

Link Road Corridor Study

Options Report

Transport for NSW | November 2020



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Glossary

Abbreviation	Description
Greater Macarthur Growth Area	A region identified by the NSW Department of Planning, Industry and Environment as an area of future urban development to cater for the growing population of Sydney
Investigation area	An area extending about four kilometres south east between Menangle Road and Appin Road where the Link Road may be developed
KPI	Key performance indicators
kV	Kilovolts
Link Road	The planned future east-west road link between Menangle Road, Menangle Park and Appin Road, Gilead
NSW	New South Wales
Spring Farm Parkway (Stage 1)	Future interchange connecting the M31 Hume Motorway and Menangle Road at Menangle Park.
The project	The planned future east-west road link between Menangle Road, Menangle Park and Appin Road, Gilead

Executive summary

Transport for New South Wales (Transport for NSW) has identified four short-listed route options for the Link Road Corridor Study project. This follows an intensive process of investigations, planning, community and stakeholder consultation, and design work based on the strategic design developed by Transport for NSW over the last two years.

The Link Road would provide a connection between Menangle Road and Appin Road within the Campbelltown local government area. This would form a major transport link in the Campbelltown area and support the future development of Menangle Park and Mount Gilead.

Background

The Greater Sydney Regional Plan: A Metropolis of Three Cities, published by the Greater Sydney Commission in March 2018, identified the Greater Macarthur as an area of future urban development to cater for the growing population of Sydney. As part of this growth, a future east-west link within the investigation area was identified as a key development need to support the housing development and urban land releases at Menangle Park and Mount Gilead within the proposed Greater Macarthur Growth Area. The Link Road Corridor Study project was developed to meet this objective.

Purpose of Report

The purpose of this report is to outline the steps followed and records the assessment and decision-making processes taken to identify the four short-listed Link Road Corridor Study options.

Short List Selection Process

The short-listed options were identified through an extensive short-listing and option elimination process. This included the development of nine long list options which was narrowed down to a selection of four shortlisted options.

An initial workshop was held on 28 November 2018 with Transport for NSW and key stakeholders of the project. Workshop participants agreed on the key performance indicators to effectively score each long-listed option to meet the agreed project objectives. This workshop agreed on the assessment criteria and endorsed a multi-criteria assessment tool to assess the options.

A shortlisting workshop was held on 25 February 2019 with Transport for NSW and key stakeholders. Each of the nine long-listed options were presented and assessed using a multi-criteria analysis against the agreed key performance indicators. As a result of this assessment, four options were shortlisted.

Following the shortlisting workshop additional modelling and design refinements were completed for the short-listed options. These design refinements were presented at an evaluation of short list options workshop which was held over two days on 14 May and 19 June 2019.

The evaluation of short list options workshop included a multi-criteria analysis of each of the four short-listed corridor options. The workshop attendees identified their recommended corridor option (option 001) at the completion of the workshop. Prior to Transport for NSW selecting a preferred option it was determined that feedback would be sought from the community. Community feedback is being sought on the four short-listed options.

Short-listed Options

The four shortlisted options are:

- **Option 001:** Which largely follows the northern part of the investigation area. The eastern extent of the corridor connects to Appin Road about 350 metres south of its intersection with Copperfield Drive. The corridor follows the road reserve previously gazetted in the Campbelltown Local Environmental Plan 2015 to preserve a corridor for the future link between Menangle Road and Appin Road for about 2.8 kilometres, crossing over Glendower Street. The corridor then deviates from the existing road reserve and traverses largely undeveloped land and the State heritage listed Sugarloaf Farm before connecting at its western extent to the future Spring Farm Parkway interchange at Menangle Road just north of the Broughton Anglican College.
- **Option 002:** Which largely follows the northern part of the investigation area. The eastern extent of the corridor follows the same alignment as Option 001 for 2.8 kilometres along the existing road reserve. The corridor continues for a further 500 metres along the existing road reserve and continues to skirt the northern edge of the investigation area until it connects to Menangle Road about one kilometre north of the future Spring Farm Parkway interchange.
- **Option 403:** Which follows the central part of the investigation area. The eastern extent of the corridor connects to Appin Road at the southern end of investigation area, 2.8 kilometres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west then diverts in a north-westerly direction around the Mount Gilead stage 1 land development area. The corridor then enters the western part of Mount Gilead stage 1 and crosses the Water NSW canal. It traverses largely through undeveloped privately-owned land until it connects at its western extent about one kilometre south of the future Spring Farm Parkway interchange at Menangle Road.
- **Option 424:** Which follows the southern and western parts of the investigation area. The eastern extent of the corridor connects to Appin Road at the southern end of the investigation area. From its connection with Appin Road the corridor travels west along the southern extent of the investigation area until it meets the Nepean River and diverts north. The corridor then follows the alignment of Medhurst Road north until it connects at its western extent about 800 metres south of the future Spring Farm Parkway interchange at Menangle Road.

Next Steps

The four short-listed options will go on display for community comment in November 2020. This will provide an opportunity for the community to review the short list of options and provide feedback. Transport for NSW will use this information to select and refine a preferred option.

1 Introduction

Transport for New South Wales (Transport for NSW) is carrying out the Link Road Corridor Study to investigate a planned future east-west road link (the Link Road) between Menangle Road, Menangle Park and Appin Road, Gilead (the project). The Link Road would form one of three major east-west links between Appin Road and the M31 Hume Motorway and would support the development of Menangle Park and Mount Gilead. Transport for NSW identified an area extending about four kilometres south-east between Menangle Road and Appin Road where the Link Road may be developed (the investigation area). The investigation area is shown in Figure 1-1.

Four road corridor options for the Link Road have been identified through an options selection process described in this Options Report (this report).



LEGEND

- ▭ Investigation area

Date: 8/02/2019 Path: \\HRC-AUS-NS-FS-09\proj\30024456\4-GAS\A_Current\B_Maps\FEIS_10024456_P01_investigationArea_AAP_v5.mxd

Figure 1-1 Link Road investigation area

1.1 Project objectives

The objectives of the project are listed and described in Table 1-1. Project objectives are intended to apply throughout all stages of project development, from route selection through to construction. Minor refinements may be considered to take into account future government strategies.

Table 1-1 Project objectives

Objective	Description
1. Provide an efficient east-west link across the Greater Macarthur Growth Area	Provision of one connection between Appin Road and Menangle Road within the central Greater Macarthur Growth Area and south of the existing developments, in the context of additional proposed east-west connections to the south. The connection is to maximise broader network efficiency and reliability and be compatible with other planned road network upgrades.
2. Cater for active and public transport	Provision of integrated active transportation, considering future planned corridors. Accommodation of future public transport including safe and efficient bus stops and (if appropriate) bus lanes, transitways and/or light rail.
3. Integrate with existing and future land uses	Ensuring that the Link Road minimises adverse impacts on current land uses, and is consistent with land use planning for the corridor and aligns with the Greater Macarthur Structure Plan.
4. Minimise environmental impact	Minimisation of impact to areas of ecological and cultural sensitivity, as well as to the existing and future communities in the growth corridor.
5. Ensure the safety for all users	Ensuring that the proposed Link Road corridor is safe for all its users (including road users, construction workers and maintenance workers) across its entire life cycle.
6. Maximise value for money	Provide the best value for money across the life of the proposal with consideration of the other project objectives and wider economic benefits.

