Spring Farm Parkway Stage 1

Review of Environmental Factors

Roads and Maritime Services | February 2019

NSW GOVERNMENT

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Roads and Maritime Services | February 2019

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Executive summary

The proposal

Roads and Maritime Services is proposing to build Stage 1 of the Spring Farm Parkway at Menangle Park, an east-west arterial link road that would ultimately service several future residential land releases within the Greater Macarthur Priority Growth Area. It would provide an alternative connection to Spring Farm, Elderslie, Menangle Park, and Mount Gilead. Ultimately, this east-west link would connect Camden Bypass, the Hume Motorway and Menangle Road in Sydney's south west.

The key features of the proposal are the provision of:

- A new four lane divided road (Spring Farm Parkway) extending about 0.9 kilometres from Menangle Road west to Menangle Park land release
- A grade separated interchange to connect Spring Farm Parkway with the Hume Motorway with north facing entry and exit ramps to and from the motorway, including a bridge about 20 metres wide and 76 metres long over the Hume Motorway
- Upgrades of Menangle Road near the proposed Spring Farm Parkway intersection including widening to four lanes, and tie-ins to suit the new intersection to cater for forecast traffic demand
- Four new signalised intersections
- A shared-use path on the southern side of Spring Farm Parkway and the south-eastern side of Menangle Road through to Broughton Anglican College at the southern limit of work.

Further details of the proposal are provided in Section 3.1.

Need for the proposal

The proposal is needed to support the development of the Menangle Park land release area. Stage 1 would provide access to a new housing subdivision being developed by Dahua Pty Ltd on the western side of the Hume Motorway. Access to the new housing subdivision would be provided to and from the Hume Motorway and Menangle Road. The proposal has strong short-term benefits in meeting access requirements for housing release in the urban development whilst enabling the realisation of longer term future network benefits.

In addition, the proposal would include opportunities for future road widening and tie-in connections for Stage 2 of Spring Farm Parkway, which would provide access for future residential and industrial development within Spring Farm and Elderslie.

Proposal objectives and development criteria

The objectives of the proposal include:

- Support residential growth by providing arterial road access to the Menangle Park land release
- Support employment growth by improving arterial road access to the Hume Motorway and Campbelltown
- Connect future communities to the NSW state road network
- Provide access for buses
- Provide a minimum of 1 in 100-year flood immunity
- Provide access for B-double vehicles
- Provide east-west connectivity for proposed and future land use
- Provide the provisions for a Smart Motorway enabled connection to the Hume Motorway.

The overall proposal goal is to achieve the best possible result for each of the above proposal objectives and development criteria, both in isolation, and when considered together.

Options considered

A number of options were considered during the development of the proposal, including alternative alignments for the northbound entry ramp to the Hume Motorway, the extent and location of widening along Menangle Road, and various combinations of bridge structures and abutments. In total nine bridge options were considered.

Each option was assessed in terms of its ability to meet the proposal objectives. The preferred option would offer the best solution to meeting the objectives of the proposal and supporting the relevant regional planning policies outlined in Section 2.1.1.

Statutory and planning framework

The proposal is subject to assessment under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In line with Section 111 of the EP&A Act, this review of environmental factors (REF) examines and takes into account to the fullest extent possible, all matters affecting or likely to affect the environment as a result of the proposal. This REF also considers Clause 228 of the Environmental Planning and Assessment Regulation 2000 and matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) also applies to the proposal. 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. Formal consultation for the proposal was undertaken with Campbelltown City Council and Subsidence Advisory NSW.

Community and stakeholder consultation

During development of the proposal, Roads and Maritime Services (Roads and Maritime) has consulted with the Department of Planning and Environment and Campbelltown City Council. The REF will be publicly displayed for comment from Monday 25 November to Friday 29 March 2019..

Following public display of the REF, all comments received would be recorded and addressed in a Submissions Report detailing how each issue raised would be considered in finalising the proposal design. The Submissions Report would be made available to the public on the proposal webpage on the Roads and Maritime website.

Environmental impact

Detailed technical investigations have been carried out to assess, manage and minimise the proposal's potential impacts.

The following outlines the proposal's key impact to the environment and surrounding community. The safeguards and mitigation measures identified in this REF would help minimise the expected adverse impact.

Traffic and transport

Construction would be required on Menangle Road, which would lead to some increased travel times and would affect access to a number of properties, including Broughton Anglican School. Partial road closures would also be required on the Hume Motorway during some work. Closures would require temporary cross overs and contra flow arrangements. It is expected that work affecting the Hume Motorway would occur outside of peak traffic demand periods and would maintain through traffic at all times.

Access to and from the proposal would also impact on the local road network in the early stages of construction, with vehicles requiring the use of the local roads in Menangle Park. Construction would be scheduled to prioritise delivery of the northbound access ramps and a deceleration lane to provide direct

access to and from Hume Motorway. This would limit the duration of impacts to receivers in Menangle Park.

When finalised, the completed proposal would provide access to the new Spring Farm development area, and extra capacity on the existing road network for future traffic volumes. The proposal would also improve active transport in the area, by including a new shared path along the southern side of Spring Farm Parkway.

Noise and vibration

Noise may be experienced at about 200 receivers during standard construction hours work, although this number is expected to reduce to fewer than 20 receivers during out of hours works. Construction vibration limits would be exceeded at one residence and up to 10 commercial premises. Where possible, work would be carried out during standard working hours. To minimise disruption to traffic and reduce construction timeframes, some work would take place outside of these hours.

Mitigation measures would include limiting noise related work to standard construction hours and minimising machinery noise wherever possible.

Aboriginal heritage

The proposal would result in a direct impact to three areas of Aboriginal archaeology, with low scientific significance. An Aboriginal Heritage Impact Permit would be sought for the impact to land and identified sites/objects prior to the commencement of pre-construction or construction activities associated with the proposal that would affect the sites.

Non-Aboriginal heritage

The study area includes part of the curtilages of state listed Sugarloaf Farm and Glenlee Homestead. The proposed widening of Menangle Road would be carried out primarily on the western side of the road, and so the potential impact to Sugarloaf Farm is limited. While the proposal does not intersect with the curtilage of Sugarloaf Farm, some work would extend partially into the curtilage of this heritage item. Acquisition of an area of Sugarloaf Farm, adjacent to Menangle Road, would be required.

Compound 1 is located immediately to the south of Grazier's Arms Inn, which is identified as an archaeological site. Fencing would be installed to prevent access to the curtilage of this site, and so no impacts to archaeological items are anticipated.

Biodiversity

Construction of the new Spring Farm Parkway would require the clearance of around 1.92 hectares of moderate to low condition Cumberland Plain Woodland and 0.47 hectares of low condition Swamp Oak Floodplain Forest. Both of these areas of mapped threatened vegetation are located to the west of the Hume Motorway. Minimal vegetation clearance would be required for the widening of Menangle Road. The clearance of vegetation would result in some reduction of habitat, including eight hollow-bearing trees, for a range of birds and mammals including threatened species.

Biodiversity offset credits would be sought to compensate for this loss and help achieve long-term conservation outcomes.

Justification and conclusion

The proposal would result in some adverse impacts to the local environment and community. The minimisation measures provided in this REF would help reduce the expected impact.

The proposal is considered justified as it would support the longer-term development of the region, by providing the first stage of the Spring Farm Parkway proposal and helping to meet the strategic objectives

of the Greater Macarthur Growth Area. In the short-term this proposal would meet the needs of the Menangle Park land release area.

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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 proposal development history are detailed, and the purpose of the report provided.

1.1 Background

NSW Roads and Maritime Services (Roads and Maritime) is proposing to deliver the Spring Farm Parkway in two stages. When complete, stages 1 and 2 would provide a 6.1 kilometre east-west arterial road link between Camden Bypass, the M31 Hume Motorway (the Hume Motorway) and Menangle Road in Sydney's south west, 11 kilometres south of Campbelltown and 70 kilometres from Sydney CBD.

Spring Farm Parkway would service existing and future residential land releases including Spring Farm, Elderslie, Menangle Park and Mount Gilead. It would provide an alternative east-west route to Narellan Road, with direct access to the Hume Motorway. The section of road linking to the Hume Motorway would be designated as a State or Regional Road due to the intersection with the Hume Motorway. It is assumed the remaining section of road would remain a local road.

1.2 Proposal identification

Roads and Maritime propose to build stage 1 of Spring Farm Parkway, which would provide the principal arterial route between Glen Alpine and Spring Farm. Key features of the proposal include:

- A new four lane divided road (Spring Farm Parkway) extending about 0.9 kilometres from Menangle Road west to Menangle Park land release
- Capacity for widening Spring Farm Parkway to an ultimate six lanes in the future
- Inclusion of a shared-use path on the southern side of Spring Farm Parkway and the south-eastern side of Menangle Road through to Broughton Anglican College at the southern limit of work
- Provision of access to the Menangle Park land release area at the western end of Spring Farm Parkway
- A grade separated interchange to connect Spring Farm Parkway with the Hume Motorway with north facing entry and exit ramps designed to be compatible for future implementation of Smart Motorway requirements. The length of the entry and exit ramps would be about 1.6 kilometres
- A bridge about 20 metres wide and 76 metres long bridge over the Hume Motorway with provisions for future widening to accommodate a six lane Spring Farm Parkway and turn lanes for south facing ramps to allow access to and from the Hume Motorway
- Four signalised intersections including:
  - an intersection between Spring Farm Parkway and Menangle Road
  - a north facing exit ramp from the Hume Motorway onto Spring Farm Parkway
  - a north facing entry ramp from Spring Farm Parkway to the Hume Motorway
  - an intersection providing access to the proposed Menangle Park land release area at the western end of Spring Farm Parkway (stage 1) including a stub for the future connection of Spring Farm Parkway (stage 2)
- Upgrade of Menangle Road near the proposed Spring Farm Parkway intersection including widening to four lanes, and tie-ins to suit the new intersection to cater for forecast traffic demand
- Installation of new drainage infrastructure and upgrade of existing drainage infrastructure including kerb and gutters, pits, pipes and open drains

- Ancillary work associated with the proposal including:
  - Relocating, adjusting or protecting existing utility services that are in conflict with the proposal
  - Installation of new street lighting to improve the night-time visibility of intersections and various road furniture
  - Delineation including signage, line-marking and other items to facilitate road user safety of the new infrastructure
  - Urban design improvements, amenity planting and landscaping
  - Property adjustments where necessary.

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

1.3 Terms used in this report

For the purposes of this review of environmental factors (REF) the following definitions have been used:

- The ‘proposal’ refers to all the activities and ancillary sites associated with the Spring Farm Parkway stage 1 proposal
- The ‘proposal area’ refers to the area that would be directly impacted by the proposal (this is generally assumed to be 10 metres from the boundary of the proposed road). It also includes the total proposal footprint and any other areas that would be temporarily disturbed
- The ‘study area’ refers to the proposal area and the wider area that may be indirectly impacted by the proposal and varies for specialist studies
- The ‘site compounds’ are ancillary facilities which may be used for material processing including batch or crushing plant, stockpiles site for materials, and site compound facilities including offices, sheds for the storage of equipment and plant.

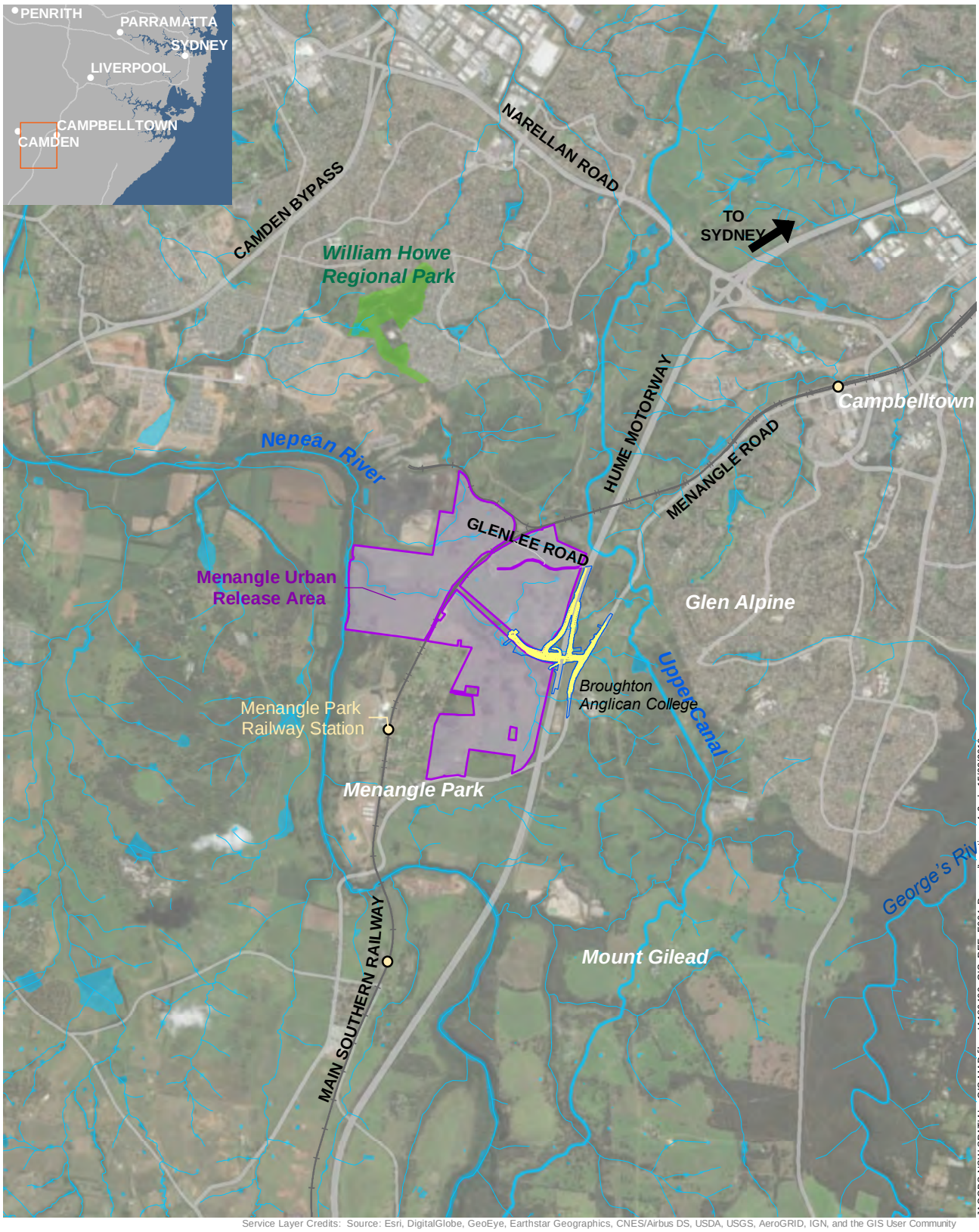
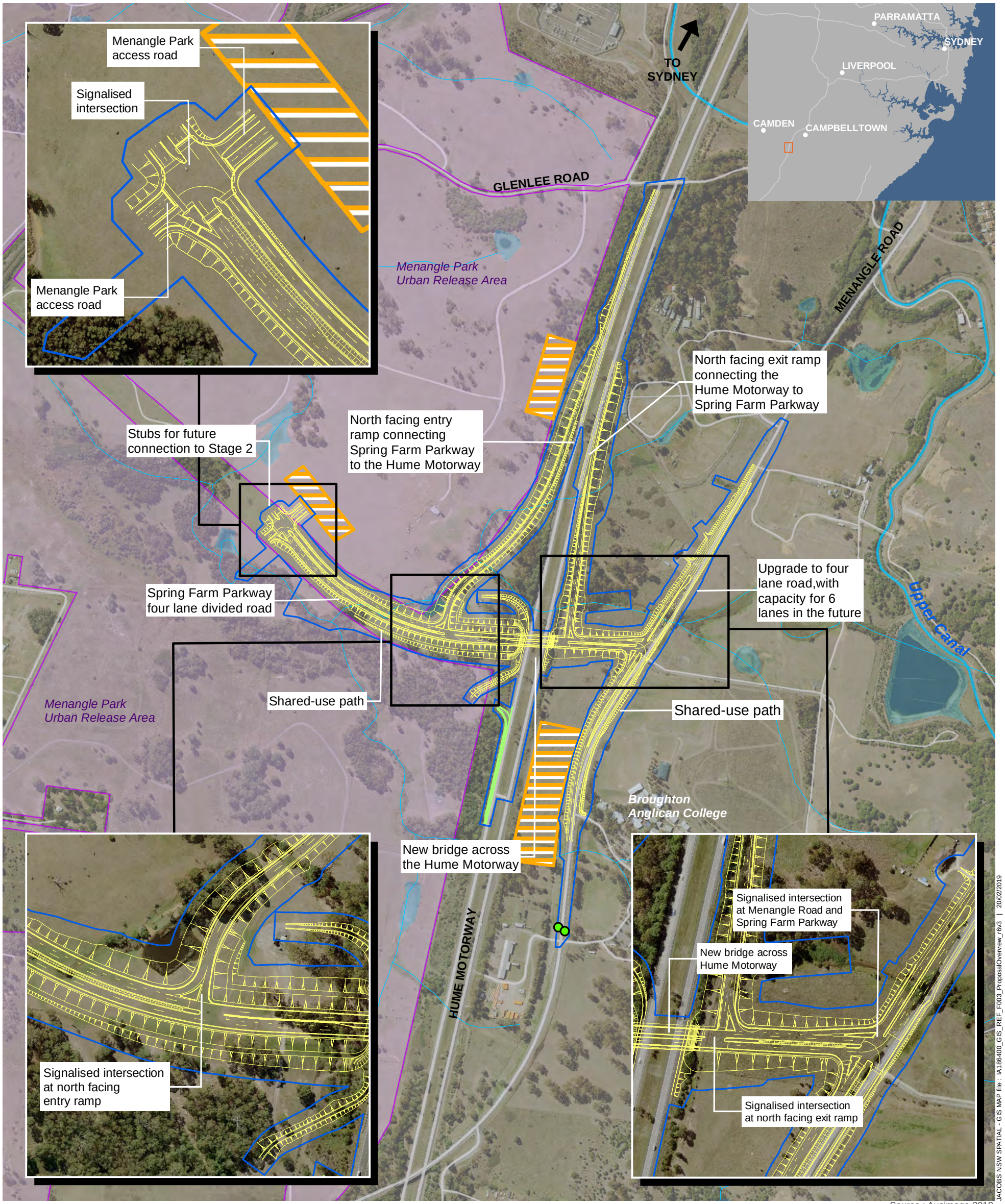


Figure 1-1 | Study Area



Legend

- 80% design
- Menangle Park Urban Release Area
- Site compound
- Proposal area
- Deceleration lane
- Waterway
- Road
- Bus stop

Figure 1-2 | Proposal overview

1.4 Purpose of the report

This REF has been prepared by Jacobs on behalf of Roads and Maritime. For the purposes of this work, 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 impact 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 impact has been carried out in the context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), *Roads and Related Facilities EIS Guideline* (DUAP 1996*)*, the *Biodiversity Conservation Act 2016 (BC Act), the Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

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 consider 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 need for the proposal in terms of its 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

The proposal is located within the Greater Macarthur Growth Area, which was identified as a strategic greenfield development area in 2016 which would support continued growth in the region. As part of this, Menangle Park was identified as a priority growth area in the *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* (the Growth Centres SEPP).

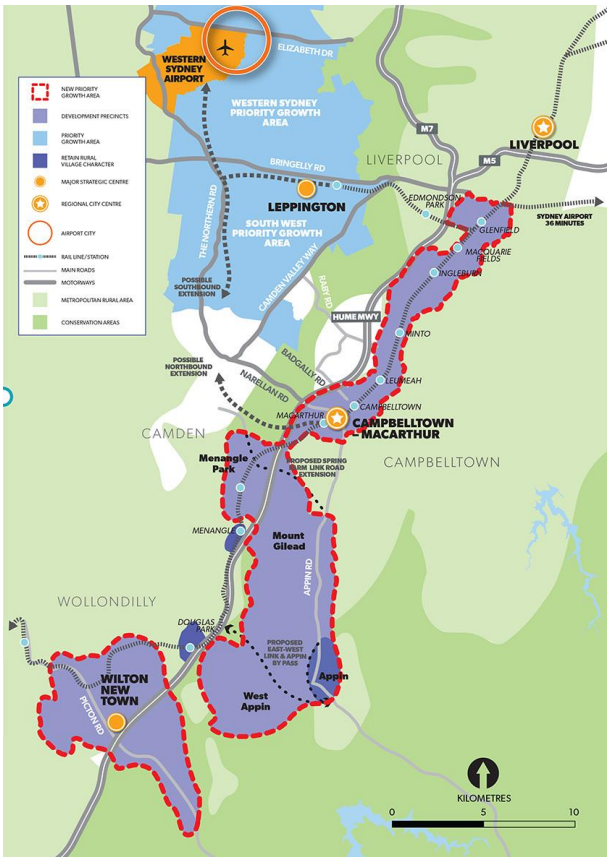


Figure 2-1 Greater Macarthur Growth Area (Source: Department of Planning and Environment)

The proposal is needed to support the development of the Menangle Park land release area. Stage 1 would provide access to a new housing subdivision being developed by Dahua Pty Ltd on the western side of the Hume Motorway, which consists of 1,500 lots proposed for completion in 2022. Access would be provided to and from the Hume Motorway and Menangle Road. The proposal has strong short-term benefits in meeting access requirements for housing release in the urban development whilst enabling the realisation of longer term future network benefits.

In addition, the proposal would include opportunities for future road widening and tie-in connections for stage 2 of Spring Farm Parkway, which would ultimately provide access for future residential development within Spring Farm, Elderslie, Menangle Park and Mount Gilead, as well as providing an alternative east-west route to Narellan Road, with direct access to the Hume Motorway.

2.1.1 Strategic planning and policy context

In addition to directly supporting the Greater Macarthur Growth Area, the proposal is also supported under a number of key Government policies and strategies including:

- NSW *Premier's and State priorities*
- *NSW 2021: A plan to make NSW number one* (NSW 2021) (NSW Government, 2011)
- *Towards our Greater Sydney 2056* (Greater Sydney Commission, 2016)
- *Directions for a Greater Sydney 2017-2056* (Greater Sydney Commission, 2017)
- *Building Momentum: The State Infrastructure Strategy 2018-2038* (Infrastructure NSW, 2018)
- The *Future Transport Strategy 2056* (NSW Government, 2018)
- *The Western City District Plan* (Greater Sydney Commission, 2018).

NSW Premier's and State priorities

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

Building infrastructure is one of the priorities. Under this priority, the NSW Government is committed to improving road travel reliability.

The proposal would contribute to achieving the following Premier's and State priorities:

- Delivering infrastructure - key metropolitan, regional and local infrastructure projects to be delivered on time and on budget
- Improving road travel reliability - working to make better use of existing road infrastructure, build extra road capacity and encourage commuters to use public transport and to undertake off-peak travel more often
- Increasing housing supply – it is estimated that Sydney will need 664,000 new homes over the next 20 years.

NSW 2021: A plan to make NSW number one (NSW 2021)

NSW 2021: A plan to make NSW number one (NSW 2021) is the 10-year strategic plan to rebuild the economy, provide quality services, renovate infrastructure, restore government accountability and strengthen the local environment and communities of NSW.

NSW 2021 identifies a commitment to delivering an efficient and effective transport system that reduces the time it takes to travel around Sydney and across NSW. This includes delivering road infrastructure that would relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors. NSW 2021 identifies 32 goals in five strategy areas. Strategy areas and goals relevant to the proposal are summarised below, including details of how the proposal responds to priority actions for each goal.

- Goal 5: Place downward pressure on the cost of living by facilitating the delivery of 25,000 new dwellings in Sydney per year. This included the delivery of 1,500 houses in the Menangle Park Release by 2020
- Goal 7: Reduce travel times by Improving the efficiency of the road network during peak times on Sydney's road corridors

- Goal 10: Improve road safety by relieving congestion on the Sydney road network and by enhancing network connectivity and navigability
- Goal 19: Invest in critical infrastructure by improving the quality of urban and rural roads. Stage 1 of Spring Farm Parkway would also enable the development of Menangle Park residential release area and provide a future east-west link between Camden and Campbelltown.

Towards our Greater Sydney 2056

Towards our Greater Sydney 2056 is the Greater Sydney Commission's draft amendment to update *A Plan for Growing Sydney* (NSW Government, 2014) and was released for public exhibition in November 2016.

Towards our Greater Sydney 2056 outlines a 'three cities' approach, with the Sydney CBD representing the 'Eastern City', the Parramatta CBD representing the 'Central City' and the future western Sydney Airport and surrounds representing the 'Western City'.

As part of Towards our Greater Sydney 2056 the Greater Sydney Commission also publicly exhibited draft District Plans to provide a basis for strategic planning at a district level.

The proposal would support the three cities approach by improving access to the 'Western City', resulting in more people having access to jobs and services.

Directions for a Greater Sydney 2017-2056

Directions for a Greater Sydney 2017-2056 aims to better integrate land use and infrastructure in Greater Sydney to accommodate a population that will grow from five to eight million people over the next 40 years. It builds on the 'three cities' approach identified in *Towards our Greater Sydney 2056*. Directions for a Greater Sydney identifies ten directions, including:

- A city supported by infrastructure
- A city for people
- Housing the city
- A city of great places
- Jobs and skills for the city
- A well-connected city
- A city in its landscape
- An efficient city
- A resilient city
- A collaborative city.

Strategies for progress towards these ten directions are highlighted in State Infrastructure Strategy (Infrastructure NSW, 2018) and Future Transport Strategy 2056 (NSW Government, 2018) and methods for implementation are detailed in District Plans along with relevant local environmental plans, agency programs and transport programs.

The proposal would support this vision improving road network performance, resilience and efficiency, enabling sustained growth and productivity across Greater Sydney. The proposal would also improve access to the South West Growth Area and Greater Macarthur Growth Area, resulting in more people having access to jobs and services.

Building Momentum: The State Infrastructure Strategy 2018-2038

Infrastructure NSW was established in 2011 to identify and prioritise critical infrastructure projects across Sydney and NSW. The Infrastructure NSW Act 2011 requires that Infrastructure NSW prepares and publishes a 20-year State Infrastructure Strategy.

Building Momentum: The State Infrastructure Strategy 2018-2038 (the State Infrastructure Strategy) outlines Infrastructure NSW's recommendations for priority infrastructure projects and initiatives for Sydney and NSW over the two decades to 2038, In particular, the Strategy identifies road building and upgrading as crucial to enabling Sydney's growth and the associated requirement for new dwellings over the next 20 years. A key priority includes the need to prioritise intercity road connections to support access from all directions and the need to include major transport connections to the north and south, and to surrounding established centres near Campbelltown and Macarthur.

The proposal supports the recommendations and of the State Infrastructure Strategy by improving access to the South West Growth Area and Greater Macarthur Growth Area.

The Future Transport Strategy 2056

The Future Transport Strategy 2056 builds on the *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) and sets the 40-year vision, strategic directions and outcomes for customer mobility in NSW. It will be delivered through a series of supporting plans, including the Future Transport Strategy, the Tourism and Transport Plan, the Greater Sydney Services and Infrastructure Plan, and the Regional NSW Services and Infrastructure Plan. The strategy established six state-wide outcomes for transport in NSW, including:

- Customer focused
- Successful places
- A growing economy
- Safety and performance
- Accessible services
- Sustainability.

To support these outcomes, the strategy contains policy, service and (road, rail, active) infrastructure improvements and potential initiatives. The proposal supports the state-wide outcomes for transport in NSW identified above.

The Western City District Plan

The *Western City District Plan* sets out priorities and actions for Greater Sydney's Western City District, which includes the project-based local government areas of the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly. The Western City District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney.

The proposal complements the Western City District Plan by providing improved connectivity and transport capacity, which would enhance the Western City's network resilience and increase the proportion of people with good access to jobs.

The Spring Farm Parkway proposal is identified as a priority by the Western City District Plan under Action 34. That action requires the planning and delivery of east-west and north-south roads to facilitate access to the strategic centres.

Housing Acceleration Fund

The Housing Acceleration Fund (HAF), managed by the NSW Department of Planning and Environment, was established in 2012 with $875 million in funding from the NSW Government to deliver critical enabling infrastructure to stimulate and accelerate housing development in NSW. The HAF subsequently received an additional $1.6 billion in funding from Restart NSW and the State Capital Program to continue to accelerate housing supply.

As part of the 2016-17 NSW budget, $30 million for the Spring Farm Parkway Stage 1 proposal was included in the reservation of funds for the HAF (NSW Government, 2016). The over-arching objective of the HAF program, which is partially funding this proposal, is to provide for essential infrastructure including utility and road networks to accelerate the delivery of new homes and jobs and put downward pressure on housing prices.

2.2 Existing infrastructure

This section describes the existing roads and infrastructure in the area, which has helped define the options.

2.2.1 Road network

Table 2-1 describes the existing road infrastructure that forms and intersects with the proposal. Figure 1-2 shows the location of the main infrastructure described below.

Table 2-1 Existing road network and infrastructure

Road description
Hume Motorway (M31)
The Hume Motorway, which runs northeast to southwest, connecting Sydney with Melbourne, The Hume Motorway is classified as a Roads and Maritime State Road. Within the proposal area: • The Hume Motorway consists of a four-lane carriageway (two in each direction), separated by an extended grassed median (about 15 metres wide) • The carriageway is about 45 metres wide, with 3.65-metre-wide travelling lanes • Carries about 53,000 vehicles per day (south of Narellan Road) • Road pavement is good condition • General straight horizontal alignment that follows the natural topography with little modification.
Menangle Road
Menangle Road runs about 21 km northeast to southwest, connecting Campbelltown to the north, through Menangle and to Maldon to the south. The road is generally a two-lane undivided road, with three roundabout intersections in Campbelltown. Menangle Road has bridge crossings over the Hume Motorway and the Nepean River and crosses beneath the main Southern Railway line, with a clearance of 4.4 metres. Operating speeds on Menangle Road vary between posted speed limits of 40 km/h and 80 km/h. Within the proposal area: • The carriageway ranges from between eight and 11 metres wide, with 3.5-metre-wide travelling lanes, with a mixture of grassed and paved verges • Operates at 80 km/h, with the exception of a 40km/h school zone for about 590 metres from 375 metres south to 215 metres north of Broughton Anglican College • No parking or public transport facilities • Additional lanes provided for dedicated left and right turns into Broughton Anglican College

Road description
• Carries about 12,500 vehicles per day (north of Cummins Road), including bus routes 889 and 890.
Glenlee Road (local road)
Glenlee Road runs east to west, connecting Glenlee Homestead to Menangle Road and is a 1.4-kilometre, single lane road. It crosses the Upper Canal and the Hume Motorway (Mark Evans Bridge).

2.2.2 Infrastructure

Drainage

The Hume Motorway has three drainage culverts within the limit of the proposed work. There are two existing drainage pipes beneath Menangle Road. The location and size of the existing drainage pipes are provided in Table 2-2.

Table 2-2 : List of Existing Drainage Culverts

Road	Chainage	Size (mm diameter)	Length (m)
Hume Motorway	310	750 reinforced concrete pipe (RCP)	66.30
Hume Motorway	450	1350 RCP	67.68
Hume Motorway	515	2 x 1800 RCP	19.69
Menangle Road	350	2 x 1650 RP	92.14
Menangle Road	820	600 RCP	15.76

Utilities

A Dial-before-you-dig request was carried out on the 8 June 2018 to identify all existing utilities in the proposal area, the utility authorities and establish initial contact details to commence consultation. These results of the Dial-before-you-dig request are outlined in Table 2-3.

Table 2-3: Identified authorities

Gas	Water and Sewer	Electrical	Telecommunications
AGL Energy APT Management Services (APA Group) Jemena Jemena Eastern Gas Pipeline Jemena Gas Land Services NSW	Sydney Water	Endeavour Energy	AAPT NBN NextGen Optus Telstra

A Utility Services Strategy Report (Jacobs, 2018) was prepared which identified the existing utilities within the proposal area, the approach to services design and management of conflicts, recommended strategies for mitigation of clashes, and consultation carried out to date. Key utilities identified in the proposal area are discussed in the following sections.

Gas

Three high pressure gas mains have been identified within the proposal area owned by Jemena and APA. The 500mm eastern gas pipeline owned by Jemena crosses Menangle Road just north of the limit of work on Menangle Road. The 850mm diameter Jemena and 200mm diameter APA mains run parallel to one another and cross Menangle Road and the Hume Motorway. The proposed road levels at these crossings are in fill and therefore in-situ protection is the likely mitigation strategy.

A low pressure gas main owned by AGL is also within the proposal area leading to the AGL gas well heads. The location of the northern well head has dictated the position of the Hume Motorway entry ramp, as a 20-metre clear zone is to be provided to the nearest paved surface (Figure 2-2).

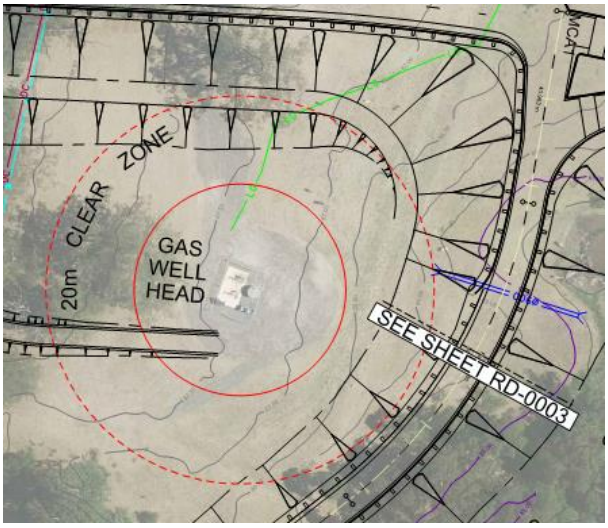


Figure 2-2: AGL well head clearances

Water and sewer

Two 200 mm diameter Sydney Water mains are located within the proposal area; one running adjacent to the northbound Hume Motorway carriageway and the other adjacent the southbound Menangle Road carriageway. It is proposed to relocate both of these assets. A local supply water main is impacted by the eastern bridge embankment and associated drainage channel and is proposed to be relocated. An existing local water connection underneath the Hume Motorway is to remain as this area is in fill. No sewer assets have been identified within the proposal area.

Electrical

There are existing electrical assets running along Menangle Road. Overhead assets consist of a major transmission line running adjacent to the southbound carriageway, low voltage assets connecting to the properties on the western side of Menangle, and high voltage assets connecting to the property on the eastern side of Menangle Road. Endeavour Energy underground conduits are located at the Broughton Anglican College and towards the northern limit of work.

Overhead major transmission lines also cross Menangle Road towards the northern limit of work; however, there is significant clearance from these assets and they would not be impacted by the proposal.

Telecommunications

AAPT (PowerTel), NBN, NextGen, Optus and Telstra optical fibre conduits are located within the proposal area, predominantly adjacent the northbound carriageway of Menangle Road. A large number of these may be impacted by the proposal due to the widening of this road and the Spring Farm Parkway intersection.

The extent of impact cannot be confirmed until the detailed design is finalised. Strategies to address the impact may include protection or relocation of the utility, or adjustments to the proposal design to avoid any impact. The required work would be confirmed during detailed design in consultation with utility providers.

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal include:

- Support residential growth by providing arterial road access to the Menangle Park land release
- Support employment growth by improving arterial road access to the Hume Motorway and Campbelltown
- Connect future communities to the NSW state road network
- Provide access for buses
- Provide a minimum of 1 in 100-year flood immunity
- Provide access for B-double vehicles
- Provide east-west connectivity for proposed and future land use
- Provide the provisions for a Smart Motorway enabled connection to the Hume Motorway.

2.3.2 Development criteria

The proposal objectives are supported by the following key development criteria:

- The proposal would be designed to meet environmental requirements in addition to avoiding and minimising the adverse impact to the environment while maximising the environmental benefits
- The proposal would satisfy the technical and procedural requirements of Roads and Maritime
- The proposal design would be optimised to ensure that the proposal can be practically and efficiently constructed, maintained and decommissioned while meeting all proposal objectives
- Appropriate urban design, landscape and visual principles would be applied to the design
- All connections, modifications and improvements necessary to link the proposal to the existing road system would be designed
- Temporary arrangements would minimise disruption to local and through traffic and maintain access to adjacent properties during construction.

The overall proposal goal is to achieve the best possible result for each of the above proposal objectives and development criteria, both in isolation, and when considered together.

2.3.3 Urban design objectives

The objectives outlined in Table 2-4 are derived from the nine urban design principles defined in the *Road and Maritime Services urban design policy - Beyond the Pavement*. They reflect both the unique character of the road, its rural residential context and key issues which adjoin it.

Table 2-4 Urban design principles and objectives

Key urban design principle	How applied to the proposal
Principle 1 - Contribute to the overall landscape structure and revitalisation of the region	• Reinforce the road's role as a link road servicing development within the Greater Macarthur Priority Growth Area, provide an alternative connection to Spring Farm, Elderslie, Menangle Park, and Mount Gilead and connect Camden Bypass, the Hume Motorway and Menangle Road in Sydney's south west • Develop an alignment which permits Menangle Park to function as an urban centre without the disruption of through traffic • Design an alignment which is responsive to its landscape setting and does not detract from it • Minimise the negative physical impact on parklands, open space, the creeks and aquatic environments which drain Menangle Park and the nearby rural and residential areas to the north and east • Design an alignment which is compatible with a possible future east-west link road extending eastwards to Appin Road and planned future stages connecting northwest to Liz Kernohan Drive.
Principle 2 – Respect the land uses and built form of the surrounding land and highway corridors	• Minimise the footprint of the corridor to limit the impact to adjoining vegetation, communities, and farm holdings including Sugarloaf Horse Farm and residences along Menangle Road • Design an alignment which minimises fragmentation of agricultural land or the loss of connections between paddocks • Maintain the ecological integrity of the vegetated sections and landscape character of the corridor • Minimise the intrusion of road-related elements (fencing and water quality control measures) on the local landscape.
Principle 3 – Connecting modes and communities	• Provide safe and efficient pedestrian access to Menangle Park residential development along the proposed corridor • Provide active transport opportunities both within the alignment and connecting to the broader local context and networks • Provide a design response which acknowledges the wider population centres of Spring Farm, Mount Annan, Menangle Park and Campbelltown and its suburbs. Facilitate movement of people within this context providing an environment which reflects this human scale.
Principle 4 – Fit the landform of the corridor	• Consider the relationship between road and landscape minimising the overall scale of fills and cut along the alignment • Provide a formation which addresses local flood events • Vary the gradient of earthworks to provide visual impact interest and reflect characteristics of the surrounding landform and landscape • Integrate cut and fill embankments with surrounding terrain by grading out and varying slopes.
Principle 5 - Responding to natural pattern	• The route selection should respond to the grain of the landscape and avoid, where possible, the disruption of patches of vegetation, both natural and

Key urban design principle	How applied to the proposal
	cultural • Identify and aim to preserve existing elements and patterns within the landscape that contribute to broader scale and landscape character • Preserve the natural structure and ecological integrity of riparian corridors where appropriate • Utilise a combination of trees and understory treatments which respond to the existing adjacent context • Maximise tree planting opportunities.
Principle 6 - Protect, maintain and enhance existing views, heritage, cultural and roadside landmarks and values.	• Preserve the integrity of existing heritage items and areas of cultural importance to the local community • Avoid, where possible areas of identified historic and Aboriginal heritage and cultural value. Also acknowledge and respond to Aboriginal values and places in the broader landscape • Acknowledge and respond to the heritage and cultural values of the local area, including Glenlee Homestead, Sugarloaf Farm and Mt Annan and its surrounding area • Consider the interpretation of the heritage areas along the corridor • Protect, maintain and enhance views to existing prominent landscape features where practicable, including western views towards the Blue Mountains • Identify and, where appropriate respond to existing heritage, cultural and roadside landmarks that reflect a unique identity or that may contribute towards a sense of place along Menangle Road and Spring Farm Parkway • Identify opportunities to incorporate additional landscape elements or sculptural elements to reflect and enhance the sense of place of Spring Farm and Menangle Park.
Principle 7 - Designing an experience in movement	• Minimise disruption to the visual qualities of the land use • Maximise the opportunities for high quality and varied view • Use landscape to frame views from the road • Improve pedestrian and cyclist amenity along and across the corridor, especially by providing connecting paths between key transport nodes and amenities.
Principle 8 - Creating self-explaining road environments	• Provide a landscape design that defines the edge of bends and leads the driver through the landscape • Provide a distinctive, legible and visible gateway setting for Menangle Park • Provide plantings that reinforce the reduced speed zones and initiate a strong sense of arrival and connection with the adjoining proposed town centre of Menangle Park • Provide a landscape design which reflects the needs and performance requirements of intersections along the corridor • Provide a simple and unified suite of road and roadside elements and details that contribute to establishing a desired future character for Spring Farm Parkway and that are easily maintained.
Principle 9 - Achieving integrated and minimal maintenance design	• Develop a consistent approach to the design of bridges along the proposal. Urban design principles are to be consistent with those outlined in '*Bridge Aesthetics: Design Guidelines to Improve the Appearance of Bridges in NSW'* (RTA, 2003) • Develop a consistent approach to the design of soft landscaping along the route. Planting design principles shall be consistent with those outlined in the

Key urban design principle	How applied to the proposal
	Landscape Guidelines: Landscape Design and Maintenance Guidelines to Improve the Quality, Safety and Cost Effectiveness of Road Corridor Planting and Seeding' (RTA, 2008) • Provide a landscape which is self-reliant and regenerating with minimal maintenance input requirements • Provide plantings to frame views and guide the driver along the alignment • Provide planting to screen views from and to residences.

2.4 Alternatives and options considered

The Spring Farm Parkway corridor has been established by the Department of Planning and Environment as part of the Menangle Park Urban Structure Plan. As part of that plan, a road corridor was established to assist the development of Spring Farm Parkway. The approach to options development was guided by the established road corridor.

New alignment options (wholly separate to the established Spring Farm Parkway corridor) were not considered in detail as they would require reconfiguration of the Menangle Park Urban Structure Plan and Indicative Street Layout Plan, included in the Revised Menangle Park Planning Proposal.

A summary of alternatives and options considered are summarised in this section.

2.4.1 Methodology for selection of preferred option

The options evaluation process involved several stages. The initial stages focused on establishing a corridor and occurred as part of the Menangle Park land release area planning process. This was followed by information gathering, Stage 1 options development and workshop evaluation.

A Risk Assessment Workshop, Constructability and Safety in Design Workshop and Value Management Workshop were held in September and October 2017. The workshops were attended by representatives from Roads and Maritime, Transport for NSW, Campbelltown City Council, Landcom and AGL and Dahua Group Australia (Menangle Park developer). The strategic design was endorsed by the Value Management Workshop participants.

Following the strategic design, further options for the bridge design were considered as part of the concept design process, which included consideration of alternative span configurations and abutment design.

2.4.2 Identified options

During the strategic design phase, a number of options were considered by Roads and Maritime. Only those that are relevant to the proposal (stage 1 of Spring Farm Parkway) are presented in this section.

The ‘do nothing’ option was considered. However, this option does not meet the proposal objectives or address the identified need and would therefore only be preferred in circumstances where the costs and environmental impact of proceeding were assessed as outweighing identified benefits. This was not the case and therefore the ‘do nothing’ option was discarded.

It is worth noting that two other options were considered but then rejected during the Value Management Workshop:

1. Build underneath the Hume Motorway instead of constructing bridges – This option was rejected due to excessive cost, unsuitable topography, and because it would not meet the objective of 1 in a 100-year flood immunity
2. Build a suspension bridge rather than a Super-T concrete bridge – This option was rejected due to excessive cost and design complexity.

Horizontal alignment

Northbound Entry Ramp to the Hume Motorway

Two options for the northbound entry ramp to the Hume Motorway were considered.

One option would intersect with the westbound carriageway of Spring Farm Parkway and loop around 180 degrees beneath Spring Farm Parkway before merging with the northbound carriageway of the Hume Motorway (see Figure 2-3).

Figure 2-3: Option for northbound entry ramp onto the Hume Motorway

The alternative configuration includes a north facing grade separated interchange, which would extend 1.6 km to connect Spring Farm Parkway with the Hume Motorway.

Menangle Road Widening

The proposal developed by Department of Planning and Environment and Urban Growth/Landcom showed widening on the western side of Menangle Road.

Consideration was given to widening the eastern side of Menangle Road rather than the western side as previously identified. Roads and Maritime already owns the land that would be required on the eastern side of Menangle Road, with the exception of two lots.

Bridge structures and abutments alternatives

During the strategic and concept design process a number of alternative bridge structures and abutment designs were considered. These included various combinations of either a single span, double span or four span bridge structure, and the use of either spill through abutments or reinforced soil wall (RSW) abutments. Further details are provided below.

Spill through abutments

The abutments comprise spill-through earth-fill embankments that are part of the road construction with a reinforced concrete headstock founded on concrete piles to directly support the bridge girders. The abutments are generally set back to provide sufficient space between the road corridor and the toe of the embankment to provide maintenance and construction access. This abutment design requires a longer bridge deck structure.

RSW abutments

Reinforced soil walls (RSW) consist of soil backfill which is held behind vertical concrete wall panels and stabilised with reinforcing strips embedded within the soil backfill. The soil, concrete panels and reinforcing strips combine to form a stable earth mass for the road construction; the bridge girders are supported on reinforced concrete founded on piles located behind the front of the RSW. This abutment design results in a shorter bridge deck structure but is more difficult to modify for future widening. RSW abutments are generally used where there are strict spatial constraints.

In total, nine bridge options were considered, with Option 1 and Option 4-CD considered to be identical. These are summarised in Table 2-5, with key differences presented in bold.

Table 2-5: Bridge options considered during the strategic and concept design phases

Option number	Stage	Bridge Option	Features
1	Strategic design	**Four span** bridge	• Overall bridge length of 88 meters • Two 20-metre-long end spans and two 24-meter-long central spans • Central pier within the median of the Hume Motorway • Outer piers adjacent to the Hume Motorway left lanes
2A	Strategic design	Two span bridge with **single bridge superstructure**	• Overall bridge length of 76 metres • Each span 38 metres long • Composite concrete cast-in-place deck slab • Central pier within the median of the Hume Motorway
2B	Strategic design	Two span bridge with **two bridge superstructure**	• Similar to bridge option 2A • Two superstructures located in front of the traffic barrier on the westbound carriageway • First bridge 19.5 metres wide, for traffic lanes • Second bridge 4.6 metres wide, for westbound footway • No structural connection between bridges • Two bridges separated by nominal 10-20 millimetre gap

3	Strategic design	**Single span** bridge	• Single 70 metre span constructed as either:
			  ○ Steel trough girder composite
			  ○ Cable-stayed bridge
			  ○ Arch bridge

Abutment alternatives			
1A-CD	Concept design	Single span with **spill through abutments**	• Total bridge length 74.5 metres • Spill through abutments • Varying depth ‘weathering steel’ trough girders 2200-3100 millimetre deep
1B-CD	Concept design	Single span with **RSW abutments**	• Total bridge length 59 metres • Reinforced soil walls abutments • Varying depth ‘weathering steel’ trough girders 1800-2500 millimetre deep

Option number	Stage	Bridge Option	Features
2A-CD	Concept design	Two span with **spill through abutments**	• Two equal spans • Spill through abutments • Total bridge length 74.5 metres • 1800-millimetre-deep Super-T girders
2B-CD	Concept design	Two span with **RSW abutments**	• Two equal spans • Total bridge length 59 metres • 1500-millimetre-deep concrete Super-T girders
3-CD	Concept design	Three span with **spill though abutments**	• Three equal spans • Eastern and middle spans cross the motorway, western end span towards the northbound on-ramp. • Overall bridge length 111 metres • 1800-millimetre-deep concrete Super-T girders
4-CD	Concept design	Four span with **spill through abutments**	• Same as Option 1 from strategic design

2.4.3 Analysis of options

Table 2-6 compares and analyses the options against the proposal objectives.

Table 2-6 Analysis of options

Options	Provide east-west connectivity for proposed and future land use	Provide access for buses	Provide a minimum of 1 in 100-year flood immunity	Enable Smart Motorway connections	Minimise social and environmental impact	Consistent with urban design, landscape and visual objectives	Minimise temporary disruption to local traffic and access
Do nothing	No connectivity provided	No access provided	No changes introduced	No connectivity provided	Increased travel times and loss of amenity	No changes introduced	No temporary impact
Entry Ramp to Hume Motorway							
Entry loop	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Improved capacity for Smart Motorway	Impact to existing vegetation, and reduced open space	Larger proposal footprint. Land in loop sterilised	Reconstruction required for future widening
North facing	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	Reduced scale and extent of impact. Impact still likely	Minimised proposal footprint. Increased visual prominence	Partial disruption to the Hume Motorway for ramp connections

Options	Provide east-west connectivity for proposed and future land use	Provide access for buses	Provide a minimum of 1 in 100-year flood immunity	Enable Smart Motorway connections	Minimise social and environmental impact	Consistent with urban design, landscape and visual objectives	Minimise temporary disruption to local traffic and access
Menangle Road Widening							
West	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	Reduced impact to Sugarloaf Farm, although impact still possible	Meets urban design objectives	Partial acquisition of residential property and temporary access disruption.
East	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	Increased impact to, and partial acquisition of Sugarloaf Farm	Meets urban design objectives	Minimise property acquisition. Temporary access disruption.
Bridge structure							
1	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	Minimise quantities of imported fill needed	Lowest fill height, reduced visual prominence	Lane closures of the Hume Motorway required
2A	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	Moderate increase to imported fill, associated traffic and construction impact	Fill height 0.6m higher, moderate visual prominence	This option would require lane closure of the Hume Motorway
2B	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	Moderate increase to imported fill, associated traffic and construction impact	Fill height 0.6m higher, moderate visual prominence	This option would require lane closure of the Hume Motorway
3	Allows for connectivity	Access provided	Consistent with flood immunity requirement.	Future connection enabled	Increased imported fill, associated traffic and construction impact	Fill height 1.8m higher than Option 1	Full closure of the Hume Motorway required during construction

Options	Provide east-west connectivity for proposed and future land use	Provide access for buses	Provide a minimum of 1 in 100-year flood immunity	Enable Smart Motorway connections	Minimise social and environmental impact	Consistent with urban design, landscape and visual objectives	Minimise temporary disruption to local traffic and access
Abutment alternatives							
1A-CD	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	N/A	Abutments visually comparable to nearby bridges	Partial disruption to the Hume Motorway
1B-CD	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	N/A	Partially meets urban design objectives - Inconsistent visual experience for road users.	Closure of one lane of the Hume Motorway to construct the outer piers
2A-CD	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	N/A	Abutments visually comparable to nearby bridges	Partial disruption to the Hume Motorway
2B-CD	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	N/A	Partially meets urban design objectives - Inconsistent visual experience for road users.	Closure of one lane of the Hume Motorway to construct the outer piers
3-CD	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	N/A	Abutments visually comparable to nearby bridges	Partial disruption to the Hume Motorway
4-CD	Allows for connectivity	Access provided	Consistent with flood immunity requirements	Future connection enabled	N/A	Abutments visually comparable to nearby bridges	Closure of one lane of the Hume Motorway to construct the outer piers

2.5 Preferred option

The preferred option is identified in Figure 1-2 and comprises the following:

- A four-lane dual carriageway road with provision for future widening to six lanes to the south
- A grade separated interchange with the Hume Motorway. Initially only north facing ramps would be built, but the design caters for future south facing ramps when these are required. The ramps would be designed to accommodate future upgrades as part of the Smart Motorways program
- A two-span bridge with twin bridges over the Hume Motorway that is designed to facilitate future widening and to allow access to an existing gas well located on the northern side of Spring Farm Parkway
- Four new intersections with traffic signals at:
  - Menangle Road
  - The southbound Hume Motorway exit ramp
  - The northbound Hume Motorway entry ramp
  - Menangle Park Land Release Area access road
- Potential widening of Menangle Road to four lanes. Acquisition of land on the western side of Menangle Road to accommodate the widening.

