locally, the proposal covers an important traffic route providing access from the M4 Motorway to Penrith CBD, and more broadly, Western Sydney. The existing stretch of road currently experiences congestion during peak travel hours increasing travel time through the area. The main objectives of the proposal are to better manage congestion, reduce travel times, improve road safety and provide the needed increase in capacity to cater for the population and employment growth. The proposal to do this was selected through a six-stage process that involved analysis, consultation and input from various stakeholders. This led to the selection of a preferred option that best-met the objectives, need and criteria for widening and developing this section of Mulgoa Road.

As reflected in chapter 6, Roads and Maritime realises that to build and operate the proposal there would be several impacts for the local area. There would also be some short-term temporary disruption while the proposal is being built. Such impacts are consistent with similar road projects in urban areas and would be safeguarded and managed by implementing measures that have been set out in Roads and Maritime environmental management guidance as being effective in reducing the magnitude, extent, duration and scope of the proposal's impacts. Central to this would be managing and timing the work to minimise disruption as far as is feasibly and reasonably possible for road users, residents and businesses. The proposal would result in some vegetation and tree loss whose values are protected under State and Commonwealth legislation. This REF and its supporting technical studies have identified the risks and impacts that would occur because of building the proposal, and included additional safeguards and controls before work starts to ensure the proposal's residual effect on the environment is not significant. The following sub-headings discuss the impacts and benefits of the proposal.

8.1.1 Social factors

Overall, the proposal is anticipated to benefit the local and wider community. It would provide the needed increase in capacity to cope with expected future traffic growth generated by commercial and residential development in the area. It would also improve travel times along Mulgoa Road. This would indirectly benefit and support population growth, job creation and employment in the area. However, there are some unavoidable impacts such as vegetation removal and property loss that would result from delivering the benefits of the proposal. In addition, there would be temporary amenity-related impacts during the

construction phase related to noise and vibration, dust and visual impacts. Safeguard measures would be put in place to minimise impacts as far as possible.

8.1.2 Biophysical factors

The proposal would result in vegetation and tree removal, which includes a TEC protected under the BC Act. However, section 6.3.2 identifies the TEC to be in 'poor condition' as the patch has been isolated from the higher-quality communities locally. It was also concluded that the proposal would not result in a significant impact for threatened species or ecological communities or habitats under the BC Act, FM Act or EPBC Act. As the area is already highly disturbed, the proposal is also unlikely to result in any impacts for Aboriginal or non-Aboriginal heritage. For flooding, further investigation would be undertaken through the detailed design phase to minimise flooding impacts. Importantly, the proposal would not impact on the form, function, survival or wider condition of the biophysical values of the local area.

8.1.3 Economic factors

The capital investment needed to build the proposal is likely to deliver local and regional economic benefit through the creation of construction jobs and purchase materials from local manufacturing and construction businesses. There is also likely to be secondary spending by construction workers. This would benefit retail businesses locally, potentially including the service stations and hotel. Operation of the proposal would support socio-economic growth in the local area by improving the main access route to Penrith CBD and more broadly improving connectivity to the Western Sydney region. The proposal would support the commercial and residential future development in the area.

8.1.4 Public interest

The proposal would be in the public interest as it would contribute to benefits for the local and wider community by providing the needed increase in road network capacity to service the future growth in traffic in the area. It therefore would provide a wide community benefit despite the local impacts described in the REF. Safeguard measures would be implemented during construction and operation to minimise any environmental and social impacts.