1.2 Investigation area

The investigation area is shown in Figure 1-1 and extends about four kilometres from Menangle Road, Menangle Park to Appin Road, Gilead. The total investigation area is about 1,300 hectares.

The investigation area is located within the Campbelltown local government area and the suburbs of Gilead, Menangle Park, Rosemeadow and Glen Alpine. Menangle Road is at the western extent of the investigation area and is a two-lane undivided road. Appin Road is at the eastern boundary of the investigation area and is a two-lane undivided road that runs north-south from Campbelltown to Appin. The investigation area is bounded to the north by the suburbs of Rosemeadow and Glen Alpine. The south-western portion of the investigation area contains the Rosalind Park gas plant and the Beulah Reserve bounds the eastern portion of the investigation area to the south. The investigation area was expanded after consultation with Campbelltown City Council.

New urban development is emerging in adjacent areas in the southern part of Campbelltown as part of the Greater Macarthur Growth Area. Isolated elements of urban development in the investigation area include the Broughton Anglican College and Mount Gilead estate. Areas of Gilead have been designated for future urban release, including the Mount Gilead stage 1 development proposal in the eastern portion of the investigation area.

The investigation area has a mainly rural character and has largely been cleared of native vegetation. Patches of remnant vegetation, which are mapped as endangered ecological communities, are distributed through the investigation area. These remnant patches of native vegetation provide habitat and connectivity corridors that support the movement of fauna, including koalas, through the broader Campbelltown area. The Noorumba Reserve is a registered Biodiversity Stewardship site and has had a number of recorded koala sightings within the last five years. Biodiversity Stewardship sites are also located within the Mount Gilead stage 1 development area in the eastern portion of the investigation area.

The investigation area is within the Georges River subcatchment of the Sydney metro catchment area. Within this catchment, the Georges River is located about 500 metres east of the investigation area. The investigation area is also located within the Nepean River subcatchment of the Hawkesbury-Nepean system. The Nepean River intersects the south western corridor of the investigation area.

Topography within the investigation area generally consists of undulating hills and steeply sloping terrain to the north-eastern and south-western sections of the investigation area. The topography of the investigation area slopes downwards from east to west in the eastern portion of the investigation area from an elevation of about 200 metres Australian Height Datum near Appin Road. Undulating hills and valleys are present within the north-western portion of the investigation area. The low point within the investigation area occurs where Menangle Creek meets the Nepean River in the south-western corner of the investigation area.

Infrastructure within, and next to, the investigation area includes a local road network, Telstra optical fibre cables, WaterNSW upper canal (including a decommissioned sediment basin and tunnel), Sydney Water and Trility DN1200 watermain, Sydney Water pumping station, four gas transmission pipelines, high voltage transmission lines (11, 66 and 330 kilovolts) and coal seam methane boreholes.

The existing public transport in the area adjacent to the investigation area consists mainly of buses along Menangle Road which connect with Menangle Park train station, west of the investigation area. There are also buses that travel along Appin Road providing a connection to Rosemeadow and Campbelltown train station, north of the investigation area. The active transport currently available in the vicinity of the investigation area is limited and is currently not connected as a network.

1.2.1 Future development

A number of other urban development and infrastructure projects are currently being developed adjacent to, or within, the investigation area. These include:

- **Spring Farm Parkway:** Transport for NSW is planning to build Stage 1 of Spring Farm Parkway at Menangle Park, a key east-west link to support the Greater Macarthur Growth Area. Stage 1 of the Parkway would provide a new four lane divided road extending almost one kilometre, with an interchange connecting Menangle Park and new land releases with the M31 Hume Motorway and Menangle Road. Ultimately an extension of the Parkway would provide a connection between Camden Bypass and the Hume Motorway.
- **Appin Road Upgrade, Gilead:** The current proposal for the upgrade of Appin Road includes the duplication of about four kilometres of Appin Road, between Fitzgibbon Lane, Rosemeadow and Mount Gilead. Three existing intersections at Copperfield Drive and Kellerman Drive, Fitzgibbon Lane and Kellerman Drive, and the intersection with St Johns Road would also be improved. Two new signalised T-intersections would be installed to the north and south of the proposed Mount Gilead stage 1 urban release in order to provide access to the development site.
- **Appin Road Safety Improvements between Mount Gilead and Appin:** Early safety works on Appin Road were completed in 2018. The next stage of work will include targeted safety improvements to about five kilometres of Appin Road between Mount Gilead and Brian Road to improve safety for residents, motorists and freight operators, as well as create further traffic efficiencies. This includes installation of new turn bays and road resurfacing.
- **Mount Gilead stage 1 development:** As part of the Greater Macarthur Growth Area, the Department of Planning, Industry and Environment recently rezoned much of the eastern portion of the investigation area from rural to low density residential. This area forms the Mount Gilead stage 1 development of which Lendlease Communities Pty Ltd. is proposing to construct a residential development. The plans consist of the construction of approximately 1,700 lots which would include residential housing, a community centre, small commercial development, parkland and biodiversity offset and environmental conservation areas. A further rezoning application has recently been prepared and submitted by Campbelltown City Council to the Department of Planning, Industry and Environment to include environmental protection, medium density and mixed use areas within the stage 1 site.

2 Consistency with strategic planning

The project is consistent with various NSW Government strategic plans for the region, including:

- *NSW Premier's and state priorities* (NSW Government, 2015): The project supports the Premier's priority of delivering infrastructure and supports the state priorities of improving road travel reliability and increasing housing supply
- *The Greater Sydney Regional Plan: A Metropolis of Three Cities* (Greater Sydney Commission, 2018a): The plan identifies the Greater Macarthur as an area of future urban development to cater for the growing population of Sydney. As part of this growth, a future east-west link within the investigation area was identified as a key development needed to support housing development and urban land releases at Menangle Park and Mount Gilead within the proposed Greater Macarthur Growth Area (shown in Figure 2-1). The project directly and indirectly contributes to the goals to transform the productivity of Western Sydney through growth and investment, to deliver infrastructure, and to deliver timely and well-timed greenfield precincts and housing
- *Western Sydney District Plan* (Greater Sydney Commission, 2018b): The project directly contributes to priority W7 – establishing the land use and transport structure to deliver a liveable, productive and sustainable Western Parkland City
- *Building Momentum State Infrastructure Strategy 2018-2038* (Infrastructure NSW, 2018): The Strategy outlines the need to increase road capacity to cater for future traffic growth through the development of Greater Sydney. The project supports the goal of road building and upgrading as crucial elements for enabling Sydney's growth
- *Future Transport Strategy 2056* (Transport for NSW, 2018): The project aligns with the overarching objectives of the Strategy to provide efficient public transport and road connections for passengers and freight and to deliver a safe and reliable road network with zero trauma
- *Road network plan report MR177 / 179 / 680 Campbelltown Road: Camden Valley Way / Hume Highway, Casula to Menangle Road, Menangle and Appin Road, Gilead* (Roads and Maritime Services, 2018): The project aligns with the overall road network outcomes and required developments due to the growth in the Greater Macarthur area
- *Greater Macarthur Strategic Transport Infrastructure Study* (Department of Planning and Environment, 2017): The report broadly describes the process in the identification of the preferred future transport network required to supplement the Greater Macarthur Growth Area in which the study area and project falls.
- *Campbelltown 2040 Local Strategic Planning Statement* (Campbelltown City Council, 2020). The project directly contributes Statement's focus on improving transport connectivity and infrastructure to support future land development within the Campbelltown local government area.

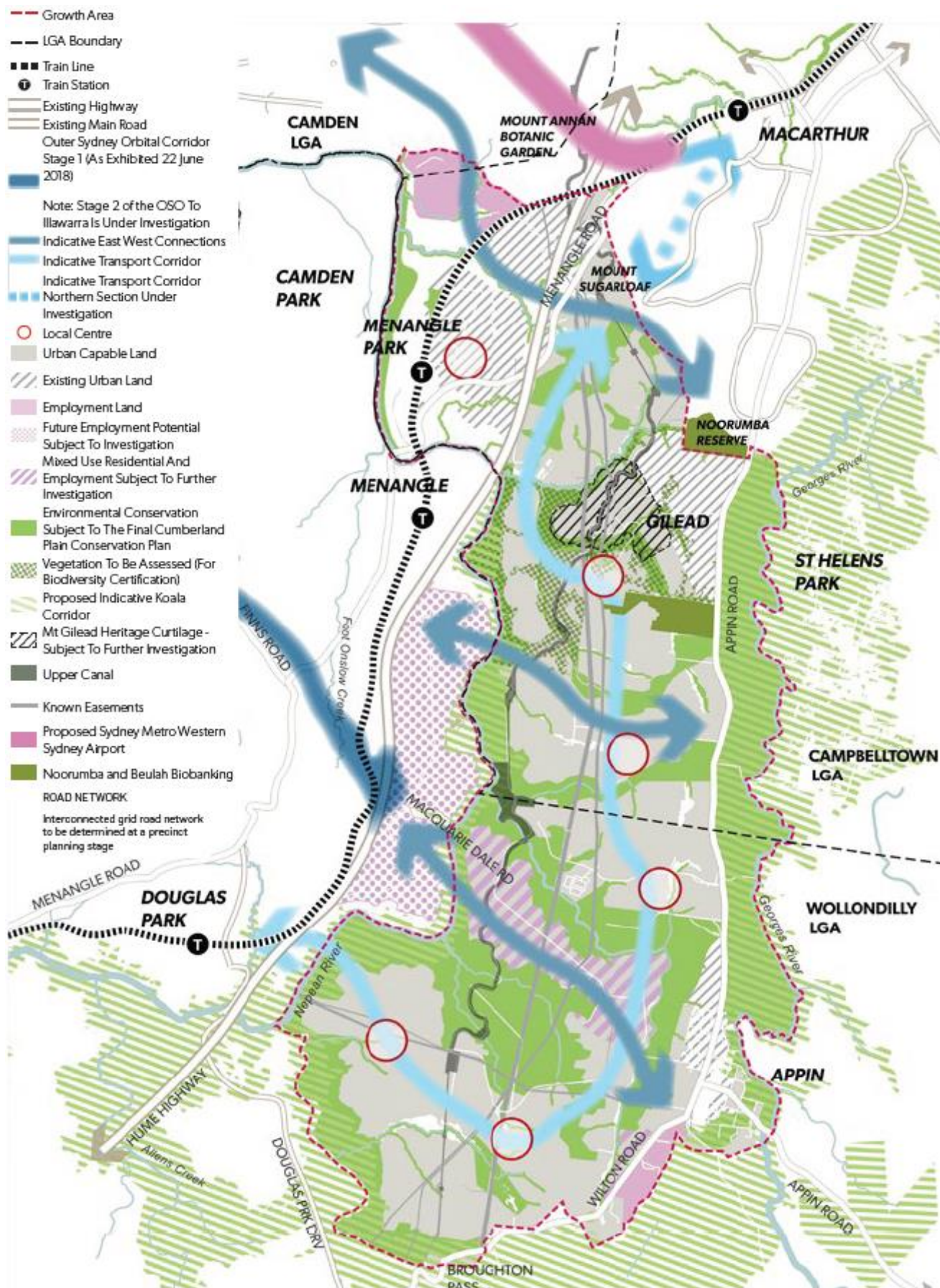


Figure 2-1 Greater Macarthur Growth Area

Source: Department of Planning and Environment (2018)

3 Stakeholder involvement

3.1 Consultation strategy

A communication and stakeholder engagement strategy has been developed for implementation. This strategy will be monitored throughout implementation and adjusted as required to guide consultation for the project.

The strategy's objectives are to:

- Inform the community and other stakeholders of the Link Road Corridor Study and its objectives
- Provide the community and other stakeholders with regular and targeted information to build awareness and understanding about the Link Road Corridor Study
- Advise directly affected stakeholders and community about the project, its potential impacts, and how they can obtain further information
- Keep the community and stakeholders regularly informed of progress with the project
- Ensure that project information is distributed in an effective and timely manner
- Engage in a manner that is collaborative, innovative, adaptive and sustainable
- Encourage participation from key stakeholders
- Ensure enquiries about the project are managed and resolved effectively
- Ensure feedback is monitored and consideration is given to enhance further communication.

3.2 Identified stakeholders

The following stakeholders have been identified as having a potential interest in the project:

- Federal, state and local elected representatives
- APA Group
- Bicycle NSW
- Camden Chamber of Commerce and Industry
- Campbelltown Chamber of Commerce
- Campbelltown City Council
- Commonwealth Department of Environment and Energy
- Department of Infrastructure, Transport, Regional Development and Communications
- Emergency services
- Endeavour Energy
- Jemena HP Gas
- Landowners, residents and local businesses
- Lendlease and other developers
- NSW Department of Planning, Industry and Environment
- NSW Department of Premier and Cabinet (Heritage)
- NSW Environmental Protection Authority
- NSW Mine Subsidence Board

- NSW State Emergency Services
- Road users
- Rural Fire Services
- Sydney Water
- Tharawal Local Aboriginal Land Council
- Total Environment Centre
- TransGrid
- Transport for NSW
- Utility providers
- Water NSW.