This outcome would be achieved by combining the following options:

- North facing entry ramp to the Hume Motorway
- Menangle Road Widening – East
- Bridge option 2B
- Abutment option 4CD.

The preferred option best addresses the objectives of the proposal and supports the relevant regional planning policies outlined in Section 2.1.1 by:

- Supporting residential and employment growth, by providing arterial road access to the Menangle Park land release and arterial road access to the Hume Motorway and Campbelltown
- Providing east-west connectivity for proposed and future land use and helping to connect NSW state road network
- Providing increased access for buses and for B-double vehicles.

Further information on the preferred option is provided in Chapter 3 (Description of the proposal).

2.6 Design refinements

The drainage design presented and assessed in this REF would be refined as part of the design development process and the recommendations for further investigation contained in the *Spring Farm Flooding and Drainage Investigation* (Lyall & Associates, 2017) would be addressed.

3. Description of the proposal

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

3.1 The proposal

Roads and Maritime is proposing to build Spring Farm Parkway at Menangle Park, an east-west arterial link road that would ultimately service several future residential land releases within the Greater Macarthur Priority Growth Area. Key features of the proposal would include:

- A new four lane divided road (Spring Farm Parkway) extending about 0.9 kilometres from Menangle Road west to Menangle Park land release
- Capacity for widening Spring Farm Parkway to an ultimate six lanes in the future
- Inclusion of a shared-use path on the southern side of Spring Farm Parkway and the south-eastern side of Menangle Road through to Broughton Anglican College at the southern limit of work
- Provision of access to the Menangle Park land release area at the western end of Spring Farm Parkway
- A grade separated interchange to connect Spring Farm Parkway with the Hume Motorway with north facing entry and exit ramps designed to be compatible for future implementation of Smart Motorway requirements. The length of the entry and exit ramps would be about 1.6 kilometres
- A bridge about 20 metres wide and 76 metres long bridge over the Hume Motorway with provisions for future widening to accommodate a six lane Spring Farm Parkway and turn lanes for south facing ramps to allow access to and from the Hume Motorway
- Four signalised intersections including:
    - an intersection between Spring Farm Parkway and Menangle Road
    - a north facing exit ramp from the Hume Motorway onto Spring Farm Parkway
    - a north facing entry ramp from Spring Farm Parkway to the Hume Motorway
    - an intersection providing access to the proposed Menangle Park land release area at the western end of Spring Farm Parkway (stage 1) including a stub for the future connection of Spring Farm Parkway (stage 2)
- Upgrade of Menangle Road near the proposed Spring Farm Parkway intersection including widening to four lanes, and tie-ins to suit the new intersection to cater for forecast traffic demand
- Installation of new drainage infrastructure and upgrade of existing drainage infrastructure including kerb and gutters, pits, pipes and open drains
- Ancillary work associated with the proposal including:
    - Relocating, adjusting or protecting existing utility services that are in conflict with the proposal
    - Installation of new street lighting to improve the night-time visibility of intersections and various road furniture
    - Delineation including signage, line-marking and other items to facilitate road user safety of the new infrastructure
    - Urban design improvements, amenity planting and landscaping
    - Property adjustments where necessary.

An overview of the proposal is shown on Figure 1-2 and detailed description of the key design features are outlined below.

3.2 Design

The following sections provide a description of the design criteria, design features and engineering constraints of the proposal. These features have been based on as built drawings of the existing Hume Motorway and Menangle Road and the current design for the proposal. The construction drawings may be subject to refinement during detailed design and the construction phase.

3.2.1 Design criteria

The concept design for the proposal has been developed in accordance with the following standards and guidelines:

- Roads and Maritime Documents and QA Specifications:
  - Roads and Maritime QA Specification PS261 - Bridge and Structure Design
  - Roads and Maritime QA Specification PS351 – Road Design
  - Roads and Maritime QA Specification PS271
  - Roads and Maritime Bridge Technical Direction Manual and Specifications
- *Austroads Guide to Road Design* and relevant published Roads and Maritime supplements
- Australian Standards
- *Australian Rainfall & Runoff (AR&R) 1987*.

The key design criteria used for the development of the concept design is detailed in Table 3-1 below.

Table 3-1 Key design criteria

Design element	Design value
Design speed	Main carriageway: - Horizontal – 90 km/h - Vertical – 80 km/h Ramps – 80 km/h Local roads – 80 km/h
Posted speed	Main carriageway – 80 km/h Ramps – 80 km/h Local roads – 80 km/h
Design vehicles	19.0 m semi-trailer 26.0 m B-Double
Maximum grade	6 per cent
Minimum lane width	3.5 metres
Shoulder width	Nearside Shoulder – 2.0 metres Offside shoulder – 1.0 metres
Cut and fill batter slopes	Cut - 1 in 2 or flatter Fill - 1 in 2 or flatter for main carriageway or 1 in 4 for ramps and local roads
Minimum Vertical Clearance	The bridge would have a minimum be 5.4 metre clearance above the Hume Motorway road surface

Drainage and water quality design criteria

Drainage and water quality design criteria has been developed based on Roads and Maritime QA Specification PS271, industry standard reference documents and experience on other similar Roads and Maritime projects. The approach to drainage design for is to provide a practical design solution that does not exacerbate the existing drainage conditions.

Drainage elements have been designed to provide a design life as below:

- New drainage pits and headwalls - 100 years
- New drainage pipes and culverts - 100 years

The pavement drainage design would consider the impact of climate change by adopting a 10 per cent increase in the intensities of rainfalls in the drainage design.

3.3 Engineering constraints

Boundary constraints

- The road reserve boundary – for the Spring Farm Parkway and entry ramp to the west of the Hume Motorway. This boundary was established as the corridor for the permanent road pavement, with additional infrastructure such as earthworks embankments, drainage, water quality, access tracks and fencing likely to lie outside. Additional property is currently being negotiated for this permanent infrastructure
- The site boundary – including the current property acquisition arrangements for all work to the east of the Hume Motorway.

Others engineering constraints:

- A minimum vertical clearance of 5.4 metres between the underside of the new bridge over the Hume Motorway to the future motorway median lane road surface levels
- The existing geometry of Menangle Road and tie-in designs
- Private developments proposed on the north and south of Spring Farm Parkway west of the Hume Motorway and the tie-in designs for the access road
- Reduction in earthworks where possible to limit imported material – there are no cuttings on the proposal to enable cut and fill balance
- Existing utilities.

3.3.1 Major design features

Road configuration

Spring Farm Parkway

The proposed Spring Farm Parkway would extend about 940 metres from Menangle Road west to Menangle Park and provides access to new land release and housing areas.

The typical cross-section for the Spring Farm Parkway allows for two lanes in each direction separated by a wide central median (4.8 metres wide) to allow for future widening. General traffic lanes would be 3.5 metres wide with a 2.0 metre shoulder.

Dual 3.5 metre left turn lanes would be provided on the eastbound carriageway of Spring Farm Parkway turning left into the northbound Hume Motorway entry ramp and also for the left turn into Menangle Road northbound. Single lane dedicated left turn lanes would be provided from Spring Farm Parkway westbound into the subdivision access road and from Menangle Road northbound into Spring Farm Parkway. Indented 3.3 metre right turn lanes would be provided in both directions at the intersection of Spring Farm Parkway and the Menangle Park access road.

The main carriageway for Spring Farm Parkway would have a design speed of 90 km/h, with an anticipated posted speed limit of 80 km/h.

A typical cross section for the proposed Spring Farm Parkway can be seen in Figure 3-1.

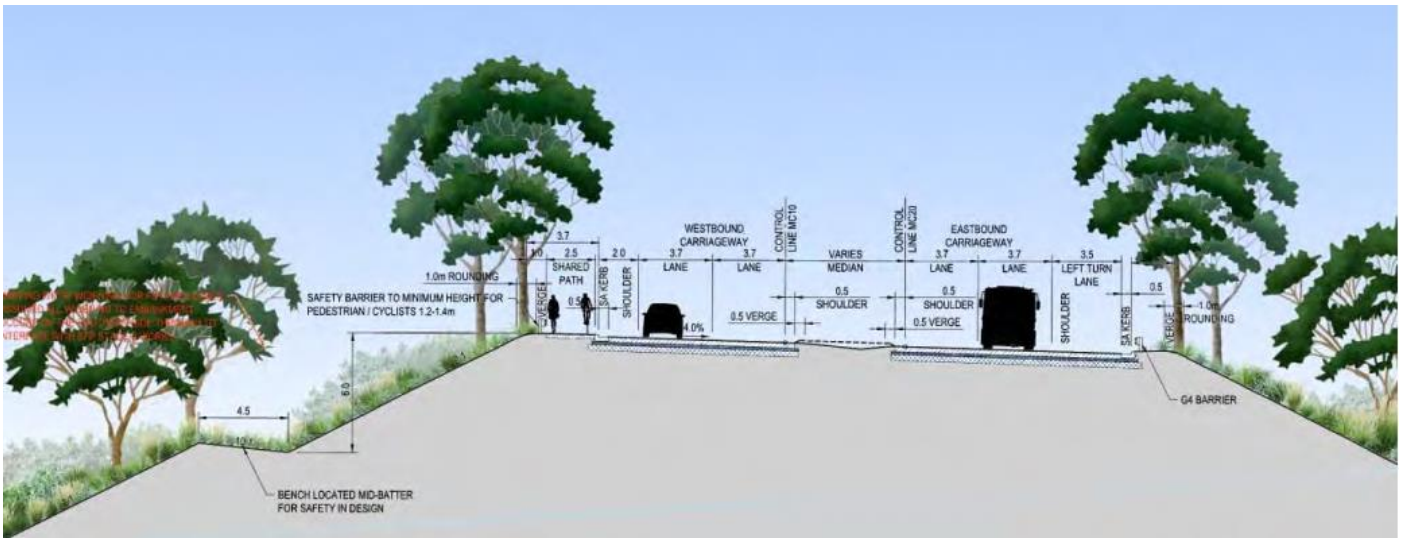


Figure 3-1 Indicative cross section of Spring Farm Parkway

Menangle Road

Menangle Road would be widened to four lanes through the intersection with Spring Farm Parkway.

Menangle Road would be widened from the existing two lane rural road cross section to two 3.5 metre through lanes in each direction separated by a depressed median. Two 3.3 metre southbound right turn lanes and one 4.0 metre dedicated left turn lane would be provided at the intersection with Spring Farm Parkway. Two metre outer shoulders would be provided, with 0.5 metre shoulders provided between the edge of the through lanes and the median. Menangle Road would have a design speed of 80 km/h, with an anticipated posted speed limit of 80 km/h. A typical cross section for the upgraded section of Menangle Road can be seen in Figure 3-2

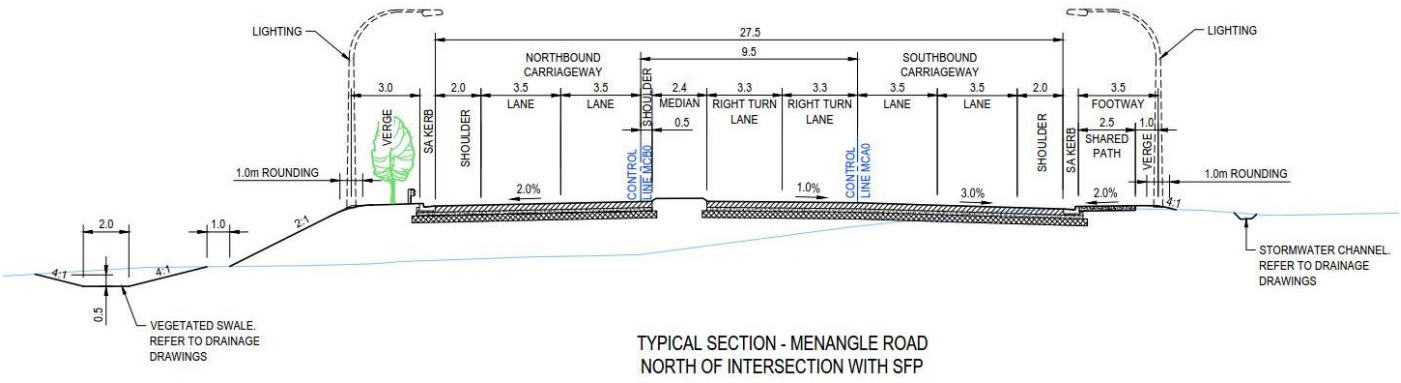


Figure 3-2: Indicative cross section of Menangle Road

Local Access

Menangle Park Land release

Access to the future Menangle Park land release area would be provided. The access road would connect to Spring Farm Parkway from the north and south and would be two lanes in each direction.

The access road would have a design speed of 60 km/h, with an anticipated posted speed limit of 60 km/h.

AGL gas well access road

It is proposed to provide maintenance access to the existing AGL gas well, which would be situated on the triangle of land between the Hume Motorway, Spring Farm Parkway and the northbound entry ramp to the Hume Motorway. The unsealed track would run underneath Spring Farm Parkway between the western abutment of the Hume Motorway overbridge and the northbound carriageway of the Hume Motorway and then northwest to the well site.

North facing entry and exit ramps

A grade separated interchange would connect Spring Farm Parkway with the Hume Motorway via:

- A north facing exit ramp from the Hume Motorway onto Spring Farm Parkway
- A north facing entry ramp from Spring Farm Parkway to the Hume Motorway.

The typical cross section for the northbound Hume Motorway entry ramp consists of two 3.5 metre lanes, which merge to a single lane before merging with the northbound carriageway of the Hume Motorway. There is a 2.0 metre left hand shoulder and a 1.0 metre right hand shoulder. The ramp has been designed to be compatible with future managed motorway operation.

The southbound exit ramp from the Hume Motorway diverges from the motorway as a single lane, widening out to a cross section, which consists of two 3.5 metre right turn lanes and a 5.0 metre entry angle left turn lane at the stop line. One metre shoulders are provided on each side of the exit ramp.

As part of future work additional south facing entry and exits ramps would be included. For the purposes of some assessments, such as the traffic and transport assessment and noise and vibration assessment, consideration of these additional elements has been included when assessing the operation of the proposal in the future (i.e. from 2036 onwards).

A typical cross section for the proposed entry and exit ramps can be seen in Figure 3-3.

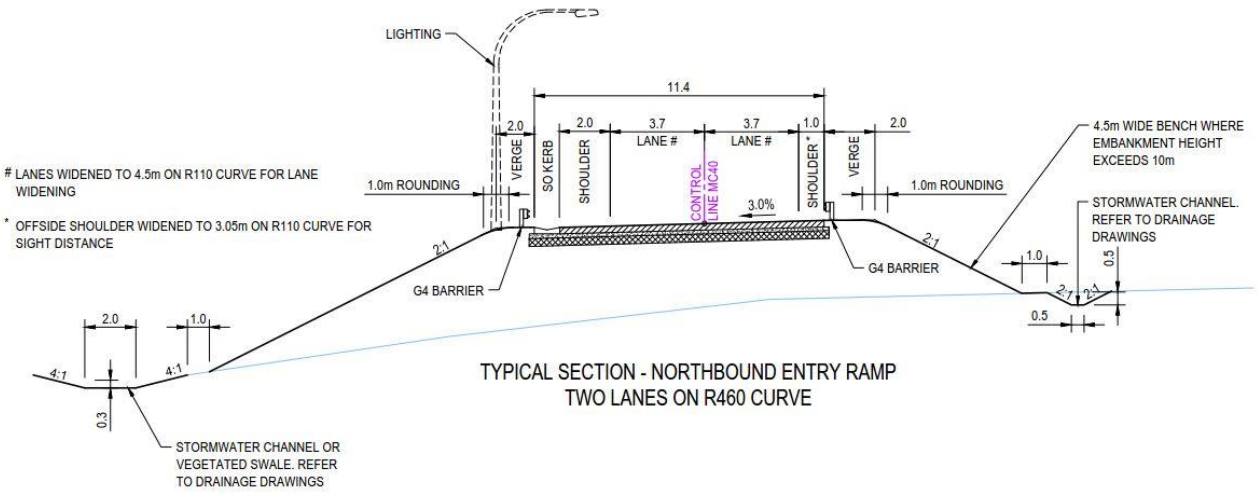


Figure 3-3 Indicative cross section of entry and exit ramps

Intersections

The proposal would include four traffic signal-controlled intersections at Menangle Road, the southbound Hume Motorway exit ramp, the northbound Hume Motorway entry ramp and the Menangle Park Land Release access road.

Aimsum traffic modelling has been carried out to inform the design and arrangements of the intersections and more detailed traffic modelling of intersections would be carried out during design refinement of the proposal. The proposed intersections are described below.

Intersection 1 – Spring Farm Parkway and Access Road

The intersection of Spring Farm Parkway and the subdivision access road would be a four-way traffic signal-controlled intersection. A 19.0 metre semi-trailer has been used as the design turning vehicle for this intersection, because it has been assumed that B-Doubles would not be permitted on the Menangle Park Land Release access road.

Spring Farm Parkway would have two through lanes through the intersection with 110 metre single right turn bays in each direction. There would be a 190-metre westbound left turn lane from Spring Farm Parkway to the southern leg of the access road including a high entry angle left turn treatment at the intersection. The northern leg of the subdivision access road would have two lanes on approach to the intersection and one lane on departure. The right hand lane would be a dedicated right turn lane to facilitate traffic signal phasing of the intersection.

The southern leg of the intersection would have three lanes on approach and one on departure. The three approach lanes would consist of one left turn/through lane, and two right turn lanes. The proposed arrangement for this intersection can be seen in Figure 3-4.

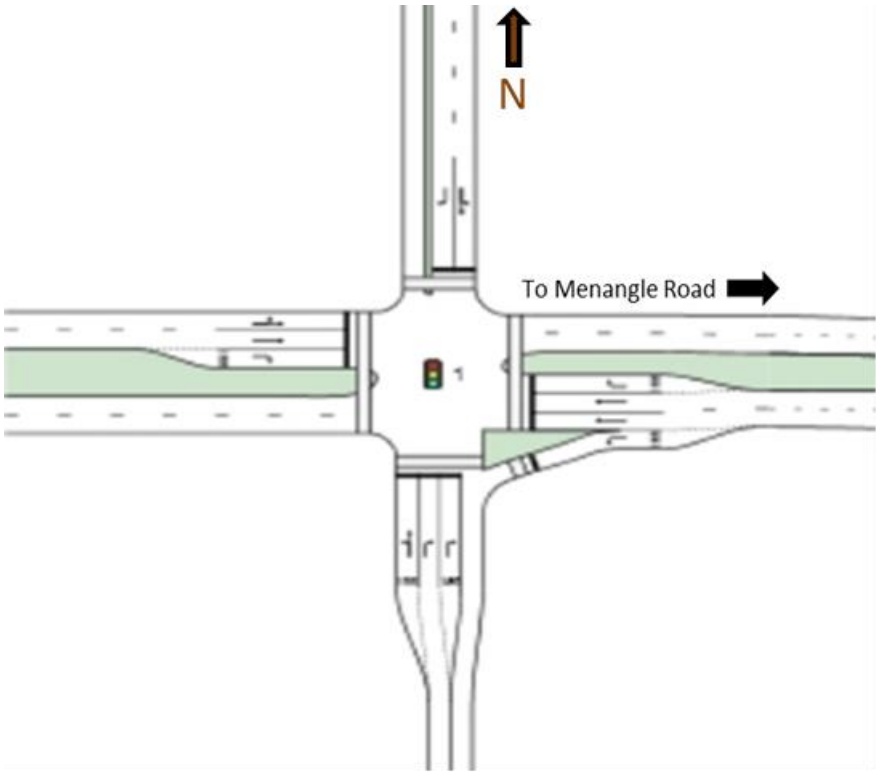


Figure 3-4 Intersection 1 arrangement

Intersection 2 – Spring Farm Parkway and Entry Ramp

The intersection of Spring Farm Parkway and the northbound Hume Motorway entry ramp would be a traffic signal-controlled T-intersection. The intersection would be located to be compatible with a future northbound exit ramp from the Hume Motorway and to avoid impact on the existing AGL gas well.

Spring Farm Parkway would have two through lanes in each direction with a 200-metre single lane right turn bay for westbound traffic and a 150 metre, two lane left turn bay in the eastbound direction. The left turn lanes would have a traffic signal controlled high entry angle treatment at the intersection with the Hume Motorway entry ramp.

The northbound Hume Motorway entry ramp has two lanes on the departure from the intersection with Spring Farm Parkway, merging to one lane before merging with the northbound carriageway of the Hume Motorway. The ramp has been designed to be compatible with future Smart Motorway operation. The proposed arrangement for this intersection can be seen in Figure 3-5.

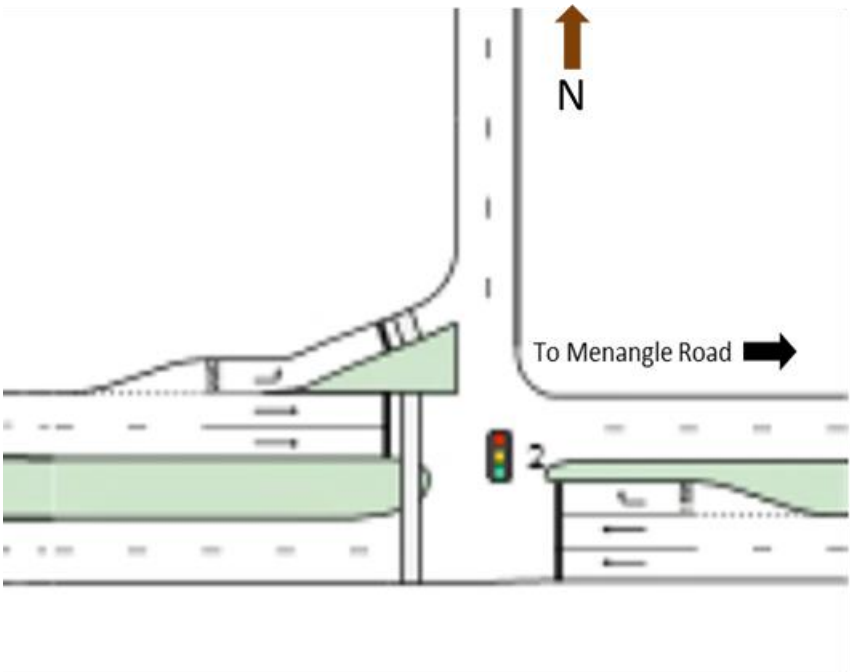


Figure 3-5 Intersection 2 arrangement

Intersection 3 – Spring Farm Parkway and Exit Ramp

The intersection of Spring Farm Parkway and the southbound Hume Motorway exit ramp would be a traffic signal-controlled T-intersection. The intersection would be located to be compatible with a future southbound entry ramp to the Hume Motorway.

The Hume Motorway exit ramp would diverge from the southbound carriageway of the Hume Motorway in a single lane, diverging to two right turn lanes and a left turn lane 230 metre before the intersection. The left turn lane would have a high entry angle left turn treatment at the intersection with Spring Farm Parkway. Spring Farm Parkway would have two through lanes in each direction through the intersection.

The proposed arrangement for this intersection can be seen in Figure 3-6

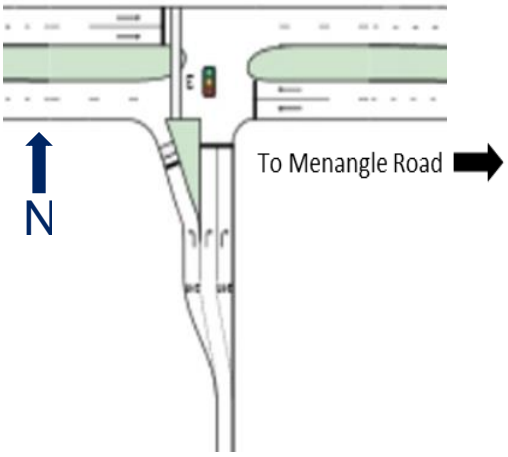


Figure 3-6 Intersection 3 arrangement

Intersection 4 – Spring Farm Parkway and Menangle Road

The proposed intersection at Menangle Road would be a new traffic signal-controlled T-intersection. The southbound approach in Menangle Road would feature two through lanes and two right turn lanes, which would be about 120 metres long. The two through lanes merge into one lane about 500 metres south of the intersection, before the design ties back into the existing pavement.

The northbound approach in Menangle Road includes two through lanes and a single left turn lane 130 metres long, which has a high entry angle left turn treatment at Spring Farm Parkway.

In the Spring Farm Parkway leg of the intersection, there are two westbound lanes departing the intersection. The two eastbound through lanes become dual right turn lanes at Menangle Road, with two left turn lanes diverging from the two through lanes east of the Hume Motorway exit ramp. The two left turn lanes flow into a signal controlled high entry angle treatment at the intersection with Menangle Road.

The intersection with Menangle Road would also be designed to allow for a future connection to Appin Road.

The proposed arrangement for this intersection can be seen in Figure 3-7.

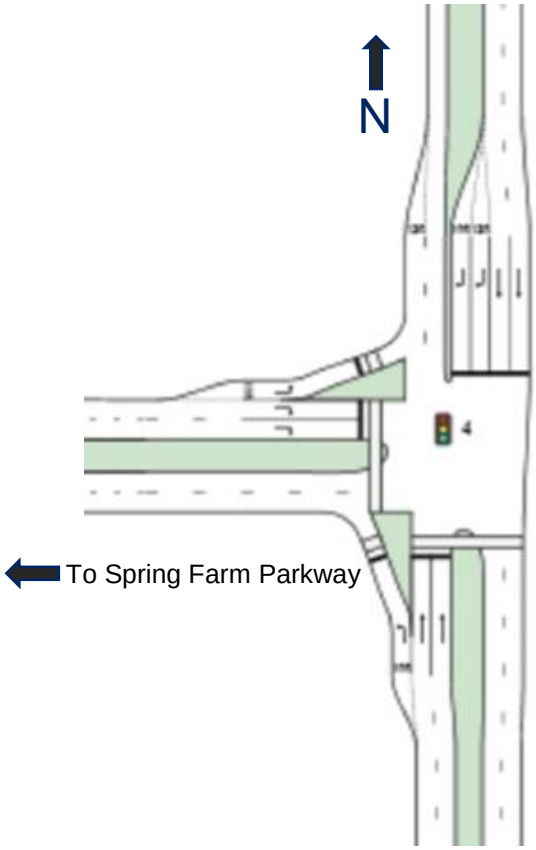


Figure 3-7 Intersection 4 arrangement

Bridge structure

A new bridge would be built to carry Spring Farm Parkway over the Hume Motorway and connect to Menangle Road.

The bridge would be about 20 metres wide and 76 metres long with provisions for future widening on the southern side to accommodate a six lane Spring Farm Parkway and turn lanes for south facing ramps to and from the Hume Motorway. The bridge would also be designed to allow access to the existing AGL gas well on the northern side of Spring Farm Parkway.

The bridge superstructure would comprise 1800 deep Super-T girders with a 200 mm nominal thickness cast-insitu concrete deck. The approach embankments are up to about 12 metres in height.

The bridge would allow for four 3.3 metre lanes with a 4.7 metre median. A 4.0 metre shared use path would be provided on the southern side of the bridge.

The cross section of the proposed bridge can be seen in Figure 3-8.

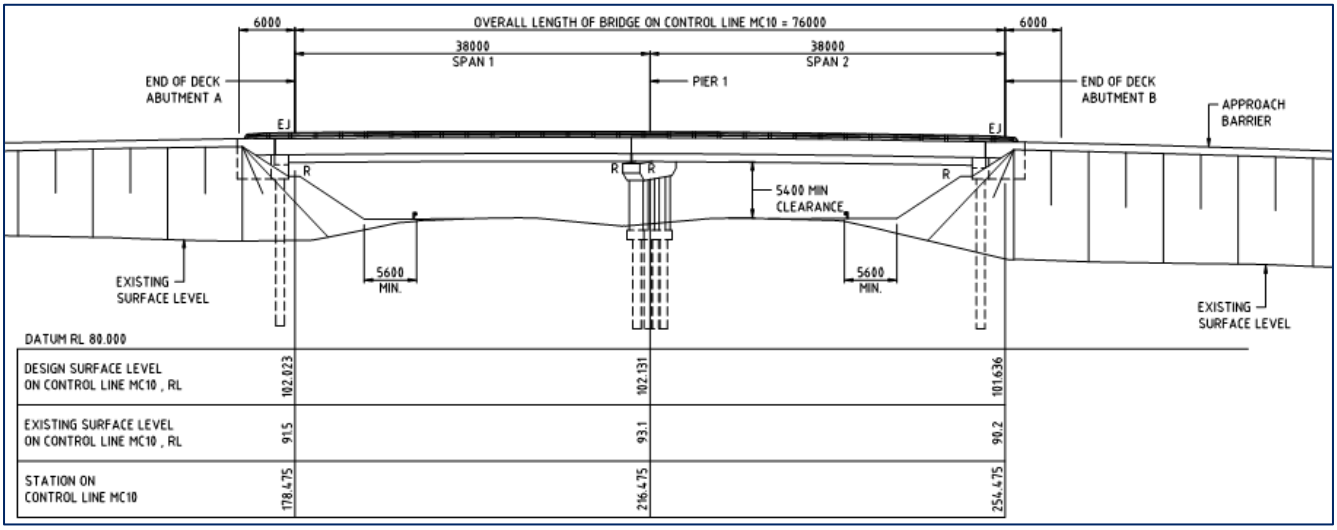


Figure 3-8 Two span bridge arrangement

Shared use path

The proposal includes the following shared use paths:

- A 2.5 metre shared path is provided between the Menangle Park Land Release access road and Menangle Road on the southern side of Spring Farm Parkway. This includes a 4.0 metre section crossing the bridge over the Hume Motorway
- A 2.5 metre shared path is also provided along Menangle Road adjacent the southbound carriageway south of the Spring Farm Parkway intersection
- Pedestrian crossings at intersection 1 and intersection 4 would provide access between the footpaths at the subdivision and along Menangle Road.

There are no specific provisions for on-road cyclists.

Cut and fill batter slopes

Cut and fill batters have been designed at 2 horizontal to 1 vertical. Flatter batter slopes were not deemed viable, because flattening the batter slopes would have increased the proposal footprint where there are high fill embankments, and substantially increase the amount of imported fill required, which is already close to 400,000 m^3. Some fill embankments around the Hume Motorway are in excess of 12 metres high.

These embankments would have 5-metre-wide benches to allow greater safety for maintenance operations.

Drainage infrastructure

The stormwater drainage infrastructure for the proposal consists of the following:

- Transverse drainage
- Pavement drainage pit and pipe system
- Open channels that includes road side channels and culvert inlet and outlet channels
- Water quality basins or vegetated swales
- Scour protection at drainage outlets
- Bridge deck drainage.

The existing drainage pit and pipe system for the Hume Motorway has sufficient hydraulic capacity for storm events up to 1 in 10-year ARI. Road gutters, pits, pipes and open drains would be provided to collect and convey stormwater runoff from the new road pavement work to a water quality treatment device before being discharged into a receiving waterway. The drainage design for the proposal assumes that stormwater

treatment to the pavement runoff on the western side of the Hume Motorway would be achieved by water quality basins. Stormwater treatment for pavement runoff from road catchments on the eastern side of the Hume Motorway would be by vegetated swales only.

Drainage from the Spring Farm Parkway would be discharged into a permanent water quality basin located near the south western corner of Spring Farm Parkway and a future local road (to be designed by others as part of future developments). Flows from the water quality basin would then discharge into the existing watercourse.

Vegetated swales would be provided near the south western corner of the intersection of Menangle Road and Spring Farm Parkway and also to the vegetated swale on the western side of Menangle Road. Six transverse drainage pipes would be provided to allow discharge of the road runoff from Menangle Road to be transferred to the swales.

The existing drainage pit located on the northern side of access to Broughton Anglican College, associated with Drainage 1b, would be impacted by the proposed earthworks. A new pit would be provided to capture the stormwater runoff. This new pit would be connected to the existing pit which would be modified as a buried pit.

3.4 Construction activities

3.4.1 Construction timing

Table 3-2 outlines the indicative construction timeframe for the various construction stages of the proposal.

Table 3-2 Indicative construction timeframe for construction activities

Construction activity	Indicative construction timing											
	2021				2022				2023			
Early work												
Earthworks												
Road construction												
Drainage												
Bridge construction												
Pavements and signalised intersections												
Finishing works												

The remaining section of Spring Farm Parkway (stage 3) required to link stage 2 to Liz Kernohan Drive is currently under construction.

3.4.2 Work methodology

Construction activities would be guided by a construction environmental management plan (CEMP) to ensure work is carried out to Roads and Maritime specifications within the specified work area. Detailed work methodologies would be determined during detailed design and construction planning. The proposed work methodologies are described below.

The proposed construction work and methodology provided is indicative and based on the current concept design and would be further developed during detailed design. Detailed construction staging plans and methods would be determined by the construction contractor(s) after completion of the detailed design in consultation with Roads and Maritime. In the event that construction activities result in any environmental impact above that assessed in this REF, further environmental assessment would be required to be carried out and approved by Roads and Maritime.

Construction work would be expected to involve the following methodology:

- Pre-construction identification and marking of sensitive areas as identified in this REF and the CEMP
- Site establishment (including temporary fencing and construction compound)
- Installation of traffic management measures such as placing safety barriers in accordance with the traffic control plan

- Construction of temporary deceleration lane for vehicles exiting the Hume Motorway to access the site
- Vegetation removal and installation of erosion and sediment controls
- Utility adjustments
- Drainage work
- Earthwork
- Road construction work that includes placement and compaction of subbase, base and wearing surface materials
- Kerb and gutter construction
- Installation of permanent traffic control signals
- Installation of line marking, signposting and other road furniture
- Landscaping work
- Signposting
- Site clean-up.

Table 3-3 Construction activities

Construction activity	Construction methodology
Preconstruction / Early work	
Environmental management systems	• Develop environmental management plans • Obtain approvals and licensing for construction activities • Establish exclusion zones around environmentally sensitive areas, including retained trees and heritage items. This would be carried out in accordance with the Roads and Maritime Biodiversity Guidelines.
Site establishment	• Obtain required working approvals from network authorities (including Traffic Management Centre (TMC) and Campbelltown City Council) • Notify adjacent businesses and residents of proposed work at least five days prior to the work commencing • Establish temporary fencing to secure work site (ATF fencing and/or traffic barriers to re-direct pedestrians and traffic using appropriate directional signage) • Installation of construction signage and advisory signs • Installation of environmental controls • Establishment of temporary ancillary facilities, including clearing and grubbing, installation of office accommodation, utilities and other facilities • Establishment of construction site access points • Establishment of temporary haulage routes, including the Hume Motorway deceleration lane • Establishment of traffic control at worksite including the supply of Variable Message Signs (VMS) • Establishment of temporary drainage

Construction activity	Construction methodology
Service relocations	• Adjust utility infrastructure as required. Some of the service relocations would be carried out as pre-construction activities if possible, but there may be some relocation where part of the construction work would need to be carried out first. In these instances, temporary relocations of services may be required to enable safe and efficient construction operations • Install temporary signals as required.
Construction	
Earthwork	• Install drainage structures such as culverts and sediment basins to manage surface water during construction • Topsoil stripping and stockpiling • Excavation of any excess or geo-technically unsuitable subsoils • Areas of new cut and fill along the alignment • Construction of retaining walls (if required) • Cut and fill for preparation of site for the new bridge over the Hume Motorway and north facing access ramps • Installation of road drainage infrastructure.
Drainage	• Establish sediment and erosion controls including temporary basins • Where required, a temporary diversion channel would be constructed to enable the installation of culverts • Excavate, install and backfill new drainage lines as required including subsurface drainage.
Pavement work including: • new road (Spring Farm Parkway and subdivision accesses) • access ramps • road widening (Menangle Road)	• Minor demolition of asphalt, other road elements and structures on Menangle Road • Clearing of any vegetation • Removal and stockpiling of topsoil • Cut to fill operations including the removal of spoil to achieve the required levels at the underside of the new road surfaces and access ramps • Placement and compaction of selected material (usually crushed rock or natural gravels) • Placing, compacting and finishing of either concrete or gravel road surface sub-base layers (to match existing adjacent road surface profile where required) • Placing, compacting and finishing of pavements.
Bridge construction	• Installation of piling • Construction of bridge abutments and the pier(s) in the central median of the Hume Motorway • Installation of pre-cast concrete girders • Bridge superstructure construction including decking and barriers • Installation of lighting and throw screens.

Construction activity	Construction methodology
Road furniture and signalised intersections	• Installation of traffic lights • Finishing work, such as: line marking; kerb and gutter construction; installation of safety barriers, street lighting and sign posting.
Finishing work	• Install safety barriers (if/where required) • Carry out landscape and re-vegetation work • Install final line marking, signs and guide posts • Remove traffic management and reopen lanes to traffic • Decommission temporary facilities (eg site compounds and temporary deceleration lane from the Hume Motorway) and rehabilitate to original condition or better • Clean up the site and dispose of all surplus waste materials.

3.4.3 Construction workforce

The construction workforce would be expected to fluctuate, depending on the stage of construction and associated activities (see Table 3-2). The workforce would be expected to be between 15 and 25 personnel at the peak of the construction period.

Construction activities would generate traffic for both staff and truck haulage routes. Based on assessments of similar projects the proposal may generate up to 60 truck trips per day and 180 light vehicles per day during peak construction days

3.4.4 Construction hours and duration

It is anticipated that construction would generally be carried out during standard construction working hours in accordance with the *Interim Construction Noise Guideline (DECC, 2009):*

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- Sundays and public holidays: no work.

To minimise disruption to daily traffic and disturbance to surrounding land owners and businesses, it would be necessary to carry out some work outside of these hours. It is expected that out of hours work would be required for the following activities:

- Construction of the pier(s) in the central median of the Hume Motorway
- Installing bridge girders over the Hume Motorway
- Set-up and access to the median of the Hume Motorway
- Setting up any traffic switches that might be needed on the Hume Motorway or Menangle Road
- Delivery of some materials to compounds.

Out of hours work would be subject to permitted road occupancy licences (ROLs) and construction staging. Out of hours work would be carried out in line with the procedures contained within the EPA *Interim Construction Noise Guideline* (ICNG) (DECC 2009) and the Roads and Maritime *Construction Noise and Vibration Guideline 2016*.

The local community would be notified a minimum of five days prior to work outside of standard hours commencing. They would be provided with work details and contact information if there are any issues.

A noise and vibration assessment has been carried out for the proposal. Refer to Section 6.2 and Appendix D for details.

3.4.5 Plant and equipment

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be determined by the construction contractor. An indicative list of plant and equipment is provided below:

- Front end loaders
- Bulldozers
- Backhoes
- Dump trucks
- Road trucks
- Excavators
- Road sweepers
- Water trucks
- Elevated work platforms
- Concrete saws
- Asphalt/concrete pavers
- Compacters and rollers
- Graders
- Scrapers
- Concrete trucks
- Generators
- Chainsaws
- Light vehicles
- Wood chippers.

3.4.6 Earthworks

Excavations would be required to widen Menangle Road, construct Spring Farm Parkway and to relocate utilities. The proposal would also require the use of large volumes of imported (fill) materials to construct cut and fill batter slopes, which as detailed in Section 3.3.1, have been designed at 2 horizontal to 1 vertical, or 4 horizontal to 1 vertical for the ramps, with 5-metre-wide benches and at some locations are expected to be in excess of 12 metres high.

Overall, the proposal is expected to require the following earthworks:

- About 13,700 m^3 of material to be excavated
- About 374,000 m^3 of fill material.

Overall the proposal would require the import of about 360,000 m^3. This assumes that excavated materials would be physically and chemically suitable to reuse as engineering fill. The ability to reuse the material would depend on its physical and chemical properties. Uncontaminated material that is not suitable for use as structural fill could be used to line the utility trenches or in areas of landscaping. Material unsuitable for

construction use would need to be transported offsite by a licensed contractor for disposal at a licensed waste management facility following testing and classification (refer to Section 6.12.3). Any unsuitable or surplus material would be managed in accordance with Roads and Maritime policy.

3.4.7 Source and quantity of materials

Various construction materials would be needed to build the proposal. Major prefabricated deliveries are likely to be transported directly to their point of use given their size and scale. Otherwise, the materials would be transported to the site compound when needed.

Based on the concept design, the estimated quantities of materials associated with proposal are provided in Table 3-4

Table 3-4 Materials and estimated quantities required

Material	Volume
Engineering fill	374,000 m^3
Sub base and base (bound and unbound)	44,700 m^2
Asphalt and bitumen: general	94,700 m^2
Concrete: general (shared path, medians)	8,910 m^2
Concrete: bridge structure (2 x 38 metre spans)	3,680 m^2
Kerbs	6530 metres
Drainage: Aggregate filter and concreting	1,260 m^3
Drainage: Corrugated Plastic Drainage Pipe	5,100 metres
Safety barriers	2,980 metres

The road pavement materials would be sourced from appropriately licensed facilities (e.g. quarries). The demand for resources would be separated into the various stages of construction work.

Surplus or unsuitable material that cannot be used on-site would be classified in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014) and disposed of at an approved materials recycling or waste disposal facility.

The amount of water that would be required during construction is unknown at this stage. The amount would depend on material sources and methodologies applied by the contractor. It is proposed that water would be obtained from the local water supply network.

3.4.8 Traffic management and access

Traffic management and access controls would be developed during the detailed design and implemented under a construction traffic management plan. However indicative traffic haulage routes have been identified and have formed the basis of this assessment. These haulage routes have been developed to minimise the potential impact to surrounding sensitive receivers and the environment as a result of construction traffic accessing land to the west of the Hume Motorway.

For activities carried out on Menangle Road, access would be via Menangle Road.

Interim construction traffic access

At the start of construction activities, construction vehicles would access the site via the following roads (see Figure 6-1):

- Menangle Road
- Racecourse Avenue
- Cummins Road
- Fitzpatrick Street
- AGL access road.

The use of these routes would be restricted to the early phases of the proposal only. The use of these access routes would be permitted while work on the north bound access ramp, and the temporary deceleration lane from the Hume Motorway are being carried out. Work on these elements would be prioritized during the construction scheduling to minimise the duration of the traffic related impact to sensitive receivers within Menangle Park.

Final construction traffic access

A temporary deceleration lane would be constructed to enable construction traffic to access the site via the Hume Motorway. Construction activities associated with this work is considered in the environmental assessment provided in Chapter 6.

The operation of this deceleration lane would enable construction vehicles to access the area to the west of the Hume Motorway without disrupting existing traffic flows. Once construction is completed, this deceleration lane would be removed and reinstated to its original condition.

3.5 Ancillary facilities

Temporary site compound facilities would be required as part of the proposal. These sites may be used for material processing including batch or crushing plant; stockpiles site for materials; and site compound including offices, sheds for the storage of equipment and plan. The following areas would be used as site compounds throughout the construction of the proposal:

- A site compound area of approximately 24,000 m^2 is located on the eastern side of Menangle Road, within a clear paddock opposite Broughton Anglican College (Compound 1)
- A site compound area to the west of the Hume Motorway, on the northern boundary of Spring Farm Parkway (Compound 2). This site compound, which would be about 7,600 m^2.
- A site compound area on the western side of the Hume Motorway, adjacent to the northbound entry ramps (Compound 3). This compound would be about 9,500 m^2.

Compound facilities are shown in Figure 1-2. It is expected that the compound facilities would be accessed directly from Menangle Road or via the Hume Motorway deceleration lane (see Section 3.4.8) and onto Spring Farm Parkway.

These areas have been selected in accordance with Roads and Maritimes' *Stockpile Site Management Guidelines* (Roads and Maritime, 2015). These guidelines also recommend that where possible, site compounds should be located at least 100 metres from noise sensitive receivers. Compound 1 is located about 200 metres from the Broughton Anglican College. However, controls to limit noisy activities during sensitive periods, such as exam periods, would be implemented during construction in consultation with the Broughton Anglican College. The northern boundary of Compound 1 is adjacent to the Grazier's Arms Inn, which is identified as an area of archaeological potential. Fencing would be installed to prevent access to and disturbance of this site.

Once construction is complete, the land where the site compounds are located would be reinstated to their previous condition.

3.6 Public utility adjustment

The following public utility adjustment would be required. This has been informed by the Utility Services Strategy Report, which has been prepared in parallel to the concept design (Jacobs, 2018).

Table 3-5 Public utility adjustments

Utility	Location	Adjustments
AAPT (PowerTel)	Existing optical fibre direct buried cable runs along the south-western side of Menangle Road and then parallel with the proposed Spring Farm Parkway bridge.	**Protection**: No adjustments proposed. Services would be protected rather than relocated.
AGL Energy	Existing low pressure AGL gas main, feeds two AGL gas well heads. The existing alignment runs parallel with Spring Farm Parkway and then crosses transversely (north and south) to connect to the existing gas well heads.	**Adjustment**: To the southern side of Spring Farm Parkway, and a section to the east underneath the proposed bridge. If gas wells are decommissioned at the time of construction, no relocation would be required.
APT Management Services	High pressure gas transmission pipeline crossing both the Hume Motorway and Menangle Road.	No protection or adjustments proposed. Additional potholing would be required to confirm depths of pipeline beneath Menangle Road.
Endeavour Energy	Two underground electrical conduits located: • On the eastern side of Menangle Road, connecting to Broughton Anglican College • Parallel to Menangle Road on the western side, south of the Campbelltown Steam Museum. Various overhead electrical powerlines located within the proposal area.	**Relocation:** Overhead powerlines and section of impacted underground conduits to be relocated outside of the road corridor.
Jemena	Various throughout the proposal area.	No direct impact to these services is anticipated.
Jemena Eastern Gas Pipeline	High pressure gas main crosses north of Menangle Road near Sugarloaf Riding Farm.	**Protection**: No adjustments proposed. Pipeline outside of proposal area. Services would be protected rather than relocated.
Jemena Gas Land Services NSW	Two high pressure gas mains are shown crossing both the Hume Motorway and Menangle Road south of Campbelltown Steam Museum.	**Avoidance**: No work is proposed within six metres of pressure gas mains.

Utility	Location	Adjustments
NBN	Various throughout the proposal area.	**Relocation:** To the proposed shared path on eastern side of Menangle Road, and then crossing to run parallel to Spring Farm Parkway. **Replacement:** Existing property connections to align with proposed road corridor extents and existing conduit running parallel to Spring Farm Parkway.
NextGen	Optical fibre conduits (size, number unknown) runs along the western side of Menangle Road.	**Relocation:** To the proposed shared path on eastern side of Menangle Road, and then crossing to run parallel to Spring Farm Parkway.
Optus	Various throughout the proposal area.	No direct impact to these services anticipated.
Telstra	Various optical fibre and telephone conduits located: • Western side of Menangle Road • Western side of the Hume Motorway, including conduits running in parallel to Spring Farm Parkway.	**Replacement:** Removal of existing conduits along Spring Farm Parkway, and replacement on same alignment. Existing property connections to align with proposed road corridor extents. **Relocation:** To the proposed shared path on eastern side of Menangle Road, and then crossing to run parallel to and beneath Spring Farm Parkway.
Sydney Water	Three watermains within the proposal area located: • Western side of the Hume Motorway • Underneath the Hume Motorway • Eastern side of Menangle Road	**Protection**: No adjustments proposed to local water connections. **Relocation:** To outside of proposed road, parallel to Spring Farm Parkway then crossing beneath proposed bridge to western side of entry ramp.

3.7 Property acquisition

On the western side of Menangle Road, substantial property acquisition would be required from Lot 12 DP 249530 (116 Menangle Road), with lesser amounts required from the adjacent Menangle Road frontage of Lot 11 DP 249530 (96 Menangle Road). The extent of acquisition required from these lots is detailed in Table 3-6.

On the eastern side of Menangle Road Lot 12 DP 791365 is partially affected. Lot 2 DP 842735 which is located within the state heritage listed Sugarloaf Farm, and it is location of the Sugarloaf Horse Centre would be affected, with the western boundary of the property requiring acquisition.

Areas of land to the west of the Hume Motorway would require acquisition. The majority of this land has been zoned as SP2 (Infrastructure) for the development of Spring Farm Parkway. There are some locations where the cut and fill batter slopes, and drainage extend partially into the adjoining lots.

3.7.1 Property adjustments

Property adjustments would be required on both sides of Menangle Road. The widening of the footway within the existing road reserve would require a cut batter to be constructed within the Broughton Anglican College property and the replacement of the existing steel fence.

The other affected properties would need to have their accesses and fences reinstated. Following construction, the batters and construction area would be revegetated.