8.2 Objects of the EP&A Act

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

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

Object	Comment
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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 is in a highly urbanised area where impacts from road traffic such as congestion, noise and emissions already exist. As the road is an important traffic route providing access between the M4 Motorway, Penrith CBD, and more broadly Western Sydney, it has been identified a priority upgrade under the WSPGR program.</p> <p>The proposal would benefit and support supporting socio-economic growth in the area by introducing additional network capacity to support access and development in Western Sydney. While building the proposal would result in vegetation loss, this would be from either remnant 'poor quality' areas or amenity-planted kerb sides and gardens. Landscape planting would also be introduced to mitigate for these losses.</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>Refer to section 8.1.</p>
<p>1.3(c) To promote the orderly and economic use and development of land.</p>	<p>The proposal would provide the needed increase in capacity to support the orderly economic growth and development of the area. While it would involve acquisition from residentially and commercially zoned land, including the loss of four residential lots, it would not affect the primary core function or viability of the wider zonings.</p>
<p>1.3(d) To promote the delivery and maintenance of affordable housing.</p>	<p>The proposal would provide the needed increase in capacity to support the delivery of planned housing in the area, some of which Penrith City Council has stated needs to be affordable.</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>The proposal would remove 0.81 hectares of poor condition threatened ecological community (red forest gum). The ecological condition and value of this community is compromised due to its isolated location from the higher-value better-condition red gum forest in the area. The impact of the loss was therefore assessed as not significant in statutory terms.</p> <p>Despite six threatened micro-bat species and the vulnerable grey-headed flying fox being/having the potential to be present locally the habitat of the study area only provides low-value foraging habitat, with far better-quality habitat provided over the range of all seven species. As such, it was concluded that there would be no significant impact in statutory terms.</p>
<p>1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).</p>	<p>No Aboriginal or non-Aboriginal built or cultural heritage values were identified in the construction and operational footprints. Further, the potential for undiscovered archaeology was discounted on the grounds of the extensive disturbance that has occurred locally, as supported through field survey and wider assessment in the area.</p>

Object	Comment
1.3(g) To promote good design and amenity of the built environment.	The proposal has been designed to industry and Roads and Maritime standards and specifications to consider environmental, social and economic factors throughout the design process. Once built, the proposal would provide beneficial effects through amenity for road users, pedestrians, cyclists, and the local community. This would be achieved through an effective landscape planting and urban design strategy. Despite this, there would be amenity loss during construction and during the initial operational stages, until the landscape planting established and matures. Also, the views for certain residents and businesses along Mulgoa Road would be impacted through the increased presence and dominance of the road and the introduction of other infrastructure such as signage and the noise wall.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to this proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to this proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Roads and Maritime has consulted with the community and sought their participation through feedback, briefing sessions and direct consultation, before determining whether to build the proposal. Roads and Maritime has also committed to continuing its consultation in developing the proposal's design, while planning to build the proposal, while the proposal is being built and once it is operational. Chapter 5 describes the detail of how the public has been, and how they will be involved, in the environmental planning and assessment process.

8.2.1 The precautionary principle

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

- The concept design construction and proposal footprints were selected based on design uncertainty that exists at the time to ensure they allow for refinement during the detailed design. As such, the indicated land use, property, biodiversity and vegetation loss impacts stated in this REF are precautionary. They can be refined and where feasible, reduced through the detailed design process.
- Impacts such as major spills or leaks or road traffic accidents were still identified and assessed as a precautionary measure despite the adoption of industry-wide common-place controls on all construction sites.
- Worst case assumptions have been made throughout the noise assessment. This included assuming a combination of all equipment being in use, at its maximum output, at the closest distance to adjacent receivers. It also used the concept of noise catchment areas. A noise management level was selected for the catchment areas based on background noise levels monitored at locations that

were representative of those that would be worst-affected (ie. closest to) by construction activities. The assessment also considered the potential impact from all activities taking place outside of standard work hours.

- Operational noise impacts were also assessed using conservative modelling assumptions based on the maximum predicted changes introduced under the proposal to ensure that all potentially-affected receivers eligible for noise treatment would be identified.
- Operational visual impacts were assessed before any replanting or vegetation treatments have established and matured. This ensures that the worst-case visual impact at any receiver is considered.
- Precautionary controls are included in the safeguards to provide additional protection. They include physical safeguards such as providing 110 per cent containment for chemicals and other environmental harmful materials and providing buffered exclusion zones around sensitive areas onsite.
- Ensuring that the impact of elements of the proposal's design that are not fully detailed are assessed during the next stage and safeguarded before work starts.
- Undertaking verification monitoring and modelling once the proposal is operational to validate modelling results and modifying safeguards and mitigation controls accordingly.