3.3 Consultation activities to date

An information line (1800 312 766) and email address (linkroadcorridorstudy@rms.nsw.gov.au) provide channels for the community and other stakeholders to contact the project team at Transport for NSW.

A webpage has been developed (<https://www.rms.nsw.gov.au/linkroadcorridorstudy>) to showcase proposed Transport for NSW projects in the Macarthur area. The Link Road Corridor Study is featured as part of the Appin Road improvements.

The corridor study is featured on an interactive portal available on the project website. The portal will be further developed as the project progresses. The portal showcases projects with the following:

- An overview video of Transport for NSW projects in the Macarthur area
- An interactive map featuring different projects in the Macarthur area, with before/after slider images and further project information
- A feedback form for the community and other stakeholders to register their interest in the Link Road or other projects, ask questions, or send a submission in response to project displays. The feedback form is linked directly to consultation manager.

The Hon Anthony Roberts MP, Minister for Planning announced the Appin Road Improvements (including the Link Road Corridor Study) together with the Macarthur 2040 Plan in November 2018.

Collateral featuring the Appin Road Improvements and the Link Road Corridor Study was distributed to about 12,500 homes and businesses in the Macarthur area, inviting attendance at planned information sessions.

The Link Road Corridor Study was displayed at information sessions for Appin Road improvements in November-December 2018. Sessions were held in Appin, Hurley Park and Rosemeadow and attended by over 250 community members and other stakeholders.

3.3.1 Project workshops

A series of four project workshops were held in November 2018, February, May and June 2019. The purpose of these workshops was to carry out a multi-criteria analysis to identify a short-list of options for the Link Road Corridor Study. Key stakeholders present in these workshops included:

- Transport for NSW
- Department of Planning, Industry and Environment
- Campbelltown City Council

- Office of Strategic Lands.

This process is described in sections 7 to 9 of this report.

3.3.2 Targeted stakeholder meetings

Stakeholder Consultation Committee Meetings have commenced with key stakeholders for projects in the Macarthur area. The objective of the Stakeholder Consultation Committee is to ensure key stakeholders work together to obtain the best outcome for the projects. The meetings are held regularly, with the following key stakeholders in attendance:

- Transport for NSW
- Local government – Campbelltown, Camden and Wollondilly
- Department of Planning, Industry and Environment
- Department of Infrastructure, Transport, Regional Development and Communications

Further to this, a number of consultation activities have occurred specifically as part of the route selection process. The participants and key issues discussed are presented in Table 3-1.

Table 3-1 Consultation activities to date

Activity	Stakeholders consulted	Key Issues raised
Stakeholder consultation in August 2018	Broughton Anglican College	• The investigation area was presented to stakeholders • Information about constraints within the study area were requested by Transport for NSW from stakeholders
	Campbelltown City Council	
	Department of Planning, Industry and Environment	
	Lendlease Communities Pty Ltd	
	Nadia Samaha	
	Office of Strategic Lands	
Community consultation on the study area in November and December 2018	R.E. Bloom and Sons Pty Limited	• The community raised concerns about the increase in traffic to Appin Road and impact to the environment and koalas • Council also proposed the investigation area be extended
	Campbelltown City Council	
Stakeholder meetings held in December 2018	Community members	• The road corridor should be at least 60m to allow for provision of amenities • Timeframe of proposal and overlap with the development of the Mount Gilead stage 1 urban release area • Biodiversity Stewardship sites within Mount Gilead stage 1 urban release area are being planned • Potential for future residential development beyond the 30,000 previously stated • Retention of existing tree corridors where possible should be a priority • Consideration should be given to the future north-south transit corridor
	Campbelltown City Council	
	Department of Planning, Industry and Environment	
	Lendlease Communities Pty Ltd	
	Old Mill Properties (on behalf of Mt Gilead Pty Ltd)	
	R.E. Bloom and Sons	
Stakeholder meeting held on 11 February 2019	Transport for NSW and project team	
	Department of Planning, Industry and Environment	

Activity	Stakeholders consulted	Key Issues raised
Stakeholder meetings held in March 2019	Office of Strategic Lands	• Discussion on future land use for the Sugarloaf Farm
	Campbelltown City Council	• Refinement opportunities of the short-listed route Options 403 and 424
	Department of Planning, Industry and Environment	
	Lendlease Communities Pty Ltd	
	Old Mill Properties (on behalf of Mt Gilead Pty Ltd)	
	R.E. Bloom and Sons	
	Transport for NSW and project team	
Written consultation received 2 April 2019	NSW Department of Premier and Cabinet (Heritage)	• Significance of heritage items, in particular Sugarloaf Farm within the investigation area
Consultation meeting held on 9 April 2019	Department of Planning, Industry and Environment	• Discussion of future land use and active transport considerations • Project integration into the Greater Macarthur Structure Plan
Consultation meeting held on 17 June 2019	Transport for NSW and project team	• Discussion on Sydney Water future plans around the Sugarloaf pumping station
	Sydney Water	
	WaterNSW	• Discussion on WaterNSW future plans for the canal and land where the decommissioned sedimentation basin is located.
Consultation meeting held on 6 September 2019	Transport for NSW and project team NSW Department of Premier and Cabinet (Heritage)	• Discussion on heritage considerations, including potential impacts to the Sugarloaf Farm and the Upper Canal System

3.4 Ongoing future consultation

Communication with the community and other stakeholders will continue as the project approaches key milestones. Communication will include collateral, updates to the website and interactive portal, media releases, announcements/photo opportunities, advertising and information sessions as required.

The short-listed options are presented in section 8.1 and will go on display for community comment in November 2020.

4 Approach to the selection of a short list of options

The approach to identifying a short list of options for the project involved a five-stage process as shown in Figure 4-1. Each stage is described in detail in sections 5 to 8 of this report. Workshops were held at key stages to ensure collaboration between key stakeholders and members of the project team.