Table 3-6: Proposed property acquisition

Description	Total area (m^2)	Acquisition type	Lot and DP	Land use zone (LEP)
Spring Farm Parkway, west of the Hume Motorway	80,558	Required acquisition	Lot 2006, 2007,2011, 2012 and 1002 DP 1234643	R2, SP2, RE1
	1,699	Required acquisition	Lot 1 DP 598067	SP2
	139	Required acquisition	Lot 2000 DP790848	RU2
	345	Required acquisition	Lot 9 DP 249530	RE1
Eastern side of the Hume Motorway	4,661	Required acquisition	Lot 3004 DP 802845	RU2
	812	Required acquisition	Lot 12 DP791365	RU5
116 Menangle Road	23,933	Required acquisition	Lot 12 DP 249530	R5
96 Menangle Road	7,321	Required acquisition	Lot 11 DP 249530	R5
Sugarloaf Horse Centre, eastern side of Menangle Road	3,559	Required acquisition	Lot 2 DP 842735	E3
	812	Required acquisition	Lot 12 DP 791365	RU2
Broughton Anglican College	1,559	Required acquisition	Lot 19 DP 249334	RU2
	5,628	Required acquisition	Lot 9 DP 791365	RU2
	383	Required acquisition	Lot 40 DP 1082972	RU2
TOTAL	131,409			

Description	Total area (m^2)	Acquisition type	Lot and DP	Land use zone (LEP)
Compound 1	24,000	Temporary acquisition	Lot 9 DP 791365	RU6
Compound 2	7,600	Temporary acquisition	Lot 2008 DP 1234643	R2
Compound 3	9,500	Temporary acquisition	Lot 2006 DP 1234643 and Lot 2008 DP 1234643	R5

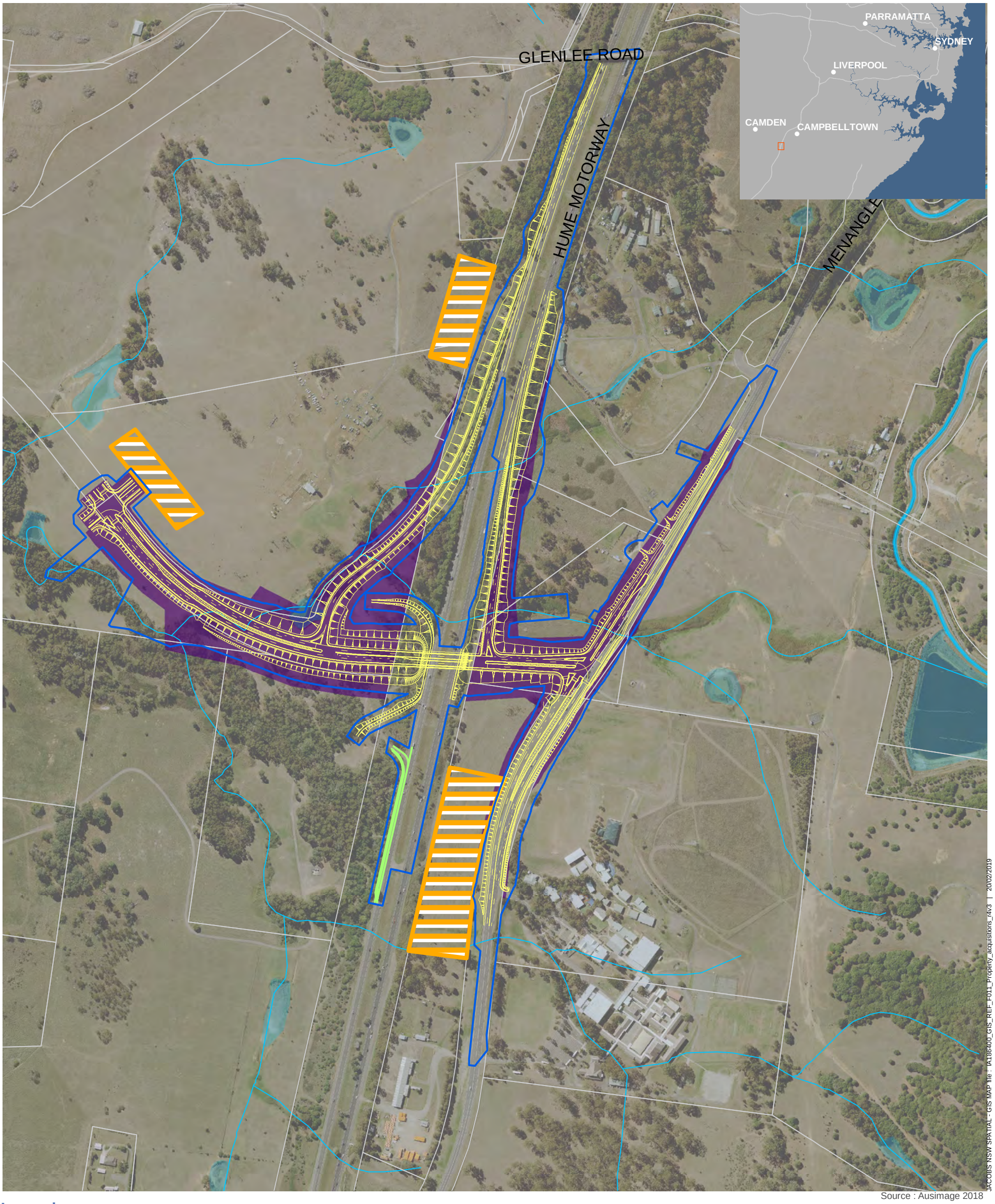


Figure 3-3 | Proposed property acquisition

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 legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

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

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

As the proposal is for a road and is to be carried by Roads and Maritime, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by State Environmental Planning Policy No. 14 - Coastal Wetlands, State Environmental Planning Policy No. 26 - Littoral Rainforests, 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.

State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 relates to the use of land within the Sydney drinking water catchment. Clause 12 of the SEPP requires consideration of whether an activity to which Division 5.1 of the EP&A Act applies would have a neutral or beneficial effect on water quality before carrying out the activity.

The proposal is not located within the boundary of Sydney's drinking water catchment.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

Campbelltown LGA is listed in Schedule 1 of the State Environmental Planning Policy No 44 – Koala Habitat Protection, which aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas.

A biodiversity assessment was carried out for the proposal (see section 6.7 for further details). It was considered unlikely that the study area contains core koala habitat as defined in SEPP 44, given the poor condition of the habitats in the study area and the absence of any signs of the species during targeted surveys undertaken as part of this assessment.

State Environmental Planning Policy No. 55 – Remediation of Land

State Environmental Planning Policy No. 55 – Remediation of Land promotes the remediation of contaminated land and specifies when development consent is required to carry out remediation work. SEPP 55 describes 'category 1 remediation work' as requiring development consent and 'category 2 remediation work' as not requiring development consent.

In SEPP 55 'remediation' is defined 'as removing, dispersing, destroying, reducing, mitigating or containing the contamination of any land, or eliminating or reducing any hazard arising from the contamination of any land (including by preventing the entry of persons or animals to the land)'. Preliminary investigations indicate the potential for contamination at the proposal site that would require excavation and off-site disposal. The removal of surplus fill would meet the definition of remediation if the fill is contaminated, therefore SEPP 55 may apply to the proposal.

As the proposal is permissible without development consent under the Infrastructure SEPP, remediation (if required) would be classified as category 2 remediation work and would not require development consent under SEPP 55. Section 6.12 provides assessment of potential contamination impact related to the proposal and measures to mitigate the potential impact.

Sydney Regional Environmental Plan No. 20 – Hawkesbury Nepean River (No 2 – 1997)

All regional environmental plans are now deemed SEPPs. The proposal is located on land to which Sydney Regional Environmental Plan No. 20 – Hawkesbury Nepean River (No.2 – 1997) (SREP 20) applies. The aim of SREP 20 is to protect the environment of the Hawkesbury Nepean River System. The proposal does not require consent under SREP 20. However, under Clause 4(1)(b), the matters listed under Clauses 5 and 6 that apply to a proposal must be considered by a public authority or State owned corporation carrying out development that does not require consent. Table 4-1 addresses these matters as they apply to the proposal.

Table 4-1 Consideration of the provisions of SREP 20

Consideration	Comment
Clause 5 The general planning considerations relevant for this Part are:	
The aim of this plan which is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impact of future land uses is considered in a regional context.	This REF fully assesses the impacts of the proposal and considers the potential regional impact of the construction and operation of the proposal. The proposal is not anticipated to have any significant and/or regional level impact.
The strategies listed in the Action Plan of the Hawkesbury-Nepean Environmental Planning Strategy.	The proposal is not inconsistent with any of the strategies listed in the Action Plan.
Whether there are any feasible alternatives to the development or other proposal concerned	Chapter 4 (Statutory and planning framework) describes and assesses alternatives and options to the proposal.
The relationship between the different impact of the development or other proposal and the environment, and how those impacts would be addressed and monitored.	Chapter 6 (Environmental assessment) assesses the impact of the proposal. The proposal would not significantly impact the environment of the Hawkesbury Nepean River System.

Consideration	Comment
Clause 6 The specific planning policies and recommended strategies for this plan are as follows:	
Specific planning policies and recommended strategies	The specific planning policies and recommended strategies for the Plan have been considered throughout chapter 6 (Environmental Assessment). Mitigation measures consistent with the Plan have also been outlined in chapter 6 and considered in chapter 7 (Environmental management)

4.1.2 Local Environmental Plans

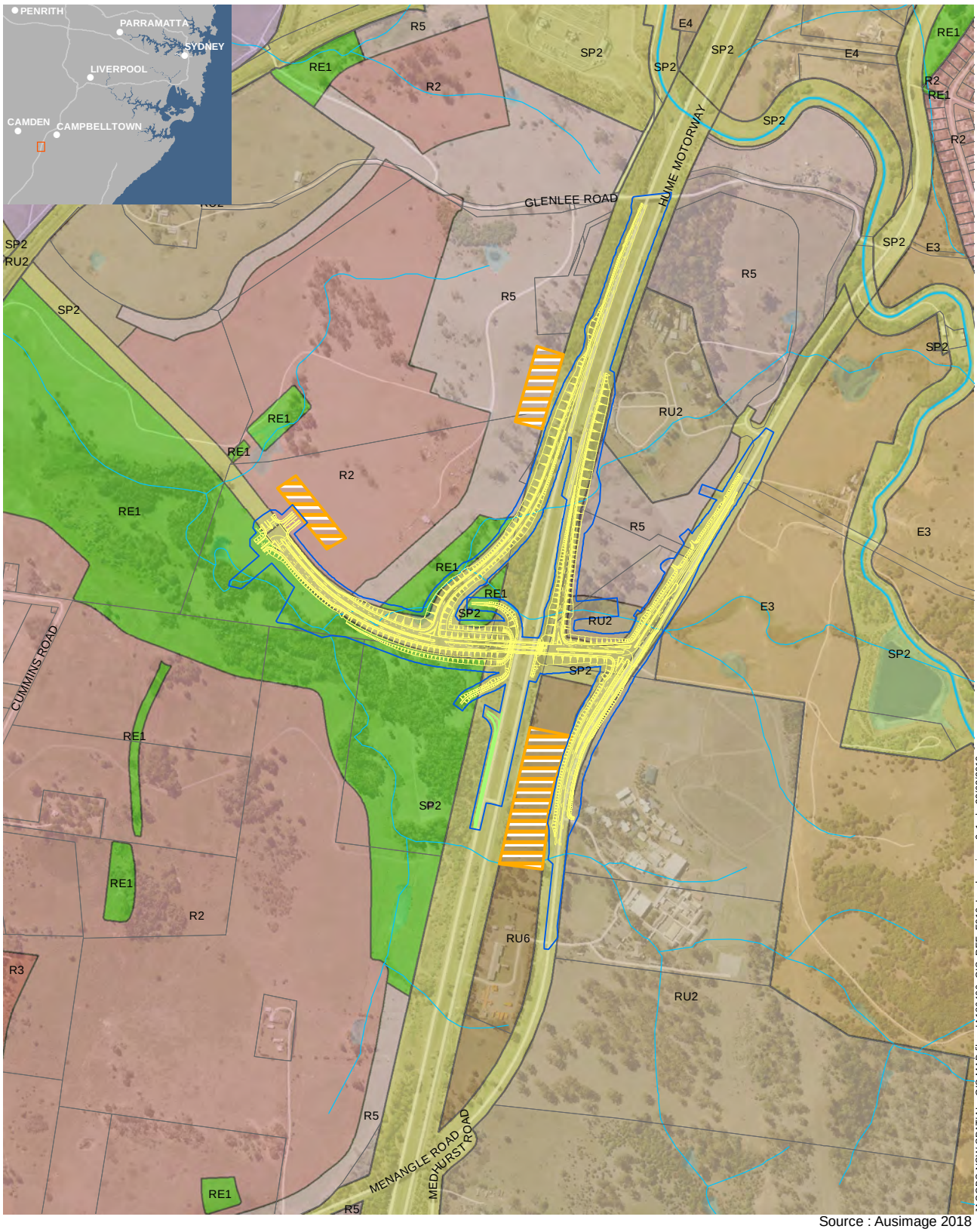
The proposal is within the Campbelltown and Camden local government areas. Land use and development within these areas is primarily regulated by the *Campbelltown Local Environmental Plan 2015* (Campbelltown LEP). The zonings which apply to the land affected by the proposal are outlined with their objectives in Table 4-2 and shown on Figure 4-1.

Table 4-2 Consistency of the proposal against affected LEP zones

LEP Zone	Objectives	Consistency of the proposal with the objectives
Campbelltown LEP		
RE1 – Public Recreation	• To enable land to be used for public open space or recreational purposes • To provide a range of recreational settings and activities and compatible land uses • To protect and enhance the natural environment for recreational purposes • To provide for land uses compatible with the ecological, scientific, cultural or aesthetic values of land in the zone • To facilitate the multiple use of certain open space areas • To facilitate development that is ancillary or incidental to the special land uses provided for in this zone • To provide for the sufficient and equitable distribution of public open space to meet the needs of the local community • To preserve and rehabilitate bushland, wildlife corridors and natural habitat, including waterways and riparian lands, and facilitate public enjoyment of these areas • To provide for the retention and creation of view corridor • To protect and enhance areas of scenic value and the visual amenity of prominent ridgelines • To preserve land that is required for public open space or recreational purposes.	Yes – The proposal has been developed to minimise the impact to this land zone as far as is practical. The proposal reinforces this land use by providing improved transport options to this location through the provision of Spring Farm Parkway. The proposal would result in some decreased amenity of the area as an open space in the immediate future. As discussed in Section 2.1.1, the area would be developed as part of the Menangle Park land release and so in the long term the proposal would be consistent with the character of the area. Controls would be implemented during construction (see chapter 7) to minimise the risk to the values of this zone.
SP2 – Infrastructure	• To provide for infrastructure and related uses • To prevent development that is not compatible with or that may detract	Yes – The proposal is consistent with the aims of this land zone as it involves the provision of road infrastructure.

LEP Zone	Objectives	Consistency of the proposal with the objectives
	from the provision of infrastructure • To encourage activities involving research and development • To optimise value-adding development opportunities, particularly those associated with research • To provide for the retention and creation of view corridors • To preserve bushland, wildlife corridors and natural habitat • To maintain the visual amenity of prominent ridgelines.	
R2 – Low Density Residential	• To provide for the housing needs of the community within a low density residential environment • To enable other land uses that provide facilities or services to meet the day to day needs of residents • To enable development for purposes other than residential only if that development is compatible with the character of the living area and is of a domestic scale • To minimise overshadowing and ensure a desired level of solar access to all properties • To facilitate diverse and sustainable means of access and movement.	Yes – The proposal supports and improves access to and from this residential area.
RU2 – Rural Landscape	• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base • To maintain the rural landscape character of the land • To provide for a range of compatible land uses, including extensive agriculture • To preserve and enhance bushland, wildlife corridors, natural habitat and water resources, including waterways, ground water and riparian land	Yes - The proposal would involve minor encroachments into this land zone on the eastern side of Menangle Road. The use of this land use would not be compromised or detracted from in building and operating the proposal.

LEP Zone	Objectives	Consistency of the proposal with the objectives
	• To protect and enhance areas of scenic value, and the visual amenity of prominent ridgelines, by minimising development and providing visual contrast to nearby urban development.	
E3 – Environmental Management	• To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values • To provide for a limited range of development that does not have an adverse effect on those values To enable development for purposes other than rural-residential only if that development is compatible and complementary, in terms of design, size and scale, with the character of land in the zone • To allow cellar door premises, restaurants and cafes only where they are directly associated with the agricultural use of the land • To protect, and maintain the environmental, ecological and visual amenity of, the Scenic Hills, the Wedderburn Plateau and environmentally sensitive lands in the vicinity of the Georges River from inappropriate development • To preserve the rural heritage landscape character of the Scenic Hills • To protect and enhance areas of scenic value and the visual amenity of prominent ridgelines • To protect bushland, wildlife corridors and natural habitat, including waterways and riparian lands • To ensure the preservation and maintenance of environmentally significant and environmentally sensitive land.	Yes - The proposal has been designed to reduce the required impact on and loss of areas of high ecological, scientific, cultural or aesthetic values by restricting work in these areas where possible. The proposal would result in an impact to the Sugarloaf Farm heritage item within this land zone. The impact is assessed in Section 6.9. While the proposal is inconsistent with the aims of this land use, measures have been taken to ensure feasible and reasonable controls would be implemented to minimise any impact.



Source : Ausimage 2018

Legend

- 80% design
- Proposal area
- Site compound
- Deceleration lane
- Waterway

Land zoning

- E3 Environmental Management
- E4 Environmental Living
- IN1 General Industrial
- R2 Low Density Residential
- R3 Medium Density Residential
- R5 Large Lot Residential
- RE1 Public Recreation
- RU2 Rural Landscape
- RU6 Transition
- SP2 Infrastructure

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N

Figure 4-1 | Land zoning

4.2 Other relevant NSW legislation

4.2.1 National Parks and Wildlife Act 1974

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

An assessment of the impact to Aboriginal cultural heritage is provided in Section 6.8. The proposal would involve work within three areas which, based on archaeological test excavations undertaken in July 2018 where confirmed as Aboriginal archaeological sites. A draft Cultural Heritage Assessment Report (CHAR) has been prepared and is provided in Appendix H. The CHAR will support an Aboriginal Heritage Impact Permit (AHIP) is being sought for this proposal for impacts to three areas of Aboriginal archaeology.

4.2.2 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) aims to protect items of State and local heritage significance and outlines the process for the approval of development that may impact on items of heritage significance.

Matters protected under the Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council Local Environmental Plans (LEPs), and the heritage and conservation registers established under section 170 of the Act by NSW Government agencies (section 170 Registers). The Act also provides for the protection of archaeological 'relics', being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance. Under section 57(1), approvals are required for work to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register (SHR). An excavation permit under section 139 is required to disturb or excavate any land containing or likely to contain a relic.

It is assessed that the existing built elements of Sugarloaf Farm would not be impacted, and that any road widening to the eastern corridor of Menangle Road would be compulsorily acquired and no longer be part of the heritage curtilage of Sugarloaf Farm. The proposal would not require a permit under section 60 of the Heritage Act (see Appendix I).

4.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) commenced on 25 August 2017 repealing the *Threatened Species Conservation Act 1995*. The BC Act seeks to conserve biological diversity and promote ecologically sustainable development (ESD); to prevent extinction and promote recovery of threatened species, populations and ecological communities; and to protect areas of outstanding biodiversity value. The BC Act provides a listing of threatened species, populations and ecological communities, areas of outstanding biodiversity value, and key threatening processes.

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or *Fisheries Management Act 1994* (FM Act), are assessed using a five-part test. Where a significant impact is likely to occur, a SIS or Biodiversity Assessment Report (BAR) must be prepared in accordance with the Director-General's requirements.

An assessment of the potential impact to biodiversity is provided in Section 6.7.

4.2.4 Fisheries Management Act 1994

The Fisheries Management Act 1994 (FM Act) aims to conserve, develop and share the fisheries resources of the State for the benefit of present and future generations, including conserving fish stocks and key fish habitats and promoting ecologically sustainable development. The FM Act applies to all waters within the limits of the State, except where Commonwealth legislation applies.

Threatened species, populations and ecological communities of fish and marine vegetation are protected under the FM Act. In addition, an object of the FM Act is to conserve key fish habitat. Permits from NSW Department of Primary Industries (DPI) – Fisheries are required for certain impact in key fish habitat, including blocking of fish passage.

Within the study area there are three unnamed tributaries/drainage lines that are directly traversed by the proposal and all drain in a westerly direction towards the Nepean River. Waterways (Tributary 1, and Drainage Lines 1a and 1b) were assessed against the Key Fish Habitat "Types" in the Department of Primary Industries (DPI) *Policy and Guidelines for Fish Habitat Conservation and Management* (2013) (DPI, 2013) and the *Fish Passage Requirements for Water Crossings* (Fairfull & Witheridge, 2003).

Overall the majority of the waterways were classified 'Class 4' unlikely key fish habitat, with a section of Tributary 1 to the west of the Hume Motorway classed conservatively as 'Type 2' key fish habitat. The waterways are not considered to be sensitive receiving environments. Refer to Section 6.4 and Appendix F for an assessment of the condition of these waterways. Mitigation of the potential direct and indirect impact is provided in Section 6.4 . No permits or further consideration of the FM Act is required.

4.2.5 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (NSW) (POEO Act) provides for the issue of an Environment Protection Licence (EPL) for scheduled activities.

An EPL would be required for the scheduled activity of ***waste disposal by application to land***, as the proposal is within a regulated area (Campbelltown LGA) and involves the filling, raising, reclaiming or contouring the land with over 200 tonnes of building and demolition waste (mixed with virgin excavated natural material). As such, the proposal would require an EPL.

Section 148 of the POEO Act requires immediate notification of pollution incidents causing or threatening material harm to the environment to each relevant authority. An Incident Management Plan would be included in the CEMP.

4.2.6 Waste Avoidance and Resource Recovery Act 2001

The purpose of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) is to develop and support the implementation of regional and local programs to meet the outcomes of a State-wide strategy for waste avoidance and resource recovery. It also aims to 'minimise the consumption of natural resources and final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste'.

Waste generation and disposal reporting would be carried out during the construction and operation of the proposal. Procedures would be implemented during construction in an attempt to promote the objectives of the Act.

4.2.7 Coal Mine Subsidence Compensation Act 2017

The *Coal Mine Subsidence Compensation Act 2017* was passed by the NSW Parliament in August 2017. The Act, which repealed and replaced the *Mine Subsidence Compensation Act 1961*. The purpose of this Act is to make provision of the payment of compensation for damage caused by subsidence arising from coal mining. The Act also includes conditions relating to the approval of development within mine subsidence districts, and functions and powers of the Subsidence Advisory NSW (previously the Mine Subsidence Board). Part 3 of the Act outlines the conditions and approvals required for development within mine subsidence districts.

The proposal is located within the South Campbelltown Mine Subsidence District. Approval under section 22 of the *Coal Mine Subsidence Compensation Act 2017* was granted for the proposal, subject to conditions detailed in Section 6.13.2.

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 impact to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impact to these biodiversity matters is also considered as part of chapter 6 of the REF and Appendix G.

Findings – matters of national environmental significance

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

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

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Chapter 6 of the REF describes the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposal is permissible without consent. The

proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

Roads and Maritime is the determining authority for the proposal. This REF fulfils Roads and Maritime's obligation under section 5.5 of the EP&A Act including to examine and consider to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

5. Consultation

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

5.1 Community and stakeholder consultation

During development of the proposal, consultation with the community and government agencies would be undertaken. A Communication and Stakeholder Engagement Plan (CSEP) has been prepared to support the proposal (Appendix L). The CSEP outlines the communication and stakeholder objectives, delivery methods and potential issues the proposal needs to manage. It also presents the communication tools, key messages, protocols and evaluation process to support the delivery of the communication and stakeholder components of the proposal.

Roads and Maritime Services is committed to meeting the reasonable needs and desires of the community for information and consideration of their views on the proposal. The following communication and engagement objectives have been developed for the proposal:

- Provide regular and targeted information to build awareness about the proposal as well as information about the likely impact and benefits of the proposal
- Provide clear direction to the community and stakeholders about whether we are providing information or seeking feedback, so expectations are clear at all stages
- Ensure community and stakeholder views are continuously fed into the proposals' development and used to understand and effectively assess impact
- Collaborate with government agencies and local councils to ensure a whole-of-government approach and consistent key messaging.

Consultation with community and key stakeholders would be carried out to:

- Seek comment, feedback, ideas, and suggestions for us to consider when developing the proposal, including consultation outcomes into the environmental impact assessment known as a review of environmental factors
- Build a database of interested and concerned community members with whom we can continue to engage during the proposal's development and delivery.

Feedback was received by Roads and Maritime during the display of the Appin Road Upgrade and Appin Road Safety Improvements REF's, which was held during November and December 2018. Some feedback related to Spring Farm Parkway (stages 1 and 2). Comments relating to the proposal, and the additional details, including the location within this REF where these queries are addressed:

Table 5-1 Summary of submissions received on the proposal during the Appin Road Upgrade and Appin Road Safety Improvements REF's exhibition

Summary of feedback	Response and location of additional information
Queries about where Spring Farm Parkway (Stages 1 and 2) would connect to and from.	Spring Farm Parkway would ultimately provide access for future residential development within Spring Farm, Elderslie, Menangle Park and Mount Gilead, as well as providing an alternative east-west route to Narellan Road, with direct access to the Hume Motorway (see Section 2.1 for further details).
Noted the timing or absence of south facing entry and exit ramps to the Hume Motorway	The proposal caters for future south facing ramps when these are required. The ramps would be

Summary of feedback	Response and location of additional information
	designed to accommodate future upgrades as part of the Smart Motorways program. As outlined in Section 3.3.1, the traffic and transport assessment and noise and vibration assessment have included consideration of these additional elements when assessing the operation of the proposal in the future (i.e. from 2036 onwards).
Concerns raised about congestion at the Narellan Road / Hume Motorway intersection and additional traffic on Appin Road. Submission noting that the Spring Farm Parkway (Stages 1 and 2) provides an opportunity to connect Appin Road and the Hume Motorway, bypassing Campbelltown CBD.	The traffic and transport assessment has included consideration of future widening of Spring Farm Parkway and connections to Appin Road (i.e. from 2036 onwards). Further details are provided in Section 6.1 and Appendix C.
Queried the timing of additional investigations relating to the Spring Farm Parkway corridor and what will happen to the RMS land set aside in Naroomba reserve for the Spring Farm link.	A number of investigations have been undertaken as part of this REF. The proposal would not result in impacts to Naroomba Reserve. Additional investigations would be undertaken as part of the development of stage 2 of Spring Farm Parkway.

5.2 Aboriginal community involvement

Roads and Maritime is committed to effective consultation with Aboriginal communities regarding Roads and Maritime activities and their potential for impact on Aboriginal cultural heritage. The proposal has been consultation with Aboriginal people has been carried out in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011), the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (OEH, 2010) and the requirements of Clause 80C of the National Parks and Wildlife Regulation 2009. An outline of the procedure is presented in Table 5-2, and the activities which have been undertaken for this proposal.

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

PACHCI Stage	Description
Stage 1	***Initial Roads and Maritime assessment*** Desktop assessment to determine whether a Roads and Maritime proposal is likely to harm Aboriginal cultural heritage, and whether further assessment or investigation is required.
Stage 2	***Site survey and further assessment*** The study area falls within the boundaries of Tharawal Local Aboriginal Land Council (Tharawal LALC). Mark Lester, Roads and Maritime Aboriginal Cultural Heritage Officer (ACHO) liaised with Tharawal LALC throughout the proposal. Arika Jalomak from Tharawal LALC participated in the field survey.

PACHCI Stage	Description
Stage 3	***Formal consultation and preparation of a cultural heritage assessment report*** Roads and Maritime advertised in local media and contacted potential Aboriginal stakeholders identified from government agency notification responses. Investigations for the proposal have included consultation with the 27 Aboriginal community groups and individuals as listed in Appendix H. The formal consultation process has included: • Advertising for registered Aboriginal parties (Appendix H) • Government agency notification letters • Notification of closing date for registration • Provision of proposed assessment methodology allowing 28-day review (letters dated 1 May 2018) • An Aboriginal Focus Group (AFG) meeting held on 8 May 2018 to discuss archaeological assessment methodology • Ongoing compilation of registrants list, through continuing to register individuals and groups for consultation on the proposal • Provision of draft CHAR for review (allowing a minimum 28-day review) • A second AFG meeting to discuss investigation results, draft CHAR and detailed mitigation strategies • Ongoing consultation with the local Aboriginal community.

5.3 ISEPP consultation

Part 2, division 1, clauses 13-15 of the ISEPP specify the consultation requirements for infrastructure development. These largely relate to the requirement for public authorities other than local councils to consult with the relevant local government authority as part of the assessment process. Consultation is required if the proposal would affect council infrastructure or services, impact local heritage items, or if the development would impact flood liable lands.

As the proposal is located within the South Campbelltown Mine Subsidence District, Roads and Maritime is required to given written notice of the intention to carry out the development (together with a scope of work) to the Subsidence Advisory NSW under clause 16(2)(i) of the State Environmental Planning Policy (Infrastructure) 2007.

Campbelltown City Council and Subsidence Advisory NSW have been consulted about the proposal as per the requirements of the ISEPP. Appendix B contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered.

Issues that have been raised as a result of this consultation are outlined in Table 5-3.

Table 5-3: Issues raised through ISEPP consultation

Agency	Issue raised	Response / where addressed in REF
Subsidence Advisory NSW (SANSW)	SANSW NSW granted approval for the proposal subject to specific design parameters being met including: • The proposed bridge structure is to be designed within specific subsidence parameters provided by SANSW • An Engineering Impact Statement should be submitted to SANSW identifying a range of specified design requirements • Establishment of survey marks to AHD to assist in monitoring any structural movement • A work-as-executed certification to be submitted upon completion of construction.	The requirements of SANSW have been considered in the concept design for the proposal and would be carried forward during detailed design and construction. • Ongoing consultation with SANSW would be carried out throughout design and construction of the proposal
Campbelltown City Council	A formal response was not received prior to submission of this REF.	N/A

5.4 Ongoing or future consultation

This REF will be placed on public exhibition for stakeholder and community comment. All comments received will be considered when finalising the proposal design. The community would be kept informed of any further changes to the proposal resulting from this and any future consultation process. Information sessions will be held during the REF public display period. Details of these information session dates and locations would be advertised prior to the events and issued through Roads and Maritime Community Updates.

Following public display of the REF, all comments received would be recorded and addressed in a Submissions Report detailing how each issue raised would be considered in finalising the proposal design. The Submissions Report would include feedback presented in Table 5-1. The Submissions Report would be made available to the public on the proposal webpage on the Roads and Maritime website.

6. Environmental assessment

This section of the REF provides a detailed description of the potential environmental impact 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 impact 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 impact.

6.1 Traffic and transport

This chapter describes the existing traffic conditions on the Hume Motorway, Menangle Road and local streets within Menangle Park, and identifies the potential impact to those conditions as a result of the construction and operation of the proposal and assesses the impact. This chapter also recommends environmental management measures to reduce the impact of the proposal.

The Traffic and Transport Assessment (Appendix C) has been used to inform this chapter.

6.1.1 Methodology

The traffic assessment has been based on the process testing of traffic forecasts for 2026 and 2036 scenarios using Sidra network models. The traffic forecast used in this assessment have considered future widening and additional south facing entry and exit ramps to the Hume Motorway, as described in Section 3.3.1.

The traffic forecasts used in this assessment are based modelling results provided by the Roads and Maritimes strategic models. Table 6-1 provides a summary of the modelling scenarios used for the traffic assessment. The 2026 scenario has assumed that the proposal would be connected to the future stage 2 of Spring Farm Parkway. The scenario used for 2036 has included the widening of Spring Farm Parkway, connections to Appin Road, and also the inclusion of south facing ramps. The south facing ramps adopted are indicative only and the final location and configuration of these ramps would be confirmed during the future development of the Spring Farm Parkway.

Table 6-1: Traffic Modelling Scenarios for 2026 and 2036

Proposal	2026	2036
Stage 1 Spring Farm Parkway	✓	✓
North Facing Ramps	✓	✓
Stage 2 Spring Farm Parkway	✓	✓
Widening Spring Farm Parkway to 3 lanes in each direction	-	✓
South Facing Ramps (indicative)	-	✓
Connection to Appin Road	-	✓
Hume Motorway 6 lanes	-	✓

Forecasted traffic volumes were also provided for 2026 and 2036, which were applied to the Sidra model to assess the performance of intersection. The assessment of intersection performance is based on criteria outlined in and defined in the *Guide to Traffic Generating Development, version 2.2* (Roads and Traffic Authority , 2002) and summarised in Table 6-2.

Table 6-2 Level of Service criteria for intersections

Level of Service	Average Delay per Vehicle (sec)	Traffic signals and roundabouts	Give Way and Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; incidents would cause excessive delays at signals Roundabouts require other control modes	At capacity, requires other control mode
F	>70	Over capacity; unstable operation	Over capacity; unstable operation

Intersection performance of Level of Service (LoS) D or better was established as the target criteria (Roads and Traffic Authority , 2002). An assessment of the impact of the new north facing entry ramp on the Hume Motorway was also carried out based on the methodology provided in the *Highway Capacity Manual* (Transportation Reseach Board, 2016). As with the intersection performance, the target level of service for the ramp merge is LoS D.

The assessment also considers the impact on all road users including public transport, pedestrians and cyclists. Further details of the traffic and transport assessment methodology is provided in Appendix C.

6.1.2 Existing environment

The Hume Motorway is part of the national highway linking Sydney to Melbourne and Canberra. In the study area the motorway is two lanes in each direction on a divided carriageway with a speed limit of 110km /h. The nearest interchange is at Narellan Road near Blair Athol four kilometres north of the proposal while the next interchange is at Picton Road 15 kilometres south of the proposal near Wilton.

Menangle Road is a single lane in each direction two-way road with a speed limit of 100km/h. It provides access to Menangle Park and surrounding residential areas as well as crossings of the southern railway and the Hume Motorway.

Existing traffic volumes

Typical traffic volumes were obtained from the Roads and Maritime permanent count station located on the Hume Motorway near Menangle (ID 07737). The data for 2017 is shown in Table 6-3.

Table 6-3: Hume Motorway traffic volumes 2017

	Daily traffic volumes	Morning Peak Period (7:00am – 8:00am)	Evening Peak Period (4:00pm – 5:00pm)	Friday Evenings (5:00pm – 6:00pm)	Sundays (4:00pm – 5:00pm)
Northbound	25,917	1585	1914	2041	2919
Southbound	26,597	1395	2089	2650	1905
Total	52,514	2,980	4,003	4,691	4,824

The data shows that there is an average annual daily traffic volume of over 52,000 vehicles per day.

Public transport

The nearest train station to the proposal is Menangle Park on the Main Southern Railway Line between Campbelltown and Moss Vale with an average 30-minute service interval during the peak periods. The area is currently serviced by the 889 and 900 bus routes, which are operated by Picton Buslines. The 889 connects Campbelltown Station to Menangle. This service runs once an hour in the mornings and once an hour in the evening peak. The 900 service connects Picton to Campbelltown with four services per day. These bus routes offer limited service at the weekend, with two services on Saturdays. No services operate during the evenings or on Sundays. Bus stops near the proposal are located at Menangle Road near to Broughton Anglican College, as shown on Figure 1-2.

Menangle Park station is located to the east of the proposal in Menangle Park. Long stay station parking is provided, free of charge for up 650 cars. Access to this station and its associated car park is via Menangle Road and Racecourse Avenue.

Active transport

There are no pedestrian or bicycle facilities provided within the study area. The Hume Motorway allows for cyclists to ride in the shoulder though this is suitable only for experienced road cyclists. Menangle Road has no provision for pedestrians or cyclists and the narrow road shoulders would be unsuitable for most cyclists.

6.1.3 Potential impact

Construction

Construction traffic generation

Construction activities would generate traffic for both staff and truck haulage routes. Based on assessments of similar projects the proposal may generate up to 60 truck trips per day and 180 light vehicles per day during peak construction days. As outlined in Section 3.4.4, construction activities would occur primarily during the standard construction working hours (7:00 am to 6:00 pm, Monday to Friday and between 8:00 am and 1:00 pm on Saturdays).

The volume of construction related vehicles is unlikely to impact the performance of the road network.

Some out of hours work would be required for the following activities, to minimise disruption to daily traffic and disturbance to surrounding land owners and businesses:

- Construction of the pier(s) in the central median of the Hume Motorway
- Installing bridge girders over the Hume Motorway
- Set-up and access to the median of Hume Motorway
- Setting up any traffic switches that might be needed on the Hume Motorway or Menangle Road
- Delivery of some materials to compounds.

Truck traffic would mainly be trucks transporting soil, road base, concrete and asphalt. There would also be the transportation of oversized precast concrete sections which would occur outside of peak traffic hours.

Traffic access impact

As outlined in Section 2.3.1, a key objective of the proposal is to minimise temporary disruption to local traffic and access. As such, the following conditions would need to be maintained throughout the construction period:

- Hume Motorway would be open to traffic 24 hours a day throughout construction.
- Menangle Road would be open to traffic 24 hours a day throughout construction.

To provide access to and from the proposal area, the following routes would be used in the early stages of construction work:

- Menangle Road
- Cummins Road
- Fitzpatrick Street
- Racecourse Avenue
- Existing AGL access track.

Indicative access routes are shown on Figure 6-1. Construction would be staged to provide the north facing access ramps to the Hume Motorway as a priority, after which construction traffic would exit to the Hume Motorway via the new access ramp.

Entry to the site would also be via a new temporary deceleration lane that would be constructed on the western side of the Hume Motorway.

The widening of Menangle Road would affect access to a number of properties, including Broughton Anglican School. Access to properties near to construction work for the proposal would be maintained during construction. Where changes are required, suitable access arrangements would be implemented in consultation with affected property owners.

Impact on road network

The assessment of construction traffic impact assumes that most of the construction would occur on new roads and so would have little impact on the existing road work.

Construction activity is likely to impact traffic operation in the following instances:

- Partial road closures of the Hume Motorway and Menangle Road
  - During construction of the temporary deceleration lane
  - During construction of the north facing entry and exit ramps, temporary closure of the eastern shoulder of the Hume Motorway would be required to provide space for construction work.
  - Widening of Menangle Road and construction of new intersection would require partial closure

- The construction of the bridge structure would require the temporary closures at night of a carriageway on the Hume Motorway. This would require temporary cross overs and contra flow arrangements. It is expected that these works would occur outside of peak traffic demand periods and would maintain through traffic at all times.
- Construction near live traffic: reduced speed limits and active traffic control would be required wherever construction activities would be taking place near live traffic. This may occur at the locations of bridge work over the Hume Motorway and where widening of the existing road corridor on Menangle Road is planned.

Impact to traffic on the Hume Motorway would be discussed with the Transport Management Centre (TMC) as part of the development of the detailed design.

Public transport

There are two bus stops located within the proposal area. These would require temporary relocation during work on Menangle Road. The operation of bus services would not be affected by construction work. The final location of temporary bus stops would be confirmed based on consultation with the bus route operator (Picton Buslines). Some delays may occur for the 889 and 900 bus routes as a result of construction work along Menangle Road.

The use of Racecourse Avenue and Cummins Road for temporary construction traffic is not expected affect commuters accessing Menangle Park railway station. Long stay station parking is provided, free of charge for up 650 cars, and so on street informal parking around Menangle Park station is not be anticipated. Access to this car park is via Racecourse Avenue, and entry and exit to the car park would be maintained at all times for commuters. A bus stop is located opposite Menangle Park station. The 889 services this stop up to eight times a day, mostly during morning and evening peak. Another bus stop is located on Cummins Road. The interaction between commuters accessing the station across Racecourse Avenue, and construction traffic would be managed to ensure safety for road users as part of the construction traffic management plan.

Active transport

Closure of the shoulders would have an impact on cyclists who occasionally use the Hume Motorway. Alternative routes would be identified as part of the construction traffic management plan which may require closure of the motorway to cyclists between Picton Road and Narellan Road.

Parking

Staff parking is likely to be provided on site at each construction compound. It is not expected that surplus parking demand from construction activities would reduce the availability of surrounding public parking.

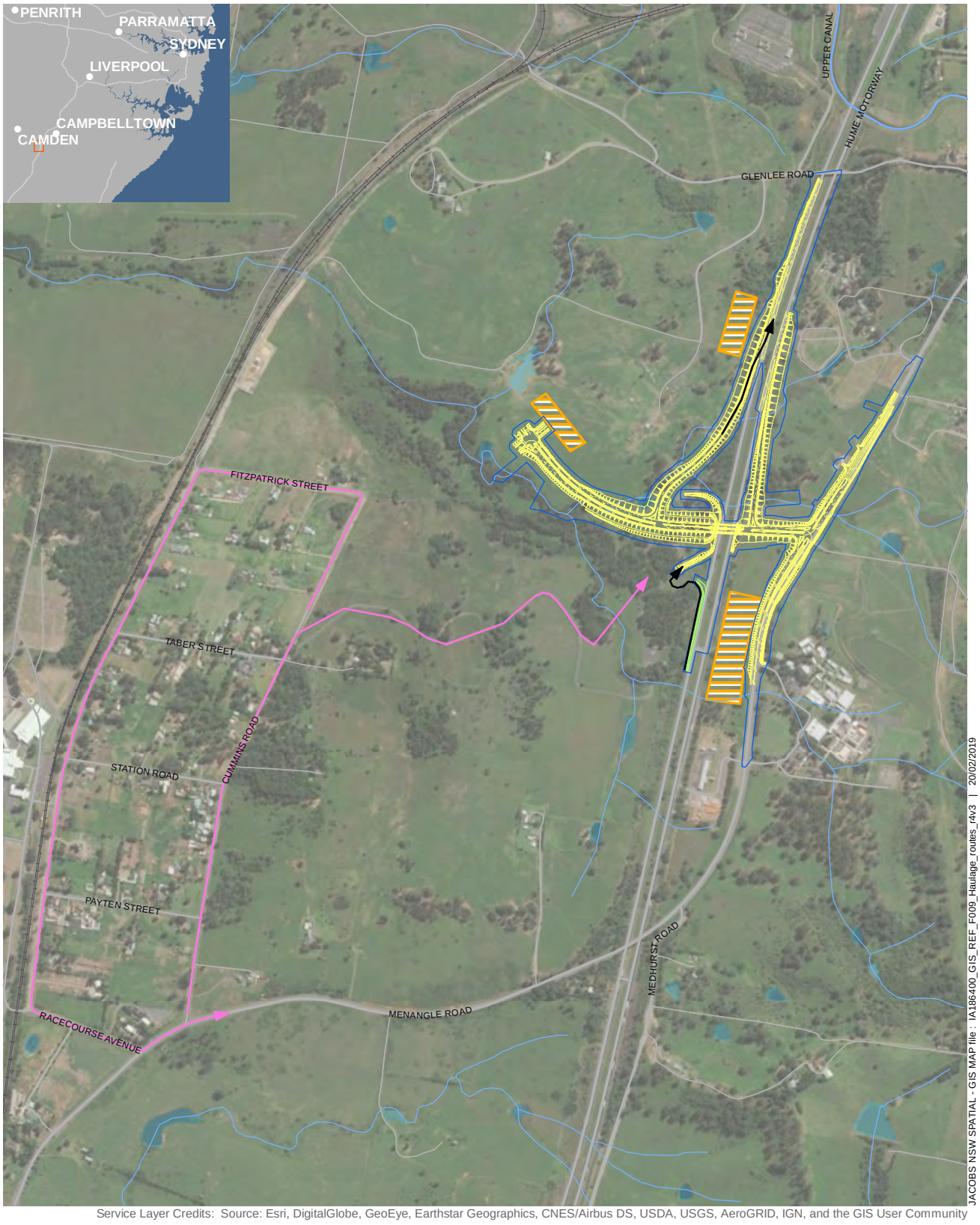


Figure 6-1 | Interim and final construction haulage routes

Operation

Intersection and ramp merge performance

The intersection and ramp merge performance criteria are summarised in Table 6-4. The performance of the following intersections was considered (the intersection layout is shown in Figure 1-2):

- Intersection 1: New Access Road to future Menangle Park land release
- Intersection 2: Entry Ramp
- Intersection 3: Exit Ramp
- Intersection 4: Menangle Road
- Ramp merge: Northbound entry ramp onto the Hume Motorway.

Table 6-4 summarises the performance of intersections under the 2026 and 2036 scenarios. The results show that in 2026 the proposal would operate at a LoS D or better.

In 2036, the modelling has assumed that Spring Farm Parkway would have been expanded to include three through lanes in each direction as well as south facing ramps and the future connection to Appin Road. it was found that in 2036, intersections 3 and 4 would experience capacity issues during the evening peak period.

Further analysis of these results indicated that these capacity issues were due to the proximity of the intersections to each other and the introduction of the south facing ramps and the proximity of these indicative ramps in relation to intersections 3 and 4. As outlined in Section 6.1.1, the locations of these ramps are indicative only at this stage, and the final location and configuration would be developed as part of stage 2 Spring Farm Parkway to reduce the impact of the interchange and improve the performance of intersections 3 and 4.

Therefore, although the modelling has identified issues with the future performance of intersections 3 and 4, these intersections would be unlikely to experience these issues. Without these ramps, it is anticipated that intersections 3 and 4 would operate at a LoS D or better in 2036 during the evening peak.

Table 6-4 2026 and 2036 Traffic Modelling Results

	Intersection 1		Intersection 2		Intersection 3		Intersection 4	
	Average Delay (sec)	**Level of Service**	**Average Delay (sec)**	**Level of Service**	**Average Delay (sec)**	**Level of Service**	**Average Delay (sec)**	**Level of Service**
2026								
Morning peak	29	LOS C	16	LOS B	13	LOS A	21	LOS B
Evening peak	31	LOS C	9	LOS A	27	LOS B	26	LOS B
2036								
Morning peak	55	LOS D	33	LOS C	19	LOS B	37	LOS C
Evening peak	40	LOS C	17	LOS B	66	LOS E	64	LOS E

The results of the assessment for the northbound entry ramp associated with this proposal are shown in Table 6-5.

Table 6-5: HCM merge capacity analysis

	Main Line Flow	Ramp Flow	Density Pcu / km /lane	Level of Service
2026 Morning	2809	377	15	C
2026 Evening	1904	411	10	B
2036 Morning	2869	1621	28	D
2036 Evening	1963	715	9	B

The capacity analysis for the north facing on ramp indicates that in 2026 the merge would operate at LoS C in the morning peak. In the 2036 assuming the extension of Spring Farm Parkway to Appin Road and the forecast uplift in residential development there would be significant increase in northbound traffic entering the motorway. It was assumed that by 2036 there would be three lanes in each direction on the motorway. The LoS for this scenario would be 'D' on the outside lane. This would have some impact on the merge lanes with a reduction in speeds of up to 15km /h but have no effect on the centre lanes.

Public transport

The proposed roadway does not directly impact on existing public transport services. The new roadway would facilitate additional bus services in the future with potential realigning of the 889 and 900 bus routes.

Active transport

The proposal does not affect any existing pedestrian or bicycle routes. The design includes a new shared path along the southern side of Spring Farm Parkway. At present this path would not be connected to any existing networks however longer term it is envisaged that shared paths would connect the length of the new Spring Farm Parkway and provide connections between residential areas and the Broughton College Anglican School.

Parking

Parking is not currently permitted along the length of Menangle Road or the Hume Motorway. The proposal would not remove or add to parking availability within the study area.

6.1.4 Safeguards and management measures

Table 6-6 Traffic and transport environmental management measures

Impact	Environmental safeguards	Responsibility	Timing
Traffic and transport	A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would 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 would include:	Contractor	Detailed design / Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	• Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impact 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.		
Road damage	Undertake a pre-construction dilapidation survey of local roads used for construction. Defects caused by construction activities would be rectified prior to completion of construction.	Contractor	Construction
Property access	Access to properties along Menangle Road would be maintained during construction. The need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.	Contractor	Construction
Broughton Anglican School access	Access to Broughton Anglican School would be maintained during construction. The need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.	Contractor	Construction
Traffic and transport – bus services	Interaction between commuters accessing Menangle Park Station across Racecourse Avenue, and construction traffic would be	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	managed to ensure safety for road users as part of the construction traffic management plan.		
Traffic and transport – bus services	The final location of temporary bus stops would be confirmed based on consultation with the bus route operator (Picton Buslines).	Contractor	Construction
Traffic and transport – cycling facilities	Alternative routes would be identified as part of the construction traffic management plan which may require closure of the motorway to cyclists between Picton Road and Narellan Road.	Contractor	Construction

6.2 Noise and vibration

A construction and operational noise and vibration assessment has been undertaken to support the assessment of this proposal. The results of this assessment are summarised below, with the complete assessment included in Appendix D.

6.2.1 Methodology

The assessment methodology for the noise and vibration impact involved:

- Identifying the study area including:
  - Identification and classification of sensitive receivers. Receivers were classified using a combination of recent aerial and ground photography, web-based information sources and cadastral data
  - Grouping noise receivers into Noise Catchment Areas (NCA). This grouping is directed by procedures in the Interim Construction Noise Guideline (ICNG) and is primarily based on the measured background noise levels, types of receivers in the area and potential noise impact from localised construction activities.
- Background noise monitoring to identify existing noise levels. Background noise was measured at seven locations throughout the study area using calibrated, industry standard, type 1 noise loggers. The noise loggers measured background noise levels between 25 June and 6 July 2018, and monitoring was repeated at location 7 between 8 to 18 August 2018
- Attended noise monitoring surveys were undertaken, consisting of a single 15-minute attended ambient noise measurement using an SVAN 958 Type 1 sound level meter (see Table 6-13 and Table 6-14)
- Validation of noise models using data from concurrent background noise and traffic surveys. The noise and traffic data are combined and compared through a detailed 3D noise model. Using the validated model with proposal specific traffic data provides operational noise predictions that satisfy the guideline tolerances
- Establishing proposal specific noise management levels, derived as an acceptable exceedance above the level of background noise, defined as the Rating Background Level (RBL) and residential sleep disturbance screening criteria
- Modelling of operational noise, and construction noise and vibration. Operational noise was modelled and predicted using proposal specific traffic data. Construction noise was modelled and predicted using construction sound power levels as per the Roads and Maritime Construction Noise and Vibration Guideline (CNVG) and construction scenarios which assume worst-case scenarios for construction activities, such as sources operating concurrently, minimum offset distances between source and receiver and no mitigation measures
- Assessment of those noise predictions against relevant construction and operational noise criteria, including sleep disturbance. For construction, the guidelines are the EPA Interim Construction Noise Guideline (ICNG) and the Roads and Maritime CNVG. For operational noise the applicable guidelines are the EPA Road Noise Policy and the Roads and Maritime Noise Criteria Guidelines (NCG)
- Identification of mitigation measures for any operational noise impact identified as per the Roads and Maritime Noise Mitigation Guideline (NMG)
- Identification of feasible and reasonable environmental management measures. The Interim Construction Noise Guideline (Department of Environment and Climate Change (DECC) 2009) (ICNG) defines ‘feasible’ and ‘reasonable’ as:
  - Feasible: A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements
  - Reasonable: Selecting reasonable measures from those that are feasible involves making a

judgment to determine whether the overall noise benefits outweigh the cost of applying.

The study area and sensitive receivers

The assessment study area extends from Menangle Park in the west to Glen Alpine and Rosemeadow in the east. Land uses to the west of the proposal in the suburb of Menangle Park are predominately semi-rural residential while the area east of the proposal in Glen Alpine, Campbelltown is populated primarily with low-density residential development. The region also accommodates commercial and educational land uses. In total the study area incorporates 1,937 acoustically-sensitive buildings including residences, schools, commercial premises and one childcare centre (Bellbirds Early Learning Centre). Based on an approximate number of receivers within each building, it is predicted that 11,246 receivers are within the study area.

The study area for this assessment extends to a minimum of 600 m either side of the proposed road alignment in accordance with Road Noise Policy (RNP) and has also been extended further from the proposal alignment in some regions to ensure that all potential exceedances of construction or operational noise limits have been identified. For example, to the west and east of the proposal to ensure residences in Menangle Park and Glen Alpine have been included in the assessment of potential construction noise impacts.

Noise catchment areas

Receivers likely to be affected by the same construction work have been grouped into the Noise Catchment Areas (NCAs) as indicated in Figure 6-2. NCA's assist with noise impact assessment, consultation and notification. The acoustic features of each of these NCAs are detailed in Table 6-7.