8.2.2 Intergenerational equity

The proposal would provide immediate improvements for the people living and working in the area in terms of journey time improvements, and additional public and activity transport provisions. The proposal would also provide the needed increase in capacity to support future (intergenerational) planned and committed residential and economic growth in the area through to the mid-2030s. The intergenerational loss of natural finite resources has been minimised through Roads and Maritime's commitment to use recycled materials where feasible, reasonable and suitable in terms of performance, while any surplus materials would be prioritised for reuse. The intergenerational loss of the natural environment would also be marginal and limited to a small area of remnant red gum woodland that is potentially planted. This would be offset by the proposed introduction of urban design measures and landscape planting.

8.2.3 Conservation of biological diversity and ecological integrity

The proposal would result in 0.81 hectares of poor condition red gum forest which forms part of the wider endangered and threatened River-Flat Eucalypt Forest on Coastal Floodplains ecological community protected under the BC Act. However, given the condition and isolated, degraded and fragmented nature of this woodland, it provides little biological diversity and its integrity is already heavily compromised. As such, its loss would neither be significant in statutory terms nor conservation terms. This habitat is also of low foraging value to the protected bat species either recorded or likely to occur locally. Therefore overall, there would be limited ecological and biodiversity value in conserving this vegetation to support these species given the availability of higher quality local habitat.

Nonetheless, any mature vegetation removal would inherently result in a loss of biological diversity and ecological integrity, both in its own right, and for the range of non-threatened fauna that are likely to use it as a valuable habitat. Also, the widening of the road would introduce edge-effects to areas previous unimpacted by the road. Despite these impacts, these values would be recreated overtime by replacement well-planned and design landscape planting.

8.2.4 Improved valuation, pricing and incentive mechanisms

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

- Reduce the likelihood of routine pollution occurring while the proposal is being built and once it is operational and therefore the associated prosecution and fines associated with causing environmental harm
- Adopt safe work methods to reduce the likelihood of an accidental spillage or pollution event occurring during construction or in the future once the upgraded road is operation, again to prevent prosecutions and fines
- Ensure there is an equitable and fair process for the compulsory purchase of land as set out under the *Land Acquisition (Just Terms Compensation) Act 1991*, the supporting NSW Government Land Acquisition Reform 2016 and the Land Acquisition Guide and Policy (Roads and Maritime, 2012a and 2012b)
- The use of specifications, contract-terms and mechanisms to incentivise contractors to minimise their environmental impact and footprints when building the proposal to the extent as is feasible and reasonable. These include controls such as:
 - Using recycled and low-embodied energy materials where feasible and reasonable in their application to consider the lifecycle demand on natural resources and their conservation
 - Sourcing materials and dispose of waste locally to minimise transportation impacts. This is termed the ‘proximity principle’.

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

8.3 Conclusion

The proposed road upgrade of Mulgoa Road between Jeanette Street and Blaikie Road is subject to assessment under Division 5.1 of the EP&A Act. The REF has “examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity”.

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

Several potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on noise, biodiversity, visual amenity and flooding. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also ease traffic congestion and reduce travel times through the area which has subsequent amenity benefits for the community. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

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

Significance of impact under Australian legislation

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

9. Certification

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

Chris Fay, CEnvP (IA), C.Wem, C.SocENV

Technical Director

Arup Australia Pty Ltd

Date: July 2018

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

Matthew Allen

Project Development Manager,

Western Sydney Project Office

Date: July 2018

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Terms and acronyms used in this REF

Term/acronym	Description
BC Act	<i>Biodiversity Conservation Act 2016 (NSW).</i>
CEMP	Construction environmental management plan
EIA	Environmental impact assessment
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW).</i> Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).</i> Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
MNES	Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999.</i>
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
Roads and Maritime	NSW Roads and Maritime Services
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
QA Specifications	Specifications developed by Roads and Maritime Services for use with road work and bridge work contracts let by Roads and Maritime Services.

Appendix A

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

Appendix B

Statutory consultation checklists

Appendix C

Traffic and transport assessment

Appendix D

Noise and vibration assessment

Appendix E

Biodiversity assessment report

Appendix F

Surface water and groundwater assessment

Appendix G

Preliminary site investigation

Appendix H

Landscape character, visual impact assessment and urban design assessment

Appendix I

Aboriginal heritage PACHCI assessment

Appendix J

Social assessment



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August 2018
RMS.18.965
ISBN: 978-1-925797-66-4