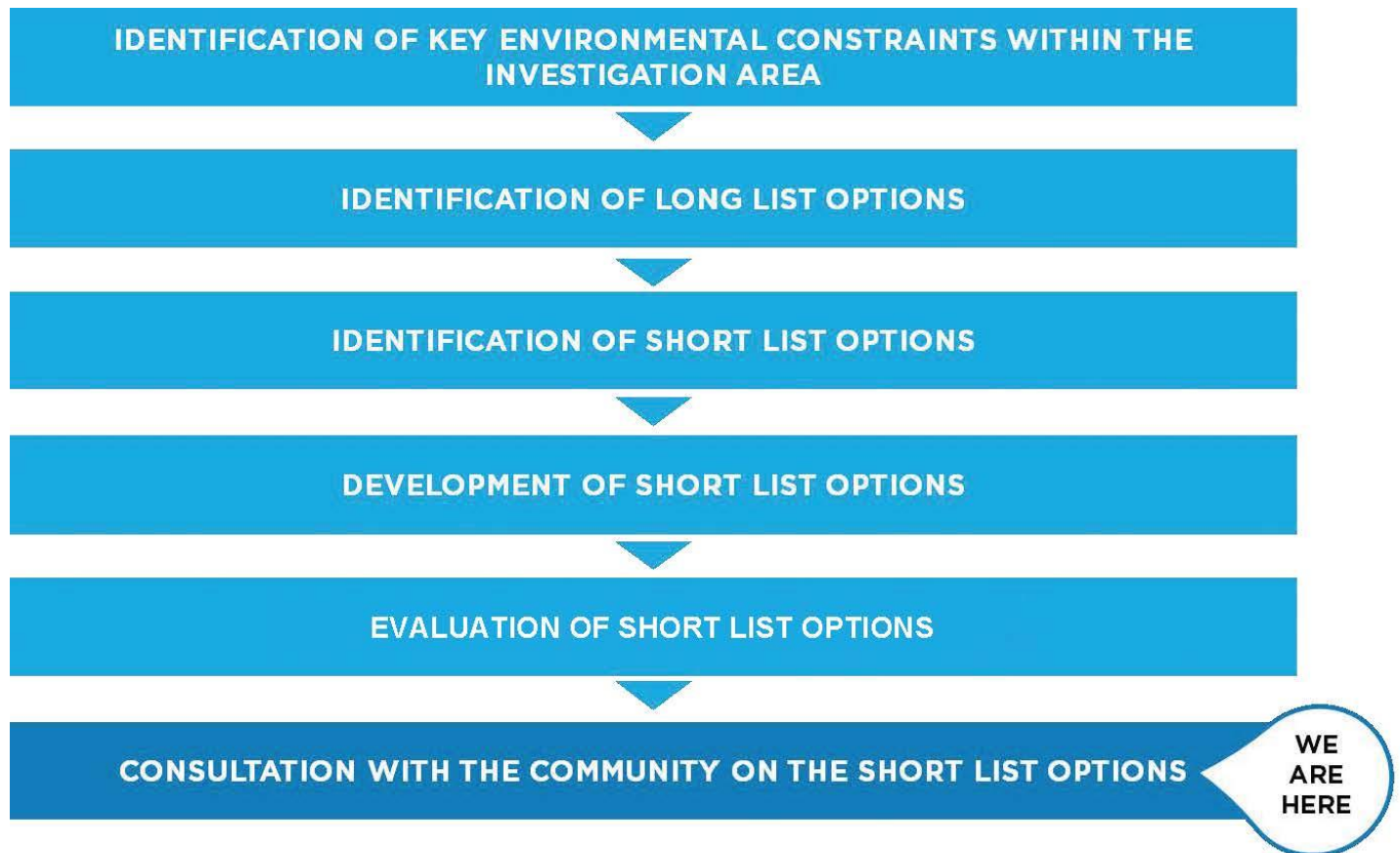


Figure 4-1 Approach to selection of a short list of options

5 Constraints and opportunity analysis

A constraints analysis was completed in 2019 to assess existing conditions within the investigation area that may influence the location and nature of a future road development. The constraints analysis involved mapping social and environmental information within the investigation area.

The constraints analysis was based on key findings from the Preliminary Environmental Investigation (Roads and Maritime Services, 2019) prepared for the project, and subsequent information gathered during the preparation of this report.

The constraints analysis evaluated the following 10 factors:

- Biodiversity
- Non-Aboriginal heritage
- Aboriginal heritage
- Water quality
- Flooding
- Noise and vibration
- Air quality
- Socioeconomic and land use
- Utilities
- Landscape character and visual amenity.

To identify the nature of each potential constraint, classifications of high, medium and low were assigned to each factor. These classifications reflect the significant local issues within the investigation area.

For each factor:

- A high constraint suggests that the road development would be undesirable in terms of that factor, and would need a strong justification, careful design and environmental management measures to be implemented
- A moderate constraint suggests that the road development would have potential impact that would need consideration in terms of design and appropriate environmental management
- A low constraint suggests that the road development would have a lower impact and that there is greater certainty around the possible design solutions and measures to minimise impact.

The analysis was based on data available at the time, with limited field investigation carried out. Specific limitations for individual factors are discussed in the relevant sections below. The project would be subject to detailed environmental assessment and planning approval processes at a later stage, where detailed investigations would be carried out, as appropriate.

The constraints analysis for the 10 factors is presented in the following sections.

5.1 Biodiversity

5.1.1 Mapping considerations

Much of the investigation area has been cleared of native vegetation and comprises exotic grasslands, agricultural land uses and urban development. All native vegetation within the investigation area fall within the definition of endangered ecological communities under relevant NSW and Commonwealth legislation.

Noorumba Reserve is in the north-eastern corner of the investigation area. This is a registered Biodiversity Stewardship site, which contains four endangered ecological communities (as defined under the Biodiversity Conservation Act 2016), including Cumberland Plain shale woodlands, shale-gravel transition forest, shale sandstone transition forest, and moist woodland on shale. Remnant patches of these vegetation types exist along many watercourses within the investigation area. Much of this remnant vegetation has been identified as providing habitat connectivity for flora and fauna, including koalas.

The biodiversity constraint analysis was based on the following aspects:

- Native vegetation
- Endangered ecological communities
- Core koala habitat
- Existing and potential fauna connectivity corridors.
- The analysis identified key constraints which have been classified and considered in Table 5-1. Biodiversity constraints are shown in

Figure 5-1.

Table 5-1 Biodiversity constraint criteria and findings

Constraint level	Constraint	Findings
High	• Endangered ecological communities • Core koala habitat and connectivity corridors • Un-fragmented native vegetation.	• Areas of high biodiversity constraint reflect the vegetation communities associated with the woodland and open forest of the Cumberland Plain • All the vegetation within the investigation area was found to be a high constraint due to its classification as endangered ecological community • The high constraint areas also coincided with areas of core koala habitat and identified fauna connectivity corridors.
Medium	• Fragmented native vegetation that is not an endangered ecological community.	• No areas have been identified as a moderate constraint with all vegetation within the investigation area meeting one or more of the high constraint criteria.
Low	• Areas not containing native vegetation.	• The extensive areas of low constraint are generally associated with areas cleared of native vegetation for agricultural purposes and areas where vegetation has been disturbed by urban and rural development.