Table 6-7: Noise catchment areas and their key acoustic features

NCA	Location	Character and existing ambient noise	Receiver offsets to nearest construction works (m)	
			Nearest	Farthest
1	Glen Alpine, Campbelltown	Suburban. Day and night ambient noise determined by traffic on Englorie Park Drive, Menangle Road and Hume Motorway	620	2,100
2	Broughton Anglican College and surrounds	Semi-rural. Day and night ambient noise determined by traffic on Menangle Road and Hume Motorway	30	1,000
3	Menangle Park Land Release Area (South)	Semi-rural. Day and night ambient noise determined by traffic on Hume Motorway	680	1,600
4	Menangle Park	Semi-rural. Day and night ambient noise determined by traffic on Menangle Road and Hume Motorway	520	1,800
5	Menangle Park Land Release Area (North)	Semi-rural. Day and night ambient noise determined by traffic on Hume Motorway	145	780

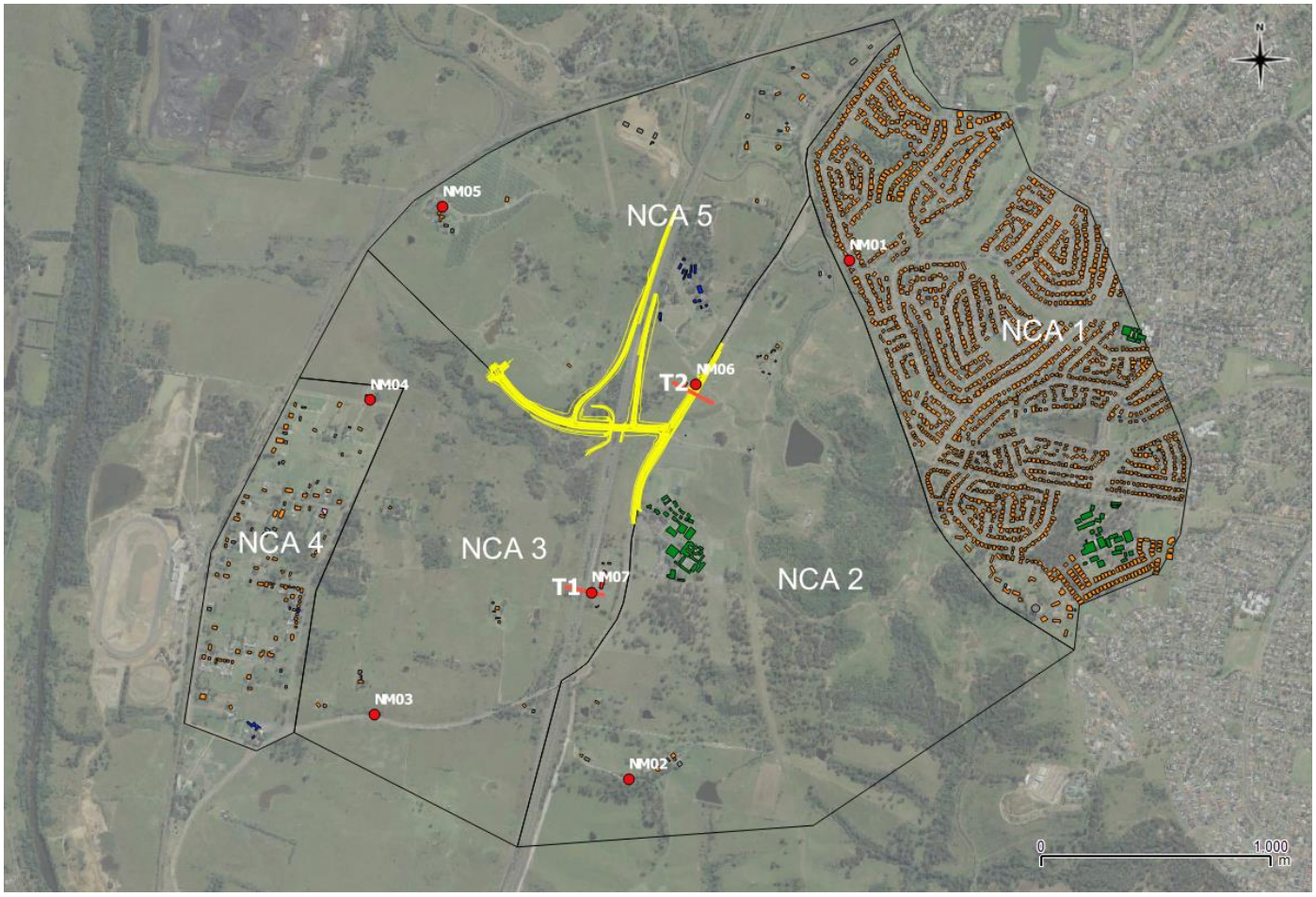


Figure 6-2: Noise Catchment Areas, sensitive receivers and Noise monitoring locations

6.2.2 Criteria

Construction noise and vibration criteria

The effects of construction noise on the community relate to the type, timing and duration of the works, existing background noise level, and the intensity and character (eg, whether a constant or impulsive noise) of the noise from the works. This section outlines the assessment of noise from construction of the project in accordance with the Roads and Maritime CNVG, the Roads and Maritime application of the Interim Construction Noise Guideline (ICNG). Where impact is predicted, “reasonable and feasible” noise mitigation is outlined in Section 6.2.6.

The following noise and vibration assessment criteria are relevant to the construction of the proposal:

- Noise Management Levels (NML’s) applied to the assessment of surface construction activities and construction sites
- Sleep disturbance criteria applied to the assessment of construction activities that may be carried out during out of hours work (10pm to 7am)
- Construction traffic noise criteria
- Construction vibration criteria.

Construction noise management levels

The CNVG specifies that any sensitive receiver potentially impacted by noise from construction of the proposal be assigned a construction Noise Management Level (NML). NMLs are determined in accordance with the ICNG's noise goals.

Table 6-8 outlines how the ICNG determines NMLs for residential receivers potentially impacted by noise from construction of the proposal. Table 6-8 also outlines how receivers that may be "Highly Noise Affected" (HNA) by construction work are identified. In general, the management of the predicted HNA impact may require restrictions to construction hours.

Table 6-8 Construction Noise Management Levels for residential receivers

Time of Day	Noise Management Level (NML) LAeq(15 min)*	How to apply
Recommended standard hours	Noise affected (RBL + 10 dB(A))	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and the duration, as well as contact details.
	Highly noise affected (75 dB(A) or greater) (75 dB(A))	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (RBL + 5 dB(A))	A strong justification would typically be required for work outside the recommended standard hours The proponent should apply all feasible and reasonable work practices to meet the noise affected level Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC, 2009).

The ICNG also provides NMLs for the following non-residential receivers:

- Industrial premises (external) 75 dB(A) $L_{Aeq(15min)}$
- Offices, retail outlets, cafes/bars/restaurants (external) 70 dB(A) $L_{Aeq(15min)}$:
- Classrooms (internal) 45 dB(A) $L_{Aeq(15min)}$
- Places of worship (internal) 45 dB(A) $L_{Aeq(15min)}$
- Active recreational areas (external) 65 dB(A) $L_{Aeq(15min)}$
- Passive recreational areas (external) 60 dB(A) $L_{Aeq(15min)}$

- Hotel (external) 50 dB(A) $L_{Aeq(15min)}$
- Library (external) 55 dB(A) $L_{Aeq(15min)}$

Sleep disturbance screening criterion

Construction activity during night periods (10pm-7am) has the potential to cause sleep disturbance in nearby residences. The ICNG prescribes the following sleep disturbance "screening criterion":

$$L_{Amax} \leq L_{A90(15min)} + 15 \text{ dB(A)}$$

This screening criterion indicates that sleep disturbance may be possible where the L_{Amax} maximum noise level from construction exceeds the background noise level by more than 15 dB(A) at the external facade of a residence. Where this screening criterion is not met, more detailed assessment and response is required at the detailed design stage.

Construction vibration criteria – human comfort

The limits (vibration dose values) above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be affected by construction work are taken from *Assessing Vibration: A Technical Guideline* (EPA, 2006). These are detailed in Table 6-9.

Table 6-9: Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical working areas [1]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.20	0.40
Offices, schools, educational institutions	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

NOTE 1: Includes operating theatres, precision laboratories and other areas where vibration sensitive activities may occur.

Construction vibration criteria – structural damage

The CNVG presents safe working distances with reference to the *British Standard BS 7358-2*. This provides guidance on the 'evaluation and measurement of vibration in buildings' and defines guidance for categorising building damage in terms of 'cosmetic', 'minor' and 'major'; providing limits for each. The cosmetic damage limits are presented in Table 6-10.

Table 6-10 : Transient vibration guideline values for structure damage

Group	Type of structure	Peak component particle velocity in frequency range of predominant pulse [1]		
		4 Hz – 15 Hz	14 Hz – 40 Hz	40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 mm/s – 20 mm/s[2]	20 mm/s – 50 mm/s	50 mm/s

NOTE 1: Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).
NOTE 2: At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded.

The levels for structural damage outlined in the standard refer to non-continuous vibration sources and are considered 'safe limits' up to which no damage due to vibration effects are expected to occur for the various building types. Where vibration is continuous these levels may be reduced by up to 50 per cent and additional assessment against the standard would be necessary.

The Roads and Maritime *Construction Noise and Vibration Guideline* (CNVG) notes that separate guidance for assessment of heritage structures is contained in the German Standard DIN 4150:Part 3-1999 *Structural vibration - Effects of vibration on structures*, (Deutsches Institute fur Normung, 1999). This standard recommends guideline values for short term vibration impact on heritage structures (see Table 6-11). This criterion could also be applied to buried archaeological artefacts.

Table 6-11 : DIN 4150 Structural Damage – Safe limit for short-term vibration

Group	Type of Structure	Peak Particle Velocity (mm/s)			
		At Foundation			Plane of Floor of Uppermost Storey
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	All Frequencies
3	Structures that because of their sensitivity to vibration (structurally unsound), do not correspond to those listed in Lines 1 or 2	3	3 at 10 Hz increasing to 8 at 50 Hz	8 at 50 Hz increasing to 10 at 100 Hz	8

Operational noise criteria

Operational noise from the proposal refers to the noise from traffic using the road once it is opened to the public – the 'operational' phase of the proposal.

The potential for an operational noise impacts is assessed against the Noise Criteria Guideline (NCG) which describes the Roads and Maritime implementation of the Road Noise Policy (RNP). The NCG applies noise criteria to sensitive receivers for both the proposal's year of opening (in this case, 2026) and 10 years after its opening (2036).

The NCG applies more stringent noise criteria for new roads than for redeveloped roads given the greater opportunity to minimise the noise impact, especially in greenfield locations.

Above all, the intention of the NCG in all situations is to meet the following principles. These principles take precedence over even the procedures of the NCG:

- Criteria are based on the road development type a residence is affected by due to the road proposal
- Adjacent and nearby residences should not have significantly different criteria for the same road
- Criteria for the surrounding road network are assessed where a road proposal generates an increase in traffic noise greater than 2 dB(A) on the surrounding road network
- Protect existing quiet areas from excessive changes in amenity due to traffic noise.

Operational noise criteria for residential receivers

A residence may be assigned new road, redeveloped road, transition zone or relative increase criteria depending on how the proposal would influence noise levels. For each facade of the residence the most stringent applicable criterion is applied.

Criteria are based on the road development type a residence is affected by due to the proposal. In some cases, residences may be exposed to noise from both new and redeveloped road segments. In this instance the proportional contribution from each road is used to determine “transition zone” criteria.

An additional test – known as the relative increase criteria - is applied to protect residences within quiet areas from large (more than 12 dB(A)) increases in noise due to the proposal.

For the purposes of assessment against the NCG, the proposal is a new road except for:

- The Menangle Road segment, which constitutes a redeveloped road, and
- Those lower segments of the proposal’s on and off ramps near the Hume Motorway. These are also redeveloped road segments.

The proposal includes transition points within the proposal, where the above new and redeveloped road segments meet. Separately, the proposal also includes transition points where it joins with the Hume Motorway and with Menangle Road.

All of the above considerations inform the determination of operational noise criteria for residences in the study area. The operational noise criteria for residences adopted in this assessment are presented in Table 6-12.

Table 6-12: NCG operational noise criteria for residential receivers

Road category	**Type of project/land use**	**Assessment Criteria**	
		Daytime (7am-10pm)	**Night-time** (10pm-7am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	55 dB(A) $L_{Aeq\ (15hour)}$ (external)	50 dB(A) $L_{Aeq\ (9hour)}$ (external)
	Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads	60 dB(A) $L_{Aeq\ (15hour)}$ (external)	55 dB(A) $L_{Aeq\ (9hour)}$ (external)
	Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments		
	Existing residences affected by increases in traffic noise of 12 dB(A)or more from **new** freeway/arterial/sub-arterial roads	Existing $L_{Aeq\ (15hour)}$ (external) + 12 dB(A) [capped at 55 dB(A)]	Existing $L_{Aeq\ (9hour)}$ (external) + 12 dB(A)

Road category	Type of project/land use	Assessment Criteria	
		Daytime (7am-10pm)	**Night-time** (10pm-7am)
			[capped at 50 dB(A)]
	Existing residences affected by increases in traffic noise of 12 dB(A)or more from **redeveloped** freeway/arterial/sub-arterial roads	Existing $L_{Aeq\ (15hour)}$ (external) + 12 dB(A) [capped at 60 dB(A)]	Existing $L_{Aeq\ (9hour)}$ (external) + 12 dB(A) [capped at 55 dB(A)]
Local roads	Existing residences affected by noise from **new** local road corridors Existing residences affected by noise from **redevelopment** of existing local roads	55 dB(A) $L_{Aeq(1\ hour)}$ external	50 dB(A) $L_{Aeq(1\ hour)}$ (external)

Sleep Disturbance

A guide for assessing the potential for sleep disturbance within residences from the proposal's vehicle pass by is provided in the RNP:

"Triggers for, and effects of sleep disturbance from, exposure to intermittent noise such as noise from road traffic are still being studied. There appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise. The NSW Roads and Traffic Authority's Practice Note iii (NSW Roads and Traffic Authority 2008a) outlines a protocol for assessing and reporting on maximum noise levels and the potential for sleep disturbance."

It is generally accepted that the level of traffic noise within a dwelling having its windows open is 10 dB(A) lower than the corresponding noise level immediately outside the facade (refer ICNG), and as such the internal noise goals provided in the ENMM Practice Note iii may be re-expressed as the following external noise goals:

- Maximum external noise levels below 60–65 dB(A) are unlikely to cause awakening reactions, and
- One or two noise events per night with maximum external noise levels of 75–80 dB(A) are not likely to significantly affect health and wellbeing.

A "maximum noise event" is defined as any vehicle pass-by for which:

$$L_{Amax} - L_{Aeq(1\ hour)} \geq 15\ dB(A)$$

Practice Note iii states that the maximum noise level assessment should be used as a tool to help prioritise and rank mitigation strategies but should not be applied as a decisive criterion in itself.

6.2.3 Existing environment

Existing ambient noise environment

The existing (or baseline) noise environment was established by carrying out long-term, unattended noise surveys along the study corridor to determine the existing level of background noise at all receivers potentially affected by the proposal. These monitoring results were also used to establish construction noise parameters. The results of the noise monitoring are presented in Table 6-13.

Table 6-13: Long-term unattended ambient noise monitoring surveys

Logger location (ID and Address)	Measured noise level dB(A)				
	Rating Background Level [1]			$L_{A,eq}$ noise level over period	
	Standard Hours	OOH1	OOH2	$L_{Aeq,Day}$	$L_{Aeq,Night}$
1 - 120 Abington Rd, Glen Alpine	35	42	38 [2]	51	49
2 - 33 Medhurst Rd, Menangle Park	43	44	39	52	49
3 - Menangle Rd, 900m west of Hume Motorway	42	45	37	68	60
4 - 45 Fitzpatrick Rd, Menangle Park	40	42	42	53	51
5 - 60 Menangle Rd (Glenlea House), Menangle Park	37	39	38	51	51
6 - 116 Menangle Rd, Menangle Park	54	55	46	65	61
7 - Lot 8, Menangle Rd, Menangle Park	63	58	49	70	69

Notes: 1 Refer to Appendix D – Noise and vibration assessment or definitions of Standard Hours, Out of Hours 1 (OOHW1) and Out of Hours 2 (OOHW2) periods

2 For logger 1, as the OOH2 RBL (38 dB(A)) was measured to be higher than the corresponding Standard Hours RBL (35 dB(A), noise from out of hours construction works (OOHW1 and OOHW2) will be based on NMLs based on the (lower) standard hours RBL as a conservative measure

The results of the attended noise monitoring surveys are presented in Table 6-14.

Table 6-14: Results of short-term attended noise monitoring surveys

ID	Location	Date	Start Time	Duration	Measured noise level dB(A)		Comments
					LA90	LAeq	
1	56 Donalbain Ct, Rosemeadow	8 Aug 18	2:50pm	15min	43	55	Background noise level determined by distant traffic
2	92 Crispsparkle Dr, Ambarvale	8 Aug 18	3:15pm	15min	41	62	Background noise level determined by distant traffic
3	15 Invergowrie Ave, Glen Alpine	8 Aug 18	3:40pm	15min	41	63	Background noise level determined by distant traffic

6.2.4 Construction noise and vibration impact assessment

Noise management levels

NMLs for residential receivers

The NMLs and residential sleep disturbance screening criteria adopted in this assessment are summarised in Table 6-15. The NMLs are derived as an allowable emergence above the level of night time background noise, defined as the Rating Background Level (RBL). The night RBLs for each NCA have been determined from the monitored background data for the local region (refer Table 6-13). Note that the out of hours (ie, OOH1, OOH2 and Sleep Disturbance) criteria for NCA1 have conservatively been determined in reference to the standard hours RBL (35 dB(A)) rather than OOH2 RBL (38 dB(A)) as a conservative measure.

Table 6-15 Construction Noise Management Levels (NMLs) and sleep disturbance screening criteria at residences

NCA	Background noise level RBL dB(A) (refer Table 6-13)			Noise Management Level (NML) $L_{Aeq(15\ minute)}$ dB(A)			Sleep disturbance screening criterion L_{Amax} dB(A) (RBL+15dB)
				Standard hours (RBL+10dB)	Out of Hours (OOH) (RBL+5dB)		
	Standard hours	OOH1	OOH2	Day	OOH1	OOH2	
1	35	42	38	45	40 [1]	40 [1]	50 [1]
2	43	44	39	53	48	44	54
3	42	45	37	52	47	42	52
4	41	42	42	51	46	46	57
5	37	39	38	47	42	42	53

Note: 1 The OOH NMLs and sleep disturbance screening criterion for NCA1 have been determined based on the RBL for Standard Hours rather than the OOH2 RBL as a conservative measure

Noise Management Levels for non-residential receivers

The NMLs adopted for non-residential receivers within the study area are presented in Table 6-16. As the study area includes high rise apartment blocks and multi storey dwellings, the assessment has assessed the noise impact per floor per building. Each floor on each building facade has been treated as a separate receiver. Table 6-16 details the number of receivers in the study area are categorised by land use.

Note that buildings with a mixed usage in the study area contain a commercial receiver on the ground floor and residential receivers for each floor above this.

Table 6-16 Construction Noise Management Levels - Non-residential receivers

Non Residential Land Use	No. of buildings	No. of Receivers	NML (When in use) $L_{Aeq\ (15\ minute)}$ dB(A)
Commercial premises (offices, retail outlets and small commercial premises)	22	85	70
Educational buildings	67	549	55 (external) 45 (internal)
Childcare centres	1	6	55 (external) 45 (internal)

Construction noise levels were predicted using the SoundPLAN 8.0 noise modelling software based the ISO 9613 noise prediction algorithms. This three-dimensional model accounted for local topography, screening by buildings, the offset distance from the work to sensitive receivers and other acoustic factors such as ground and air absorption.

The construction noise model assumed:

- Ancillary facilities are not fitted with perimeter hoarding, as they would provide little acoustic benefit. For example, as the peak construction noise impacts to Broughton Anglican College result from work carried out within the Menangle Rd corridor, hoardings at the ancillary site will not provide any screening benefit
- It is expected that the only out of hours construction activity (i.e. during OOH1 and OOH2 periods) would be the operation of the three ancillary facilities, bridge construction and some truck haulage
- The construction noise predictions presented in this assessment are based on assessing the peak construction noise exposure of each receiver and considers the noise impact resulting from each work scenario when operating at capacity and nearest that receiver.

Construction noise modelling scenarios

The proposal would be constructed over a 30-month period. Table 6-17 indicates the timing and duration of each type of work the construction program is likely to incorporate. This includes consideration of temporary ancillary facilities, as detailed in Section 3.5. The worst-case noise level predicted from each of these construction scenarios – including from the three proposed ancillary facilities is presented in Table 6-19.

Table 6-17: Likely construction scenarios, timing and durations

Works ID	Work Scenario	Indicative Duration (weeks)	Work Periods		
			Standard Hours	OOH1	OOH2
SC01	3 Ancillary facilities	2	✓	✓	✓
SC02	Early works	4	✓		
SC03	Tree clearing	1	✓		
SC04	Earthworks (early)	6	✓		
SC05	Earthworks (late)	6	✓		
SC06	Drainage	20	✓		
SC07	Pavement work – Spring Farm Parkway	10	✓		
SC08	Pavement work – ramps	15	✓		
SC09	Pavement work – Menangle Road	10	✓		
SC10	Bridge work (early)	20	✓		
SC11	Bridge work (late)	40	✓	✓	✓
SC12	Road furniture & traffic signals	2	✓		

Works ID	Work Scenario	Indicative Duration (weeks)	Work Periods		
			Standard Hours	OOH1	OOH2
SC13	Finishing works	4	✓		
SC14	(internal) Haul routes & ancillary facilities (only)	10	✓	✓	✓

Most of the 14 work scenarios (Table 6-17) would be undertaken throughout the proposal's construction footprint. Some work however (e.g. bridge construction), would be very localised. The precise construction program would be determined during detailed design.

Working hours

As outlined in Section 3.4.4, construction work is expected to be undertaken during standard construction hours where feasible. However, some work such as bridge construction, would likely need to be undertaken outside of these standard hours (ie. during evening, night or weekend periods) either to ensure that safe work practices are upheld or to minimise disruption to traffic. Work undertaken outside of outside of standard hours are referred to as "Out of Hours Works" (OOHW). The CNVG segregates "Out of Hours Works" periods into the following two bands:

- **Out of Hours Works 1 (OOHW1):**
  Monday - Friday 6:00pm - 10:00pm
  Saturday 7:00am - 8:00am and 1:00pm - 10:00pm
  Sunday 8:00am - 6:00pm

- **Out of Hours Works 2 (OOHW2):**
  Monday - Friday 10:00pm – 7:00am
  Saturday 10:00pm - Sunday 8:00am
  Sunday 6:00pm – Monday 7:00am.

Construction equipment sound power levels

The main plant and equipment expected to be required for each construction scenario is listed in Table 6-18. Table 6-18 also indicates the energy average ($L_{Aeq,15min}$) and maximum (L_{Amax}) sound power levels for each item of plant and the typical usage (number of minutes) within the typical worst-case 15 minute work period. Noise Management Levels are determined in terms of 15 minute $L_{Aeq,15min}$ exposure periods, while the assessment of the potential for sleep disturbance within residences from night time construction activity is determined in terms of L_{Amax} noise descriptor.

The sound power level data used for this assessment has been drawn from the CNVG, Australian Standard AS 2436 and Jacobs' database of field noise measurements. The final schedule of plant and equipment to be used would be confirmed at the time of detailed design.

Table 6-18: Work scenarios and equipment sound power levels used in the noise modelling of construction noise

Equipment	SWL LAeq,15min dB(A)	Annoyance penalty (+5 dB)	Usage factor within 15 min	SWL Lmax, dB(A) (Sleep Disturbance)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
					Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle Rd)	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
Excavator (tracked) 35t + hydraulic hammer	122	5	15	130		1													
Concrete saw	118	5	15	126							1	1	1						
Tub grinder/ mulcher 40-50hp	116		15	124			1												
Pavement laying machine	114		15	122							1	1	1						
Chainsaw 4-5hp	114	5	15	122			1												
Grader	113		15	121					1										
Mobile crane	113		15	121										1	2				
Piling rig - bored	112		15	120										1					
Excavator (tracked) 35t (upper limit)	112		15	120		1				1									
Front end loader 23t	112		15	120							1	1	1						
Backhoe	111		15	119						1									

Equipment	SWL LAeq,15min dB(A)	Annoyance penalty (+5 dB)	Usage factor within 15 min	SWL Lmax, dB(A) (Sleep Disturbance)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
					Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle Rd)	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
Backhoe (upper limit)	111		15	119				1											
Dump truck (upper limit)	110		15	118		1	1	4			4	4	4					4	
Excavator (tracked) 35t (lower limit)	110		15	118				1									1		
Scraper 651	110		15	118				1											
Compressor	109		15	117										1	1				
Concrete pump (upper limit)	109		15	117											1				
Concrete truck	109		15	117						1	1	1	1		4				
Roller (large pad foot)	109		15	117					1		1	1	1	1					
Vibratory roller	109	5	15	117					1	1									
Line marking truck	108		15	116												1			
Road truck	108		15	116						1						1			
Asphalt Paver	108		15	116							1	1	1						

Equipment	SWL LAeq,15min dB(A)	Annoyance penalty (+5 dB)	Usage factor within 15 min	SWL Lmax, dB(A) (Sleep Disturbance)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
					Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle Rd)	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
Smooth drum roller	107	5	15	115					1		1	1	1	1					
Water cart	107		15	115				1	1								1		
Asphalt truck & sprayer (upper limit)	106	5	15	114							1	1	1						
Cherry picker	105		15	113			1												
Power generator	103		15	111		1												1	
Truck (medium rigid)	103		15	111														1	
Asphalt truck & sprayer (lower)	103	5	15	111								1	1	1					
Hand tools (Electric)	102		15	110		1													
Franna crane 20t	98		15	106		1					1				1		1		
Scissor Lift	98		15	106													1		
Truck Mounted Hiab	98		15	106		1													
Front end loader (small)	91		15	99								1	1	1				1	

Equipment	SWL LAeq,15min dB(A)	Annoyance penalty (+5 dB)	Usage factor within 15 min	SWL Lmax, dB(A) (Sleep Disturbance)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
					Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle Rd)	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
Light vehicles	88		15	96		2												1	
Truck compressor	75		15	83						1									

Construction noise impacts

The construction noise impact has been assessed based on the indicative timeframes and staging of work as presented in Section 3.4, which also outlines the justification for work outside standard hours in some instances.

Due to the nature of construction work, construction noise levels at any receiver would reduce as work progresses away from a receiver. Therefore, for the most part, the construction noise impact is considered short-medium term. This would increase where receivers are located next to ancillary facilities, where activities would impact the same receiver for a longer periods. However, there is some level of conservatism in this construction noise assessment, such as all plant and equipment operating simultaneously during each of the scenarios, and construction activities being undertaken nearest to a particular receiver during periods of greatest noise sensitivity (eg, night periods).

The construction noise assessment indicates that construction noise management limits at approximately 200 receivers would be exceeded during standard hours work, although this number is expected to reduce to fewer than 20 receivers during out of hours work. Construction vibration limits would be exceeded at one residence and up to 10 commercial premises.

The highest noise NML exceedances at receivers are predicted to result from:

- Early Work (work scenario SC02), from which noise exceedances of up to 45 dB(A) may result at one residence, and up to 23 dB(A) at the western-most building with the Broughton Anglican College campus. At these levels, construction noise exceedances would typically be perceived as being highly intrusive
- Menangle Road Pavement Work (SC09), from which noise exceedances of up to 30 dB(A) may result at one residence, and up to 22 dB(A) at the western-most building with the Broughton Anglican College campus. At these levels, construction noise exceedances would typically be perceived as being highly intrusive
- Out of hours haul truck movements on the temporary western access route (SC14), from which noise exceedances of the sleep disturbance screening criterion of up to 26 dB(A) may result. It should be noted that the western haul route would be operational only until the Hume Motorway deceleration lane is constructed.

The assessment predicts that two receivers would be highly noise affected by the proposal's construction noise, likely necessitating targeted noise management measures. The proposal's highest noise impact is predicted to result from early works, road paving work and night time truck movements, from which, worst case noise exceedances of up to 45 dB(A) are predicted at one receiver north of the proposal. However, exceedances of construction noise management levels (NMLs) from ground work are expected to be contained to 6 dB(A) for residences in Glen Alpine and Rosemeadow, and also for most residences in Menangle Park.

The assessment predicts that noise from haul trucks temporarily using the western access road at night may give rise to exceedances of the sleep disturbance screening criterion by up to 26 dB(A) at residences nearest the proposal's haul routes. This temporary access route would be used only until the vehicle deceleration lane and access ramp to the Hume Motorway has been completed (see Section 3.4.8).

A summary of the predicted worst-case noise level within each NCA for each construction scenario is presented in Table 6-19. These predictions represent the worst-case noise impact at the most affected receiver in the NCA when work is nearest the receiver. Values shown shaded in Table 5-5 indicate that the predicted noise level exceeds the NML. Construction noise levels at most other receivers would be lower than the worst-case noise levels reported in Table 6-19. Results are presented in this manner to provide overview of the likely highest level of noise mitigation required of the proposal.

Noise predictions in Table 6-19 are highlighted where they exceed the NML. The highlighting is colour-coded to reflect the extent of the exceedance of the NML in accordance with the following qualitative descriptions of the expected impact (as defined in the CNVG):

- Construction noise levels are predicted to be 1 dB to 10 dB above the NML
  In these cases, construction noise levels would be clearly audible to almost all receivers
- Construction noise levels are predicted to be 11 dB to 20 dB above the NML
  Construction noise levels would typically be perceived as being moderately intrusive
- Construction noise levels are predicted to more than 20 dB above the NML
  In these circumstances, construction noise would typically be perceived as being highly intrusive.

Table 6-19: Predicted worst case L_{Aeq} and L_{Amax} (Sleep Disturbance) construction noise levels (dB(A))

Noise Catchment Area (NCA)	NML dB(A)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
		Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
STANDARD HOURS																
Residential																
NCA 1	45		24	51	47	47	45	45	46	50	50	40	41	40	41	25
NCA 2	53		37	61	57	57	55	55	50	50	60	43	45	49	51	37
NCA 3	52		36	50	46	44	43	42	47	45	47	42	42	39	40	38
NCA 4	51		31	47	48	47	45	44	50	46	43	38	42	40	41	47
NCA 5	47		48	92	78	74	72	62	62	66	77	55	56	66	68	48
Commercial																
NCA 4	70		14	28	26	26	24	24	29	27	27	22	24	19	20	45
NCA 5	70		30	62	75	70	68	59	53	73	61	51	50	62	64	31
Childcare Centre																
NCA 4	55		26	43	42	42	40	39	45	42	40	37	38	34	36	37
Education																

Noise Catchment Area (NCA)	NML dB(A)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
		Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
NCA 1	55		17	39	37	36	34	33	39	38	39	33	35	29	31	17
NCA 2	55		45	78	74	74	72	55	56	57	77	52	54	66	68	45
OUT OF HOURS 2																
Residential																
NCA 1	40		24										41			25
NCA 2	44		37										45			37
NCA 3	42		36										42			37
NCA 4	46		31										42			47
NCA 5	42		48										55			48
SLEEP DISTURBANCE																
Residential																
NCA 1	50		26										43			34
NCA 2	54		39										47			40
NCA 3	52		38										43			58

Noise Catchment Area (NCA)	NML dB(A)	ID	SC01	SC02	SC03	SC04	SCO5	SC06	SC07	SC08	SC09	SC10	SC11	SC12	SC13	SC14
		Work Scenario	Ancillary sites	Early works	Tree clearing	Earthworks (early)	Earthworks (late)	Drainage	Pavement work (SFP)	Pavement work (ramps)	Pavement work (Menangle	Bridge work (early)	Bridge work (late)	Road furniture & signals	Finishing works	Haul routes
NCA 4	57		33										44			83
NCA 5	53		50										57			51

Construction vibration

The potential for vibration impact to either residents or buildings is expected to be contained to the construction phase of the proposal. The construction program is expected to include the use of equipment such as rock breakers, vibratory rollers and impact piling rigs that could give rise to vibration impact.

Safe work distances are presented in Table 6-20.

Table 6-20 Safe working distances for vibration intensive plant (TfNSW 2013)

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (British Std 7385)	Human response (DECCW)
Vibratory roller	<50 kN (typically 1-2 t) <100 kN (typically 2-4 t) <200 kN (typically 4-6 t) <300 kN (typically 7-13 t) >300 kN (typically 13-18 t) >300 kN (> 18 t)	5 m 6 m 12 m 15 m 20 m 25 m	15 m to 20 m 20 m 40 m 100 m 100 m 100 m
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7 m	23 m
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤800 mm	2 m	n/a
Jackhammer	Hand held	1 m	Avoid contact with structure

The safe working distances presented in Table 6-20 are indicative and would vary depending on the item of plant and local geotechnical conditions. The cosmetic damage thresholds apply to typical buildings under typical geotechnical conditions and vibration monitoring is recommended at specific sites. Where structures are more sensitive such as heritage items, more stringent conditions may be applicable and should be considered individually.

In relation to human response, the safe working distances relate to continuous vibration. For most construction activities, vibration emissions are intermittent and higher vibration levels over shorter periods are acceptable. Additional assessment should be undertaken where the human response criteria are exceeded.

Vibration intensive plant scheduled to be operated during the construction program include:

- Vibratory/smooth drum rollers required for drainage, road, milling and paving work
- Bored pilling rigs required in specific locations for construction of retaining walls
- Pneumatic hammers required for utility relocations.

It is understood that in all cases, small to medium sized units would be selected to complete the work.

Based on the safe working distances to preserve the structural integrity of dwellings recommended in Table 6-20, cosmetic damage criteria would be complied with where vibratory/smooth drum rollers, pile boring rigs or pneumatic hammers are operated not closer than 15 metres from any dwelling or sensitive structure. The required buffer distance increases to 30 metres in the vicinity of heritage structures. No heritage structures are within 30 metres of the proposed construction work.

Vibratory rolling is expected may be undertaken within 100 metres of residences and the Broughton Anglican College for some stages of work and so may impact human comfort within those buildings. In these cases, the procedures outlined in Appendix C of the CNVG are to be followed in order to mitigate any such potential impacts. These management measures would be identified and actioned at the detailed design stage.

There is one residential and one commercial building located within the 15-metre structural integrity affectation zone. These are both within NCA 5. An additional four commercial receivers in NCA 5 and five commercial receivers in NCA 2 are within the 100-metre buffer zone for human comfort.

It is noted that where construction methods differ from those outlined above, vibration impacts may change, and further assessment may be necessary. This should be reconsidered during preparation of the CNVMP.

6.2.5 Operational noise impact assessment

Assessment scenarios

The assessment of the proposal's operational noise impact requires comparing the modelled traffic noise levels resulting from the "Build" and "No Build" ("do nothing") options in order to correctly identify the proposal's contribution to any increase in traffic noise. In accordance with the RNP, the following four scenarios are modelled, where 2026 is taken to be the year of opening of the proposal:

- Year of Opening – No Build. Modelling is based on 2026 traffic volumes of the existing road network (where the proposal is not built)
- Year of Opening – Build. Modelling is based on 2026 traffic volumes for the road network that includes the Spring Farm Parkway
- 10 Years after Opening - No Build (ie, the "do nothing" case). Modelling is based on the forecast 2036 traffic volumes of the unchanged road network (i.e. Spring Farm Parkway is not built)
- 10 Years after Opening – Build. Modelling is based on the 2036 traffic volumes based on a road network that includes Spring Farm Parkway. This future traffic scenario also includes the additional trips ("induced demand") created by the introduction of the road based on offered network efficiency time savings.

Each of these scenarios was modelled for both day (7am-10pm) and night (10pm-7am) periods.

Identifying receivers that qualify for consideration of noise mitigation

The noise impact predicted during operation of the proposal is considered a long-term impact as it would occur for the lifetime of the proposal.

Any of the following three triggers qualify a receiver for consideration of noise mitigation. Note that these do not prescribe that a receiver shall receive mitigation necessarily, as there are matters of the "reasonableness and feasibility" of the measures to also consider. These triggers are:

- The predicted total noise level to a receiver in the proposal "Build year" is 5 dB(A) or more above the relevant NCG noise criterion (the cumulative limit) and it is the proposal road noise that contributes most to this increase

- The noise level contribution from the road proposal is “acute”, which is to say, greater than either 65 dB(A)$L_{eq,15hour}$ during daytime periods or 60 dB(A)$L_{eq,15hour}$ during night periods (regardless of the level of noise contributed from non-project roads)
- The predicted total noise level to a receiver for the proposal Build year both exceeds the NCG noise criterion AND the increase in noise created by the proposal (i.e. the Build minus the No Build noise level) is greater than 2 dB(A).

Operational noise levels prior to consideration of mitigation

Detailed predictions of operational noise from the proposal at each sensitive receiver building are presented in Appendix D. A summary of the number of receivers within the study at which operational noise from the proposal is predicted to exceed the NCG criteria and which therefore qualify for consideration of mitigation is provided in Table 6-21. Table 6-21 also indicates the trigger(s) by which these receivers qualify for consideration of mitigation. These receivers are also shown in Figure 6-3.

Table 6-21: Number of receivers that qualify for consideration of noise mitigation

Noise Catchment Area	Number of receivers qualifying for consideration of mitigation	Trigger by which receiver qualified for consideration of mitigation		
		Cumulative Limit	Acute Noise Exposure	>2dB(A) increase
NCA 1	0	0	0	0
NCA 2	3	3	0	0
NCA 3	0	0	0	0
NCA 4	0	0	0	0
NCA 5	1	1	0	0
Total	**4**	**4**	**0**	**0**

Figure 6-3 Receivers that quality for consideration of operational noise mitigation

The four receivers identified in Table 6-21 as qualifying for consideration of mitigation are all included in one residential building in NCA 5 and one educational building (potentially a live-in residence) at the Broughton Anglican College in NCA 2. These four receivers are shown in Figure 6-3.

Consideration of operational noise mitigation

This section identifies feasible and reasonable options for the mitigation of the operational noise impact predicted for the 2 buildings in accordance with the NMG.

Additional noise mitigation option: low noise pavement

In general, the use of low-noise pavements is a preferred form of traffic noise mitigation as its use has the potential to benefit the largest number of receivers. However, the NMG specifies that the use of low noise pavement may be considered only if the acoustic benefit arising would be conferred to at least four “closely spaced” receivers. (The NMG provides a more detailed definition of “closely-spaced”).

On these grounds, the use of low noise pavement is not considered reasonable in this instance where there are only two buildings in the entire study area that qualify for consideration of noise mitigation. The use of low noise pavement is not considered further.

Additional noise mitigation option: noise barriers

The use of roadside noise barriers is not a reasonable mitigation option for the same reasons outlined above, and so this option is not considered further.

Additional noise mitigation option: at-property treatments

Where mitigation cannot reasonably be provided by low noise pavement or noise barriers, the noise impact at mitigation-eligible buildings would need to be mitigated by implementing at-property treatments. The objective of this form of mitigation is to achieve noise reduction from outside to inside that would achieve an internal noise level within a habitable room at least 10 dB(A) below external noise goals.

The specific form of acoustic building treatment applied to achieve these reductions would be determined with regard for the existing construction of the building, and in consultation with the landowner.

6.2.6 Safeguards and management measures

Table 6-22 Noise and vibration environmental management measures

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	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: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Roads and Maritime, 2014). • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contactor	Detailed design / pre-construction
	Viable mitigation measures that will be expected to be deployed by the construction contractor once the final construction sequencing and scheduling is known include: • Restricting work to standard construction hours as far as practicable, considering safety and traffic management requirements • Selecting quieter plant and equipment • Erecting temporary acoustic hoarding to reduce noise from work within a confined area • Deploying mobile hoardings (eg, acoustic screen curtains mounted on a wheeled trailer) to track moving, but tightly-contained processes • Maximising offset distances between receivers and noisy plant or activities	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	• Orientating plant and processes away from residences, where reasonably practicable • Scheduling work for times outside of heightened sensitivity for the impacted receiver, eg, outside of school hours; • Scheduling respite periods for noise-intensive processes undertaken near receivers, eg. limiting operation of pavement sawing to three hours at a time • Planning any out-of-hours work (OOHW) so that noisier work is carried out in the earlier part of the evening or night-time • Minimising the number of consecutive nights of work adjacent to any particular set of receivers • Restricting heavy vehicle movements, heavy deliveries and loading and unloading processes to daytime periods and to areas well away from receivers • Regularly maintaining and monitoring plant and equipment to ensure that their noise emissions are not excessive • Minimising the annoyance from reversing alarms by either fitting closed circuit monitors or non-tonal reversing alarms (“quackers”) on vehicles or deploying ‘spotters’ to oversee reversing movements • Reducing throttle settings and switching off equipment when it is not being used.		
Noise and vibration	All sensitive receivers (eg schools, local 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: • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information.	Contactor	Detailed design / pre-construction

Impact	Environmental safeguards	Responsibility	Timing
Construction noise	Consider respite periods and verification for receiver identified as being eligible for additional mitigation in accordance with CNVG	Contractor	Construction
Construction traffic	Schedule construction of the Hume Motorway deceleration late and northbound access ramp as early as practicable to limit the construction traffic impact to residents of Menangle Park.	Contractor	Pre-construction /
Construction vibration	Where vibration intensive plant such as vibratory rollers, rock hammers or bored piling rigs are used, vibration must be managed to minimise disturbance to building occupants and to avoid damage to buildings and other structures. Specific measures to manage the potential for vibration impact would be determined as part of the CNVMP developed at the detailed design stage once the specific equipment schedule and localised geotechnical conditions are known.		
Construction vibration	CNVMP should consider implementing the following measures to limit construction vibration levels: • Use lower vibration generating items of excavation plant and equipment, such as smaller capacity rockbreakers or concrete crushers/pulverisers in place of rockbreakers, where feasible • Suitably program the hours of operation of major vibration generating plant and equipment • Minimise consecutive work in the same locality • Use dampened rockbreakers and/or “city” rockbreakers • Undertake attended vibration monitoring where vibration-intensive work are required to be undertaken within the safe working distances • Complete building condition surveys before and after vibration-intensive work to identify existing damage and any damage due to the works.		
Operational noise – at property treatment	Determine the specific form of acoustic building treatment required to meet the necessary noise reductions of internal noise levels at least 10 dB(A) below external noise goals, with regard for the existing construction of the building, and in consultation with the landowner.	Roads and Maritime	Detailed design / pre-construction

6.3 Landscape character and visual impact

This chapter has been written with information provided in the Urban Design Landscape Character and Visual Impact Assessment Report (Tract, 2018). This report can be found in Appendix E.

6.3.1 Methodology

Two aspects are considered when determining the effect that the proposal would have on the landscape and its users. This is the landscape character and visual impact.

To assess landscape character, the local context of the site is first determined by dividing the proposal area and surrounds into a number of units. These landscape character zones (LCZs) share similar spatial, environmental or other character properties. The effect of the proposal on each of these LCZs considers the impact and also the overall sensitivity to change.

The visual impact assessment assesses the visibility of the proposal. Visibility is considered from the perspective of static receptors and mobile receptors. Static receptors are the users who live and/or work within the visual catchment of the corridor, and mobile receptors are the users of the corridor such as the vehicles, cyclists or pedestrians who travel along part or all of the alignment. These receptors have a short-term experience with the space, however, they constitute the majority of the visual receptors for this proposal. The visual catchment for the proposal is shown in Figure 6-15

Both landscape character and visual impact are equally important. The landscape assessment determines the overall impact of the proposal on an area's character, while the visual assessment helps define the day-to-day visual impact of the proposal on people's views. The effect of the proposal on both these areas is quantified by ranking Sensitivity and Magnitude.

Table 6-23 summaries the ranking assessment of sensitivity and magnitude and how they are combined to provide an overall impact assessment.

Sensitivity indicates how sensitive an area is to change. This takes into consideration both the physical qualities of an area as well as the number and type of receivers. Magnitude refers to the nature and scale of the change. For example, a large interchange would have a different and larger impact on landscape character compared to a localised road in the same area.

Table 6-23 Landscape Character and Visual Impact Assessment Matrix

		Magnitude			
		High	*Moderate*	*Low*	*Negligible*
Sensitivity	*High*	High Impact	High - Moderate	Moderate	Negligible
	Moderate	High - Moderate	Moderate	Moderate - Low	Negligible
	Low	Moderate	Moderate – Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

6.3.2 Existing environment

Local Context

The proposal is located 50 kilometres southwest of the Sydney Central Business District in the Campbelltown LGA. The proposal lies approximately 11 kilometres to the southwest of Campbelltown.

The dominant land use surrounding the proposal contains the existing residential development of Menangle Park, along with some existing scattered rural dwellings to the north and west of the proposal. There is a broad swathe of land immediately to the east of the proposal study area, which corresponds to the general alignment of the SHR listed water supply canal running north-west to south-east of the proposal. Broughton Anglican College is located to the south east of the proposal, on Menangle Road.

Land adjoining the Hume Motorway to the north and east of the proposal currently consists of larger holdings composed of cleared pasture and regenerated woodland communities. It is noted that much of this pasture/grassland landscape to the west of the Hume Motorway is zoned for residential development associated with the Menangle Park land release area, however, this assessment is based on the current existing character of the area.

Topography and drainage

The landform surrounding the proposal is flat to moderately undulating and falls to the west and the Nepean River. The proposal is located on the floodplain of the Nepean River system. The main arm of the Nepean River runs in a northerly direction, located approximately one kilometre to the west of Spring Farm Parkway.

The proposal runs immediately adjacent and to the north of an ephemeral creek tributary. This tributary forms part of a broader riparian corridor that drains the open pasture/grassland catchments to the west of Menangle Road. Several drainage structures control runoff as it flows westward via Menangle Road and the Hume Motorway corridor towards the Nepean River. There are several farm dams located to the west of the proposal within future Menangle Park land release area.

Non-Aboriginal heritage

The study area was settled by early colonists who farmed the land on large grants. There is a high retention of physical evidence relating to these early land grants in the form of heritage homesteads and outbuildings. An assessment of the potential impact to heritage in the area is provided in Section 6.9. The largely rural land use and character has also been retained, enhancing the visual heritage values of these items.

Ecology and vegetation

Vegetation in the study area mostly comprises cleared exotic grassland and disturbed native vegetation with some remnant or regrowth stands of native woodland trees occurring predominantly along drainage corridors and on steeper slopes. A large corridor of riparian woodland and open grassland is located to the west of the proposal.

The native vegetation within the study area generally consists of Cumberland Plain Woodland and Swamp Oak Floodplain Forest. It is generally poor and fragmented as a result of past and current land uses. A detailed assessment of the impact to native vegetation is provided in Section 6.7.

Despite the highly fragmented structure and presence of weedy growth, these vegetation elements contribute significantly to the broader landscape character of the study area. Together with the topography it influences the character of the landscape, as well as the views and vistas.

Landscape Character Zones

The proposal and surrounds have been classified into five different character zones:

- LCZ1 – Woodland on foot slope / Broughton Anglican Collage landscape
- LCZ2 – Woodland on high point / Tourism (Steam and Machinery Museum) landscape
- LCZ3 – Open pasture / grassland landscape (typically grazing land and open grassland with some trees)
- LCZ4 – Woodland riparian landscape
- LCZ5 – Hume Motorway corridor landscape.

Figure 6-6 illustrates the distribution of these character zones and their relationship to the proposal.

LCZ1 – Woodland on foot slope / Broughton Anglican College

This character zone is located to the east of the Hume Motorway and to the south of the proposed widening of Menangle Road. The landform ranges from flat with gentle undulation closer to Menangle road, to steeper slopes and enclosing ridges to the east and south.

The college campus is characterised by clusters of low rise buildings, set back from Menangle Road behind scattered native woodland. The natural landform mostly encloses the built elements and limits views from the north and the west. The site has a mixture of mature plantings and native trees with open grassy areas, extending into the hilly backdrop of remnant woodland and pasture to the south and east.

Typical images of LCZ1 are shown below in Figure 6-4 and Figure 6-5

Figure 6-4 LCZ1 Broughton Anglican College Frontage

Figure 6-5 LCZ1 Broughton Anglican College Frontage

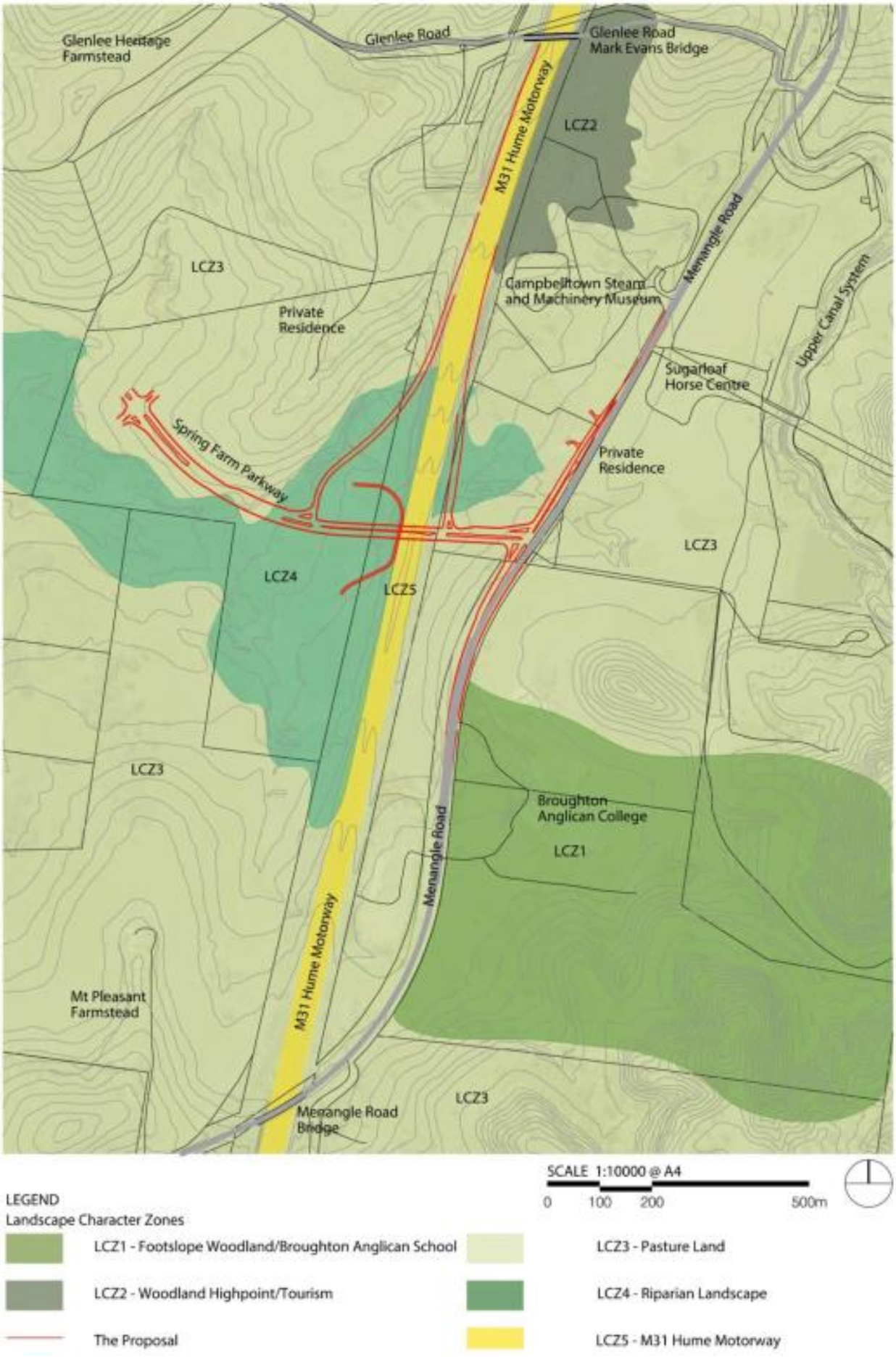


Figure 6-6 Landscape character zones (Tract, 2019)

LCZ2 – Woodland on high point / Tourism (Steam and Machinery Museum)

This character zone is defined as the woodland area covering the raised landform to the north of the Campbelltown Steam and Machinery Museum, as well as the area encompassing the tourist facility. The zone is bound by the Hume Motorway to the west, Glenlee Road to the north and Menangle Road to the east. The zone is situated adjacent to the tie-in of the proposed southbound exit ramp from the motorway.

In the more elevated portions of LCZ2 to the north, the zone consists of a dense patch of native woodland vegetation that screens the Hume Motorway from the Museum grounds. The southern portion of LCZ2 is mainly flat open space of mown grass. The built structures are mostly grouped together and set back into the adjacent wooded hillside. Several overhead transmission lines run north-south across the landscape. Typical images of LCZ2 are shown below in Figure 6-7 and Figure 6-8.

Figure 6-7 LCZ2 Campbelltown Steam and Machinery Museum entry

Figure 6-8 LCZ2 Woodland area beyond Campbelltown Steam and Machinery Museum looking north

LCZ3 – Open pasture / grassland

This landscape constitutes the majority of the proposal study area. It is typically comprised of open grazing pasture divided by the Hume Motorway running north-south. The landscape also contains patches of other landscape character zones including woody weeds, remnant native woodland, and screening vegetation along the Hume Motorway corridor. This zone is also fragmented by overhead transmission lines, as well as meandering drainage channels with established riparian vegetation.

This LCZ is generally bisected east to west by the proposal. The Hume Motorway and several smaller roads throughout the landscape also contribute to its overall character. Traffic flows are visible from a significant portion of the zone.

Typical images of LCZ3 are shown below in Figure 6-9 and Figure 6-10.

Figure 6-9 LCZ3 Open pasture looking west towards the Hume Motorway

Figure 6-10 LCZ3 Grassland looking north to Campbelltown Steam and Machinery Museum

LCZ4 – Woodland riparian

This landscape is typically defined by tall woodland vegetation and lower weedy margins that follow the drainage corridors meandering throughout the proposal study area.

Typical images of LCZ4 are shown below in Figure 6-11 and Figure 6-12.

Figure 6-11 LCZ4 looking towards the proposal from the northern extent of Mount Pleasant Farm

Figure 6-12 LCZ4 Woodland riparian landscape looking along a drainage corridor

LCZ5 – Hume Motorway corridor

This character zone is defined by the existing motorway and the heavy traffic flow it accommodates. The motorway has two lanes of traffic in each direction with a hard shoulder and narrow grass verges. A wide grass median separates the two carriageways, which allows some central vegetation.

Typical images of LCZ5 are shown below in Figure 6-13 and Figure 6-14.

Figure 6-14 LCZ5 Looking south along the Hume Motorway from Glenlee Road Bridge

Figure 6-13 LCZ5 Northbound Hume Motorway with riparian corridor to the west

Visual catchment

In assessing the visual impact, the visual range has been considered to be the effective distance where a viewer can be influenced by changes in traffic movement and discern individual details such as signage and planting elements. This distance varies in relation to the topography and effectiveness of screening vegetation however the quality of detail in the landscape typically deteriorates rapidly for distances greater than 200 metres. Typically, the viewpoints have considered the impact of those overlooking the proposal. Of the adjoining observers it is the residential users who would be the most sensitive to change. These are generally the primary viewpoint assessed.

Nine viewpoints have been identified within the proposal area and surrounds. Figure 6-15 illustrates the locations of these viewpoints relative to the proposal. An assessment of the visual impact is presented in Section 6.3.4.

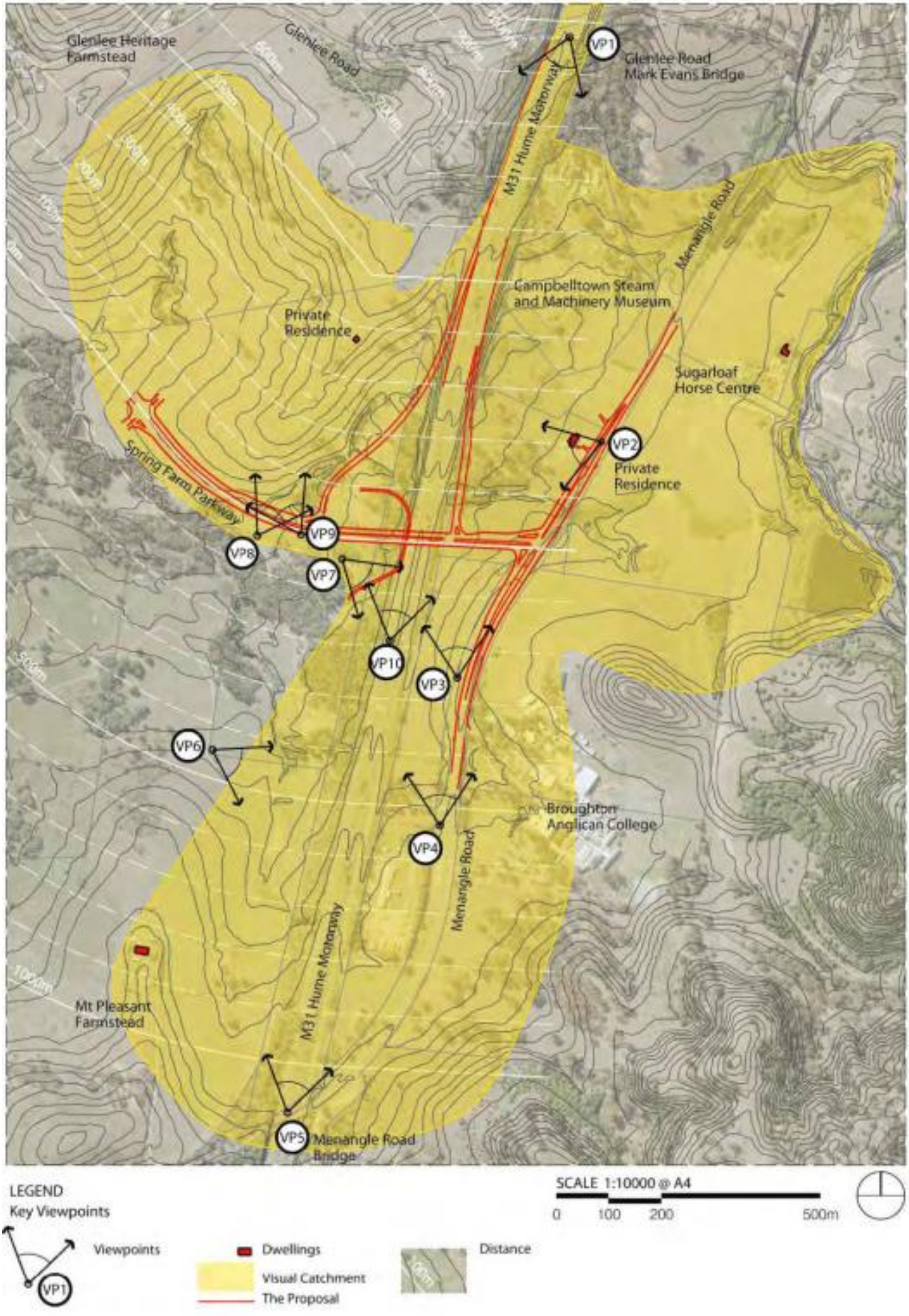


Figure 6-15 Key Viewpoint Locations (Tract, 2019)

6.3.3 Design rationale and urban design concept

The development of the urban and landscape design response considers a number of guidelines which inform the development of the overall concept. These include:

- Road Design Guidelines
- Environmental Impact Assessment Practice Note: Guideline for Landscape Character and Visual Impact Assessment - EIA-N04
- Beyond the Pavement, Urban Design Policy, Procedures and Design Principles, Roads and Maritime January 2014
- Landscape Guidelines, Roads and Traffic Authority, April 2008
- Bridge Aesthetics - Design Guidelines to improve the aesthetics of bridges in NSW, 2012
- Noise wall design guideline Design guideline to improve the appearance of noise walls in NSW, Roads and Maritime, March 2016
- *Water Sensitive Urban Design Guideline*, Roads and Maritime, May 2017.

A number or urban design objectives have been proposed based on *Beyond the Pavement* (Roads and Maritime, 2014), which is the overarching Roads and Maritime policy guiding urban design for all its projects. The policy outlines nine design principles as being key factors to achieving and integrated engineering and urban design outcome for all Roads and Maritime projects. The broad overarching urban design strategies are as follows:

- Ensure attractive views into the broader landscape are maintained by revegetation disturbed areas along the road edges
- Incorporate materials and finishes for new road elements that are site appropriate and reduce their prominence
- Ensure there is a visually complementary relationship between the proposed bridge and its local context
- Include a planting design intended to reduce the scale of the proposed road infrastructure by the provision of appropriate tree species in the road margins, using appropriate planting to integrate the proposal with the adjacent riparian zones and provide distinctive feature landscaping elements at entry points to Menangle Park and key precinct thresholds
- Provide screening, through the use of native plant species, of the road infrastructure to residential areas.

The proposed urban design objectives and concept for the proposal is outlined in detail in Appendix E.

6.3.4 Potential impact

Construction

Construction activities would tend to be more visible than the operational stage of the proposal, however impact would be temporary and would change throughout the different stages of construction. Temporary elements likely to be introduced into the visual environment during construction would include:

- Fencing and hoarding
- Road barriers and signage
- Construction equipment/plant
- Site office and amenities.

Night work is also likely to be required for the proposal which would involve temporary lighting for operational, safety and security purposes. Lighting installations would be placed to avoid light spill to adjoining road corridors and residential areas.

Compound Sites

As outlined in Section 3.5 ancillary facilities would be required. These are interim elements, present only for the extent of the construction period. These sites may be used for material processing including batch or crushing plant; stockpiles site for materials; and site compound including offices, sheds for the storage of equipment and plant.

Three sites have been identified as potential construction compounds as shown on Figure 1-2.

Compound 1 would be located on Menangle Road on a block of land opposite the Broughton Anglican College. The site comprises an open grassland site set between Hume Motorway and Menangle Road and is visible to both. The proposal is south of works on the Hume Motorway and adjacent to the southern limits of Menangle Road works. Its location exposes the Hume Motorway to an extended construction footprint. The impact is considered to be moderate in the short term.

Figure 6-16 View from south eastern corner of the proposed compound facility.

Compound 2 would be located to immediately adjacent the proposal area to the north of the Menangle Park entry road stumps and would have the proposed north bound entry ramp constructed to its east. This would see the compound screened from view of the Hume Motorway by the proposed on-ramp formation. This would represent the main public view point.

The proposal is for a facility consistent with construction operations and would be screened by the formation as it develops. Its impact is considered to be low as it occurs within the immediate environs of the proposed construction and would result in the facility being screened by the ultimate on ramp formation.

Compound 3 would be located adjacent the proposal to the north of the proposed northbound entry ramp to the existing Hume Motorway. The compound would be viewed from the Hume Motorway and with a backdrop of construction works when viewed from the west.

The facility would be consistent with construction operations and will be screened by the formation as it develops. Its impact is considered to be low as it occurs within the immediate environs of the proposed construction.

Operation

Landscape Character Impact

A qualitative assessment of the landscape character impact across the five identified LCZs is detailed in the Urban Design and Visual Impact Assessment (Appendix E). Due to the relatively simple tie-ins of the proposal with existing roads, as well as the existing dominance of the Hume Motorway within the landscape, the magnitude of change has been assessed as moderate to negligible across all five of the landscape character zones. The results of this assessment are summarised in Table 6-24.

Table 6-24 Summary of Landscape Character Impact

Landscape Character Zone	Sensitivity	Magnitude	Impact
LCZ1 Woodland on foot slope / Broughton Anglican College	Moderate The landscape is relatively open onto Menangle Road with existing built elements and some vegetative screening. The landscape is considered relatively robust to change.	Negligible The proposal adjoins this area to the north and west and would not significantly change the physical landscape. The widening of Menangle road would not create significant cuttings and fills.	Negligible
LCZ2 Woodland on high point / Tourism (Steam and Machinery Museum)	Moderate The character of the woodland and manicured grass of the museum is distinctive, despite the presence of overhead lines. The woodland effectively screens the road corridor and sets the view apart from the wider landscape character.	Negligible Despite the removal of some trees, the overall visibility of motorway traffic would be maintained similar to existing levels.	Negligible
LCZ3 Open pasture / Grassland	Low A relatively open vista with a diversity of existing elements. This landscape is considered robust.	Low As this landscape is extensive throughout the study area and already fragmented by roads and other character elements, the proposal would not result in a significant change.	Low
LCZ4 Woodland riparian	Moderate The landscape is well defined by its vegetative structure. Changes to this structure would have a significant impact on the overall character of the drainage corridor.	Low The alignment of the proposal lies partially within the boundaries of this zone, requiring removal of some peripheral areas of vegetation.	Low to moderate
LCZ5	Low	Moderate	Low to moderate

Landscape Character Zone	Sensitivity	Magnitude	Impact
Hume Motorway corridor	This zone is defined by the built form's contrasting linearity within the rural landscape. The motorway corridor and scale are similar to the proposed Spring Farm Parkway.	The proposal bisects the motorway, and introduces an elevated bridge structure across the motorway corridor. This is in keeping with the existing broader context of large infrastructure in the corridor. The on and off ramps proposed introduce a new formation which will alter the spatial qualities of the motorway corridor	

Visual impact

Ten viewpoints were assessed in relation to the permanent work associated with the proposal. The assessment considered the nature of current land use, and the likely impact of the completed proposal. The selected viewpoints covered a range of receptors including road users, residents, and private open space users.

The overall impact of the proposal was assessed to range from low to high-moderate.

Typically, those viewpoints closer in proximity to the proposed alignment were assessed to experience a higher impact. Opportunities to moderate the impact may be possible through the planting of screening vegetation.

Those viewpoints with a lower sensitivity of receivers (such as road users and those with access to private paddocks) generally were assessed to experience a lower impact score. Table 6-25 summarises the results of this assessment.

Table 6-25 Visual Impact Assessment

Viewpoint	Sensitivity	Magnitude	Visual impact
VP1 Glenlee Road Bridge over the Hume Motorway	Low Viewpoint is on a relatively low traffic local access road, with no amenity for cyclists or pedestrians	Moderate The proposal would introduce a motorway overbridge in the far distance of the view. Some vegetation would be removed and the new structure would reduce the linear continuity of the view.	Low to moderate The field of view is already dominated by the motorway, and the proposal would be far in the distance.
VP2 Menangle Road – Private rural residential property	Moderate As a rural residence, the frontage and outlook would be highly valued. The property is currently largely exposed to views from Menangle Road.	High The proposal introduces a widened road formation in the foreground of the view, bringing the carriageway and traffic approximately 21m closer. Traffic flows following completion of the proposal are anticipated to increase.	Moderate to high The proposal is likely to have a high impact on the outlook of the property. Mitigation measures should be included along the verge of Menangle Road to minimise the effect.
VP3 Menangle Road – Road verge and agricultural land	Low Vehicle traffic would be the most common receptor at this viewpoint. The viewpoint currently has open views of nearby traffic along the motorway.	Moderate The widening of Menangle Road would be in the foreground of the view. The bridge structure across the motorway would potentially be visible, partially screened by existing vegetation.	Low to moderate Receptors would experience a broad view of the proposal, including the main alignment of Spring Farm Parkway and widening tie-in with Menangle Road.
VP4 Menangle Road – Verge opposite Broughton Anglican College	Low Vehicles on Menangle Road would be the most common receptor at this viewpoint. The viewpoint currently has views of nearby traffic along the motorway.	Low The proposed batters and bridge structure would be largely screened by existing vegetation. A partial view of the new road would be visible. Widening of Menangle Road as well as heavier traffic flows would be visible from this location.	Low Limited view of the proposal.
VP5 Existing Menangle Road Bridge over the Hume Motorway	Low Viewpoint is on a busy road with no existing amenities for cyclists or pedestrians.	Low The proposal would introduce a motorway overbridge in the far distance of the view. Some vegetation would	Low The field of view is already dominated by the motorway, and the proposal would be far in the distance.

Viewpoint	Sensitivity	Magnitude	Visual impact
		be removed and the new structure may reduce the linear continuity of the view.	
VP6 Mount Pleasant Farm access road	Low This viewpoint is restricted to private access only, so the number of receptors would be limited.	Negligible Views of the proposed Spring Farm Parkway and the entry and exit ramps would be screened by existing vegetation. There may be a partial view of the widened Menangle Road.	Negligible The main works screened by the existing riparian vegetation and other works set a substantial distance from view
VP7 Mount Pleasant Farm – Woodland facing east to the Hume Motorway	Moderate This viewpoint is restricted to private access only, so the number of receptors would be limited. The proposal would be visible from the northern areas of the school.	High The main alignment of the proposal is to the north of the viewpoint, with the batters of the 12m high road formation extending southwards to immediately adjacent the view, and vegetation removal required.	Moderate to high The proposal sits in close proximity to this viewpoint and would result in the loss of some existing vegetation within the riparian corridor.
VP8 Mount Pleasant Farm facing north to private residential property	High Typically, receptors at this location are restricted to private access. Existing views are of rolling hills and creek line bisecting the view. The residence to the north would potentially have views to the proposed raised road formation and the motorway.	High The proposal introduces a road formation up to 12m above existing ground which would pass directly across the viewpoint. Nearby vegetation would be removed and the current view to the north would be obstructed.	High The proposal sits in immediate proximity to this viewpoint and would result in the loss of some existing vegetation within the riparian corridor.
VP9 Mount Pleasant Farm facing west to Spring Farm Parkway	Moderate The receptors at this location are limited to property owners and those with authorised access. The view presents a scenic outlook across rolling farm lands.	High The proposal introduces a road formation up to 12m above existing ground which would pass directly across the viewpoint. Nearby vegetation would be removed and the current view to the north would be obstructed.	Moderate to high The proposal sits in immediate proximity to this viewpoint and would result in the loss of some vegetation, however, there are very few receptors at this location.

Viewpoint	Sensitivity	Magnitude	Visual impact
VP10 View heading north on Hume Motorway to Spring Farm Parkway	Moderate The view is experienced by many. The experience however is transitory and experienced at speed with attention focused on driving. Road infrastructure forms a dominant part of the view	High The proposal introduces an elevated embankment within the verge and bridge across the alignment, with the top of structure approximately 12m above the road. On ramps would extend adjacent the alignment into the background and much of the median vegetation is likely to be cleared	Moderate to high This viewpoint is in immediate proximity to the proposal, which includes the large proposed road formation batters, and bridge structure crossing the motorway alignment.

6.3.5 Safeguards and management measures

An urban design plan would be prepared during detailed design to incorporate the urban design, bridge and landscape concept plan outlined in Appendix E. This would include urban design treatments to reduce the visual impact during operation of the proposal. Additionally, construction management measures are proposed to reduce visual and landscape character impact during construction of the proposal as result of general construction activities, ancillary facilities and vegetation loss.

Table 6-26 Landscape character and visual impact assessment environmental management measures

Impact	Environmental safeguards	Responsibility	Timing
Landscape character and visual impact	An Urban Design Plan will be prepared to support the final detailed proposal design and implemented as part of the CEMP. The Urban Design Plan will present an integrated urban design for the proposal, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for: • 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 work taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Urban Design Plan will be prepared in accordance with relevant guidelines, including: • *Beyond the Pavement urban design policy, process and principles* (Roads and Maritime, 2014) • *Landscape Guideline* (RTA, 2008) • *Bridge Aesthetics* (Roads and Maritime 2012)	Contactor	Detailed design / pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	• *Noise Wall Design Guidelines* (RTA, 2006) • *Shotcrete Design Guideline* (RTA, 2005).		
Visual impact as a result of vegetation loss	Minimise footprint and disruption to creek lines, and retain vegetation beyond the footprint in order to retain any existing screening	Contactor	Construction
Visual impact as a result of vegetation loss	Stabilise/revegetate as work progress to limit erosion and visual impact through early integration with surrounding vegetation	Contactor	Construction
Lighting impact	The design of temporary lighting must avoid unnecessary light spill on adjacent residents or sensitive receivers and be designed in accordance with AS 1158.1-1986.	Contactor	Construction
Visual impact from construction sites	Set out compounds to limit the impact Consider screening and the location of key structures which provide the greatest visual impact	Contactor	Construction
Visual impact from construction sites	Maintain compound in a tidy and well-presented manner Provide and maintain screening	Contactor	Construction

6.4 Surface water

This chapter has been written with information provided in the surface water and groundwater assessment. This report can be found in Appendix F.

6.4.1 Methodology

The desktop assessment involved a review of the existing surface water environment across the study area to assess the likely impact of the proposal on surface water quality during construction and operation. The review of information has included:

- Review of existing literature relating to the proposal, available water quality data and existing conditions using available non-proposal literature to obtain background information on catchment history and land use to aid in interpreting the existing conditions
- Assessment of the impact of construction activities on water quality with reference to the ANZECC/ARMCANZ (2000) water quality guidelines and the Healthy Rivers Commission Independent inquiry into the Hawkesbury Nepean (HRC 1998) with regard to the relevant environmental objectives of aquatic ecosystems and visual amenity.

The study area included the proposal footprint and local catchments potentially affecting surface water. Regional characteristics have been considered in the broader context and for reference.

Water quality criteria and objectives

The NSW Healthy Rivers Commission has determined water quality objectives for the Hawkesbury-Nepean River (HRC, 1998). The Australian and New Zealand Environment and Conservation Council (ANZECC/ARMCANZ 2000) also have guidelines for water quality. These objectives and guidelines provide benchmarks for assessment of the existing water quality of the river. The application of the criteria is dependent on the environmental values assigned to the waterway. The proposal lies within the lower Hawkesbury Nepean Catchment and the nominated environmental values applying to waterways within this catchment include the protection of aquatic ecosystems and visual amenity.

There is the potential for the current water quality to not meet the existing guidelines and trigger values for protecting nominated environmental values. Irrespective of the current condition of waterways, the proposal should not further degrade water quality. As such the key objective of the proposal is to minimise the potential impact on downstream receiving waters, so that the proposal changes the existing water regime by the smallest amount practicable. This objective is consistent with the Roads and Maritime's *Water Policy 1997* (RTA, 1997) and *Code of Practice for Water Management 1999* (RTA, 1999).

Sensitive receiving environments have been determined using aquatic habitat as an indicator. Waterways were assessed against the Key Fish Habitat "Types" in the Department of Primary Industries (DPI) *Policy and Guidelines for Fish Habitat Conservation and Management* (2013) and the *Fish Passage Requirements for Water Crossings* (Fairfull & Witheridge 2003). The assessment is based on the likelihood of habitat structures such as woody debris, macrophytes and substrate characteristics. Fish Passage Requirements for Waterway Crossings were assessed by waterway "Classes" adapted from Fairfull & Witheridge (2013) but provided in the DPI guidelines.

6.4.2 Existing environment

Catchments

The proposal is located within Hawkesbury-Nepean catchment which spans from the regional city of Goulburn to Broken Bay in Sydney's north. The catchment drains an area of 21,400 square kilometres and consists a mixture of low density residential housing, industrial, agricultural and rural landscapes. The main waterways within the catchment are the Hawkesbury and Nepean Rivers. The river system has been significantly altered since European settlement due to intensive urban and industrial development.

Further information regarding the local catchments affecting the proposal is provided in Section 6.5.

Key watercourses

The proposal is located approximately two kilometres to the east of the Nepean River. The river is a freshwater system before the junction of Grose River at Kurrajong, while the downstream catchment is tidally influenced by the Hawkesbury River Estuary (DNR, 2016). Within the study area there are three unnamed tributaries/drainage lines that are directly traversed by the proposal and all drain in a westerly direction towards the Nepean River (Figure 6-17).

Tributary 1 is the major drainage line traversed by the proposal and controls runoff from three drainage structures. The downstream environment is vegetated before forming a drainage structure which runs under the Main Southern Railway line (Lyall & Associates, 2017). The tributary is an ephemeral third order stream (Strahler) with limited upstream catchment. During a site visit in June 2018, water levels were observed to be very low, consisting of shallow intermittent pools which are unlikely to contain water during dry weather.

The upstream section of Tributary 1 between the Hume Motorway and Menangle Road is grassy minor gully with limited water and channel definition. As the waterway is an ephemeral, third order drainage line with limited aquatic habitat, it has not identified as key fish Habitat (DPI, 2013). With respect to fish passage it is classified 'Class 4' unlikely Key Fish Habitat (Fairfull & Witheridge, 2003)

Downstream at Tributary 1 approximately 200 meters to the west of the Hume Motorway the banks are more densely vegetated and the waterway is wider. There are nearby farm dams located along this section which contain emergent macrophytes. It is likely that this downstream section of the tributary including the farm dams would contain more aquatic habitat characteristics including instream aquatic macrophytes. This section of the tributary has been conservatively classified as Type 2' moderately sensitive key fish habitat (however typically farm dams are not considered key fish habitat). With respect to fish passage the downstream tributary is classified 'Class 3' minimal key fish habitat (Fairfull and Witheridge 2003).

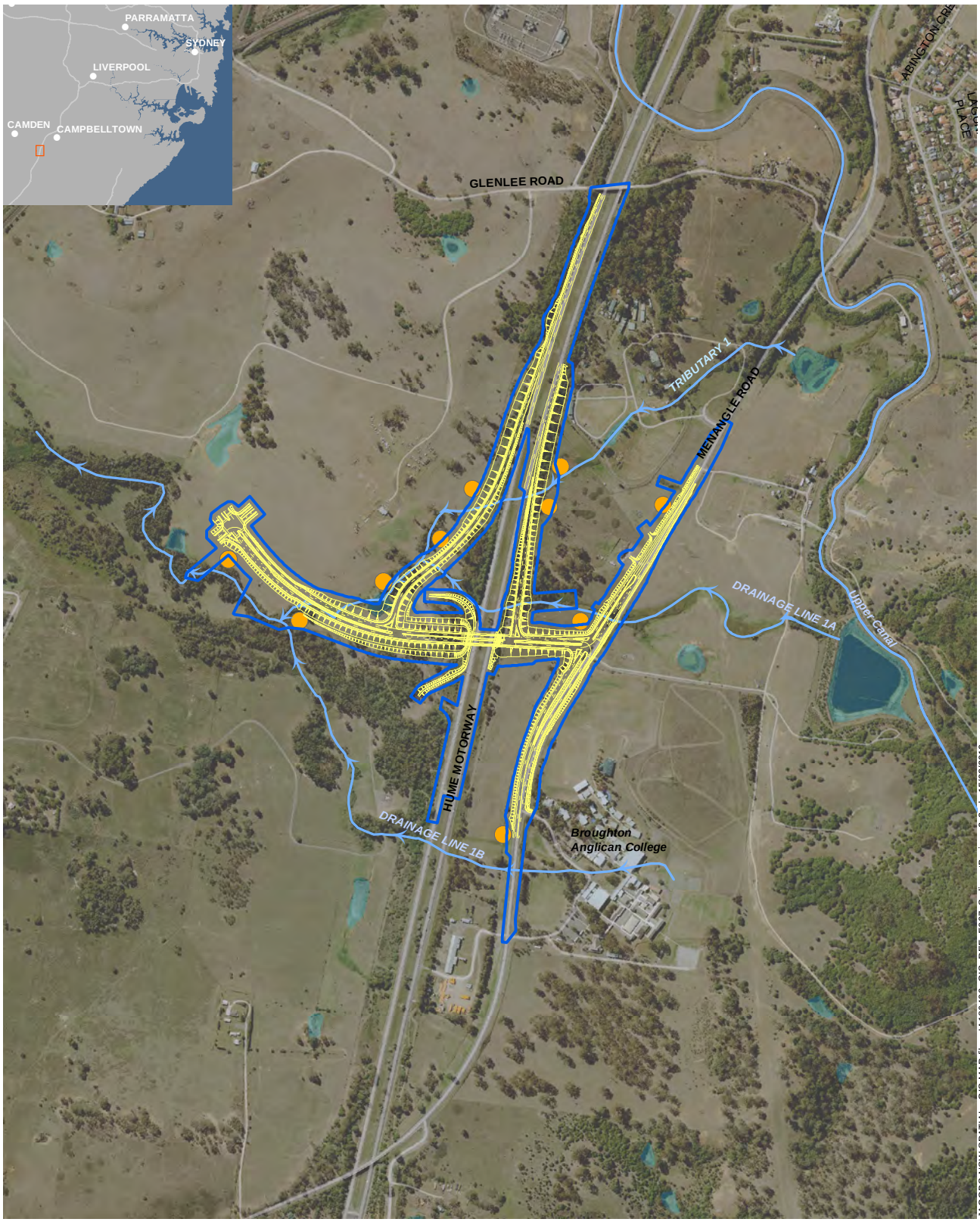
Drainage lines 1a and 1b would be traversed by the proposal and currently drain under the Hume Motorway in a westerly direction. These waterways have limited instream aquatic habitat, are surrounded by cleared farmland and macrophytes are restricted to sparse rushes along the banks. These drainage lines have not been identified as Key Fish Habitat (DPI 2013). With respect to fish passage they are classified 'Class 4' unlikely key fish habitat (Fairfull and Witheridge 2003).

The Upper Canal which runs 300 metres east of the proposal before crossing beneath Menangle Road about 450 metres north of the proposal, is also considered in this assessment.

Water quality

The majority of the Hawkesbury-Nepean is stressed, largely a result of urban and agricultural practices and changes to flow with large amounts of water diverted for water supply and irrigation. Elevated nutrient levels and reduced river flows are the key contributing factors to stresses on the river.

Annual water quality sampling carried out by WaterNSW at Menangle Bridge in 2016/2017 showed that turbidity, pH and total phosphorus were within the ANZECC/ARMCANZ (2000) guidelines in all samples. Total nitrogen was outside the guidelines in 10 per cent of samples. Additionally, monitoring on behalf of AGL at the Nepean River, Menangle Park showed that pH and salinity were within the acceptable range for protection of aquatic ecosystems (ANZECC/ARMCANZ 2000). Dissolved metal concentrations were low and total phosphorus was below the ANZECC/ARMCANZ (2000) guidelines.



Legend

- 80% design
- Proposal area
- Temporary sediment basins (construction phase)
- Key watercourses

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Figure 6-17 | Key surface water features

6.4.3 Potential impact

Construction

Construction of the proposal may degrade downstream water quality if management measures are not implemented, monitored and maintained throughout the construction phase.

If unmitigated, the highest risk to water quality would occur through the following construction activities:

- Construction across waterways, including construction of drainage devices
- Removal of vegetation and general earthworks, including stripping of topsoil, excavation or filling
- Stockpiling of topsoil and vegetation
- Ancillary facilities
- Transportation of cut and/or fill materials and the movement of heavy vehicles across exposed earth
- Potential for spills/leaks.

Construction activities would occur near or within watercourses located in the study area such as Tributary 1. Construction in proximity to watercourses could impact on water quality due to the disturbance of the bed and banks resulting in erosion and sedimentation, alteration of downstream flows (potentially creating isolated stagnant pools of water) and scouring of the bed near culvert inlets and outlets. Removal of vegetation, stripping of topsoil and filling and mobilisation of sediment associated with general earth work can impact on water quality during the construction phase if runoff is allowed to mobilise exposed soils particularly when these sites are located close to waterways. Construction activities adjacent to waterways could introduce contaminants such as oil or greases and disturb contaminated sediments, potentially having an adverse impact on water quality.

Construction support sites would be used for construction compounds, stockpile areas and sediment basins. Stockpile sites would be used to temporarily store excess spoil and wastes before their reuse on-site or disposal off-site. Stockpile sites located within existing flow paths have the potential to be mobilised during a flood and may impact on water quality downstream.

The release of potentially harmful chemicals and other substances accidentally during construction as a result of inappropriate storage and handing has the potential to impact on water quality of downstream receiving waters. These contaminants could include acids and chemicals from washing down of vehicles, construction fuels, oils, lubricants, hydraulic fluids and other chemicals.

Operation

The construction of increased roads (and therefore increased impervious areas) would discharge runoff to the receiving environment. The operation of the proposal is likely to impact on water quality due to discharge of drainage at new locations or increased discharge at existing locations where road and drainage upgrades have occurred.

The operation of the proposal has the potential to alter existing hydrology and flooding regimes which may impact on water quality due to increased runoff volumes and peak flow rates. Increased flow rates can impact on the bed and bank stability of the existing watercourses making them highly susceptible to erosion. Stream erosion increases sediment and nutrient loads leading to decreased water quality which would affect the protection of the nominated environmental values.

The operation of the proposal has the potential to impact on surface water quality from the spill of vehicle oils, lubricants and hydraulic fluids and other accidental spills including leakage of chemicals in transit. Given the distance to the Nepean River and the potential to incorporate some spill containment structures, impact to water quality is expected to be minimal.

There is a period of time following the completion of construction where recently disturbed soils are susceptible to scour and erosion from stormwater runoff, particularly as there is a small increase in impervious areas. The potential for sediment transport is dependent on status of rehabilitation, severity of rainfall events, and the slope and scale of the disturbed area. As both the area of disturbance and increased imperviousness is small, and the Nepean River (being the nearest downstream waterway) is about two kilometres from the site, the potential impact is expected to be limited and less than the construction phase.

For the operational phase, the provision of operational water quality treatment controls for pavement runoff would be required upstream of any environmental sensitive receiving waterways that are located within 500 metres of any road pavement drainage discharge point from the study area.

The water quality controls required to protect any environmentally sensitive receiving waterways should address both acute (accidental spills) and chronic conditions (pollutant loads in surface rainfall runoff).

To meet the relevant water quality objectives for the proposal, the NSW OEH Total Suspended Solids design target for water quality, as described in *Managing Urban Stormwater – Council Handbook* (EPA, 1997) should be adopted as the proposal design target for the sizing of water quality treatment controls.

As pollutants on the road surface are expected to be primarily from vehicular traffic and build-up of contaminants from tyre and pavement wear in addition to atmospheric deposition of particles, the emphasis in stormwater quality management for road runoff should focus on the export of suspended solids and associated particle bound pollutants (Austroad, 2001). Pollutants such as heavy metals, hydrocarbons and other toxicants are usually attached to fine sediments (RTA, 2003). Therefore, trapping suspended solids must be the primary focus of the water quality management strategy for the operational phase proposal. The abovementioned NSW EPA design targets prescribe an 80 per cent pollutant load reductions for Total Suspended Solids (TSS).

The proposal design includes a has developed grass surface swales mitigation controls should be considered as the first option in meeting the above design target.

6.4.4 Safeguards and management measures

Table 6-27 Surface water environmental management measures

Impact	Environmental safeguards	Responsibility	Timing
Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design / pre-construction
Soil and water	A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / Pre-construction

6.5 Hydrology and flooding

This chapter has been written with information provided in the *Spring Farm Parkway Flooding and drainage investigation* (Lyall and Associates, 2017). That report was prepared for the stage 1 (the Proposal) and stage 2 of the Spring Farm Parkway proposal and the following information has been summarised to be specific for the proposal.

6.5.1 Methodology

The key tasks comprising the flooding investigation are broadly described below:

- Undertake a review of previous studies and available data along the proposal corridor
- Liaise with Roads and Maritime to collect available data on the stormwater drainage systems within the catchments that drain to the proposal corridor
- Develop a hydrologic model of the local catchments draining to the proposal corridor to generate discharge hydrographs for input to the hydraulic model
- Develop a hydraulic model of the various drainage lines that cross the proposal corridor to define flooding patterns under pre-proposal (i.e. present day) conditions, including data on peak flood levels, depths of inundation and flow velocities
- Undertake hydrologic and hydraulic analyses for post-proposal conditions to assess changes in flood behaviour, as well as the transverse drainage requirements for the proposal.

Hydrologic (DRAINS) and hydraulic (TUFLOW) models were developed as part of the present investigation to define flooding behaviour along the drainage lines that cross the proposal corridor (Lyall and Associates, 2017).

6.5.2 Existing environment

Nepean River floodplain

The main arm of the Nepean River runs in a northerly direction about two kilometres to the west of the proposal. The in-bank area of the creek and its immediate overbank area are densely vegetated, while the broader floodplain has typically been cleared for agricultural purposes. Areas near the Main Southern Railway (west of the proposal) may be inundated during a Probable Maximum Flood (PMF) event. The proposal study area however remains relatively unaffected by 100-year annual recurrence interval (ARI) and 20-year ARI flood events.

Local catchments within the proposal corridor

There are four transverse drainage structures located along Menangle Road in the study area, generally reinforced concrete pipes (RCPs) or culverts between 750 millimetres and 1800 millimetres in diameter. All four structures control runoff that originates from the largely undeveloped rural area that lies to the east of the Menangle Road. Several farm dams and wide grass swales are present within the catchments that lead to the existing drainage structures. Once crossing Menangle Road, flows continue west until reaching the Hume Motorway.

A further three transverse drainage structures (also large diameter RCPs) control flows from east of the Hume Motorway. Flow discharging from the three transverse drainage structures is conveyed in a series of

semi-natural channels which combine into a single channel about 100-200 metres downstream of the Hume Motorway.

A tributary of the Nepean River controls runoff from the flows under the Hume Motorway and runs in a westerly direction crossing the proposed Spring Farm Parkway alignment. The tributary is a combination of grass lined channels, minor depressions and more densely vegetated drainage lines.

TUFLOW modelling of Menangle Road, the Hume Motorway and the proposed Spring Farm Parkway Alignment shows that, for the existing conditions, Menangle Road, the Hume Motorway and the proposed Spring Farm Parkway alignment generally meet a 100-year ARI hydrological standard, In accordance with Roads and Maritime standards. Small sections of Menangle Road are less than the 100-year ARI standard.

During a 100-year ARI storm event a small area of the proposal corridor would be inundated to a maximum depth of 1.5 metres where it crosses the existing tributary of the Nepean River immediately west of the Hume Motorway (Lyall and Associates, 2017).

6.5.3 Potential impact

Construction

There is potential for a flood event to occur during construction of the proposal. The impact of a large flood would depend on the stage of construction at the time of the event, and the intensity of the rainfall event. Flooding during construction could potentially impact areas within and near the construction area (specifically, temporary construction ancillary sites) and/or cause damage to construction plant and equipment.

Construction sites could increase potential runoff to the catchments during heavy rainfall due to an increase of impermeable surface. However, this increase would be relatively small in terms of the overall catchment area, and unlikely to significantly increase the severity of any flood events.

Construction compounds and materials stockpiles may also increase potential runoff to the catchments. The potential impact would be localised and most likely to occur as a result of poorly located stockpiles or compound sites, for example, locating compounds or stockpiles in drainage paths or on low-lying land. Buildings and structures associated with site compounds may obstruct flows and reduce storage capacity or divert flows into sensitive areas where increased flow velocities can cause scour and erosion. These effects may be exacerbated by large areas of cleared land or exposed soil.

During construction there is also potential for existing drainage infrastructure to be partially blocked or temporarily diverted due to earthwork and other construction activities. Blocking or diverting local drainage lines may result in local flooding upstream of the construction areas. Diverting drainage lines may also create local areas of flooding and scour.

The temporary impact is expected to be minor and would be managed through the implementation of standard construction techniques and effective protection measures.

Operation

The potential impact of the proposal on flooding behaviour within receiving drainage lines has been considered during the design of the proposal. Detailed flood modelling has considered 10, 20, 50 and 100-year ARI, respectively. In general, the assessment showed that adopting the current concept drainage design for the proposal would provide a 100-year ARI to Spring Farm Parkway and its connections to Menangle Road and the Hume Motorway.

The investigation also found that the proposal would likely lead to:

- Minor, relatively localised increase in the depth of overland flow for some properties located between Menangle Road and the Hume Motorway, primarily due to the concentrated discharge of flow from the upgraded transverse drainage structures
- An increase in peak flood levels in land between Menangle Road and the Hume Motorway near the proposed bridge structure due to the displacement of floodplain storage attributable to the new road embankment, as well as the proposed extension to transverse drainage structures
- An increase in peak flood levels in the Nepean River tributary immediately west of the proposed Hume Motorway entry ramp. While peak 100-year ARI flood levels would be increased by a maximum of 350 millimetres, no existing development would be adversely affected and the Hume Motorway would maintain a 100-year ARI.

6.5.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Flooding and hydrology	The transverse drainage and flood mitigation strategy would continue to be refined during detailed design.	Roads and Maritime	Detailed design / pre-construction
Flooding	Roads and Maritime will consult further with Campbelltown City Council to confirm the details of future development within the catchments that drain to the proposal corridor, including the extent of measures which will be incorporated into future development to control the rate of flow discharging to the proposal corridor.	Roads and Maritime	Detailed design / pre-construction
Scour	Scour protection measures will be identified and refined during detail design.	Roads and Maritime	

6.6 Soils and contamination

This section outlines the potential impact of the proposal on soils and contaminated land including the outcomes of a Phase 1 Preliminary Site Investigation carried out by JBS&G Australia Pty Ltd (JBS&G) between May and June, 2017.

6.6.1 Methodology

The assessment of the impact to soils also included a review of the following relevant soil and geology resources, including:

- 1:100,000 Wollongong-Port Hacking geological map Sheet 9029-9129
- Australian Soil Resource Information System (CSIRO, 2006)
- Soil Salinity Hazard Map (DIPNR, 2000)
- Mine Subsidence District Map (South Campbelltown) reference PP5205 prepared by NSW Government Spatial Services (2017).

Additionally, a Phase 1 Site Investigation included:

- Review of available previous environmental and geotechnical reports including *Spring Farm Parkway Stage 1, Geotechnical Desktop Study* (Roads and Maritime, 2017)
- Review of section 149(2&5) planning certificates, records of stored dangerous goods and current and historical land title records for key lots along the proposed alignment
- Review of historical aerial photographs and publicly available heritage records
- Review of online records from OEH/EPA regarding notifications/records of contaminated land, and environmental incidents or former environmental licences
- Review licensed groundwater bores along the proposed road-corridor and within one kilometre of the alignment, as available on the online NSW Natural Resources Atlas/Office of Water
- Review of the environmental setting including topography, geology and hydrogeology of the Site and surrounding areas
- Completion of a detailed inspection of accessible lots within the proposed road alignment to assist in the development of the conceptual site model (CSM). Inspections were completed between May and June 2017
- Collection of 20 soil samples from the proposed alignment to provide a limited assessment of the environmental condition of the site and for the provision of a preliminary waste classification completed in accordance with the *Waste Classification Guidelines* (NSW EPA 2014)
- Preparation of a PSI report in general accordance with relevant EPA Guidelines
- Assessment of the potential for contamination based on current and historical site activities to draw preliminary conclusions regarding the potential contamination status of the site
- Preparation of this Preliminary Site Investigation Report in general accordance with relevant EPA guidelines and State Environmental Planning Policy 55 – Remediation of Land (SEPP 55).

The study area for the Phase 1 Site Investigation was the proposed road alignment (including a 15 metres buffer).

6.6.2 Existing environment

Topography

The elevation of the study area ranges from 80 metres Australian Height Datum (AHD) to 140 metres AHD. The proposed road alignment exists within an area characterised by undulating hills with a regional slope towards the west - towards the Nepean River, and within the Nepean River flood plain – which extends to the boundary between stage 1 and stage 2 of the road alignment (Roads and Maritime, 2017).

Geology and soils

Based on the *100,000 Wollongong-Port Hacking geological map Sheet (9029-9129)*, the site is mapped as being underlain primarily by (Rwb) Bringelly Shale, with (Tal) Tertiary aged alluvium to the immediate west of the site. A description of the geological formations underlying the proposal is provided in Table 6-28 and on Figure 6-18.

Table 6-28 Geological units

Geological unit	Description
Tertiary Alluvium (Tal)	Tertiary aged, high level alluvium, comprising clays, gravels and cobbles.
Bringelly Shale (Rwb)	The Bringelly Shale sequence belongs to the Wianamatta Group which is the uppermost geological unit of the Permo-Triassic sequence and is positioned in a central location within the Sydney Basin. It is interpreted as a coastal alluvial plain sequence that contains lagoonal coastal marsh sequence at the base through to terrestrial, alluvial plain sediments at the top of the formation. The Bringelly Shales sequence in the area is typically comprised of interbedded shales, laminate and fine to medium grained sandstones.

Reference to the *1:100 000 Soil Landscape Series Sheet for Penrith (19904)* indicates that the study area is underlain by three soil landscapes: Luddenham, Blacktown, and Theresa Park. The soil landscapes relate strongly to native vegetation characteristics and distribution. A description of the soil landscapes across the proposal is provided in Table 6-29.

Table 6-29 Soil landscapes (Source: JBS&G, 2017)

Soil landscape	Landscape type	Soil material	Limitations
Luddenham (lu)	Erosional	Yellow podzolic soils on lower slopes and drainage lines	High erosion hazard, highly plastic and moderately reactive subsoils, potential mass movement hazards
Blacktown (bt)	Residual	Yellow podzolic soils on lower slopes and drainage lines	Moderately reactive, highly plastic subsoils, low soil fertility, seasonal waterlogging, soils are often saline (solodic)
Theresa Park	Fluvial	Solodic soils along drainage lines and Red Earth and Red Podzolic	Localised flooding seasonal waterlogging, very high soil erosion

Soil landscape	Landscape type	Soil material	Limitations
		soils on the floodplain and near terrace edges	hazard for concentrated flows

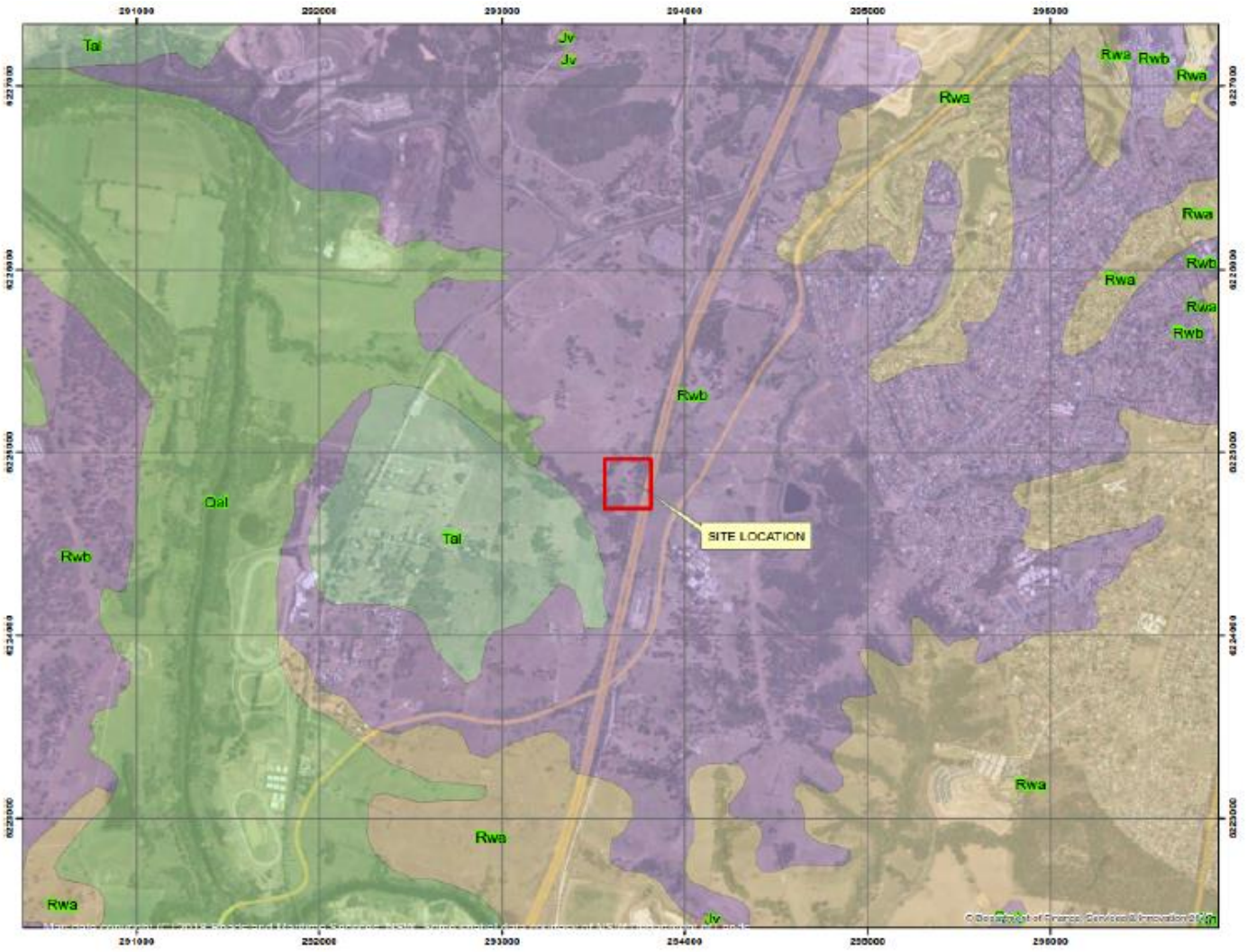

Figure 6-18 Geological units extract (RMS, 2018)

Acid Sulfate Soils (ASS)

Acid sulfate soils (ASS) are soils and sediments containing iron sulphides that, when disturbed and exposed to oxygen, generate sulphuric acid and toxic quantities of aluminium and other heavy metals. The majority of ASS are formed by natural processes under specific environmental conditions. This generally limits their occurrence to low lying sections of coastal floodplains, rivers and creeks where surface elevations are less than about five metres AHD. A review of the online ASS maps (CSIRO, 2006) for the area surrounding the proposal site indicates that there are no known occurrences of ASS within the proposal footprint, with areas of low to high potential further to the west associated with the Nepean River.

No ASS testing has been carried out and is not considered a risk for the proposal.

Salinity

An assessment of the soil salinity hazard map for western (DIPNR, 2002) indicates that the site is located within an area of ‘moderate’ soil salinity potential. An area of ‘high’ salinity potential associated with the creek line is mapped along the western side of the proposal area.

No specific testing or assessment has been carried out as part of the investigations (Roads and Maritime 2018) for the proposal and it is unlikely that soil salinity would pose any specific design constraints for the major structures, other than provision of appropriate durability allowances.