5.1.2 Future investigations

Any future road planning and design will require detailed ecological studies. More targeted mapping and assessments will be required in relation to:

- Precise extent and condition of endangered ecological communities and Biodiversity Stewardship sites
- Presence and location of threatened and other significant flora species
- Actual and potential presence of threatened and other significant fauna species, including koalas
- Extent of wildlife movement corridors
- Extent and condition of aquatic habitats and species.

5.2 Non-Aboriginal heritage

5.2.1 Mapping considerations

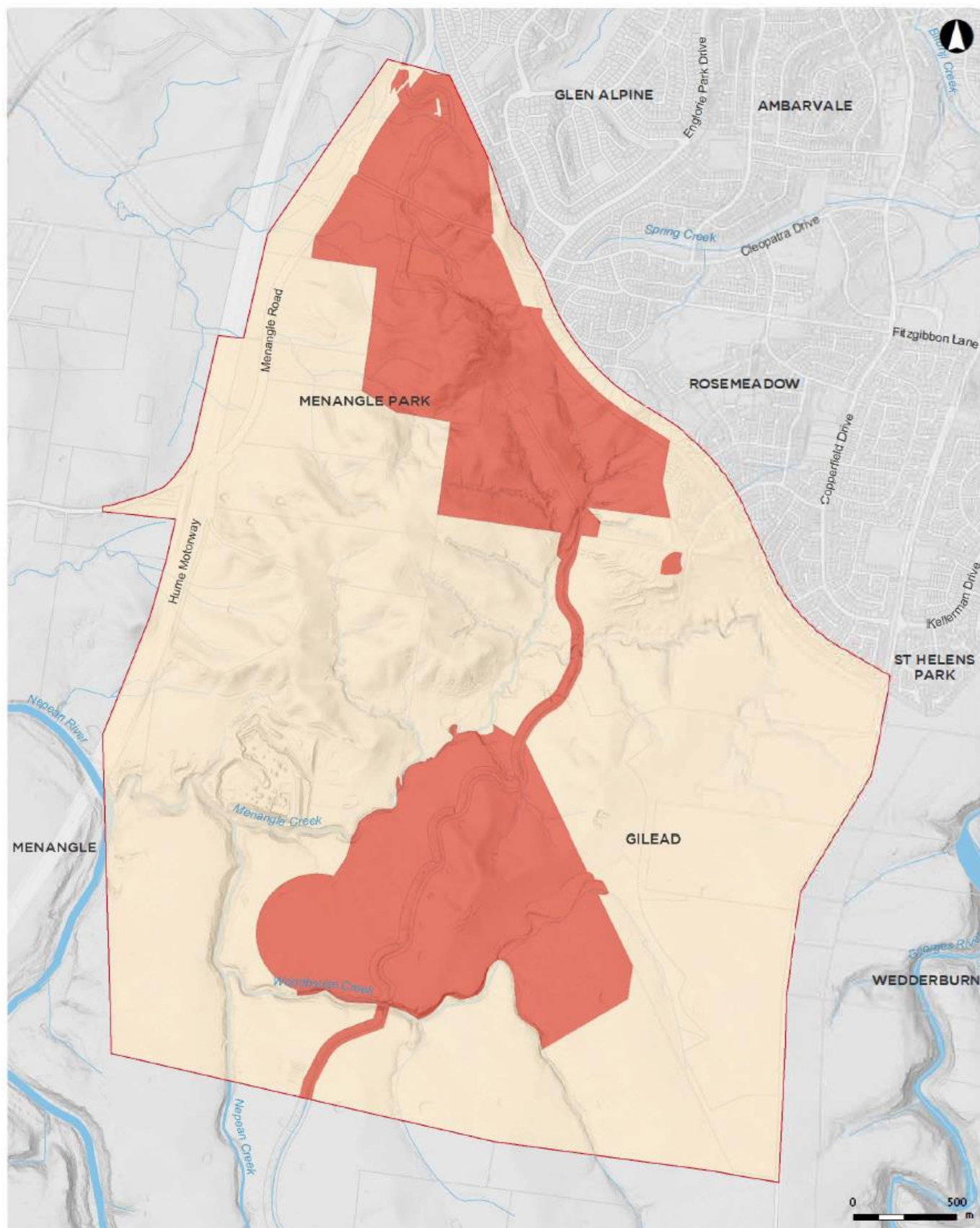
The Campbelltown area, including Gilead, has a non-Aboriginal rich cultural heritage associated with the early European settlement of western Sydney. Non-Aboriginal heritage sites within the investigation area include sites of State and local significance as well as historical preservation areas listed under the Greater Macarthur Growth Area Plan.

The constraints mapping for non-Aboriginal heritage analysis are based on a search of listed sites within the investigation area.

The analysis identified key constraints which have been classified and considered in Table 5-2. Non-Aboriginal heritage constraints are shown in Figure 5-2.

Table 5-2 Non-Aboriginal heritage constraint criteria and findings

Constraint level	Constraint	Findings
High	• Any listed State, regional and local significant non-Aboriginal heritage item • Historical preservation areas.	• The large section of high constraint in the north-western corner of the investigation area is associated with the State and locally listed Sugarloaf Farm • High constraint is also associated with the Mount Gilead Heritage Curtilage in the central portion of the investigation area. This includes the windmill tower and water reservoir associated with the Mount Gilead Estate • The upper canal system is identified as high constraint and traverses the central section of the investigation area from north to south • Isolated patches of high constraint in the centre of the investigation area are attributed to the locally listed Kilbride Nursing home.
Medium	• Not considered.	• There are no areas of medium constraint.
Low	• Areas not listed as non-Aboriginal heritage sites.	• All remaining areas are classified as low constraint.



LEGEND

Non Aboriginal heritage constraints

- Low
- High

Figure 5-2 Non-Aboriginal heritage constraints

5.2.2 Future investigations

The constraints mapping provides a general overview of all listed non-Aboriginal heritage sites within the investigation area. The mapping does not consider listed heritage items that occur in areas next to the investigation boundaries which have the potential to be indirectly impacted by a road development. Future detailed investigations would need to be carried out to identify these items as well as the presence of any unlisted sites of heritage significance.

Field investigations would likely need to be carried out as part of future planning. More detailed investigations would also need to consider the direct and indirect impact on heritage items and consider design measures to minimise any impact.