Contaminated land

A search of the NSW EPA database was carried out on 2 May 2017. No prevention, clean-up or prohibitions notices and no transfer, variation, suspension, surrender or revocation of an environment protection licences has been issued under the POEO Act for any sites (JBS&G, 2017). The study area and immediate surroundings are not on the published list of NSW contaminated sites.

Desktop and detailed site inspections have identified that most properties within the proposed road corridor appeared to be utilised for light agricultural purposes (i.e. grazing), with some properties within the alignment utilised for industrial and commercial purposes. One property adjacent to the road alignment has an active coal seam gas extraction well, operated by AGL. It is noted that AGL intend to decommission this well as part of their plans to cease the Camden Gas Project by 2023 (AGL 2016). Whilst this does not appear to represent an area of environmental concern at this stage, this should be noted for future work within these areas given the wells may remain in use until 2023.

The inspection of the road alignment, including the results of the limited soil sampling did not identify any areas which contained signs of odorous soils, staining, visible asbestos containing materials (ACM) or other potentially contaminating activities (JBS&G, 2017).

Table 6-30 outlines potential areas of environmental concern (AECs) relevant to the proposal and is based on the site history review and observations of site conditions during the detailed site inspection.

Table 6-30 Areas of Environmental Concern and Associated Contaminants of Potential Concern (Source: JBS&G 2017)

Potential Area of Environmental Concern (AEC)	Contaminants of Potential Concern (COPC)
Environmental conditions	
Potential for acid sulphate soils	High acidity (hydrogen sulphide)
Road corridors	
Potential for leaks and spills form trains and vehicles	Lead, polyaromatic hydrocarbons, total petroleum hydrocarbons/volatile organic compounds
Fill materials used to achieve design levels	Heavy metals, polyaromatic hydrocarbons, total petroleum hydrocarbons/volatile organic compounds, organochlorine pesticides/polychlorinated biphenyls
Aesthetic impact	Rubbish and fly tipped wastes
Grazing areas and 'greenfield sites'	
Pesticide and herbicide use	Organochlorine pesticides/polychlorinated biphenyls
Rural/residential uses (historical and current)	
Structures Storage and maintenance of equipment and consumables Pesticide and herbicide use	Heavy metals, polyaromatic hydrocarbons, total petroleum hydrocarbons/volatile organic compounds, organochlorine pesticides/polychlorinated biphenyls

Potential Area of Environmental Concern (AEC)	Contaminants of Potential Concern (COPC)
Industrial uses	
Operation of active coal seam gas extraction wells	Heavy metals, volatile organic compounds, total recoverable hydrocarbons
Under development	
Fill materials used to achieve design levels and stockpiling of materials Storage and maintenance of equipment and consumables	Heavy metals, polyaromatic hydrocarbons, total petroleum hydrocarbons/volatile organic compounds, organochlorine pesticides/polychlorinated biphenyls

6.6.3 Potential impact

Construction

Geology and soils

The geology of the site is not anticipated to be impacted by construction of the proposal.

The potential impact on soil from construction activities would be primarily associated with soil loss from erosion of exposed soils and stockpiles, and potential sedimentation of surrounding land and waterways. Construction activities associated with the proposal would include:

- Vehicle movements
- Stockpiling
- Excavation
- Importation of fill material
- Vegetation removal
- Grubbing processes.

Excavation and fill would be required at various locations along the proposed alignment, particularly either side of the proposed bridge where significant import of fill for development of batter slopes is required. Without effective mitigation, these and related construction activities would give rise to potential for erosion of unconsolidated material and entrainment by runoff and subsequent transported off site. Soils transported into local drainage channels could have an impact, including:

- Reduced hydraulic capacity due to deposition of material within waterway channels
- Degraded water quality including lower dissolved oxygen levels, increased nutrients (nitrogen (N), phosphorus (P)), increased turbidity, and altered pH levels
- Increased levels of nutrients, metals and other pollutants transported via sediment and runoff to receiving waterways leading to increased potential for bioaccumulation of heavy metals in aquatic species
- Increased sedimentation smothering aquatic life and affecting aquatic ecosystems.

Given the implementation of appropriate safeguard measures outlined in Section 6.4.4 the potential impact to geology and soils from the proposal is considered minor.

Contamination

Construction of the proposal, including the establishment of compound sites would predominantly occur within greenfield areas west of the Hume Motorway which has historically been undeveloped or utilised for grazing purposes. The rest of the corridor is generally within the existing road corridor.

Construction activities including clearing and grubbing, excavation and piling have the potential to disturb contaminated areas within the proposal corridor, although the potential for this is considered low as there have been no significant contamination issues identified in the study area. It is also considered that detailed environmental investigations at the site are not required.

Based on the finding of the Preliminary Site Investigation it is considered unlikely for there to be any unacceptable risks to human and ecological receptors at the site or in proximity to the site, due to environmental contamination, from proposal construction activities, particularly as much of the road would be raised above existing ground levels.

Operation

After construction, cleared areas would be paved/landscaped and scour protection installed at drainage outlets. There would be no exposed areas of topsoil and therefore only a minor potential of soil erosion and entrainment of unconsolidated material by wind or runoff. During operation, the potential for soil erosion would be minimal as all areas impacted during construction would be asphalt or rehabilitated and landscaped to avoid soil erosion from occurring.

The general operation and maintenance of the road would be managed under similar practices that are used at present to prevent any spillage or contaminant risk. As such, there is expected to be no net change or impact from maintaining the road.

6.6.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Soils	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design / Pre-construction
Soils	A site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / Pre-construction
Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All	Contractor	Detailed design / Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	other work that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.		
Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers).	Contractor	Detailed design / Pre-construction

6.7 Biodiversity

This chapter provides an assessment of potential impact to terrestrial and aquatic biodiversity from construction and operation of the proposal and recommends environmental management measures to reduce these impacts. The Biodiversity Impact Assessment was carried out by Niche Environment and Heritage Pty Ltd (Niche). Details of the assessment are presented in Appendix G.

6.7.1 Methodology

The assessment process consisted of the following steps:

- Review of the following databases for records within 10 kilometres of the proposal:
  - NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database (NSW OEH, n.d.)
  - Department of Environment (DoE) Protected Matters Search Tool (PMST) (DOE, n.d.)
- Flora and fauna surveys of the study area carried out over three days in February 2018
- The flora surveys involved:
  - Twelve Biodiversity Assessment Method (BAM) floristic survey plots, following the methodology in the BAM (OEH, 2017)
  - A total of 10 Rapid Data Points (RDP) to assist in validating vegetation mapping
  - Targeted survey for threatened plants in addition to BAM plots and RDPs. Approximately seven hours of survey for threatened plants were carried out over three days
  - An additional targeted survey for *Pimelea spicata* were undertaken over 0.5 hours in October 2018, when the plant at a nearby reference site were found to be in flower
- The fauna survey involved:
  - Targeted searches for Cumberland Plain Land Snails, frog searches and bird survey
  - Spotlighting, and koala call playback at six locations
  - Bat echolocation recording (Songmeter version 2) at five sites over a minimum of two nights in a variety of habitats throughout the study area
  - Opportunistic searches for reptiles, birds and other visible species throughout the study area.

A detailed methodology for the biodiversity assessment is provided in Appendix G. Figure 6-19 presents the survey effort and methods.

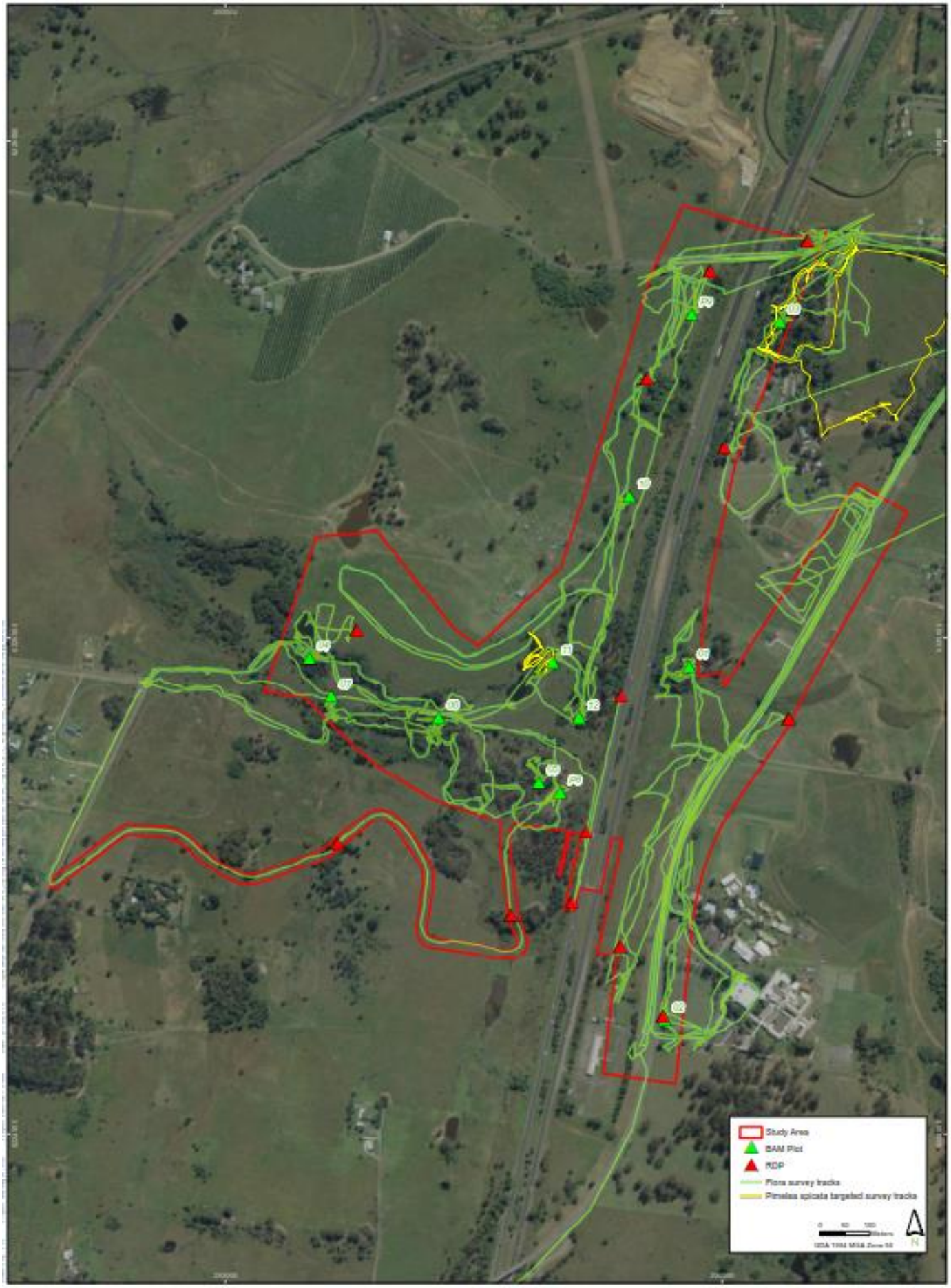

Figure 6-19 Flora and Fauna Survey Effort (Niche, 2019)

6.7.2 Existing environment

Study Area

The proposal is located between Campbelltown and Camden, southwest of Sydney. The study area is located entirely within Campbelltown City Council.

The landform surrounding the proposal is flat to moderately undulating hills to the north, south and east and falls to the west and the Nepean River. The Nepean River runs in a northerly direction and is located approximately two kilometres to the west of the proposal. Spring Farm Parkway runs immediately adjacent and to the north of an ephemeral creek tributary. The dominant soil type of the study area is clay based, originating from Wianamatta Shale. This soil type is associated with Cumberland Plain Woodland.

Vegetation communities

Regional mapping of vegetation identified three plant communities within the study area. This vegetation mapping was ground truthed during the field surveys to validate the vegetation. Table 6-31 summarises the two plant community types (PCTs) identified within the study area.

Table 6-31: Plant community types within the study area

PCT number	PCT name	TEC
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland (Critically Endangered Ecological Community, BC and EPBC Act)
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Swamp Oak Floodplain Forest (Endangered Ecological Community, BC Act)

These PCTs were then classified into six vegetation zones based on areas of native vegetation with the same PCT and of a similar broad condition state (see Figure 6-20). All native vegetation was impacted by historical clearing, weed invasion (with severe infestations of *Olea europaea* (African Olive) common), grazing by livestock, rubbish dumping and in some cases mowing/slashing.

Table 6-32: Vegetation zones within the study area

PCT number	PCT zone	Area (ha)	Description
850	PCT850 Moderate - Bursaria	0.67	A canopy of *E. moluccana* (Grey Box) and *E. tereticornis* (Red Gum) over a shrub layer dominated by Bursaria spinosa, with *Olea europaea* (African Olive) also occurring. Groundlayer dominated by a mix of native grasses and herbs.
	PCT850 Moderate - Grass	0.33	A canopy of *Eucalyptus moluccana*, with *E. crebra* (Narrow-leaved Ironbark) over a groundlayer dominated by a mix of native grasses and herbs.
	PCT850 Low - Olive	10.79	Canopy dominated by *E. molucanna*, with *E. tereticornis* also occurring over a dense shrub layer dominated by *Olea europaea*. A sparse to absent groundlayer.

PCT number	PCT zone	Area (ha)	Description
	PCT850 Low - Grass	4.09	Canopy dominated by *E. molucanna*, with *E. tereticornis* also occurring over a groundlayer dominated by a mix of native and exotic grasses. The groundlayer in this zone was often either grazed or mown.
	PCT850_Derived Native Grassland	1.40	Dominated by native grasses such as *Themeda trriandra* (Kangaroo Grass), *Microlaena stipoides* (Weeping Grass) and *Aristida ramosa* (Purple Wiregrass).
1800	PCT1800_Low	2.76	Dominated by *Casuarina glauca* (Swamp Oak), with *Angophora floribunda* (Rough-barked Apple) also occurring. The shrub layer was sparse, supporting *Olea europaea* and *Melaleuca linariifolia*. The understorey was sparse but supported a mix of native and exotic grasses and herbs. This community was impacted by weeds and grazing.
Total		**20.04**	

Groundwater dependent ecosystems

Groundwater Dependant Ecosystems (GDEs) are defined as:

> *'Ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater.'* (Serov et al., 2012)

Therefore, GDEs explicitly include any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition (Serov et al. 2012).

The level of water dependence of vegetation communities on the Cumberland Plain has been identified in the Risk Assessment Guidelines for Groundwater Dependant Ecosystems released by the NSW Department of Primary Industries (Serov et al 2012).

The Risk assessment guidelines for GDEs (Serov et al. 2012) identify both of the vegetation communities (PCT 850 and PCT 1800) recorded in the study area as having a high probability of being groundwater dependant ecosystems. See Figure 6-20 for location of these PCTs.

PCT 850 and PCT 1800 both fit the Serov et al. (2012) definition of a Terrestrial Ecosystem dependent on groundwater.

Threatened biodiversity

Flora

A search of database records within ten kilometres of the proposal found 35 recorded threatened flora species. The full assessment of likelihood of occurrence is provided in Appendix G. Four of these threatened flora were considered to have a moderate or higher likelihood of occurrence in the study area prior to field survey (see Table 6-33).

Table 6-33: Threatened flora – moderate to higher likelihood of occurrence

Common Name *(Scientific Name)*	Status[1]		Likelihood of occurrence	Habitat
	BC Act	EPBC Act		
Eucalyptus benthamii (Camden White Gum)	V	V	Moderate	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations; the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty. At least five trees occur on the Nattai River in Nattai National Park. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest.
Marsdenia viridiflora subsp. viridiflora	EP		Moderate	Grows in vine thickets and open shale woodland.
Spiked Rice-flower (*Pimelea spicata*)	E	E	Moderate	Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with grey box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey.
Brown Pomaderris (*Pomaderris brunnea*).	V	V	Moderate	The species is expected to live for 10-20 years, while the minimum time to produce seed is estimated to be 4-6 years. Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England Tableland and in far eastern Gippsland in Victoria.

[1] V – Vulnerable, E – Endangered, EP – Endangered Population, CE – Critically Endangered, M - Migratory

No threatened flora have been previously recorded in the study area (based on database searches) and none were recorded during the targeted field surveys. Habitat for threatened flora is considered to be poor across the majority of the study area, with historical clearing, weed invasion and grazing likely to inhibit the presence of threatened flora.

Areas of moderate condition vegetation (see Figure 6-20) may provide habitat for threatened flora. No threatened flora were identified in these areas during the field survey, however it is possible that *Pimelea spciata* may be present but were not in flower at the time of the survey.

With the possible exception of *Pimelea spciata*, it is considered unlikely that threatened flora are present in the study area.

Fauna

Fauna recorded in the study area included one native frog species, 24 native bird species, five exotic mammals, 12 native mammals, two native reptiles and one exotic fish.

A search of database records within ten kilometres of the proposal found 83 recorded threatened fauna. Fifteen threatened or migratory fauna were considered to have a moderate or higher likelihood of occurrence in the study area prior to field survey. These are summarised in Table 6-34 and the full assessment of likelihood of occurrence is provided in Appendix G.

Table 6-34: Threatened fauna – moderate to higher likelihood of occurrence

Common Name *(Scientific Name)*	**Status[1]**		**Likelihood of occurrence**	**Habitat**
	BC Act	**EPBC Act**		
Great Egret (*Ardea alba*)	-	M	Moderate	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.
Cattle Egret (*Ardea ibis*)	-	M	High	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor.
Dusky Woodswallow (*Artamus cyanopterus cyanopterus)*	V	-	Moderate	Often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests.
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	Moderate	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature eucalypts with hollows.
White-throated Needletail (*Hirundapus caudacutus)*	-	M, MA	Moderate (overfly only)	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.
Satin Flycatcher (*Myiagra cyanoleuca)*		M	Moderate	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests

Common Name *(Scientific Name)*	Status[1]		Likelihood of occurrence	Habitat
	BC Act	EPBC Act		
Powerful Owl (*Ninox strenua*)	V	-	Moderate (foraging only)	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within turpentine tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.
Cumberland Plain Land Snail (*Meridolum corneovirens*)	E	-	Moderate	Primarily inhabits Cumberland Plain woodland (a CEEC). This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.
Little Bentwing-bat (*Miniopterus australis*)	V	-	Moderate (foraging only)	Coastal north-eastern NSW and eastern Queensland. Little Bentwing-bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel hundreds of kilometres from feeding home ranges to breeding sites. Little Bentwing-bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.
Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	V	-	Moderate (foraging only)	Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.
Eastern Freetail-bat (*Mormopterus norfolkensis*)	V	-	Known	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.

Common Name *(Scientific Name)*	Status[1]		Likelihood of occurrence	Habitat
	BC Act	EPBC Act		
Southern Myotis (*Myotis macropus*)	V	-	Moderate	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 – 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage.
Koala (*Phascolarctos cinereus*)	V	V	Moderate	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	Known	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	-	Known	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.

[1] V – Vulnerable, E – Endangered, EP – Endangered Population, CE – Critically Endangered, M - Migratory

Of these, three threatened fauna species were recorded with the study area during the field survey:

- Two Grey-headed Flying Fox (*Pteropus poliocephalus)* were recorded along the Nepean River tributary in the south of the study area
- Eastern Freetail-bat (*Mormopterus norfolkensis)* were recorded at all five songmeter locations in the study area
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) (probable) was recorded along the Nepean River tributary in the south of the study area.

Neither the Eastern Freetail-bat or Greater Broad-nosed Bat were recorded during the early evening, indicating that these threatened bats are unlikely to be roosting locally.

An important koala population is known to occur in the locality, with a koala corridor mapped as occurring about 450 metres east of the study area, with over 1,321 records of koalas within a ten kilometre radius of the proposal. Almost all of these records occur to the east of the study area, see Figure 6-21. Records show that the koala is rarely recorded west of the study area. This is likely to be due to the fragmented and poor condition habitat and the presence of existing barriers such as the Hume Motorway. No individuals were recorded during the field survey, however recent Bionet records show that the koala utilises habitats in close vicinity to the study area, at least on an occasional basis, with three records of koalas at Broughton Anglican College.

Campbelltown LGA is listed under Schedule 1 of the State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) (see Section 4.1.1). SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas. The study area was assessed in accordance with the criteria set out in SEPP 44. Overall, it was considered unlikely that the study area contains core koala habitat as defined in SEPP 44, given the poor condition of the habitats in the study area and the absence of any signs of the species during targeted surveys undertaken as part of this assessment.

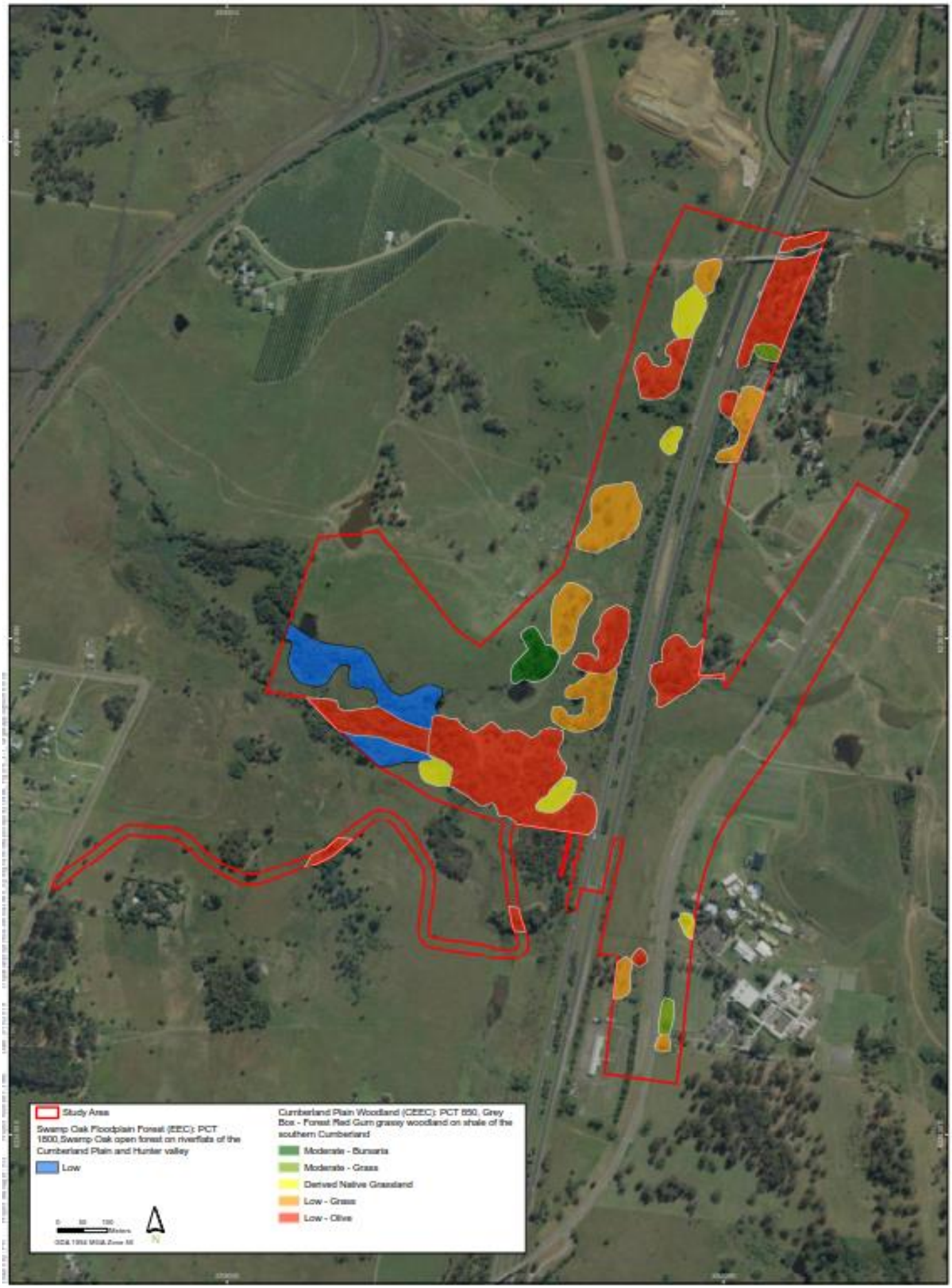

Figure 6-20 Validated Vegetation Mapping, Threatened Biodiversity and Important Habitat Features (Niche, 2019)

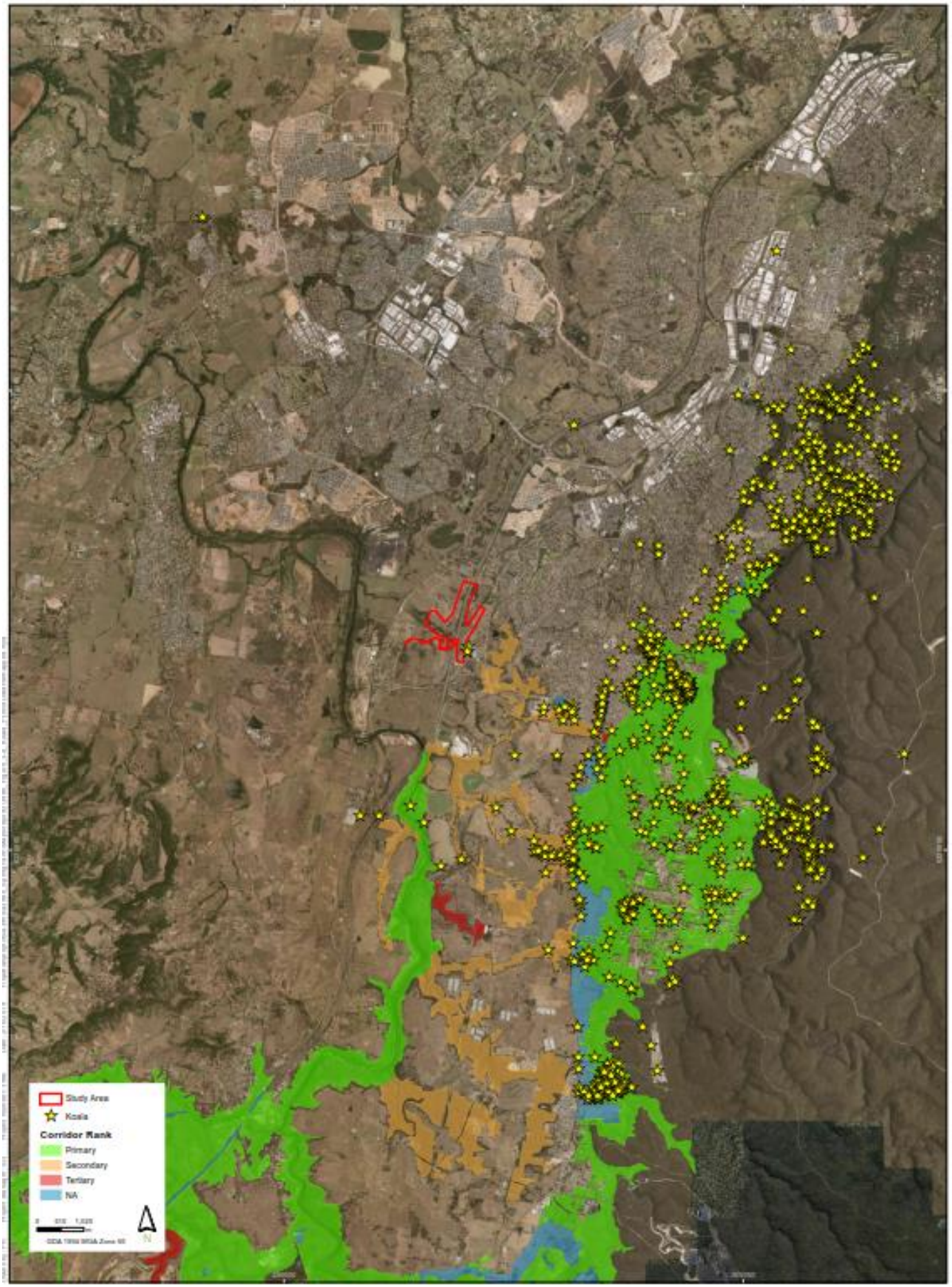

Figure 6-21 Koala Corridors, Draft OEH Data (Niche, 2019)

6.7.3 Potential impact

Construction

Construction of the new Spring Farm Parkway would require the clearance of areas of mapped threatened vegetation to the west of the Hume Motorway. Minimal vegetation clearance would be required for the widening of Menangle Road.

Table 6-35 provides a summary of the impact of the proposal on PCTs recorded within the study area.

Table 6-35 Impact of the proposal on PCTs within the study area

PCT name	Status	PCT zone	Direct Impact (ha)	Indirect Impact (ha)
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland (Critically Endangered Ecological Community, BC and EPBC Act)	PCT850 Moderate - Bursaria	0.19	0.09
		PCT850 Moderate - Grass	0	0.02
		PCT850 Low - Olive	1.06	0.73
		PCT850 Low - Grass	0.65	0.27
		PCT850_Derived Native Grassland	0.02	0.11
Total			**1.92**	**1.22**
Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Swamp Oak Floodplain Forest (Endangered Ecological Community, BC Act)	PCT1800_Low	0.47	0.28
Total			**0.47**	**0.28**

The proposal would remove up to 1.92 hectares of the critically endangered Cumberland Plain Woodland ecological community. One area of Cumberland Plain Woodland (PCT850 Moderate - Bursaria) was found to meet the condition thresholds detailed in the Commonwealth listing advice for the community (DEWHA, 2010). The vegetation removal also involves removal of about 0.47 hectares of the BC Act listed endangered Swamp Oak Floodplain Forest ecological community. The impact associated with native vegetation removal would be long-term.

This vegetation provides potential habitat and foraging habitat for several threatened fauna species listed under the BC Act and EPBC Act, including hollow-dependant bats, Grey-headed Flying-fox and koala. The proposal has the potential to impact on fauna in the following ways:

- Death or injury of individuals
- Loss or disturbance of limiting foraging resources
- Loss or disturbance of limiting breeding resources.

The impact to mobile species such as the bats and the Grey-headed Flying-fox are less likely to result in death or injury, however this is possible. Koalas however are less mobile and therefore more vulnerable to death or injury.

Assessments of significance under the BC Act

An assessment of significance has been carried out for threatened species under the BC Act that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area (refer to Appendix G).

Eight species or ecological communities and their habitats have been assessed via the application of the Five Part Test under the BC Act:

- Cumberland Plain Woodland
- Swamp Oak Floodplain Forest
- Cumberland Plain Land Snail
- Hollow-dependant bats: Eastern Freetail-bat, Greater Broad-nosed Bat, Southern Myotis
- Grey-headed Flying-fox
- Koala.

The assessments of significance concluded that significant impact to Cumberland Plain Woodland community and the Swamp Oak Floodplain Forest community were unlikely due to the generally poor and fragmented condition of the impacted patches and the relatively small area of impact compared with the local occurrence of the communities.

Vegetation clearance would remove a small amount of habitat for threatened species such as Grey-headed Flying-fox, koala and Cumberland Plain Land Snail.

Clearing for the proposal would remove approximately 1.92 hectares of potential habitat for the Cumberland Plain Land Snail, however this this habitat was found to be degraded and sub-optimal, with an absence of logs and not much leaf litter present. Targeted surveys were carried out during the field surveys, and this species was not recorded within the study area. Overall the proposal is unlikely to have a significant impact to Cumberland Plain Land Snail.

As noted in Section 6.7.2, neither the Eastern Freetail-bat or Greater Broad-nosed Bat were recorded during the early evening, indicating that these threatened bats are unlikely to be roosting locally, but use the area for foraging. Similarly, the Southern Myotis was not recorded in the study area during fauna surveys, therefore the species is unlikely to be roosting or breeding nearby. Despite not being recorded the Southern Myotis may forage irregularly in the study area, and so the clearance of vegetation may affect threatened fauna species which use the area. Overall however a significant impact to hollow-dependent bats is not likely.

There is limited access to the study area for koalas, due to the surrounding infrastructure. However, they may still be present. Management measures for this species have been included in Section 6.7.4. The assessments of significance concluded that a significant impact to the Grey-headed Flying-fox or koala is unlikely.

Assessments of significance under the EPBC Act

An assessment of significance pursuant to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* was completed for the following threatened biodiversity under the EPBC Act:

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest
- Coastal Swamp Oak (*Casuarina glauca*) Forest
- Grey-headed Flying-fox
- Koala.

The one patch that meets the criteria for EPBC Act listed Cumberland Plain Woodland in the study area is the patch mapped as PCT850: Moderate_Bursaria (see Figure 6-20). The remaining patches in the study area were either too small, did not support a native canopy of over 10 per cent projected foliage cover or did not have a sufficient proportion of native species cover in the understorey. PCT850: Moderate_Bursaria

is therefore the only patch of EPBC Act listed Cumberland Plain Woodland in the study area. The proposed work would require the clearing of 0.19 hectares of this area of Cumberland Plain Woodland, with a further 0.09 hectares indirectly impacted. Given over 2,900 hectares of Cumberland Plain Woodland is currently mapped as occurring in the locality (10 kilometre radius), the area impacted by the proposal is not likely to substantially reduce the extent of Cumberland Plain Woodland. Overall the assessment found that a significant impact is not likely.

None of the species with the potential to occur in the study area were considered likely to be significantly impacted by the proposal, primarily due to the absence of/or limited impact to key limiting resources, and minimal impact to general foraging habitat.

No threatened flora were recorded in the study area. One threatened flora species, *Pimelea spicata,* was identified as having a moderate likelihood of occurring within the study area, based on other confirmed recorded in the vicinity of the proposal (approximately nine kilometres away at Douglas Park) with similar habitat features. A subsequent field survey was undertaken in October 2018 to locate this flora species, if present, whilst in flower. None were found, and so this is not considered to be present within the study area.

Removal of habitat features

The proposal would result in the removal of eight identified hollow-bearing trees (including three stags).

Hollow-dependant bat species are not likely to be roosting or breading locally and therefore the removal of these hollow-bearing trees is unlikely to have a significant impact on the Southern Myotis, Eastern Freetail Bat or Greater Broad-nosed Bat. No other threatened species identified as known or moderately to highly likely to occur within the study area utilise hollow-bearing trees or stags.

Aquatic impact

Construction activities would occur near or within watercourses located in the study area (Tributary 1, Drainage Lines 1a and 1b). As noted in Section 4.2.4, the majority of the waterways within the study area were classified ‘Class 4’ unlikely key fish habitat, with a section of Tributary 1 to the west of the Hume Motorway classed conservatively as ‘Type 2’ key fish habitat. The waterways are not considered to be sensitive receiving environments. Nevertheless, construction in proximity to watercourses could impact on water quality due to the disturbance of the bed and banks resulting in erosion and sedimentation, alteration of downstream flows and scouring of the bed near culvert inlets and outlets. Construction activities adjacent to waterways could introduce contaminants such as oil or greases and disturb contaminated sediments, potentially having an adverse impact on water quality.

Construction work may also require some obstruction to potential fish passage during work on the creek crossings. The installation of any culverts is also considered a Key Threatening Process for in-stream structures and other mechanisms that alter natural flows. Culverts already occur under the Hume Motorway and would be widened as a result of the proposal, thus altering shading regimes of waterways.

Construction work is likely to result in the temporary displacement of aquatic fauna (such as frogs and tadpoles) and temporary changes to the turbidity and sedimentation of waterways.

The potential impact to aquatic habitats through sedimentation and run-off from the construction impact would be mitigated and managed through safeguards detailed within a comprehensive site Construction and Environmental Management Plan (CEMP). This would be developed in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries) 2013).

Operation

The proposal has the potential to result in the following impacts:

- Fragmentation of biodiversity links and habitat corridors
- Injury and mortality of fauna
- Invasion and spread of weeds
- Invasion and spread of pests.

The fauna habitat in the study area is already fragmented by existing land uses such as the Hume Motorway and local roads, agriculture and rural residential development. The proposal is unlikely to make traversing the landscape more difficult for local fauna given the existing fragmentation and barriers to movement. There would be a slight increase in habitat fragmentation due to the removal of small patches of vegetation adjacent to the road. However, given the limited extent of clearing, the proposal is not expected to substantially further fragment habitat or impact upon wildlife connectivity across the landscape.

Weed invasion is prevalent throughout the study area. As such, there is a high chance that weeds could be spread during the construction work as machinery and vehicles would pass through areas where there are high levels of weeds, and soil would be disturbed and transported around the area. The potential for invasion and spread of weeds would be mitigated and managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Proposals* (RTA, 2011).

6.7.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Roads and Maritime	Detailed design
	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction
	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Clearing limits and exclusion zones clearly identified prior to work within/adjacent Cumberland Plain Woodland and Swamp Oak Floodplain Forest.	Contractor	Construction
	A Flora and Fauna Management Plan 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 will include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the Landscape Guideline (RTA, 2008) • 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.	Contractor / Roads and Maritime	Detailed design / pre-construction
Removal of threatened species habitat and habitat features	Habitat removal will be minimised through detailed design.	Roads and Maritime	Detailed design
	Habitat removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).	Contractor	Construction
	Habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). This will include installation of nest boxes to replace lost hollows and salvage and re-use/installation of hollows from hollow-bearing trees that are removed.	Contractor	Construction
	The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.		
	Important habitat features such as woody debris and bushrock would be re-used in suitable locations nearby, in accordance with Roads and Maritime Biodiversity Guidelines - Guide 5 (Re-use of woody debris and bushrock.	Contractor	Construction
Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).	Contractor	Construction
	Clearing limits and exclusion zones clearly identified prior to work within the vicinity of the population of *Pimelea spicata* to ensure no impacts to the population.	Contractor	Construction
Aquatic impact	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	Contractor	Construction
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Roads and Maritime	Detailed design
Fragmentation of identified habitat corridors	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (RTA 2011).	Roads and Maritime	Detailed design / operation
	Any connectivity measures implemented will be designed and installed under the supervision of an experienced ecologist.	Contractor / Roads and Maritime	Detailed design / pre-construction
	Wildlife signage, street lighting and appropriate vehicle calming devices will be considered in areas with a history of fauna vehicle strike.	Contractor	Construction
	Consider installation of glider poles and/or rope crossings to assist fauna to cross the road safely.	Contractor	Construction
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor / Roads and Maritime	Detailed design / pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	Clearing limits and exclusion zones clearly identified prior to within/adjacent Cumberland Plain Woodland and Swamp Oak Floodplain Forest.	Contractor / Roads and Maritime	Detailed design / pre-construction
Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
	Implementation of two stage clearing process to allow fauna to disperse from habitat voluntarily; inspection of hollows by experienced ecologist/fauna spotter/catcher prior to and after clearing of hollow-bearing trees/stags to safely remove and relocate any injured /displaced fauna.	Contractor	Construction
Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
	Establishment of clearing limits and exclusion zones within/adjacent to Cumberland Plain Woodland and Swamp Oak Floodplain Forest.	Contractor	Construction
	To prevent the spread of weed seed, all weed material removed will be disposed of in a suitable waste facility and not mulched on site. This is to avoid the reintroduction and further spread of weeds in the area.	Contractor	Construction
Invasion and spread of pests	Pest species will be managed within the proposal site.	Contractor	Construction
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
Noise, light and vibration	Shading and artificial light impact will be minimised through detailed design.	Roads and Maritime	Detailed design

6.7.5 Biodiversity offsets

Despite avoidance and mitigation measures to minimise the impact to biodiversity, the residual impact from the clearing of threatened ecological communities as a result of the proposal are considered significant and require offsetting, in accordance with Roads and Maritime Biodiversity Offset Guidelines (RMS, 2016).

The proposal triggers the need for offsetting due to the clearing of 1.92 hectares of the CEEC Cumberland Plain Woodland. Given that the clearing of Swamp Oak Floodplain Forest TEC is less than 1 hectares in size (0.47 hectares), offsetting is not required for this TEC.

The BAM data collected during the field assessment was entered into the OEH BAM Calculator to determine the credits required to offset the impact to the CEEC Cumberland Plain Woodland (PCT 850). A

total of 27 ecosystem credits are required to offset the impact to Cumberland Plain Woodland in the study area.

Table 6-36 Summary of biodiversity offset credits required

PCT	Area of impact	Ecosystem credits required
850_Low_Olive	1.06	16
850_Low_Grass	0.65	7
850_Moderate_Bursaria	0.19	5
850_Moderate_Grass	0.00	0
850_Derived Native Grassland	0.02	0
Total	**1.92**	**29**

A Biodiversity Offset Strategy will be prepared prior to work commencing. All offset calculations will be updated following detailed design.

6.8 Aboriginal heritage

The Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) outlines a four-stage process for investigating the potential impact to Aboriginal cultural heritage as a result of Roads and Maritime road planning, development, construction and maintenance activities. The PACHCI includes a process for community consultation that aims to ensure that the role, function and views of Aboriginal people are properly considered and respected in the assessment process. The PACHCI process has been followed in the assessment of the potential impact to Aboriginal culture and heritage as a result of the proposal.

6.8.1 Methodology

A Stage 2 PACHCI assessment was carried out by Artefact Heritage in September 2017 (Artefact Heritage, 2017). The Stage 2 Aboriginal archaeological survey report was prepared in accordance with the OEH *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales 2010* and Stage 2 of the Roads and Maritime PACHCI. The Stage 2 PACHCI assessment consisted of:

- Desktop investigation, including Native Title and Aboriginal Heritage Information System (AHIMS) database searches, as well as consideration of previous archaeological survey reports within and adjacent to the study area
- Detailed site walkover across the study area on 9th and 10th March 2017.

This assessment identified three areas of potential archaeological deposits (PADs) and recommended a program of archaeological test excavations at the PADs to determine the nature, extent and archaeological significance of each area.

In July 2018, an archaeological test excavation program was carried out in accordance with the *OEH Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Test excavations were preformed within each of the PADs (Spring Farm PAD-03, Spring Farm PAD-04 and Spring Farm PAD-05). Forty eight 0.5 m^2 test units were excavated in total with the primary aim to assess the nature and extent of identified archaeological sites. The program was designed to determine the spatial boundaries of the known sites and the degree of intactness or disturbance to inform a future mitigation program. Further details about the test excavations are provided in Section 6.8.2. A subsequent site walkover was undertaken on 11th February 2019 to assess ancillary and boundary adjustments.

Following the test excavations and site walkover, a draft Aboriginal Cultural Heritage Assessment Report (CHAR) was prepared for the proposal. The CHAR would accompany an AHIP for the proposal to impact Aboriginal heritage sites during construction. A draft version of the CHAR has been attached in Appendix H and is summarised in the sections below.

The study area for the Aboriginal heritage assessment is shown in Figure 6-22.

Consultation with the Aboriginal community about the proposal has been carried out in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010) and the PACHCI and is detailed in Section 5.2 of this REF.

Figure 6-22 Aboriginal heritage study area (KNC, 2019)

6.8.2 Existing environment

Aboriginal people living in the Sydney region at the time of first European contact were distinguished by various language groups. Languages recorded across the region included the Darug, Darkingung, Gandangarra and Dharawal.

Three different Aboriginal linguistic groups were recorded in the Camden region near Menangle Park, including the Darkingung, Gandangarra (including Darug language families) and Dharawal. Early European accounts from the 1830s mention the “Cowpastures tribe” to broadly describe clans or bands then living in the Camden and Campbelltown area. Tindale (1974) mapped tribal boundaries in the Camden region and placed the Dharawal language group within the subject area.

Dharawal people were generally divided into two groups: the Sweet (fresh) Water Dharawal and the Salt Water Dharawal, alluding to inland or coastal peoples respectively. Kohen claims that clans living around Camden were part of the ‘inland’ clans (as distinct from coastal people). In the Camden area, Sweet Water Dharawal people were represented by approximately 40 to 50 clans, with individuals numbering between 30 and 60 per clan.

Landscape context

The study area is located on the south eastern margin of the Cumberland Plain, a low lying and gently undulating subregion of the Sydney Basin. The underlying geology is predominantly Bringelly Shale (Rwb) while a small area of Quaternary Alluvium (Qal) is located in the western portion of the study area (see Section 6.6 for further details). Raw materials suitable for artefact manufacture occur widely across the Cumberland Plain, in the form of rock outcrops, large cobbles and various river gravels, with cobbles and clasts deposited across the landscape by the complex network of stream channels.

Land use history

European settlement of the region began in the in the early 19th century with several land grants made along the Nepean River including a grant of 5,000 acres, known as ‘Camden Park’ made to John Macarthur in 1805 approximately three kilometres south of the current study area.

The distribution of native vegetation within the proposal area has been affected by historic and contemporary European land use practices in the region. Prior to 1788, a mixture of native vegetation communities would have extended across the entirety of the Cumberland Plain. The wide variety of native vegetation and sources of permanent water would have made the region an attractive locale for past Aboriginal people. The variety of habitats would also have encouraged a diverse population of fauna.

The clearance of native vegetation across much of the study area by European settlers has left pockets of native vegetation in the vicinity of creeks.

AHIMS search results

A search of AHIMS was conducted on 24 September 2018 to identify registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the study area. The AHIMS search showed 39 Aboriginal sites are recorded in the area surrounding the proposal. These sites are shown on Figure 6-23. The search results are attached as part of Appendix H.

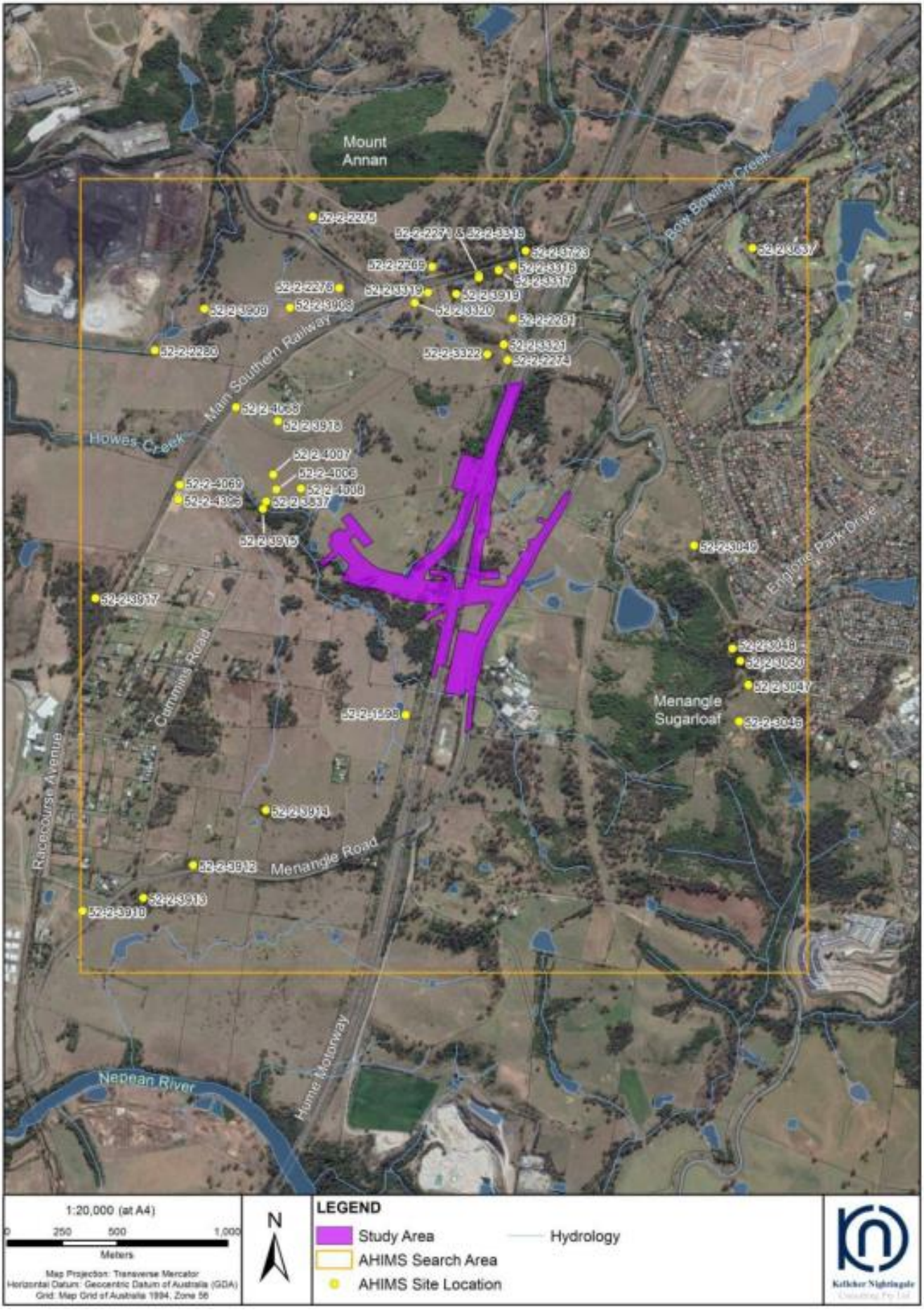

Figure 6-23 AHIMS search results (KNC, 2019)

PACHCI Stage 2 investigations

Within the study area, the following areas of PAD were identified as part of PACHCI Stage 2 investigations, which were the subject of test excavations:

- Spring Farm PAD-3, located about 240 m west of the Hume Motorway
- Spring Farm PAD-4, located about 90 metres west of the Hume Motorway corridor and 650 metres east of Fitzpatrick Street
- Spring Farm PAD-5, located about 160 metres west of Menangle Road.

The archaeological test excavation confirmed the presence of minimal subsurface archaeological deposit at the three areas of potential archaeological deposit: Spring Farm Parkway AFT 1 (formerly Spring Farm PAD-03), Spring Farm Parkway AFT 2 (formerly Spring Farm PAD-04) and Spring Farm Parkway IF 1 (formerly Spring Farm PAD-05).

Spring Farm Parkway AFT 1

Site Spring Farm Parkway AFT 1 was an artefact scatter situated on a gently south sloping landform bound by a steep south sloping spurline to the north and an unnamed tributary of Howes Creek to the south. The site was located within Lot 8 DP249530, approximately 240 metres west of the Hume Motorway corridor and 470 metres east of Fitzpatrick Street.

Test excavations indicated that the site consists of low artefact density, with a limited range of artefact types and dispersed spatial distribution of artefacts which indicate a low potential to retrieve additional archaeological information from the site.

Site Spring Farm Parkway AFT 1 represents a commonly occurring type of site in the region and the artefacts are typical of the region in terms of type and raw material. The site is determined to have **low** archaeological significance.

Spring Farm Parkway AFT 2

Site Spring Farm Parkway AFT 2 was an artefact scatter situated on a gently west sloping landform which overlooked the junction of two unnamed tributaries of Howes Creek. The site was located within Lot 8 DP249530 and Lot 11 DP584016, approximately 90 metres west of the Hume Motorway corridor and 650 metres east of Fitzpatrick Street.

Within the tested area, a range of isolated artefacts which were dispersed and are typical of the region. The artefacts represented isolated events which had been disturbed by natural processes or past land use practices. The site is determined to have **low** archaeological significance.

Spring Farm Parkway IF 1

Site Spring Farm Parkway IF 1 was an isolated artefact which was situated on a gently west sloping landform adjacent to an unnamed tributary of Howes Creek to the south. The site was located adjacent to the Hume Motorway corridor within Lot 11 DP249530 and approximately 160 metres west of Menangle Road.

The site had been disturbed by natural processes or past land use practices and it is unlikely that further investigation could contribute to our understanding of Aboriginal landscape use in the region. The site is determined to have **low** archaeological significance.

Figure 6-24 Identified Aboriginal archaeological sites within the study area (KNC, 2019)

6.8.3 Potential impact

Construction

The entirety of the study area would be impacted by construction and associated work. In total three Aboriginal archaeological sites would be impacted by the proposal. The proposed design would result in an impact to all sites listed in Table 6-37.

Table 6-37 Impact to Aboriginal archaeological sites within the study area

Site name	AHIMS identification	Significance	Degree of impact	Consequence
Spring Farm Parkway AFT 1	TBC	Low	Total	Total loss of value
Spring Farm Parkway AFT 2	TBC	Low	Total	Total loss of value
Spring Farm Parkway IF 1	TBC	Low	Total	Total loss of value

Sites Spring Farm Parkway AFT 1, Spring Farm Parkway AFT 2 and Spring Farm Parkway IF 1 are considered to display low significance based on their scientific value and potential to inform on Aboriginal landscape use in the area.

Suitable recommendations for the identified impact to the sites have been developed based on the environmental context and condition, background research, and consultation with stakeholders. An AHIP is required for impact to land and identified sites/objects prior to the commencement of pre-construction or construction activities associated with the proposal that would affect the sites.

Operation

The operation of the proposal would not result in any impact to Aboriginal heritage.

6.8.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Impact to known Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the *Procedure for Aboriginal cultural heritage consultation and investigation* (Roads and Maritime, 2012) and *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impact on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups.	Contactor	Detailed design / pre-construction

Impact	Environmental safeguards	Responsibility	Timing
Impact to known Aboriginal heritage	An AHIP for the proposal would be obtained prior to construction, and any salvage would be undertaken in accordance with the proposed salvage methodology and any conditions of approval (if granted).	Roads and Maritime Services and contractor	Pre-construction and construction
Finding unexpected artefacts	The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Pre-construction and construction
Fencing ancillary areas.	Due to the proximity of Aboriginal heritage site PAD-03, Compound 2 is to be fenced to avoid impact to nearby the heritage item.	Construction contractor	Pre-construction and construction

6.9 Non-Aboriginal heritage

This chapter describes the environmental values relating to non-Aboriginal heritage and identifies the potential impact to these values as a result of construction and operation of the proposal. This chapter also recommends environmental management measures to reduce the impact of the proposal.

The technical working paper, Non-Aboriginal Heritage Assessment (Appendix I) has been used to inform this chapter.

6.9.1 Methodology

The non-Aboriginal heritage impact assessment identifies the non-Aboriginal heritage items within and immediately adjacent to the proposal (i.e. the study area), assesses the potential impact on the heritage items from the proposed proposal activities, and develops measures to address the impact.

Database Search

A search of all available non-Aboriginal heritage registers was carried out on 5 June 2018. A wider area than the proposed road's footprint was searched to demonstrate the heritage context of the study area, and to include those items that may be impacted visually by the proposal. The register search included:

- World Heritage List
- National Heritage List (NHL)
- Commonwealth Heritage List (CHL)
- Register of National Estate (RNE)
- NSW State Heritage Register (SHR)
- Roads and Maritime Section 170 Heritage and Conservation Register
- National Trust of Australia (NSW) Register
- Campbelltown Local Environmental Plan 2015.

Previous heritage assessments

Previous heritage assessments relevant to the proposal were reviewed. These assessments included:

- AHMS, 2017, Greater Macarthur Investigation Area: Archaeological Research Design and Management Strategy (Final)
- Casey & Lowe, 2010, Non-Indigenous Heritage Study, Menangle Park, NSW
- Colleen Morris and Geoffrey Britton, 2000, Colonial Landscapes of the Cumberland Plain and Camden, NSW
- Water NSW, 2018, Guidelines for Development Adjacent to the Upper Canal and Warragamba Pipelines.

Field survey

A field survey was carried out on 16 July 2018 by Jacobs' Senior Heritage Consultant, Deborah Farina, and Jacobs' Graduate Archaeologist, Chelsea Jones. The purpose of this field survey was to ground-truth the locations of the known heritage items within the landscape and to identify areas with potential for historic archaeological deposits.

The methodology for the field survey was a combination of vehicular and pedestrian survey. Menangle Road was driven in both directions to observe Sugarloaf Farm and its setting within the landscape, as well as its proximity to the Upper Canal System. None of the heritage items were visited, as the impact are planned outside of their curtilages and in relation to Menangle Road, in the existing road corridor. Photos were, however, taken at various vantage points along the route, where possible.

For the purposes of this assessment, the study area used for the field survey is broadly made up of three distinct zones (see Table 6-38).

Table 6-38 Non-Aboriginal heritage field study area zones

Zone	Proposed impact
Menangle Road – eastern side	Widening of eastern side of Menangle Road is proposed. This area is adjacent to Sugarloaf Farm.
Menangle Road – western side	On/off ramps are proposed between the western side of Menangle Road and the eastern side of the Hume Motorway. These ramps would connect to the Hume Motorway. An intersection with Spring Farm Parkway would be built connecting Menangle Road to Spring Farm Parkway.
West of Hume Motorway	On/off ramps from the Hume Motorway and the first 720 metres of Spring Farm Parkway. This land forms part of the former Glenlee Estate.

Significance Assessment

Based on the findings of the desktop assessment and site survey, known or potential heritage items were assessed for significance against the relevant criteria adopted by the NSW Heritage Council pursuant to the *Heritage Act 1977* as well as guidelines under the NSW Heritage Manual. Additionally, for places on Commonwealth land, or owned or managed by the Commonwealth Government's Australian Heritage Council, these have been assessed against the relevant Australian Heritage Council guidelines and its 'significance threshold' test where relevant.

6.9.2 Existing environment

Historical context

When the First Fleet arrived in January 1788, they brought four cows and two bulls with them. In June of that year, the cattle escaped and their whereabouts remained unknown until 1795, when a herd of over 100 head were spotted on the western banks of the Nepean River. Recognising the importance of the herd to the fledgling colony and wishing to protect the cattle, Governor John Hunter prohibited settlement on the western banks of the Nepean.

Menangle was part of those "Cowpastures". The prohibition of land grants in the area was resisted by individuals such as Captain John Macarthur, who was keen to move his wool flock to that side of the Nepean. The Privy Council subsequently overturned the land ban in the Cowpastures and allowed Macarthur 10,000 acres, as well as a ram and ewes from the royal flock at Kew (Emery, 2016). With Macarthur's grant came several further grants along the western banks of the Nepean. On the eastern side of the Nepean, however, a number of land grants had already been made.

As part of the land grants in the Cowpastures area, Governor Macquarie granted 3,000 acres to a Scottish free settler, William Howe in 1818. Originally named "Eskdale", Howe named his grant "Glenlee" after his birthplace and began farming sheep. He also began buying nearby properties to increase his holdings. As well as cattle and sheep grazing, Howe and his neighbours, the Tabers, attempted to grow orchards to rival those of Sydney's north-west. This ultimately failed, however remnants of the Glenlee orchards are still visible on the property (Graham Brooks & Associates, 2001:22). Glenlee, however, was known as a dairy farm. Howe produced one of the first butters to be exported to Britain, under the brand name "Sun and Thistle" (Heritage Division, 2003).

In 1818, Paul Huon was granted 60 acres in the parish of Menangle. This land was named 'Sugarloaf Farm'. In the coming years, Huon began buying up lots in the vicinity of his farm, increasing its size. Sugarloaf Farm was eventually made up of a number of separate small grants and consolidated over a period of time.

Until 1856 the two predominant estates making up the study area were Glenlee and Sugarloaf Farm. After 1856, Sugarloaf Farm became part of the Glenlee Estate following a transfer of ownership.

In 1857 the Main Southern Railway line was surveyed, which ran through the Glenlee property, to the west of the main house. A portion of the Glenlee estate was resumed by the NSW Government, and in 1866 the railway was constructed through this corridor.

In 1869 work commenced on the Upper Nepean Scheme, which sought to draw water from dams outside of Sydney through a series of tunnels and pipes to Prospect Reservoir. The Upper Canal System formed part of that Scheme, comprising two diversion weirs at Pheasants Nest and Broughton's Pass in the Upper Nepean catchment, linked by a gravity fed canal and tunnels (Heritage Division, 2006). The Upper Canal System runs to the east of the study area and passes through Sugarloaf Farm. The section of the scheme passing through Sugarloaf Farm is an open canal, excavated and lined with dry rubble masonry.

Registered historic heritage items

Previous studies and heritage register searches identified the following registered heritage items located immediately adjacent or within the proposal area as described in Table 6-40. There are no items listed on the section 170 registers, National Trust register, NHL or World Heritage List within or adjacent to the proposal. Further details of these items are also presented in Appendix I.

Table 6-39: Registered historical heritage items within or in proximity to the proposal

Heritage item name	Register	Number	Significance	Location
Glenlee, outbuildings, garden	SHR RNE	00009 3277	State	Glenlee Road, Menangle Park
Sugarloaf Farm	SHR	01389	State	Menangle Road, Gilead
Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	SHR	01373	State	To the north and east of the study area

An assessment of significance of these items is included in Appendix I.

Archaeological potential

Land within the study area has generally not been altered since the consolidation of grants which became Glenlee and Sugarloaf Farm. As such, there is a potential for previously unidentified historical heritage items to be within the study area (Casey & Lowe, 2010; Graham Brooks & Associates, 2001).

A search of the listed registers, and review of the previous literature historical background and aerial imagery indicated the following types of historical heritage items may be possible in the proposal area:

- Relics associated with sheep and cattle grazing, and some wheat cropping such as tools, horseshoes and some personal items
- Evidence of small structures such as shepherds' huts or shelters for livestock are possible
- Potential remains of the Grazier's Arms Inn beneath the present-day Menangle Road, and north of Compound 1 (Casey & Lowe, 2010).

The locations of potential archaeological items are shown in Figure 6-25. Further details, including a summary of all archaeological features are provided in Appendix I.

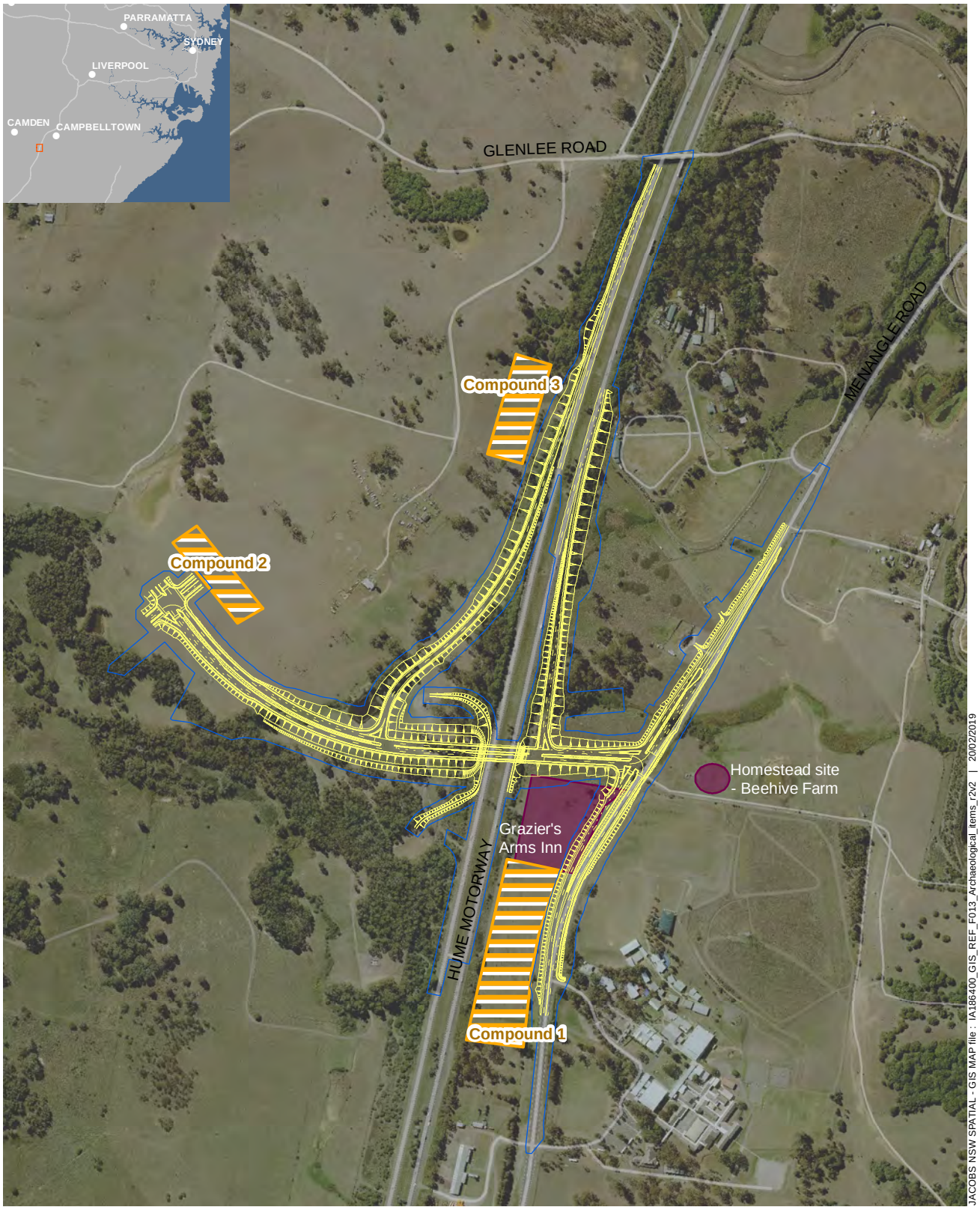

Figure 6-25 | Potential archaeological items

6.9.3 Potential impact

The study area includes part of the curtilages of Sugarloaf Farm and Glenlee homestead. An area of archaeological potential, Grazier's Arms Inn, is located immediately to the north of Compound 1, and adjacent to Menangle Road. The Upper Canal System, while not expected to be directly affected by the proposal is a significant heritage site and is therefore included. Statements of Heritage Impact for each of the identified heritage items are included in Appendix I. The implementation of the general and site-specific environmental management measures listed in Section 6.9.4 would minimise the impact on non-Aboriginal heritage to an acceptable level to proceed with the proposal as assessed.

Sugarloaf Farm

The proposed widening of Menangle Road would be carried out primarily on the western side of the road, and so the potential impact to Sugarloaf Farm is limited. While the proposal does not intersect with the curtilage of Sugarloaf Farm, some work would extend partially into the curtilage of this heritage item. As outlined in Section 3.7, acquisition of an area adjacent to Menangle Road would be required (see Figure 6-26).

A Statement of Heritage Impact has been prepared to support the development of this proposal (Appendix I).

Figure 6-26 Land acquisition – Sugarloaf Farm

While no structures are known to have been built in this zone, a review of the Conservation Management Plan for Sugarloaf Farm, which was prepared by Graham Brooks & Associates in 2001 indicates several archaeological features within the boundary of Sugarloaf Farm curtilage (Graham Brooks & Associates, 2001).

Of the archaeological features identified, most are located a suitable distance to the east to not be affected, however the following items are of relevance to the proposal:

- Deposits of hand-made bricks in large, disturbed deposit adjacent to Menangle Road. Some bricks are exposed on the surface while others form part of a distinctive mound. There is some historical evidence of a farmhouses in this vicinity circa 1830-1840, which formed part of “Beehive Farm”
- A possible additional house site may be located at the south-eastern corner of the property, marked by a cluster of exotic plant species including a pepper tree, a Claret Ash and African Boxthorn. No further information is available regarding this potential site.

Any unexpected relics associated with Sugarloaf Farm are likely to be of State significance. However, the above archaeological assessment also concludes that the potential for such relics is low (Graham Brooks & Associates, 2001). The location of the proposal, the proposed acquisition and archaeological features is shown in Figure 6-28. Further details, including a summary of all archaeological features are provided in Appendix I.

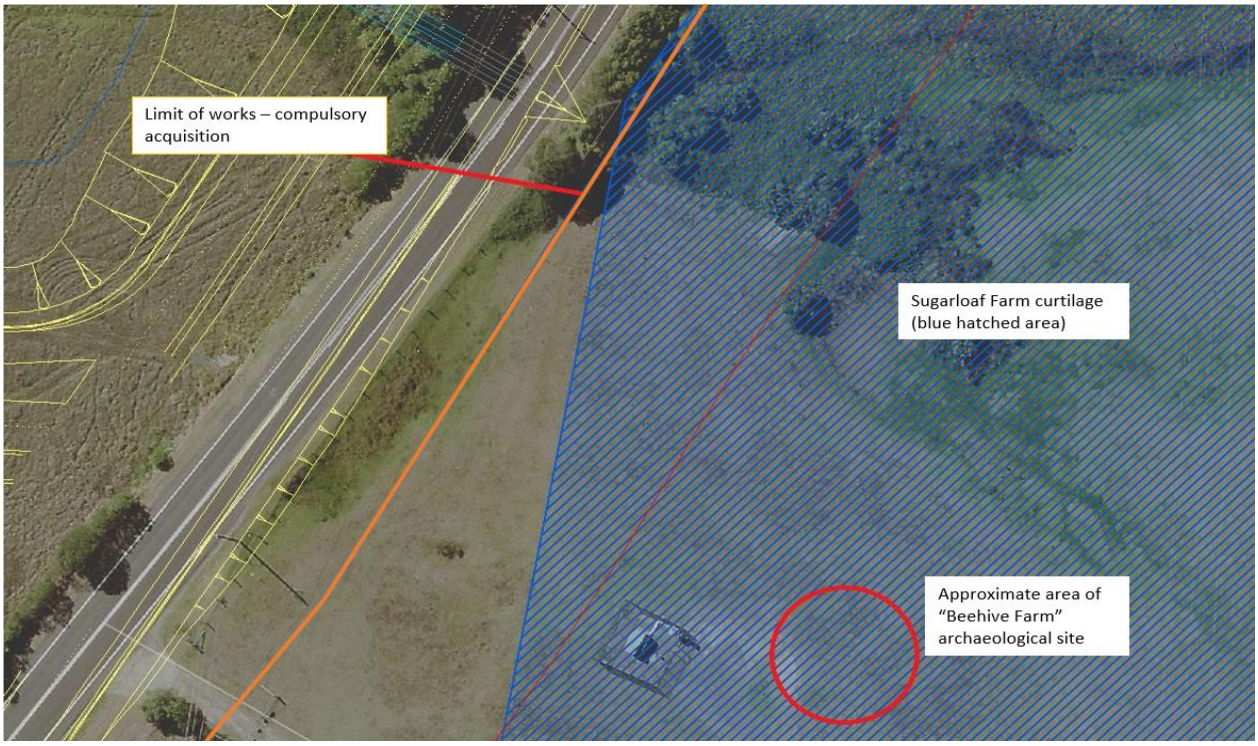

Figure 6-27 Archaeological features in relation to Sugarloaf Farm

It is assessed that the existing built elements of Sugarloaf Farm would not be impacted, and that any road widening to the eastern corridor of Menangle Road would be compulsorily acquired and no longer be part of the heritage curtilage of Sugarloaf Farm. There is no archaeological potential identified in that area.

It is concluded further that road widening is contemplated on the eastern side of Menangle Road near the site of the former Beehive Farm cottage. The site, however, is situated outside the area to be impacted by the proposal.

Glenlee Homestead, outbuildings and gate lodge

The proposal extends about 720 metres westwards into the Menangle Park land release area. This land forms part of the former Glenlee Estate. Work would be more than 450 metres from the curtilage of Glenlee homestead and so no direct physical impact is expected. No built structures are known to have been built near to the proposal (AHMS, 2017) so the potential to encounter known archaeological is considered low.

Grazier's Arms Inn

The north and eastern boundaries of the former Graziers Arms Inn site are likely to be directly impacted, however archaeological deposits including building footings and other infrastructure such as well/cistern and outbuilding remains are likely to be located to the west of the property and therefore would not be impacted by the proposal or Compound 1 to its south.

Upper Canal

This heritage item is located to the east and north of the proposal. It is not considered likely that work would affect this heritage structure.

6.9.4 Safeguards and management measures

Table 6-40 Non-Aboriginal heritage field study area zones

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impact to Non-Aboriginal heritage.	Contactor	Detailed design / pre-construction
Non-Aboriginal heritage – unexpected finds	The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design / pre-construction
Sugarloaf Farm	Work associated with the widening of Menangle Road would limit incursions into the curtilage of Sugarloaf Farm as far as practical and in accordance with the Conservation Management Plan (Graham Brooks & Associates, 2001).	Contractor	Construction
Impact to areas of archaeological potential	If relics of the Sugarloaf Farm, Glenlee or Grazier's Arms Inn are identified during monitoring work then the Roads and Maritime *Standard Management Procedure: Unexpected Heritage Items* (Roads and Maritime Services 2015) should be followed.	Contractor	Construction
Grazier's Arms Inn	Fencing would be installed on the northern boundary of Compound 1 to prevent access to and disturbance of Grazier's Arms Inn.	Contractor	Construction

6.10 Socio-economic

This chapter summarises the Land use, Property and Socio-economic Assessment (Appendix J), and provides an assessment of potential land use, property and socio-economic benefits and impact of the proposal. This chapter also recommends environmental management measures to reduce the potential impact of the proposal.

6.10.1 Methodology

The methodology for this assessment is guided by the *Environmental Impact Assessment Practice Note No. 05: Socio-economic assessment* (EIA-N05) (Roads and Maritime , 2013).

The assessment included:

- Scoping of the potential land use, property and socio-economic impact of the proposal and potentially affected communities
- Analysing existing land use, property and socio-economic conditions and values in the study area, including land use and tenure, population and housing, social infrastructure (that is, education, recreation and health services and facilities), and local businesses
- Identifying and assessing the potential land use, property and socio-economic impact of the proposal's construction and operation, including on local amenity, access and connectivity, social infrastructure and local community values
- Identifying safeguards and management measures to mitigate or manage any identified impact and maximise potential benefits.

The description of the existing socio-economic environment principally draws on data and information from the ABS 2016 Census of Population and Housing. This is supplemented with data and information from:

- NSW Government and other ABS
- Campbelltown City Council website.

6.10.2 Existing environment

The study area includes the Australian Bureau of Statistics (ABS) Statistical Areas Level 2 (SA2) geography of Rosemeadow – Glen Alpine, within the Campbelltown LGA. In June 2017, the Campbelltown LGA had an estimated resident population of 164,273 people. Over the 10 years to 2017, the LGA's population grew at an average of 1.1 per cent annually, although average population growth increased over the five years to 2017 to 1.5 per cent annually. This was below the rate of growth for Greater Sydney as a whole, which grew at 1.7 per cent and 1.9 per cent over the same periods (ABS, 2018).

The Campbelltown LGA forms part of the Greater Macarthur Growth Area – one of the most significant and current future growth areas in south west Sydney. The LGA's population is projected to grow to about 233, 150 people by 2036. This represents an average annual growth rate of 1.7 per cent between 2011 and 2036, which is marginally above the average growth rate for metropolitan Sydney over the same period (1.6 per cent) (Department of Planning and Environment, 2016).

The original inhabitants of the Campbelltown area are the Dharawal Aboriginal people. European settlement in the LGA dates from the early 1800s, with land mainly used for agricultural activities such as wheat, sheep and dairy farming, as discussed in Section 6.9. The LGA comprised predominantly rural uses until the 1960s, with significant resident and employment growth occurring from the late 1960s and continuing during the 1970s and 1980s. Today, Campbelltown LGA is a residential and rural area, with substantial areas of commercial and industrial uses.

Land use

Existing land use within or surrounding the proposal comprises mainly land used for grazing activities. Other land uses include community uses located east of the Hume Motorway (Broughton Anglican College), land used for horse breeding and horse students located south of the proposal, and rural residential uses located south west of the proposal between Racecourse Avenue and Cummins Road.

The proposal footprint is zoned as Infrastructure – future road corridor (SP2). An overview of land use zones within and surrounding the proposal, and the objectives of these zones are outlined in Table 4-2. The objectives of the SP2 zone is to provide for infrastructure and related uses, and to prevent development that is not compatible with or that may detract from the provision of infrastructure. Other objectives of the zone relate to the retention and creation of view corridors, preservation of bushland, wildlife corridors and natural habitat, and maintenance of the visual amenity of prominent ridgelines.

The proposal is located within the Menangle Park / Mount Gilead Priority Precinct of the Greater Macarthur Growth Area (refer to Figure 3-1). Future land use in the precinct is proposed to be predominantly residential uses of varying densities, with commercial uses located in proposed local centres at Mount Gilead and Menangle Park, and village centres at Glenlee and Gilead. The Menangle Park / Mount Gilead Priority Precinct is planned to ultimately provide for about 18,100 dwellings and approximately 4,500 jobs.

Spring Farm Parkway is identified in the structure plan as a proposed east-west road link (Spring Farm Link Road) that would connect Camden Bypass in Spring Farm with the Hume Motorway, Menangle Road and Appin Road. The road is proposed to ease congestion on Narellan Road and Appin Road and to support development in the Menangle Park land release area, as discussed in Section 2.1.

Socioeconomic profile

The composition of the population helps provide information about the area's communities and values. It also assists in profiling how adaptable the community is likely to be to change. The study area's demography in 2016 could be broadly described as comprising a younger population compared to Greater Sydney, with a lower median age, higher proportions of children and working aged people and lower proportions of older people aged 65 years or over. There are relatively low levels of cultural diversity, with lower proportions of overseas born people and people who speak a language other than English at home. There is also a higher proportion of Indigenous people compared to Greater Sydney.

The area's social and economic characteristics as of 2016 are presented in Table 6-42Table 6-41.

Table 6-41: Socio-economic characteristics of the study area

Indicator	Rosemeadow – Glen Alpine	Greater Sydney
Population and growth*		
Estimated resident population (as at June 30 2017)*	21,497	5,131,326
Population growth (2007-2017) (average annual change)* (per cent)	0.3%	1.7%
Age		
Median age	35 years	36 years
0-14 years (per cent)	21.6	18.7
15-64 years (per cent)	66.8	67.4
65 years and over (per cent)	11.6	13.9
Diversity		
Overseas born (per cent)	25.1	36.8
Aboriginal and/or Torres Strait Islander (per cent)	4.2	1.5
Speaks language other than English at home (per cent)	22.5	35.8
Speaks other language and speaks English not well or not at all (per cent)	3.1	6.5
Disadvantage and need for assistance		
Index of relative socio-economic disadvantage (decile)**	3	
Need for assistance (per cent)	5.8	4.9
Households		
Total private dwellings	6,654	
Occupied private dwellings (per cent)	95.6	92.3
Separate dwellings (per cent)	82.5	52.5
Semi detached, row or terrace house, townhouse etc (per cent)	9.5	12.9
Households with no vehicle (per cent)	6.2	11.1

Indicator	Rosemeadow – Glen Alpine	Greater Sydney
Households with two or more vehicles (per cent)	90.3	85.6
Employment and income*		
Median weekly individual income	$640	$719
Median weekly household income	$1,533	$1,750
Unemployment (per cent)	7.6	6.0
Industry of employment (top five responses)	Hospitals (except psychiatric hospitals) (3.7%) Supermarket and grocery stores (3.0%) Takeaway food services (2.8%) Road freight transport (2.3%) Primary education (2.0%)	Hospitals (except psychiatric hospitals) (3.4%) Computer system design and related services (2.5%) Cafes and restaurants (2.5%) Banking (2.5%) Supermarket and grocery stores (2.0%)

*Source: Unless otherwise specified, data is based on 2016 Census of Population and Housing General Community Profile (Cat No. 2001.0) for Rosemeadow – Glen Alpine SA2 and Greater Sydney; *Based on ABS.Stat, ERP by SA2 and above (ASGS 2016), 2001 onwards (**http://stat.data.abs.gov.au/Index.aspx?DataSetCode=ABS_ERP_COMP_SA#**); **ABS (2018b), 2033.0.55.001 – Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2016, released on 27 March 2018 ***2016 Census QuickStats for Rosemeadow – Glen Alpine SA2 (**http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/123021444?opendocument**) and Greater Sydney Greater Capital City Statistical Area (http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/1GSYD?opendocument)*

Households

At the 2016 census, there were 6,654 dwellings within the study area. Separate dwellings were the predominant form of housing in the study area, comprising about 82.5 per cent of total dwellings.

Households in the study area had a relatively high level of car ownership, with more than 90 per cent of households having more than two vehicles at the 2016 Census. Households without access to a motor vehicle comprised 6.2 per cent of households, below the Greater Sydney average at 11.1 per cent.

Employment and income

Individual and household incomes in the study area are below the Greater Sydney average. At the 2016 Census, median weekly incomes were $640 for individuals and $1,533 for households. This is compared to $719 and $1,750 respectively in Greater Sydney.

The study area had relatively high levels of unemployment at the 2016 Census, with 7.6 per cent of the labour force unemployed compared to 6.0 per cent in Greater Sydney. Similar to Greater Sydney, hospitals (except psychiatric hospitals) was the largest industry of employment in the study area with 3.7 per cent of employed people working in this industry. This was marginally above the proportion of people working in this industry in Greater Sydney (3.4 per cent). Other key industries of employment in the study area included supermarket and grocery stores, takeaway food services, road freight transport and primary education.

Business and industry

There are no businesses located within or immediately surrounding the proposal area. The nearest businesses to the proposal are located at Menangle Park and include:

- A newsagency at Cummins Road, that caters for residents in the local area
- Home based businesses (for example, a signwriter)
- Club Menangle within the Menangle Park Paceway facility.

Other businesses in the study area are mainly located in urban areas such as Glen Alpine and Rosemeadow. These include retail businesses such as supermarket, takeaway and food outlets and service stations, as well as various home based businesses offering personal services (for example, hairdressers, fitness training, driver training) and on-line retail services.

As indicated in Section 2.1.1, the Menangle Park / Mount Gilead Priority Precinct identifies future commercial uses in proposed local centres at Mount Gilead and Menangle Park, and village centres at Glenlee and Gilead. The precinct plan also identifies 24 hectares of land for future employment north-west of the proposal area.

An AGL gas well (MP11) is located near the proposal, west of the Hume Motorway.

Social infrastructure

Social infrastructure such as sport and recreation facilities, open space, education, and cultural facilities are generally located within the urban areas of Glen Alpine and Rosemeadow.

Facilities that cater for local and district communities are also located in Menangle Park. These include Menangle Park Paceway at Racecourse Avenue, which comprises a harness racing track and associated facilities. The Paceway is used as a training ground for as many as 200 horses and over 130 meetings are held annually.

Social infrastructure located near the proposal is generally limited and includes Broughton Anglican College and Campbelltown Steam and Machinery Museum, located at Menangle Road. The museum is a volunteer organisation which is open twice a year, including one weekend in May and one weekend in October. Special events are also held at other times of the year, for example the Menangle Military Muster, and the site is also available for hire by other organisations at other times.

Bellbirds Early Learning Centre which caters for up to 52 children a day, aged between six weeks and six years old is located on Taber Street, Menangle. The centre operates between 7:00am and 6:00pm, Monday to Friday and is open 52 weeks per year.

Transport and access

Major roads located near the proposal include the Hume Motorway and Menangle Road, as outlined in Table 2-1. The Spring Farm Parkway is identified as a future major road in the Menangle Park / Mount Gilead Priority Precinct of the Greater Macarthur Growth Area.

The study area is served by both bus and rail public transport. Bus routes operate along Menangle Road (Route 889 and 900) serving areas between Campbelltown and Menangle, including Menangle Park. The bus route operates at 60-minute frequencies during peak times, and limited times during off-peak and on Saturday. No services operate at evenings or on Sundays. Bus stops near the proposal are located at Menangle Road near to Broughton Anglican College, as shown on Figure 1-2.

Formal pedestrian and cycle access is limited near the proposal. No existing pedestrian and cycle infrastructure is currently provided along the Hume Motorway or Menangle Road near the proposal.

6.10.3 Potential impact

Construction

Land use and property

Construction of the proposal would result in a temporary impact on the use of Menangle Road and areas to the west of Menangle Road due to the location of the construction work and site compounds.

Temporary lease of land would be required during construction to accommodate ancillary construction facilities such as worksites, compounds and laydown areas. Properties identified for temporary lease comprise an area to the north of the proposed Spring Farm Parkway within the proposal area and land to the west of Menangle Road, opposite to Broughton Anglican College. The location of these compounds is shown in Figure 1-2. Consideration of the visual and amenity related (noise) impact from these compounds is provided in Section 6.3.4.

Following construction, land occupied by construction work but not required for the ongoing operation of the proposal would be reinstated to its pre-construction use. The impact associated with the temporary lease of land would be short-term and are not expected to be significant.

As indicated in Section 3.3.1, an AGL gas well is located near to the proposal. The AGL access track would be used temporarily by construction vehicles to access the site, as described in Section 6.1. It is estimated that up to 60 truck trips per day and 180 light vehicles per day would occur along this existing access track while in use, and as such the use of this track may temporarily disrupt AGL staff accessing the gas well.

Access to properties near to the construction work for the proposal would be maintained during construction. Where changes are required, suitable access arrangements would be implemented in consultation with affected property owners.

Local business and employment

The proposal would not directly impact on any businesses in the area.

The nearest businesses to the proposal are located at Menangle Park, with other businesses located in the urban areas of Glen Alpine and Rosemeadow. As such, the indirect impact on local businesses due to traffic changes or construction noise and dust is expected to be minor. As outlined in Section 6.1, access to Menangle Paceway would be maintained.

The proposal would support employment through the creation of direct construction related jobs. The proposal would also support indirect jobs in businesses and industries that service the construction phase, including businesses that provide goods and services to support the day-to-day needs of construction and the construction workforce, suppliers of materials and equipment, and transport operators.

Social infrastructure and amenity

Construction work is likely to result in temporary changes in local amenity for residents and community uses closest to the proposed work, due to increased noise and dust from construction activities and increased traffic, including heavy vehicles. The potential impact is further assessed in the relevant sections of the REF including Sections 6.1 (traffic and transport), 6.2 (noise and vibration) and 6.11(air quality). Affected residents include rural residential properties closest to construction work, and those located adjacent to the proposed work at Menangle Road, and at Cummins Road and Fitzpatrick Street west of the proposal area. Construction activities may temporarily impact on the amenity for students, teachers and visitors to the college. These effects are likely to be most noticeable in outdoor teaching and recreation areas located closest to construction work.

Access to Broughton Anglican College would be maintained throughout construction, although temporary changes may be required due to work on Menangle Road. This may result in short-term delays and

disruptions for students, teachers and visitors. An increase in construction traffic, including heavy vehicles along Menangle Road, if not appropriately managed, may present possible safety risks for students and impact on perceptions of student safety, particularly during school drop-off and pick-up times. Communication with the school community about proposed access changes and management of construction traffic would assist in mitigating the potential impact for the college's students, teachers and visitors.

Operation

Land use and property

The proposal is identified in the Menangle Park / Mount Gilead Priority Precinct of the Greater Macarthur Growth Area. Operation of the proposal would support future land use and development in the Greater Macarthur Growth Area. In particular, the proposal would support future population and employment growth in the Menangle Park and Gilead areas.

Locally, operation of the proposal is not expected to change access arrangements for local businesses in the study area. As outlined in Section 3.7, adjustments to driveway accesses would be required to some properties at Menangle Road due to road widening. Access arrangements to individual properties would be finalised during detailed design for the proposal in consultation with affected property owners.

The proposal includes provision of access tracks to the AGL gas well and no impact on the operation of this well is expected from the proposal.

Local business and employment

At a regional level, the proposal would have a longer-term beneficial impact on businesses through improved access and connectivity within the Greater Macarthur Growth Area. In particular, following completion of Spring Farm Parkway stages 1, 2 and 3, the overall proposal would support access to for future commercial centres and employment land within the Menangle Park / Mount Gilead Priority Precinct, as well as provide congestion relief for Narellan Road and Appin Road, helping to improve travel times and reliability for freight and commercial vehicles and reducing transport costs.

Social infrastructure and amenity

During operation, the proposal would improve access and connectivity from future residential areas to community services and facilities near the proposal, including Broughton Anglican College and community uses in urban areas of Glen Alpine and Rosemeadow.

The provision of a shared-use path on the southern side of Spring Farm Parkway and south-eastern side of Menangle Road would improve access for pedestrians and cyclists to the college. This would have a beneficial impact for students and teachers of the college.

Adverse changes to amenity for some parts of Broughton Anglican College may result from increased road traffic noise associated with the new interchange and changes in visual values. The potential impact is discussed further in Section 6.2 and 6.3 respectively.

6.10.4 Safeguards and management measures

Proposed safeguards and management measures relating to the proposal's property, land use and socio-economic impact are outlined in Table 6-42. Other safeguards and management measures that would address the impact is also outlined the following sections:

- Traffic and transport – Section 6.1.4
- Noise and vibration – Section 6.2.6
- Landscape character and visual amenity – Section 6.3.4

- Air quality – Section 6.11.4.

Table 6-42 Socio-economic and land use environmental management measures

Impact	Environmental safeguards	Responsibility	Timing
Property acquisition	All property acquisition will be carried out in accordance with the *Land Acquisition Information Guide* (Roads and Maritime, 2012) and the *Land Acquisition (Just Terms Compensation) Act 1991.*	Roads and Maritime project manager	Pre-construction and construction
Socio-economic	A Communication Engagement and Stakeholder Management Plan (CESMP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum): • 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 CESMP will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (RTA, 2008	Contactor	Detailed design / pre-construction
	Ongoing consultation will be carried out with managers and users of potentially affected social infrastructure (for example Broughton Anglican College, Campbelltown Steam and Machinery Museum, and Bellbirds Early Learning Centre) regarding the timing, duration and likely impact of construction activities.	Contactor	Construction
	Consideration will be given to the timing of construction activities near to social infrastructure in relation to key usage times of social infrastructure (for example, open days at Campbelltown Steam and Machinery Museum).	Contactor	Construction
Access and connectivity	Communication will be carried out with the Broughton Anglican College and Bellbirds Early Learning Centre about the timing of haulage activities and potential changes to road conditions.	Contactor	Construction
	Awareness programs will be carried out for construction workers and transport operators for the proposal about potential road safety risks, including near to	Contactor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Broughton Anglican College and Bellbirds Early Learning Centre.		

6.11 Air quality

This section of the assessment presents a review of the potential air quality impact associated with the construction and post-construction operations phases of the proposal. The method, outcomes and recommended safeguards to effectively manage the air quality-related risks during the development identified above are outlined below.

6.11.1 Methodology

The potential air quality impact associated with the proposal has been evaluated by:

- Identifying key risks during construction and operations, as well as suitable criteria for the evaluation of these risks
- Characterising key features of the surrounding environment including the location of surrounding receivers and sensitive land use areas; prevailing climate and meteorological conditions; and background air quality
- Determining the potential for an impact to occur during construction and operations. Impact during construction was evaluated using metrics developed based on guidance from *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines*, whereas the potential for operational impact was quantitatively assessed using NSW Roads and Maritime Services' Tool for Roadside Air Quality (TRAQ) prediction model, with the impact evaluated by comparing predictions against criteria developed using guidance from the Approved Methods, (EPA, 2016)
- Recommending safeguards to effectively manage any risks to air quality during the proposed work, based on the outcomes of these reviews.

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

Regarding operations, changes to roadside combustion-related pollutant concentrations is the primary risk as a result of changes to traffic conditions expected as a result of the proposal. *The Australia State of the Environment 2016: Atmosphere* (SoE 2016) report (Keywood, Hibberd & Emmerson, 2017) lists carbon monoxide (CO), oxides of nitrogen (NO_x) including nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) as the primary pollutants associated with motor vehicle emissions. Volatile organic compounds (VOCs) are also noted to be a key species of pollutants associated with motor vehicle exhaust emissions.

The Approved Methods for the Modelling and Assessment of Air pollutants in New South Wales (Approved Methods), (NSW Environment Protection Agency [EPA], 2016) lists the 'impact assessment criteria' outlined in Table 6-43 for the purpose of evaluating the key emissions during construction and operations associated with the proposal.

Table 6-43 Approved methods impact assessment criteria, (EPA, 2017)

Pollutant	Averaging period	Concentration (µg/m^3) unless stated)	Source
Total suspended solids (TSP)	Annual	90	NHMRC, 1996
Deposited dust (DD)	Annual	4 g/m^2/month	NERDDC, 1988
	Maximum increase	2 g/m^2/month	NERDDC, 1988
	24 hours	50	DoE, 2016

Pollutant	Averaging period	Concentration (µg/m^3) unless stated)	Source
Particulate matter with an aerodynamic diameter less than 10 microns (PM_{10})	Annual	25	DoE, 2016
Particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$)	24 hours	25	DoE, 2016
	Annual	8	DoE, 2016
Carbon monoxide (CO)	15 minutes	100 mg/m^3	WHO, 2000
	1 hour	30 mg/m^3	WHO, 2000
	8 hours	10 mg/m^3	NEPC, 1998
Nitrogen dioxide (NO_2)	1 hour	246	NEPC, 1998
	Annual	62	NEPC, 1998
Volatile organic compounds (VOCs)	1 hour	29	VGG, 2001

6.11.2 Existing environment

Climate and meteorology

The nearest weather station with long-term historical records operated by the Bureau of Meteorology (BoM) is the Camden Airport automatic weather station (AWS - 068192). This station is located approximately 9.4 kilometres to the northwest of the proposal.

Data from Camden Airport automatic weather station indicates that the locality around the proposal experiences warm and wet summers with mean daily maximum temperatures of around 28 degrees Celsius. The driest period of the year is between July and September with an average monthly rainfall of around 38 millimetres per month during this period. It is during periods of dry, higher temperature conditions that the potential for dust generation is greatest. Winds blowing from the southwest and west are most common in the morning, with winds from the northeast dominant in the afternoon.

Background air quality

The nearest air quality monitoring station in relation to the proposal which monitors the pollutants of interested associated with the construction and operational phases of the proposal is located at Campbelltown West (around 4 kilometres to the northeast).

Data from Campbelltown West station indicates that ambient concentrations are generally below the impact assessment criteria from the Approved Methods, with the exception of 24 hour averaged PM_{10} and $PM_{2.5}$ concentrations, where the 100th percentile concentrations were above, but the 95th percentile values were below the relevant criteria. The annually averaged $PM_{2.5}$ come close to the assessment criteria of 8 µg/m^3, but do not exceed it. This is typical with other observations from the OEH ambient air quality monitoring network throughout Sydney, and underlines the importance of managing the generation of dust including fine particulate matter during the proposal.

Surrounding receivers

The proposal is set within a primarily rural area. The nearest sensitive receivers are listed in Table 6-44 below.

Table 6-44 Nearby sensitive receivers

Receiver ID	Name/category	Distance from proposal
E1	Broughton Anglican College	60 m
R1	Private residence	60 m
R2	Private residence	150 m
M1	Campbelltown Steam and Machinery Museum	75 m

6.11.3 Potential impact

Construction

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

Construction activities have the potential to increase airborne particulate matter and cause nuisance impact where construction is in proximity to sensitive receivers such as residential dwellings and community areas. The potential impact could include:

- Temporary increased windborne dust emanating from disturbed/exposed surfaces from clearing and grubbing
- Dust generation due to the disturbance, movement, storage, loading, transfer and transportation of soil for embankments and fill areas
- Temporary increase in air emissions from dust and products of combustion (from equipment operations).

Construction activities would be temporary in nature but still have the potential to impact on nearby receivers. Environmental management measures have been recommended including appropriate work practices and scheduling, equipment selection, monitoring and preventative controls and as such, the risk of potential air quality impact from construction has been identified as low to moderate.

Operation

The potential impact to air quality during the operational phase of the proposal is generally associated with motor vehicle emissions arising from changes in the volumes of motor vehicles, model of travel, such as free flow of congested and proximity to sensitive receptors. Key pollutants associated with exhaust fumes include carbon monoxide (CO) and nitrogen dioxide (NO_2).

The operational air quality impact was predicted for the following assessment scenarios using the TRAQ dispersion model:

- Scenario 1 – Do Minimum, year of opening (2026)
- Scenario 2 – Proposal, year of opening (2026)
- Scenario 3 – Do Minimum, future year (2036)
- Scenario 4 – Proposal, future year (2036).

Predictions for each scenario where made along relevant proposal segments (i.e. main alignment, exit and entry ramps and Menangle Road) where traffic conditions have changed from the existing conditions. Pollutant concentrations were evaluated at the nearest sensitive receiver areas identified in Table 6-44.

The results from the TRAQ modelling show that incremental contributions at the nearest sensitive receiver location were predicted to be negligible for each scenario assessed and are not expected to result in any additional local exceedances, relative to the 'do minimum' (i.e. no proposal) scenarios. A summary of the predicted operational air quality impact from the TRAQ model are presented in Appendix K.

6.11.4 Safeguards and management measures

Table 6-45 Air quality environmental management measures

Impact	Environmental safeguards	Responsibility	Timing
Air quality	An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to: • 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 • Compliance with Stockpile Site Management Guidelines (Roads and Maritime, 2015) • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.	Contactor	Detailed design / pre-construction

6.12 Waste and resource management

6.12.1 Policy setting

The *Protection of the Environment Operations Act 1997* (POEO Act) covers the requirements for waste generators in terms of storage and correct disposal of waste and their responsibility for the correct management of waste and these have been considered in the assessment of waste generated by the proposal, including the development of environmental management measures.

The *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) promotes waste avoidance and resource recovery by developing waste avoidance and resource recovery strategies and programs. Roads and Maritime endeavours to manage waste in order to conserve resources and reduce the impact associated with waste disposal. The waste management hierarchy is a guide for prioritising waste management practices to achieve these outcomes. This hierarchy was established under the WARR Act. It sets out the preferred order of waste management practices from the most preferred to least preferred as follows:

- Waste Avoidance – Take action to avoid the generation of waste and to be more efficient in its use of resources. If unable to avoid generating waste, then reduce the amount of waste generated and reduce the toxicity or potential harm associated with its generation and management
- Resource Recovery – Maximise the reuse, reprocessing, recycling and recovery of energy from materials
- Disposal – Disposal is the least desirable option and must be carefully handled to minimise negative environmental outcomes.

In addition to managing waste in accordance with the relevant legislation, Roads and Maritime manages waste according to the NSW Waste Avoidance and Resources Recovery Strategy 2014-21 (EPA, 2015) and the NSW Waste Classification Guidelines (EPA, 2014).

6.12.2 Potential impact

Construction

Waste generated during construction would primarily be from work associated with site preparation, relocation of utilities, construction of road infrastructure and landscaping. Major waste-generating activities would include vegetation clearance, generating green waste such as logs and mulched material, construction of temporary construction ancillary facilities and demolition of dwellings and structures on land being wholly or partially acquired.

Additionally, construction including earthworks, placement of pavement layers, drainage, concrete pour, utilities placement and protection, installation of road furniture also has the potential to generate waste streams.

Waste streams are likely to include the following:

- Surplus spoil (excavated soil, sediment, rock) from bulk earthworks or left-over imported fill which is unable to be reused within backfilling or restoration
- Concrete, pavement, steel, and other materials from demolition of kerbs, fencing, pavements
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics, and wrapping materials
- Vegetative waste from clearing and grubbing

- Plant and vehicle maintenance waste, such as oil containers and paint and chemical residue from bridge preparation
- General office waste generated by onsite personnel, such as paper, cardboard, beverage containers, and food wastes
- Sewage waste generated through the use of personnel facilities.

The inappropriate handling or disposal of waste could result in a potential impact to the local environment, including soils, waterways and fauna. Given that all waste would be managed in accordance with Roads and Maritime guidelines and disposed of by a licensed contractor to an appropriately licensed facility, the potential for a significant impact related to waste management is considered unlikely.

A significant quantity of fill would be required for the proposal, specifically for construction of embankments required for Spring Farm Parkway. Based on estimates drawn from the concept design, it is predicted that about 400 000 m^3 of imported fill would be required for construction of the proposal. Imported fill would either be virgin excavated natural material (VENM) or would comply with the conditions for reuse attached to a relevant resource recovery exemption.

Surplus or unsuitable material that cannot be used on-site would be classified in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014) and disposed of at an approved materials recycling or waste disposal facility.

The road pavement materials would be sourced from appropriately licensed facilities (e.g. quarries). The demand for resources would be separated into the various stages of construction work.

The amount of water that would be required during construction is unknown at this stage. The amount would depend on material sources and methodologies applied by the contractor. It is proposed that water would be obtained from the local water supply network.

An estimate of material required for construction of the proposal is provided in Section 3.4.7.

Operation

Waste generated by the operation of the proposal would be limited. The main waste streams would include any oils, liquids and chemicals used for maintenance of plant and equipment used in road maintenance activities and general litter along the motorway.

Operational waste, including general litter clean up, would be managed in accordance with existing operational maintenance requirements for the proposal and the impact is expected to be minimal.

6.12.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site	Contactor	Detailed design / pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.		
Waste	Waste material, other than vegetation and tree mulch, is not to be left on site once the work has been completed.	Contactor	Construction
Spill management	An emergency spill kit is to be kept on site at all times. All staff are to be made aware of the location of the spill kit and trained in its use.	Contactor	Construction

6.13 Other impacts

This section describes the existing environment, potential impact of the proposal and proposed safeguards and management measures in relation to the following environmental factors:

- Groundwater
- Climate change and greenhouse gas emissions
- Hazards and risk.