5.3 Aboriginal heritage

5.3.1 Mapping considerations

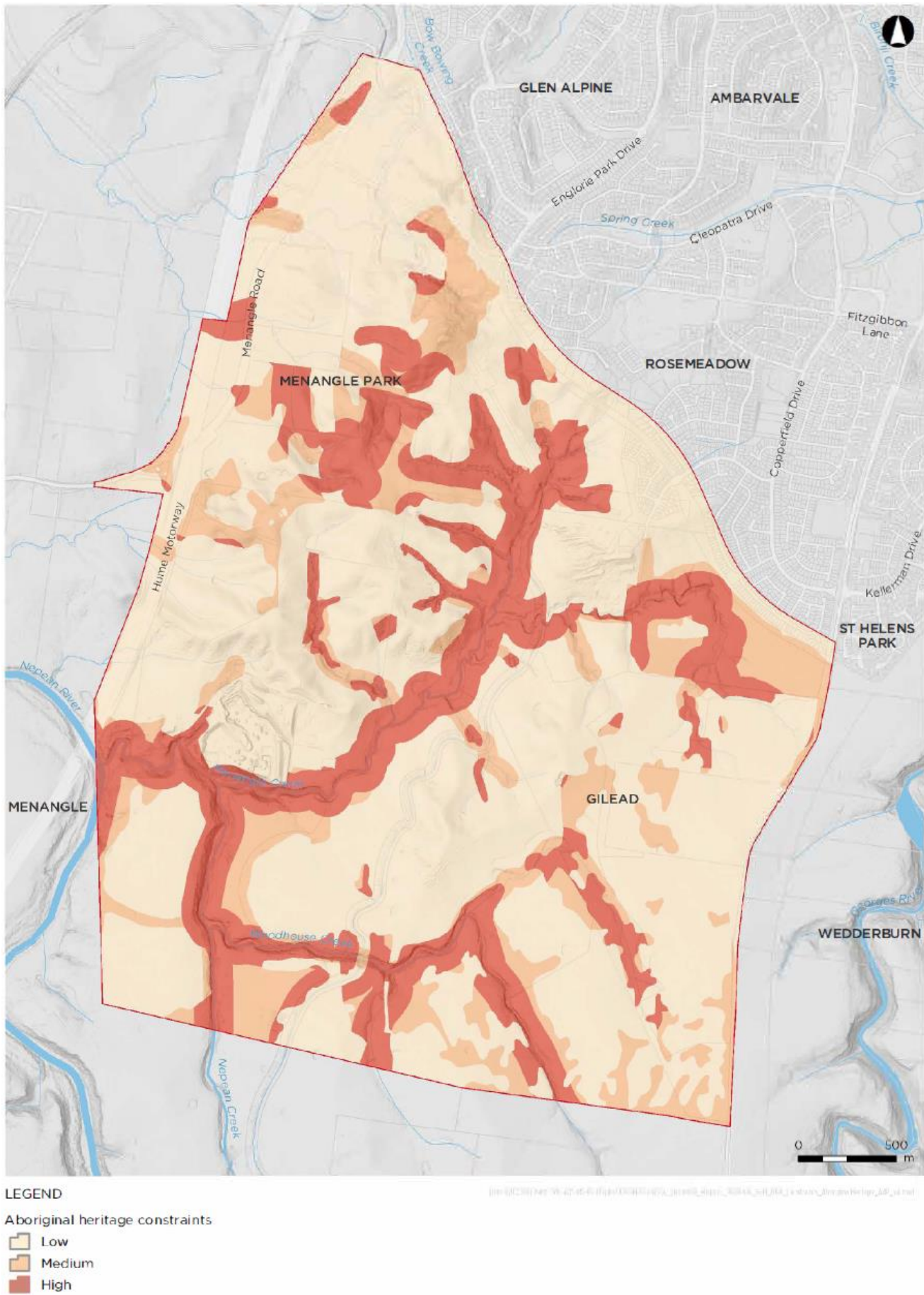
There is a long and rich history of Aboriginal occupation in the Gilead and broader Campbelltown area. Aboriginal heritage is understood to varying degrees within the investigation area due to the limited documentary evidence and the fact that Aboriginal people did not have strict geographical boundaries in the western sense (Yousif et.al, 2017). The area has traditionally been associated with the Dharawal and Darug people which were linked with particular territories or places, although these territorial boundaries appear to have been fluid.

The Aboriginal heritage constraint analysis shows areas more likely to contain Aboriginal heritage items. Much of the investigation area has been disturbed by rural and urban land uses over the past century while the remainder consists of nature conservation and public parklands. Due to this, the main factor considered was the level of disturbance to an area. Areas of high disturbance are less likely to contain Aboriginal heritage items. Aboriginal occupation and the preservation of any artefacts is considered more likely along waterways and within areas of undisturbed vegetation. Watercourses have been classified based on the stream order classification system as specified by the Department of Primary Industries. Class 1 watercourses have been excluded from the analysis as they are considered to have been unlikely to have attracted a high prevalence of Aboriginal activity. Consideration was given to the likelihood of increased Aboriginal activity along ridgelines, however, was found not to be highly relevant to the investigation due to the highly undulating nature of the topography.

The analysis identified key constraints which have been classified and considered in Table 5-3. Aboriginal heritage constraints are shown in Figure 5-3.

Table 5-3 Aboriginal heritage constraint criteria and findings

Constraint level	Constraint	Findings
High	- Undeveloped land within 100 metres of a Class 3 or 4 watercourse - Native vegetation within 100 metres of a watercourse.	- High constraint areas are generally clustered along the length of the Nepean River, Menangle and Woodhouse creeks and some smaller watercourses - High constraint areas are prevalent in the western part of the investigation area where the land is less disturbed.
Medium	- Undeveloped land within 50 metres of a Class 2 watercourse - Native vegetation more than 100 metres from a watercourse.	Moderate constraint areas are dispersed throughout the entire investigation area and are mainly associated with areas of native vegetation.
Low	Cleared land more than 50 metres from a Class 2 watercourse or 100 metres from a Class 3 or 4 watercourse.	Low constraint areas are extensive across most of the investigation area and are associated with land disturbed by rural and residential land uses.



5.3.2 Future investigations

The limited information available on Aboriginal heritage items, together with the importance of this area, indicates a need for a detailed, site-specific assessment of Aboriginal heritage as part of any future investigations. This would include targeted surveys and extensive consultation with the Aboriginal community and the Tharawal Local Aboriginal Land Council.

5.4 Water quality

5.4.1 Mapping considerations

The investigation area is within the Georges River subcatchment of the Sydney metro catchment. The investigation area also intersects with the Nepean River at the south-western boundary. The Nepean River subcatchment is part of the Hawkesbury-Nepean system.

Neither of these subcatchments provide drinking water for Sydney but are key water sources for agriculture and coal-mining operations. Menangle Creek is the major watercourse crossing the investigation area and next to this is a portion of the upper canal system which is a significant hydraulic feature within the catchment. This system also provides drinking water for Sydney. Most of the other watercourses that traverse the investigation area are non-perennial streams.

The water quality constraint analysis focussed on mapping watercourses. Watercourses have been classified based on the stream order classification system as specified by the Department of Primary Industries.

Buffers were established around the watercourses to quantify areas of constraint to delineate areas where a future road development may have the potential to impact water quality for that watercourse.

The analysis identified key constraints which have been classified and considered in Table 5-4. Water quality constraints are shown in Figure 5-4.