6.13.1 Existing environment and potential impact

Environmental factor	Existing environment	Potential impact
Groundwater	Seven boreholes were completed in the vicinity of the study area (Roads and Maritime Services, 2017; 2018), which included two boreholes that were installed to monitor groundwater levels for a period of three weeks (BH1002 and BH1003). In addition, a further four boreholes were reviewed to gain an understanding of groundwater levels in the vicinity of the proposal. Groundwater was recorded at depths of between 2.3 and 4.6 metres below ground level. Groundwater levels in the two Roads and Maritime installed boreholes generally declined over the monitoring period. None of the four additional boreholes from the surrounding area had water level or salinity records. No long term monitoring data was available.	**Construction** Groundwater take and temporary construction dewatering are not anticipated to be required for the proposal. However, this is to be confirmed during detailed design. The release of potentially harmful chemicals and other substances into the environment may occur accidentally during construction due to spills as a consequence of equipment malfunction and maintenance or refueling, as a result of inappropriate storage, handling and use of contaminated sediment and via treatment and curing processes for concrete. This has the potential to provide a source for groundwater contamination through recharge which becomes contaminated, or by direct migration of the chemical to the water table. **Operation** The operation of proposal has the potential to impact groundwater quality due to the spill of vehicle oils, lubricants, hydraulic fluids and other accidental spills providing a potential contamination source, which may cause contaminant migration to the water table. Vegetated swales would be provided to

Environmental factor	Existing environment	Potential impact
		ensure the proposal meets the recommended water quality design targets. Further details are provided in Section 6.4. Where piles are used to construct the bridge structure crossing the Hume Motorway they may extend below the water table. The final depths of these piles would be confirmed during detailed design, however if they are beneath the water table these may locally alter groundwater flows and levels. If this occurs, it would not be expected to cause material impact to groundwater systems, including groundwater levels outside the vicinity of any piles.
Climate change and greenhouse gases	Climate change projections for NSW for the years 2020-2039 and 2060-2079 from NSW and ACT Regional Climate Modelling (NARCliM) Project are as follows (OEH, 2014): • Maximum temperatures projected to rise by 0.7ºC by 2030 and 2.1ºC by 2070, with the greatest temperature increases during spring and summer • NSW is expected to experience more hot days (i.e days above 35ºC) in the future, but there are significant regional differences in the number of hot days per year. • Number of days with severe fire danger is projected to increase in summer and spring • Rainfall is projected to increase in summer and autumn and decrease in spring and winter. The projected changes to future climatic conditions would have an effect on existing and proposed projects and infrastructure. Roads and Maritime's *Technical Guide: Climate Change Adaptation Plan for the State Road Network* is to build resilience into the road infrastructure to combat sea-level rise, changes to rainfall frequency and intensity, and more extreme temperatures through controls to build-in design resilience, prevent flooding, improve runoff and	**Construction** Greenhouse gas emissions would result from the following activities: • The onsite use of fuel (both diesel and unleaded gasoline) by vehicles and equipment • The onsite use of electricity purchased from the grid in response to the power requirements to service the work site • Upstream and downstream lifecycle activities (e.g. extraction, processing, production and transport of purchased materials and fuel burned for the generation of electricity consumed onsite, and the disposal of materials off site). The majority of work activities associated with the proposal would generate greenhouse emissions. However, the proposal is of a scale that these emissions are not considered significant. The greatest contribution to the State's annual greenhouse gas emissions from the proposal would come from the embodied energy associated with the energy-intensive production of concrete and other materials required to build the proposal. The clearance of 1.92 hectares of vegetation would also contribute

Environmental factor	Existing environment	Potential impact
	drainage, improve asphalt durability, ensure wind-damage protection, and provide pedestrian shading.	lightly to the greenhouse gas emissions of the proposal due to the loss of a carbon sink. The proposal is located within the floodplain of the Nepean River. Risks of flooding and heavy rainfall would be managed in accordance with measures outlined in Section 6.4.4. However, the potential impact of climate change would be negligible during the construction phase due to its relatively short timeframe. **Operation** Once operational the proposal would support the delivery of the Menangle Park land release area by providing infrastructure needed for vehicles accessing the residential areas. Without the proposal, it is likely that local traffic would need to access these areas via existing local roads. The increased volumes of traffic associated with the residential development of the area would place extensive strain on the existing road network. The proposal would therefore support improved traffic flows and reductions in delays in the area by providing upgrades to Menangle Road, and a dedicated access road (Spring Farm Parkway stage 1). Improved traffic flows would also reduce emissions produced by stop and start traffic, from road users. The proposal would also provide pedestrian and cyclist facilities of which there are none currently provided. Therefore, the proposal would support the uptake of active transport in the area, which in turn would help to reduce the local populations reliance on cars and buses, when compared to the existing environment. Overall the effect of the proposal on greenhouse gas emissions once operational is expected to be minor.

Environmental factor	Existing environment	Potential impact
		Risks to the operation and maintenance of the proposal that might be influenced by climate change may include: • Increased flooding from more extreme flood events • More severe fire weather and elevated fire weather conditions Design of the proposal has considered the potential effects of climate change on flooding. Pavement drainage channels and culverts have been designed to consider a 10 per cent increase in rainfall intensities on the standard 100-year ARI event. Assessment of the results of the hydrological and hydraulic calculations for the 10 year ARI in the climate change scenario indicates that all other pavement drainage pipes would have sufficient capacity to cater for the increased flows (Jacobs, 2018).
Hazards and risks	Hazardous materials and dangerous goods: Storage or handling of such materials does not currently occur within the proposal area. Fuel and oils spills may occur as a result of vehicle crashes or mismanagement during construction. Bushland: The proposal is adjacent to bushland, including the riparian vegetation to the west of Menangle Road. A bushfire hazard assessment was carried out for the rezoning of Menangle Park land release area, which assessed bushfire hazard as low to moderate, based on the topography of the site and low fuel accumulation within the bushfire prone vegetation (Ecological Australia, 2010). Where work is in proximity to the riparian corridor, this area consists of bushfire prone vegetation. Mine subsidence: The proposal is located on land in a mine subsidence district. A desktop assessment completed by RCA (RCA Australia, 2017) concludes that no mining has taken place within the footprint and that current long wall	Hazardous materials and dangerous goods: Small quantities and inventories of these materials would be required during construction. Therefore, transportation, use and storage of these materials would occur. The potential impact to soil and water quality, workforce safety may occur should spills or improper storage and handling occur. The potential impact is not likely to be significant given the implementation of relevant legislation, National Codes of Practice and Australian Standards for the storage and handling of dangerous goods and materials; and recommended safeguards described in Section 6.12.3. Bushland: Bushfires whether they are prescribed burning, wildfire or unintentionally ignited would result in loss of vegetation, fauna habitat and fauna species. If uncontrolled, bushfires can result in property damage; and pose risk to the safety and health of the workforce, road users and local residences due to heat, smoke and ash generation. A safeguard is recommended to manage site activities, such as hot work, and to minimise the impact should a bushfire occur. With such

Environmental factor	Existing environment	Potential impact
	mining approvals limits are two kilometres south of the proposal area. The proposal would require construction personnel in proximity to live traffic.	management controls in place, the potential impact is not likely to be significant. Mine subsidence: No future mining in the proposal area is anticipated. As detailed in Section 4.2.7, approval under section 22 of the *Coal Mine Subsidence Compensation Act 2017* was granted for the proposal, subject to conditions detailed below.

6.13.2 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Groundwater	Groundwater quality is to be monitored on a quarterly basis over three sampling rounds at Roads and Maritime groundwater monitoring boreholes (BH1002 and BH1003) to provide baseline groundwater quality data for the proposal.	Roads and Maritime	Detailed design / pre-construction	
Groundwater-Accidental spills	Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids.	Contractor	Construction	
Greenhouse gases – emissions	Identify recycled materials (such as recycled aggregates in road pavement and surfacing; steel with recycled content) for use in construction or operation of the proposal where they are cost, quality and performance competitive	Contractor	Detailed design	
Greenhouse gases – emissions	Review of cut and fill balances for earthworks to ensure material is transported the least possible distances	Contractor	Construction	
Hazards and risk management	A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.	Contactor	Detailed design / pre-construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
Hazards and risk - Bushfire	A Bushfire Risk Management Plan (BRMP) will be prepared and implemented as part of the CEMP. The BRMP will include but not be limited to: • Fire response equipment such as fire extinguisher and fire blanket to be kept on vehicles at the work and compound sites • The fire rating will be checked at the start of each day • Hot work will not be permitted on total fire ban days • An evacuation plan will be kept onsite and staff will be made aware of this and their responsibilities in the event of a fire • A site for smoking will be established at least 40 metres away from dense vegetation and butt disposal bins will be made available.			
Hazards and risk – mine subsidence	Submit an Engineering Impact Statement, detailing the final design and design methodology for acceptance by SA NSW.	Roads and Maritime	Detailed design / pre-construction	
Hazards and risk – mine subsidence	Establish a number of permanent survey marks to AHD so that building movement can be monitored should mine subsidence occur. Detials of these permanent survey marks are to be forwarded the SA NSW	Contractor	Construction	
Utilities	Prior to the commencement of work: • Additional potholing would be required to confirm depths of APT Management high pressure gas transmission pipeline beneath Menangle Road during detailed design • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be carried out.	Contactor	Detailed design / pre-construction	

6.14 Cumulative impact

6.14.1 Study area

A cumulative impact occurs when two or more projects are carried out concurrently and in proximity to one another. The impacts may be caused by both construction and operational activities and can result in a greater impact to the surrounding area than would be expected if each project was carried out in isolation.

A search of the Department of Planning and Environment's Major Projects Register, Sydney South West Planning Panel and Campbelltown City Council Development Application Register in September 2018 was carried out for Menangle Park and the surrounding suburbs of Menangle, Spring Farm and Glen Alpine. The identified projects are described in Table 6-46.

Other developments likely to occur within the locality would be small scale projects and would be unlikely to result in a cumulative impact with the proposal.

6.14.2 Other projects, proposals and developments

At the time of review, there was no development applications lodged with Campbelltown City Council which were within the search area.

Other Roads and Maritime projects and proposals in proximity to the proposal have been considered.

It is not anticipated that during construction, the development of Menangle Park land release area would have begun, so this has been excluded from this assessment of cumulative impacts.

Table 6-46: Other projects and developments within the area

Project	Construction impact	Operational impact
Appin Road Upgrade, Mount Gilead to Ambarvale Roads and Maritime Services NSW proposes the staged upgrade of a 5.4-kilometre section of Appin Road between a section of the road in Mount Gilead in the south, and the intersection of St Johns Road, Ambarvale in the north.	The proposal would remove about 7.28 hectares of native vegetation, which is comprised of two threatened ecological communities, including Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, and Grey box – Forest Red Gum grassy woodland on flats of the Cumberland Plain. The native vegetation within the study area is potential habitat for a number of threatened species, including the koala and Cumberland Plain Land Snail which have been identified within the proposal footprint. Other temporary construction impacts would include minor travel time delays to existing traffic, temporary noise impacts to surrounding receivers	Operation of the proposal would result in significant reductions in the travel time of all vehicles in peak periods compared to the existing case if no upgrades were to occur. The provision of a dual carriageway would also provide improvement to safety for road users due to the separation of traffic flows.
Appin Road Safety Improvements from Brian Road to	The proposal would remove about 4.75 hectares of native vegetation, 3.31 hectares of which comprise two	Operation of the proposal would result in improved safety for road users along Appin Road.

Gilead Roads and Maritime Services NSW proposes road safety improvements to about a 5.2-kilometre section of Appin Road from the intersection of Appin Road and Brian Road, Appin, and extending north to about 360 metres north of Beulah Reserve, Gilead.	endangered ecological communities, these being Shale Sandstone Transition Forest and Cumberland Plain Woodland. The native vegetation within the study area is potential habitat for a number of threatened species, including koalas and Cumberland Plain land snail which have been identified as occurring within the study area. increased peak period congestion and queuing may potentially occur as a result of the work, leading to minor travel-time delays. During construction, the proposal would result in a temporary noise impact to the surrounding community. These would be most prevalent for surrounding residents, especially if there is any work at night.	The proposal is not expected to introduce more traffic onto the road when operational.
Campbelltown Hospital Redevelopment Stage 2 The project involves the removal of existing parking and construction of on-grade parking. At the conclusion of Stage 2 Redevelopment there will be an increase from the existing provision of 1280 parking spaces to 1868 spaces. The Environmental Impact Statement for this project is currently on display.	The site is located to the south-west of Campbelltown town centre, about three kilometres from the proposal. Due to the distance between work, it is unlikely that there would be cumulative noise, air quality or other amenity related impact. However, depending on the timing of construction, there may be potential cumulative traffic related impacts. The Traffic Impact Assessment (ptc, 2018) identified Menangle Road as a secondary access road and so the concurrent use of this road may result in traffic congestion due to the presence of construction vehicles and deliveries.	No operational impact is anticipated.
Newnes Kaolin Sand Processing Plant (Lot 38 DP 1098588) This project is for the development of a plant for processing raw sand railed to site from an approved quarry and mine in the Blue Mountains. Sand will be processed to produce a range of products including kaolin for ceremic use and export and sand products for a range of industrial and construction uses.	The Environmental Impact Statement is currently in preparation. The potential impacts during the construction of the Newnes kaolin processing plant may include: • Water quality, including impacts to the Nepean River • Air quality impact from dust • Noise and vibration • Non-Aboriginal heritage including impact to Glenlee Estate • Social and land use • Traffic and transport.	With total estimated reserves of over 20Mt, and geological reserves close to 70Mt, the pit life is expected to exceed 21 years once operational. Material would be delivered to and the plant for processing via the Main Southern Railway. The proposed facility would see an increase in production of heavy vehicle traffic. It is expected to generate 180 truck movements.

The processing plant would be located about 2.4 kilometres west of the proposal and would be situated off Glenlee Road Springfarm. The proponent is currently preparing an Environmental Impact Statement for this project in response to SEARs		Operational impacts of this development may include: • Noise, air quality and other amenity-based impacts • Generation of additional traffic due to operational truck movements • Generation of local jobs.

6.14.3 Potential impact

Construction

In the case of the proposal, it has been assumed that any of the above projects, or proposals have the potential to be built around the same time as the proposal. Currently there is no information available about the timing of these proposals, however for the purposes of this assessment, it has been considered possible that the projects may occur concurrently or within succession of one another. If construction activities overlap this may result in potential traffic management issues during construction. Traffic adjustments required during construction would be coordinated through the TMC and in consultation with other developments.

Development of the Campbelltown Hospital Stage 2 is located around three kilometres from the proposal and as such it is considered that the amenity related impact or community fatigue would be minimal and not considered significant. However, the construction of the Newnes Kaolin Sand Processing Plant may lead to cumulative effects of dust, noise or other amenity impacts and also result in community fatigue. With noise mitigation in place for all relevant projects, air quality impacts should be managed appropriately, and noise levels at sensitive receivers should be within specified noise criteria.

Operational

The proposal (Spring Farm Parkway) has been identified within the Newnes Kaolin Sand Processing Plant Preliminary Environmental Assessment (RPS, 2016) as one of the routes that would be utilised by the processing plant for exporting treated materials. Therefore, once operational the proposal would provide capacity for future traffic growth and improved freight access to the Hume Motorway. In doing so the proposal would create an operational benefit for the Newnes Kaolin Sand Processing Plant. Traffic modelling and assessment for proposal has taken into account regional growth and development and the resultant traffic impact for the operational phase of the proposal.

7. Environmental management

This chapter describes how the proposal will be managed to reduce the 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 impact, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) would be prepared to describe the safeguards and management measures identified. The CEMP would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The CEMP would 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 work. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the 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 would 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 would minimise any potential adverse impacts arising from the proposed work 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
GEN1	General - minimise environmental impacts during construction	A CEMP will 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 will address the following: • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review. The endorsed CEMP will be implemented during the undertaking of the activity.	Contractor / Roads and Maritime project manager	Pre-construction / detailed design
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / Roads and Maritime project manager	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
GEN3	General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the proposal. This will include up-front site induction and regular "toolbox" style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: • areas of Aboriginal heritage sensitivity, especially around Compound 2 • areas of non-Aboriginal sensitivity (Sugarloaf Farm, Glenlee and Grazier's Arms Inn) • threatened species habitat on the western side of Hume Motorway • noise management measures in relation to surrounding receivers including Broughton Anglican College.	Contractor / Roads and Maritime project manager	Pre-construction / detailed design
TT1	Traffic and transport	A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would 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 would include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impact on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic Monitoring, review and amendment mechanisms.	Contractor	Detailed design / Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
TT2	Road damage	Undertake a pre-construction dilapidation survey of local roads used for construction. Defects caused by construction activities would be rectified prior to completion of construction.	Contractor	Construction
TT3	Property access	Access to properties along Menangle Road would be maintained during construction. The need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.	Contractor	Construction
TT4	Broughton Anglican School access	Access to Broughton Anglican School would be maintained during construction. The need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.	Contractor	Construction
TT5	Traffic and transport – bus services	Interaction between commuters accessing Menangle Park Station across Racecourse Avenue, and construction traffic would be managed to ensure safety for road users as part of the construction traffic management plan.	Contractor	Construction
TT6	Traffic and transport – bus services	The final location of temporary bus stops would be confirmed based on consultation with the bus route operator (Picton Buslines).	Contractor	Construction
TT7	Traffic and transport – cycling facilities	Alternative routes would be identified as part of the construction traffic management plan which may require closure of the motorway to cyclists between Picton Road and Narellan Road.	Contractor	Construction
NV1	Noise and vibration	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: • all potential significant noise and vibration generating activities associated with the activity • feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Roads and Maritime, 2014). • a monitoring program to assess performance against relevant noise and vibration criteria	Contactor	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• 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.		
NV2		Viable mitigation measures that would be expected to be deployed by the construction contractor once the final construction sequencing and scheduling is known include: • Restricting work to standard construction hours as far as practicable, considering safety and traffic management requirements • Selecting quieter plant and equipment • Erecting temporary acoustic hoarding to reduce noise form work within a confined area • Deploying mobile hoardings (eg, acoustic screen curtains mounted on a wheeled trailer) to track moving, but tightly-contained processes • Maximising offset distances between receivers and noisy plant or activities • Orientating plant and processes away from residences, where reasonably practicable • Scheduling work for times outside of heightened sensitivity for the impacted receiver, eg, outside of school hours; • Scheduling respite periods for noise-intensive processes undertaken near receivers, eg. limiting operation of pavement sawing to three hours at a time • Planning any out-of-hours work (OOHW) so that noisier work is carried out in the earlier part of the evening or night-time • Minimising the number of consecutive nights of work adjacent to any particular set of receivers • Restricting heavy vehicle movements, heavy deliveries and loading and unloading processes to daytime periods and to areas well away from receivers • Regularly maintaining and monitoring plant and equipment to ensure that their noise emissions are not excessive	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Minimising the annoyance from reversing alarms by either fitting closed circuit monitors or non-tonal reversing alarms (“quackers”) on vehicles or deploying ‘spotters’ to oversee reversing movements Reducing throttle settings and switching off equipment when it is not being used.		
NV3	Noise and vibration	All sensitive receivers (eg schools, local residents) likely to be affected would be notified at least [insert no. of 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: • the project • the construction period and construction hours • contact information for project management staff • complaint and incident reporting how to obtain further information.	Contactor	Detailed design / pre-construction
NV4	Construction noise	Consider respite periods and verification for receiver identified as being eligible for additional mitigation in accordance with CNVG	Contractor	Construction
NV5	Construction traffic	Schedule construction of the Hume Motorway deceleration late and northbound access ramp as early as practicable to limit construction traffic impacts to residents of Menangle Park.	Contractor	Pre-construction /
NV6	Construction vibration	Where vibration intensive plant such as vibratory rollers, rock hammers or bored piling rigs are used, vibration must be managed to minimise disturbance to building occupants and to avoid damage to buildings and other structures. Specific measures to manage the potential for vibration impacts would be determined as part of the CNVMP developed at the detailed design stage once the specific equipment schedule and localised geotechnical conditions are known.		
NV7	Construction vibration	CNVMP should consider implementing the following measures to limit construction vibration levels:		

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Use lower vibration generating items of excavation plant and equipment, such as smaller capacity rockbreakers or concrete crushers/pulverisers in place of rockbreakers, where feasible. • Suitably program the hours of operation of major vibration generating plant and equipment; • Minimise consecutive work in the same locality; • Use dampened rockbreakers and/or “city” rockbreakers; • Undertake attended vibration monitoring where vibration-intensive work is required to be undertaken within the safe working distances; • Complete building condition surveys before and after vibration-intensive work to identify existing damage and any damage due to the works.		
NV8	Operational noise – at property treatment	Determine the specific form of acoustic building treatment required to meet the necessary noise reductions of internal noise levels at least 10 dB(A) below external noise goals, with regard for the existing construction of the building, and in consultation with the landowner.	Roads and Maritime	Detailed design / pre-construction
LV1	Landscape character and visual impact	An Urban Design Plan will be prepared to support the final detailed proposal design and implemented as part of the CEMP. The Urban Design Plan will present an integrated urban design for the proposal, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for: • 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	Contactor	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Urban Design Plan will be prepared in accordance with relevant guidelines, including: • *Beyond the Pavement urban design policy, process and principles* (Roads and Maritime, 2014) • *Landscape Guideline* (RTA, 2008) • *Bridge Aesthetics* (Roads and Maritime 2012) • *Noise Wall Design Guidelines* (RTA, 2006) • *Shotcrete Design Guideline* (RTA, 2005).		
LV2	Visual impact as a result of vegetation loss	Minimise footprint and disruption to creek lines, and retain vegetation beyond the footprint in order to retain any existing screening	Contactor	Construction
LV3	Visual impact as a result of vegetation loss	Stabilise/revegetate as work progress to limit erosion and visual impact through early integration with surrounding vegetation	Contactor	Construction
LV4	Lighting impact	The design of temporary lighting must avoid unnecessary light spill on adjacent residents or sensitive receivers and be designed in accordance with AS 1158.1-1986.	Contactor	Construction
LV5	Visual impact from construction sites	Set out compounds to limit impact Consider screening and the location of key structures which provide the greatest visual impact	Contactor	Construction
LV6	Visual impact from construction sites	Maintain compound in a tidy and well-presented manner Provide and maintain screening	Contactor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
SW1	Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design / pre-construction
SW2	Soil and water	A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / Pre-construction
SC1	Soils	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design / Pre-construction
SC2	Soils	A site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / Pre-construction
SC3	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.	Contractor	Detailed design / Pre-construction
SC4	Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines.	Contractor	Detailed design / Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers).		
BD1	Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Roads and Maritime	Detailed design
BD2		Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction
BD3		Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
BD4		Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
BD5		The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Construction
BD6		Clearing limits and exclusion zones clearly identified prior to work within/adjacent Cumberland Plain Woodland and Swamp Oak Floodplain Forest.	Contractor	Construction
BD7		A Flora and Fauna Management Plan 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 will include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the Landscape Guideline (RTA, 2008)	Contractor / Roads and Maritime	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• 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.		
BD8	Removal of threatened species habitat and habitat features	Habitat removal will be minimised through detailed design.	Roads and Maritime	Detailed design
BD9		Habitat removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).	Contractor	Construction
BD10		Habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). This will include installation of nest boxes to replace lost hollows and salvage and re-use/installation of hollows from hollow-bearing trees that are removed.	Contractor	Construction
BD11		The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Construction
BD12		Important habitat features such as woody debris and bushrock would be re-used in suitable locations nearby, in accordance with Roads and Maritime Biodiversity Guidelines - Guide 5 (Re-use of woody debris and bushrock.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
BD13	Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).	Contractor	Construction
BD14		Clearing limits and exclusion zones clearly identified prior to work within the vicinity of the population of *Pimelea spicata* to ensure no impacts to the population.	Contractor	Construction
BD15	Aquatic impacts	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	Contractor	Construction
BD16	Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Roads and Maritime	Detailed design
BD17	Fragmentation of identified habitat corridors	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (RTA 2011).	Roads and Maritime	Detailed design / operation
BD18		Any connectivity measures implemented will be designed and installed under the supervision of an experienced ecologist.	Contractor / Roads and Maritime	Detailed design / pre-construction
BD19		Wildlife signage, street lighting and appropriate vehicle calming devices will be considered in areas with a history of fauna vehicle strike.	Contractor	Construction
BD20		Consider installation of glider poles and/or rope crossings to assist fauna to cross the road safely.	Contractor	Construction
BD21	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor / Roads and Maritime	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
BD22		Clearing limits and exclusion zones clearly identified prior to within/adjacent Cumberland Plain Woodland and Swamp Oak Floodplain Forest.	Contractor / Roads and Maritime	Detailed design / pre-construction
BD23	Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
BD24		Implementation of two stage clearing process to allow fauna to disperse from habitat voluntarily; inspection of hollows by experienced ecologist/fauna spotter/catcher prior to and after clearing of hollow-bearing trees/stags to safely remove and relocate any injured /displaced fauna.	Contractor	Construction
BD25	Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
BD26		Establishment of clearing limits and exclusion zones within/adjacent to Cumberland Plain Woodland and Swamp Oak Floodplain Forest.	Contractor	Construction
BD27		To prevent the spread of weed seed, all weed material removed will be disposed of in a suitable waste facility and not mulched on site. This is to avoid the reintroduction and further spread of weeds in the area.	Contractor	Construction
BD28	Invasion and spread of pests	Pest species will be managed within the proposal site.	Contractor	Construction
BD29	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
BD30	Noise, light and vibration	Shading and artificial light impacts will be minimised through detailed design.	Roads and Maritime	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
ABH1	Impact to known Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the *Procedure for Aboriginal cultural heritage consultation and investigation* (Roads and Maritime, 2012) and *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impact on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups.	Contactor	Detailed design / pre-construction
ABH2	Impact to known Aboriginal heritage	An AHIP for the proposal would be obtained prior to construction, and any salvage would be undertaken in accordance with the proposed salvage methodology and any conditions of approval (if granted).	Roads and Maritime Services and contractor	Pre-construction and construction
ABH3	Finding unexpected artefacts	The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Pre-construction and construction
ABH4	Fencing ancillary areas	Due to the proximity of Aboriginal heritage site PAD-03, Compound 2 is to be fenced to avoid impact to nearby the heritage item.	Construction contractor	Pre-construction and construction
HH1	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impact to Non-Aboriginal heritage.	Contactor	Detailed design / pre-construction
HH2	Non-Aboriginal heritage – unexpected finds	The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
HH3	Sugarloaf Farm	Work associated with the widening of Menangle Road would limit incursions into the curtilage of Sugarloaf Farm as far as practical and in accordance with the Conservation Management Plan (Graham Brooks & Associates, 2001).	Contractor	Construction
HH4	Impact to areas of archaeological potential	If relics of the Sugarloaf Farm, Glenlee or Grazier's Arms Inn are identified during works then the Roads and Maritime *Standard Management Procedure: Unexpected Heritage Items* (Roads and Maritime Services 2015) should be followed. This should include consideration of, and management of potential vibration related impacts.	Contractor	Construction
HH5	Grazier's Arms Inn	Fencing would be installed on the northern boundary of Compound 1 to prevent access to and disturbance of Grazier's Arms Inn.	Contractor	Construction
SEC1	Property acquisition	All property acquisition will be carried out in accordance with the *Land Acquisition Information Guide* (Roads and Maritime, 2012) and the *Land Acquisition (Just Terms Compensation) Act 1991.*	Roads and Maritime project manager	Pre-construction and construction
SEC2	Socio-economic	A Communication Engagement and Stakeholder Management Plan (CESMP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum): · 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 CESMP will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (RTA, 2008	Contactor	Detailed design / pre-construction
SEC3		Ongoing consultation will be carried out with managers and users of potentially affected social infrastructure (for example Broughton Anglican College, Campbelltown Steam and Machinery Museum, and Bellbirds Early Learning Centre) regarding the timing, duration and likely impact of construction activities.	Contactor	Construction
SEC4		Consideration will be given to the timing of construction activities near to social infrastructure in relation to key usage times of social infrastructure (for example, open days at Campbelltown Steam and Machinery Museum).	Contactor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
SEC5	Access and connectivity	Communication will be carried out with the Broughton Anglican College about the timing of haulage activities and potential changes to road conditions.	Contactor	Construction
SEC6		Awareness programs will be carried out for construction workers and transport operators for the proposal about potential road safety risks, including near to Broughton Anglican College and Bluebells ELC.	Contactor	Construction
AQ1	Air quality	An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to: · 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 · Compliance with Stockpile Site Management Guidelines (Roads and Maritime, 2015) · Methods to manage work during strong winds or other adverse weather conditions A progressive rehabilitation strategy for exposed surfaces.	Contactor	Detailed design / pre-construction
WAS1	Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: · measures to avoid and minimise waste associated with the proposal · classification of wastes and management options (re-use, recycle, stockpile, disposal) · statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions · procedures for storage, transport and disposal · monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.	Contactor	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
WAS2	Waste	Waste material, other than vegetation and tree mulch, is not to be left on site once the work has been completed.	Contactor	Construction
WAS3	Spill management	An emergency spill kit is to be kept on site at all times. All staff are to be made aware of the location of the spill kit and trained in its use.	Contactor	Construction
GW1	Groundwater	Groundwater quality is to be monitored on a quarterly basis over three sampling rounds at Roads and Maritime groundwater monitoring boreholes (BH1002 and BH1003) to provide baseline groundwater quality data for the proposal.	Roads and Maritime	Detailed design / pre-construction
GW2	Groundwater-Accidental spills	Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids.	Contractor	Construction
GG1	Greenhouse gases – emissions	Identify recycled materials (such as recycled aggregates in road pavement and surfacing; steel with recycled content) for use in construction or operation of the proposal where they are cost, quality and performance competitive	Contractor	Detailed design
GG2	Greenhouse gases – emissions	Review of cut and fill balances for earthworks to ensure material is transported the least possible distances	Contractor	Construction
HAZ1	Hazards and risk management	A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to: · Details of hazards and risks associated with the activity · Measures to be implemented during construction to minimise these risks · Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials · A monitoring program to assess performance in managing the identified risks · Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations.	Contactor	Detailed design / pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.		
HAZ2	Hazards and risk - Bushfire	A Bushfire Risk Management Plan (BRMP) will be prepared and implemented as part of the CEMP. The BRMP will include but not be limited to: · Fire response equipment such as fire extinguisher and fire blanket to be kept on vehicles at the work and compound sites · The fire rating will be checked at the start of each day · Hot work will not be permitted on total fire ban days · An evacuation plan will be kept onsite and staff will be made aware of this and their responsibilities in the event of a fire A site for smoking will be established at least 40 metres away from dense vegetation and butt disposal bins will be made available.		
HAZ3	Hazards and risk – mine subsidence	Submit an Engineering Impact Statement, detailing the final design and design methodology for acceptance by SA NSW.	Roads and Maritime	Detailed design / pre-construction
HAZ4	Hazards and risk – mine subsidence	Establish a number of permanent survey marks to AHD so that building movement can be monitored should mine subsidence occur. Detials of these permanent survey marks are to be forwarded the SA NSW	Contractor	Construction
UT1	Utilities	Prior to the commencement of work: · Additional potholing would be required to confirm depths of APT Management high pressure gas transmission pipeline beneath Menangle Road during detailed design · The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be carried out.	Contactor	Detailed design / pre-construction

7.3 Licensing and approvals

A list of licensing and approvals that may be required for this proposal are listed in Table 7-2.

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
National Parks and Wildlife Act 1974 (s90)	Aboriginal heritage impact permit from the Chief Executive of OEH for impacts to three Aboriginal archaeological sites.	Prior to start of the activity.
Protection of the Environment Operations Act 1997	Environment Protection Licence for waste disposal by application to land within a regulated area (Campbelltown LGA)	Prior to start of the activity.
Coal Mine Subsidence Compensation Act 2017	Approval to alter or erect improvements or to subdivide land within a mine subsidence district from the Mine Subsidence Board.	Prior to start of the activity
Roads Act 1993	Road occupancy licence to dig up, erect a structure or carry out work in, on or over a road	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 impact, 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

The proposal would provide a new road link connecting between Menangle Road, the Hume Motorway and the Menangle Park Land Release Area. In the immediate future, the proposal would provide access to the new housing subdivision being developed by Dahua Pty Ltd on the western side of the Hume Motorway, which consists of 1,500 lots proposed for completion in 2022. In the future, the proposal is needed to support the development of the Menangle Park land release area, and the wider development of the Greater Macarthur Growth Area.

There would be some short-term disruption while the proposal is being built, for example due to noise, traffic and amenity-based impact. Such an impact is consistent with similar road-development proposals and would be safeguarded and managed by implementing measures that have been set out in published Roads and Maritime environmental management guidance as being effective in reducing the magnitude, extent, duration and scope of the proposal's impact. Central to this would be managing and timing the construction work to minimise the disruption as far as is reasonably and feasibly for road users, residents and other affected stakeholders.

The proposal would also result in some permanent impact to biodiversity, with the removal of 1.92 hectares of vegetation. It would also have an effect on areas of non-Aboriginal and Aboriginal heritage. This REF and its supporting technical studies have identified the risks and impact that would occur as a result of 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 operation of the proposal would provide a number of social benefits to the region, including the provision of new shared path and improved access due to the additional road capacity and new routes connecting to the west of the Hume Motorway. The proposal would also help to unlock economic and social benefits for the wider community, by facilitating the wider development of the area.

Overall, the proposal is considered to be in the public interest because it would provide the following benefits:

- Improve the capacity of Menangle Road to handle forecasted traffic levels
- Provide cycling and pedestrian facilities at Menangle Road and Spring Farm Parkway
- Support residential growth by providing arterial road access to the Menangle Park land release
- Support employment growth by improving arterial road access to the Hume Motorway and Campbelltown.

Overall the proposal is considered to be justified. It has been developed through a robust options assessment and refinement process (see Section 2.4) in order to identify a preferred option that best meets the proposal objectives, whilst minimising the construction and operational impact.

8.2 Objects of the EP&A Act

Table 8-1 below provides consideration of the proposal in accordance with the EP&A Act.

Table 8-1: Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposal would manage, develop and conserve natural and other resources appropriately and result in social and economic benefits to the community. The proposal would involve the provision of a new shared-use path on the southern side of Spring Farm Parkway and south-eastern side of Menangle Road. This would improve access and safety for pedestrians and cyclists in the area. The proposal would also provide the infrastructure for the new Menangle Park land release area and provide residents with access to and from the Hume Motorway and Menangle Road. The social and economic impact is assessed in Section 6.10. The assessment includes management measure to avoid and/or minimise the impact. A range of safeguards are proposed to address the potential environmental impact. The proposal would not impact on the social and economic welfare of the community.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in Sections 0 to 8.2.4 below.
1.3(c) To promote the orderly and economic use and development of land.	The proposal directly supports the development of the Menangle Park land release area, and in the longer term supports the wider objectives of the Greater Macarthur Growth Area, by providing opportunities for future road widening and tie-in connections for stage 2 of Spring Farm Parkway. Spring Farm Parkway would ultimately support the future residential development within Spring Farm, Elderslie, Menangle Park and Mount Gilead.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The proposal involves the use of land which has been identified as a future road corridor. Opportunities to minimise the footprint of the proposal have been considered where possible to reduce the potential environmental impact. For example, during the strategic and concept design

Object	Comment
	process a number of alternative bridge structures and abutment designs were considered The process of selecting the proposed construction access routes and site compounds, as described in Section 3.4.8, considered ways to avoid and minimise the impact to the environment, by maximising the use of existing road corridor where possible, and the existing AGL access track to the south west of the proposal, which has reduced the potential impact of the proposal where possible.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would result in a minor impact to non-Aboriginal heritage through the acquisition of an area of Sugarloaf Farm for the widening of Menangle Road. An assessment is provided in Section 6.9 and Appendix I. The proposal would result in impact to three Aboriginal archaeological sites. An AHIP would be required prior to impacts. Based on the draft CHAR (see Appendix H), these sites are considered to display low significance based on their scientific value and potential to inform on Aboriginal landscape use in the area.
1.3(g) To promote good design and amenity of the built environment.	As part of the design development of the proposal, consideration of the environment, landscape and visual impacts was made which included the development of an urban design strategy to inform the overall landscape strategy, as well as the design and placement of roadside furniture including bridge design, signage and shared paths. Further details are provided in Section 6.3 and Appendix E.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	The proposal development process has involved extensive consultation with relevant stakeholders and the community. Consultation carried out to date and proposed ongoing consultation is outlined in chapter 6.

8.2.1 The precautionary principle

Principle 15 of the United Nations Conference on Environment and Development 1992 (the Rio Summit) defined the precautionary principle: “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”. In 2000, a European Union communication further refined the definition to account for action where scientific evidence is “insufficient, inconclusive or uncertain”. Also realised was the responsibility placed on the developer to prove their actions as being safe and act in instances where there is uncertainty.

In all cases impact assessment is a subjective process. It relies on professional judgement and interpretation. Consequently, precaution has been built into the assessment carried out and reported in this REF. This includes adopting a number of worst-case assumptions, such as all noise-generating equipment operating at its maximum output at the same time in the same location, or the assumption of the worst-case vegetation impact within the proposal area.

This REF has been prepared using the precautionary principle and appropriate mitigation measures are outlined to address all of the potential impact identified for the proposal.

Moving forward, the concept design would be developed and refined into a detailed design. Once this is completed, Roads and Maritime has committed to confirming that the impact reported in this REF is still relevant, accurate and consistent and reflect the proposal’s detailed design. Additional environmental assessment would be carried out where there is an identified inconsistency. This again would ensure that uncertainty is identified, addressed and resolved throughout the proposal’s design lifecycle by implementing precaution at all stages.

8.2.2 Intergenerational equity

Intergenerational equity refers to the principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The proposal would not impact on the health, diversity and productivity of the local environment or communities in a way that would disadvantage future generations.

8.2.3 Conservation of biological diversity and ecological integrity

Preserving biological diversity and ecological integrity requires that ecosystems, species, and biological diversity are maintained and improved to ensure their survival. It is accepted that this proposal would result in the loss of about 1.92 hectares of Cumberland Plain Woodland and 0.47 hectares of Swamp Oak Floodplain Forest.

Assessments of significance were carried out for the following threatened species under the BC Act that were positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area:

- Cumberland Plain Woodland
- Swamp Oak Floodplain Forest
- *Pimelea spicata*
- Cumberland Plain Land Snail
- Hollow-dependant bats: Eastern Freetail-bat, Greater Broad-nosed Bat, Southern Myotis
- Grey-headed Flying-fox
- Koala.

These assessments, which are reported in Appendix G, conclude that the impact is not significant. Providing the safeguard measures in Section 6.7.4 are implemented, the proposal would not have a material or significant impact on biological diversity and ecological integrity.

8.2.4 Improved valuation, pricing and incentive mechanisms

The pricing of environmental resources involves placing a monetary value on natural assets and services. The principle suggests that Roads and Maritime should:

- Bear reasonable costs to avoid pollution risks (the 'polluter pays principle') and implement controls to contain or reduce pollution should it occur
- Consider the lifecycle environmental, social and economic costs of building, operating and maintaining the proposal
- Implement the proposal's environmental goals by enabling specialists to identify the most cost-effective safeguards and management measures to respond to its predicted environmental impact.

Roads and Maritime has committed to safeguards and management measures that would reduce the likelihood of routine pollution occurring while the proposal is being built and once it is operational, by installing operational drainage swales.

Roads and Maritime has also committed to safe working methods to reduce the likelihood of an accidental spillage or pollution event, while providing further precaution by implementing management measures to contain or reduce pollution in the unlikely event that it should occur. Consequently, the proposal has adopted the polluter pays principle.

Roads and Maritime has also committed to the purchase of recycled materials and materials with low-embodied energies where feasible and reasonable in their application. These provisions serve to consider the lifecycle demand on natural resources and their conservation. Roads and Maritime has also committed to sourcing the materials from local markets, including primary materials wherever possible. Finally, all materials, staff and equipment, and waste would be obtained and disposed of as close to the proposal footprint as possible (termed the 'proximity principle'). This would reduce the proposal's wider secondary, indirect and lifecycle impact.

Finally, Roads and Maritime has developed environmental assessment guidance to allow external parties to prepare its environmental assessment documentation. These external parties comprise specialists 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 specialists who review all environmental assessments to ensure the safeguards and management measures are cost-effective and achieve the proposal's environmental goals and Roads and Maritime's organisational goals.

8.3 Conclusion

The proposed Spring Farm Parkway, and upgrades to Menangle Road at Spring Farm is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, the impact on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered the potential impact to matters of national environmental significance listed under the Commonwealth EPBC Act.

Some of the potential environmental impact from the proposal has been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the proposal objectives but would still result in some impact on Aboriginal and non-Aboriginal heritage, noise and biodiversity. Safeguards and management measures as detailed in this REF would ameliorate or minimise the expected impact. The proposal would also support residential and economic growth in the area, provide facilities for pedestrians and cyclists and improve driving conditions by improving the capacity of Menangle Road to handle forecasted traffic levels. 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.

There would be no significant impact on any other aspect of 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. 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.

This REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for Roads and Maritime Division 5.1 road activities. A referral to the Australian Department of the Environment and Energy is not required.

9. Certification

Guidance:

The certification should be signed by the primary author of the REF and accepted by the project manager.

The certification must not be signed by the project manager until the review process described in the ***Project REF procedure (EIA-P05-2)*** has been completed and the REF is of adequate quality and is ready to be finalised. If in doubt, seek advice from the LEA.

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.

Damian Williams

Senior Associate Environmental Consultant

Jacobs Australia

Date: 14 February 2019

I have examined this review of environmental factors and accept it on behalf of Roads and Maritime Services.

David Tawadros

Project Development Manager

Western Sydney Project Office]

Date:

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Appendix A

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

Clause 228(2) Checklist

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

Factor	Impact
a) Any environmental impact on a community?	
The proposal would result in some short-term amenity-related impact during construction to the community, including a noise and air quality impact, increased traffic and temporary delays from partial road closures, visual impact, and disruption to access for some receivers on Menangle Road. The use of local roads for access to and from the proposal area would result in some impact to the local community within Menangle Park, but these would be experienced for a short time during the early stages of construction, before the northbound access ramp and deceleration lane were built. The impact would be mitigated with the implementation of recommended safeguards identified in Chapter 6.	Short-term minor negative.
Once operational, the proposal would provide access to the Menangle Park urban release area and increase the capacity of Menangle Road. This would have a long term positive impact to the community, by not only enabling the existing road to cope with forecasted traffic volumes but also by supporting the development of the region. It is expected that this would support future development and growth of businesses and employment in the region.	Long-term positive.
b) Any transformation of a locality?	
The proposal would result in short-term disruption during construction leading to a noise, amenity and visual impact. The impact would be mitigated with the implementation of recommended safeguards identified in Chapter 6.	Short-term minor negative.
The proposal would introduce a new road, with an elevated bridge structure across the motorway corridor. The bridge structure would be visually prominent but would be in keeping with the existing broader context of large infrastructure in the corridor. The removal of riparian vegetation and introduction of a new road would have a moderate to low impact on the locality. Visibility of these changes would be limited to a small number of receivers. The proposal would implement an urban and landscaping plan to improve the long term visual amenity of the proposal area.	Long-term minor negative.

Factor	Impact
c) Any environmental impact on the ecosystems of the locality?	
Construction of the new Spring Farm Parkway would require the clearance of around 1.92 hectares of moderate to low condition Cumberland Plain Woodland and 0.47 hectares of low condition Swamp Oak Floodplain Forest. Both of these areas of mapped threatened vegetation are located to the west of the Hume Motorway. Minimal vegetation clearance would be required for the widening of Menangle Road. The clearance of vegetation would result in some reduction of habitat, including eight hollow-bearing trees, for a range of birds and mammals including threatened species. Biodiversity offset credits would be sought to compensate for this loss and help achieve long-term conservation outcomes.	Nil
d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	
The proposal would result in short-term disruptions while it is being built, and as discussed above, this would lead to an amenity impact. The impact would mainly occur as result of construction activities in proximity to sensitive receivers, the introduction of traffic management controls and the use and movement of equipment and traffic locally around Menangle Park. Some occasional night work would also be required to build the proposal. The loss of certain ecological values locally, as discussed above, would also have an impact on the area's environmental and scientific quality. However, in all cases, the impact would be minimised by including a range of safeguards. These safeguards would also include controls to prevent any unnecessary impact while minimising any risks to other values locally.	Short-term moderate negative.
The proposal would also result in impact to Aboriginal archaeological sites of low scientific value.	Long-term minor negative.
e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?	
As above, the proposal would result in impact to Aboriginal archaeological sites of low scientific value. The proposal would also result in the direct impact to Sugarloaf Farm (State heritage listed item), and acquisition of an area of Sugarloaf Farm, adjacent to Menangle Road, would be required. No structures are known to have been built in this zone and the likelihood of encountering any archaeological relics is low (Graham Brooks & Associates, 2001). Any heritage values would be either recorded or preserved before the work starts. As such, the impact would be avoided other than the impact on any unexpected finds	Long-term minor to moderate negative.

Factor	Impact
f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?* Vegetation clearance would remove of small amount of habitat for threatened species such as Grey-headed Flying-fox, koala and Cumberland Plain Land Snail. Clearing for the proposal would remove approximately 1.92 hectares of potential habitat for the Cumberland Plain Land Snail, however this this habitat was found to be degraded and sub-optimal. Targeted surveys were carried out during the field surveys, and this species was not recorded within the study area. It is likely that protected bats (Eastern Freetail-bat or Greater Broad-nosed Bat) use the area for foraging and are unlikely to be roosting locally. Similarly, it is considered unlikely that koalas use the area to the west of Hume Motorway. Overall, none of the species with the potential to occur in the study area were considered likely to be significantly impacted by the proposal, primarily due to the absence of/or limited impact to key limiting resources, and minimal impact to general foraging habitat. Nevertheless, controls and mitigations provided in Chapter 6 would be implemented to minimise the potential impact to the habitat of protected fauna.	Long-term minor negative.
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? It is considered unlikely that the proposal would have an adverse effect on the lifecycle of any of the eight threatened species considered to have a moderate to high likelihood of occurring in the study area.	Nil
h) Any long-term effects on the environment? The proposal would impact Aboriginal archaeological sites of low scientific value. It would also require acquisition of a small area of Sugarloaf Farm (state listed heritage item). It would also require the clearance of around 1.92 hectares of moderate to low condition Cumberland Plain Woodland and 0.47 hectares of low condition Swamp Oak Floodplain Forest and result in a small reduction of habitat available for a range of birds and mammals. However a biodiversity offset strategy would help to offset the loss of protected vegetation communities. The proposal would also assist to develop the wider region, by providing access to the Menangle Park urban development area and improving the existing road capacity on Menangle Road. It is likely that the proposal would support the residential, economic and social development of the area, by being part of the staged development which would help to facilitate the development of Greater Macarthur Priority Growth Area.	Long-term minor negative. Long-term major positive.

Factor	Impact
i) Any degradation of the quality of the environment?	
The proposal would have a temporary environmental impact during construction associated with changed traffic conditions, noise and air emissions and visual amenity impact. The impact is anticipated to be minor and not likely to result in degradation of the quality of the environment.	Short-term minor negative.
The operation of the proposal has the potential to alter existing hydrology and flooding regimes and also impact surface water quality from accidental spills and increased pollutant loaded run off from the road pavement. Operational water quality treatment controls for pavement runoff, in the form of grass surface swales would be included to provide protection of the environmentally sensitive receiving waterways that are located within 500 metres of any road pavement drainage discharge point.	Nil
j) Any risk to the safety of the environment?	
During construction, the proposal may require the transportation and storage of hazardous or contaminated materials in limited quantities. These materials would be managed in accordance with the mitigation measures proposed in this REF. The potential risk to the safety of the environment would be minor and limited to the construction period. The use of wildlife exclusion fencing would be considered during detailed design to limit the risk of injury and mortality of fauna from the introduction of a new road corridor.	Short-term minor negative.
k) Any reduction in the range of beneficial uses of the environment?	
The proposal is located almost exclusively within land zoned for the provision of a new road corridor. Some property acquisition would be required immediately adjacent to the road corridor, including acquisition of some private property, and partial acquisition of an area of Sugarloaf Farm (State heritage listed item). This acquisition would not affect the use and enjoyment of Sugarloaf Farm.	Long-term minor negative.
l) Any pollution of the environment?	
Construction of the proposal would result in dust generation and air and noise emissions from machinery and construction vehicles. There is a risk of pollution to the surrounding watercourses and drainage lines. The management measures proposed in this REF would help reduce the impact.	Short-term minor negative.
During operation, pollution would largely be consistent with the current use. The proposal has been designed to ensure it complies with all safety requirements. As such, this reduces the impact of any accidents or incidents that may result in pollution, contamination or other environmental safety concerns. While this risk cannot be full discounted it has been reduced to a level that is achievable, feasible and reasonable. This includes controls to manage the stormwater runoff from the operational site via grassed swales and gross pollutant traps	Nil

Factor	Impact
m) Any environmental problems associated with the disposal of waste?	
During construction, a number of waste streams would be produced by the proposal. Where possible, excavated materials would be used on site. Where this is not possible, waste would be classified to identify suitable recycling and safe disposal methods in accordance with Roads and Maritime *Environmental Procedure – Management of Wastes on Roads and Maritime Services Land* and the requirements of the Waste Classification Guidelines.	Short-term minor negative.
During operation, waste generation is expected to be minimal and consistent with the current use	Long-term neutral impacts.
n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?	
It is predicted that about 400 000 m^3 of imported fill would be required for construction of the proposal. It is unlikely this, or any other resources required for the proposal would be in short supply.	Nil.
o) Any cumulative environmental effect with other existing or likely future activities?	
Construction of the proposal may be carried out while other proposals, including the Campbelltown Hospital Stage 2 Development, or the Newnes Kaolin Sand Processing Plant, are being undertake. Cumulative impacts could include dust, noise or other amenity impacts and community fatigue. Where necessary environmental management measures would be coordinated to reduce cumulative construction impacts. The proposal is unlikely to have any long-term impacts.	Short-term minor negative.
p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?	
None, as the proposal is located outside of coastal areas.	Nil

Matters of National Environmental Significance

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

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

Factor	Impact
a) Any impact on a World Heritage property?	Nil There are no World Heritage items located within the proposal area.
b) Any impact on a National Heritage place?	Nil There are no National Heritage items located within the proposal area.
c) Any impact on a wetland of international importance?	Nil There are no wetlands located within the proposal area.
d) Any impact on a listed threatened species or communities?	Nil The proposal is not likely to significantly impact threatened species, populations, or ecological communities. See Section 6.1 for further details
e) Any impacts on listed migratory species?	Nil The proposal is not likely to significantly impact listed migratory species. See Section 6.7 for further details.
f) Any impact on a Commonwealth marine area?	Nil The proposal area is not near a Commonwealth marine area.
g) Does the proposal involve a nuclear action (including uranium mining)?	No
h) Additionally, any impact (direct or indirect) on Commonwealth land?	Nil

Appendix B

Statutory consultation checklists

Infrastructure SEPP

Council related infrastructure or services

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Stormwater	Is the work likely to have a *substantial* impact on the stormwater management services which are provided by council?	No		ISEPP cl.13(1)(a)
Traffic	Is the work likely to generate traffic to an extent that will *strain* the capacity of the existing road system in a local government area?	Yes	Campbelltown City Council	ISEPP cl.13(1)(b)
Sewerage system	Will the work involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No		ISEPP cl.13(1)(c)
Water usage	Will the work involve connection to a council owned water supply system? If so, will this require the use of a *substantial* volume of water?	Yes	Campbelltown City Council	ISEPP cl.13(1)(d)
Temporary structures	Will the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No		ISEPP cl.13(1)(e)
Road & footpath excavation	Will the work involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	Campbelltown City Council	ISEPP cl.13(1)(f)

Local heritage items

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

Flood liable land

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Flood liable land	Is the work located on flood liable land? If so, will the works change flood patterns to more than a *minor* extent?	No		ISEPP cl.15

Public authorities other than councils

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

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	Yes	Mine Subsidence Board	ISEPP cl. 16(2)(i)

Appendix C

Traffic and transport assessment

Appendix D

Construction and operational noise and vibration assessment

Appendix E

Urban Design Landscape Character and Visual Impact Assessment Report

Appendix F

Surface water and groundwater assessment

Appendix G

Biodiversity Impact Assessment

Appendix H

Stage 3 PACHCI Assessment

Appendix I

Non-Aboriginal Heritage Assessment

Appendix J

Land use, Property and Socio-economic Assessment

Appendix K

TRAQ modelling results

Appendix J

Community and Stakeholder Engagement Plan

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