Table 5-4 Water quality constraint criteria and findings

Constraint level	Constraint	Findings
High	Undeveloped land within 50 metres of a Class 3 or 4 watercourse.	- High constraint areas typically follow Menangle Creek which runs through the centre of the investigation area - A small portion of the Nepean River is captured by the south-western portion of the investigation area. This is considered a high constraint due to the significance of the waterway in a regional context.
Medium	Undeveloped land within 50-100 metres of a Class 3 or 4 watercourse.	Most of Class 1 and 2 watercourses have been classified as moderate constraint areas as there may still be potential for water quality impact in high rainfall periods.
Low	Undeveloped land within 50 metres from a Class 1 or 2 watercourse.	The low constraint areas are extensive across the investigation area and correspond to lower order watercourses and areas of land that are distant from watercourses.

5.4.2 Future investigations

Future detailed investigations should consider the direct and indirect impact of the project on water quality. Any road development may also require a site-specific soil and water management plan to address construction phase water quality and may require water quality monitoring to be carried out.

Water quality would also be a key consideration of the design of any future road development due to the need to avoid road contaminants entering sensitive waterways as a result of road operation. Planning and design will need to consider spill containment and the quality of day-to-day road runoff.

5.5 Flooding

5.5.1 Mapping considerations

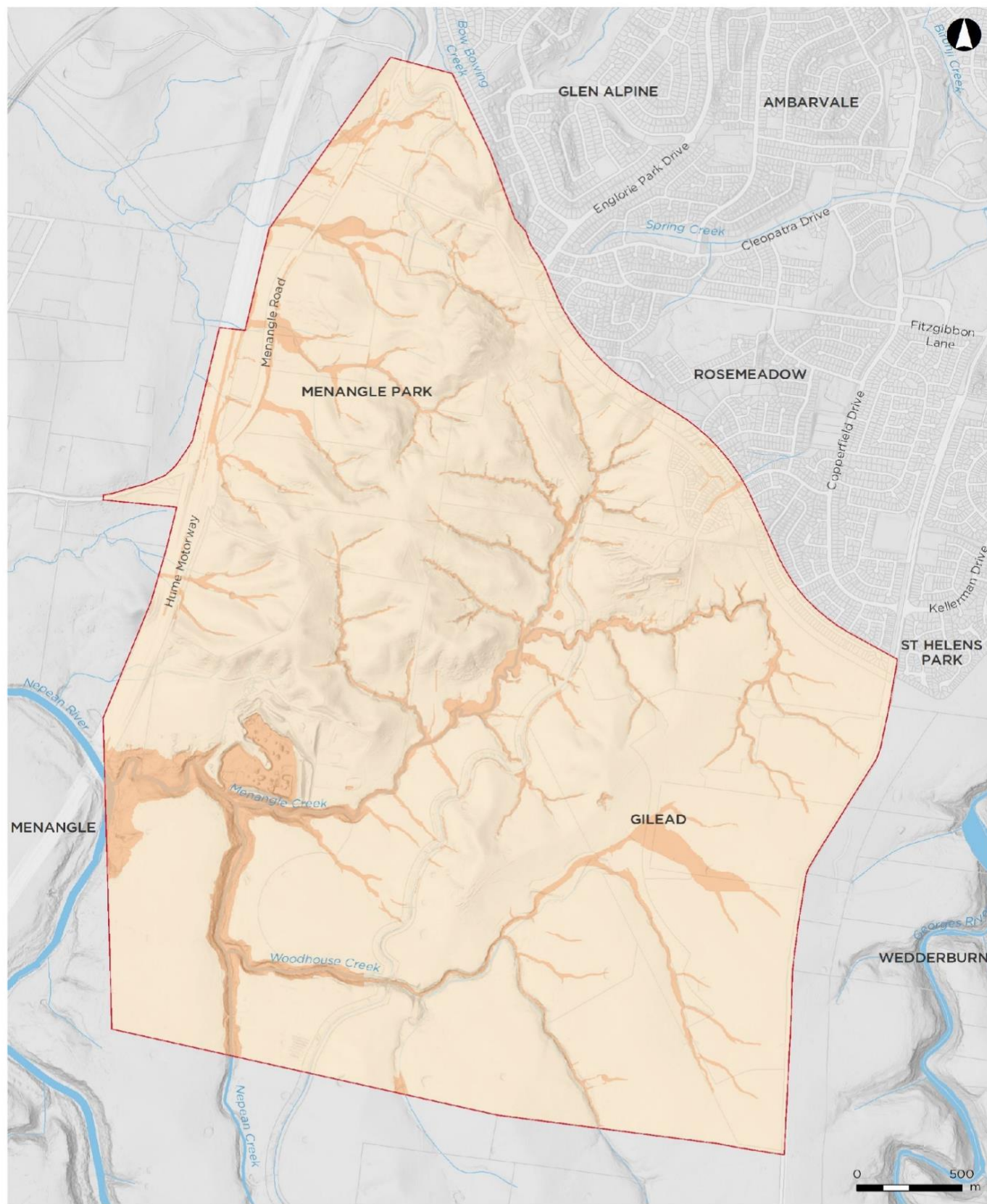
Major waterways within the investigation area include the Nepean River, Menangle Creek and Woodhouse Creek and their associated tributaries. The watercourses within the investigation area are mainly steep-walled due to the mainly steep, rural landscape.

The flooding constraint analysis focussed on the flooding associated with the watercourses within the boundaries of the investigation area. The constraint classifications were based on the 1 in 100-year rainfall event flood conditions in the investigation area.

The analysis identified key constraints which have been classified and considered in Table 5-5. Flooding constraints are shown in Figure 5-5.

Table 5-5 Flooding constraint criteria and findings

Constraint level	Constraint	Findings
High	There are no areas of high constraint.	There are no areas of high constraint as design solutions such as bridging have been implemented to avoid or minimise flooding impacts.
Medium	Within the 1 in 100-year flood level.	Areas of moderate constraint are generally restricted to within close proximity of the watercourses of the investigation area.
Low	Outside the 1 in 100-year flood level.	Flooding is a low constraint across most of the investigation area.



LEGEND

Flooding constraints

- Low
- Medium

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Figure 5-5 Flooding constraints

5.5.2 Future investigations

Hydrological modelling will be needed in the detailed design phase of any future road development in the investigation area. The provision of flood immunity and impacts on flood behaviour will need to be considered.

Consideration of other modelled flood levels other than the 1 in 100-year event will also be key in planning and design, including the probable maximum flood event, and smaller (higher recurrence interval) events.

5.6 Noise

5.6.1 Mapping considerations

The noise environment of the investigation area is likely typical of a mixed use rural and urban area. The main noise generator is likely to be road traffic with background noise varying in level due to traffic volumes and the distance from roads.

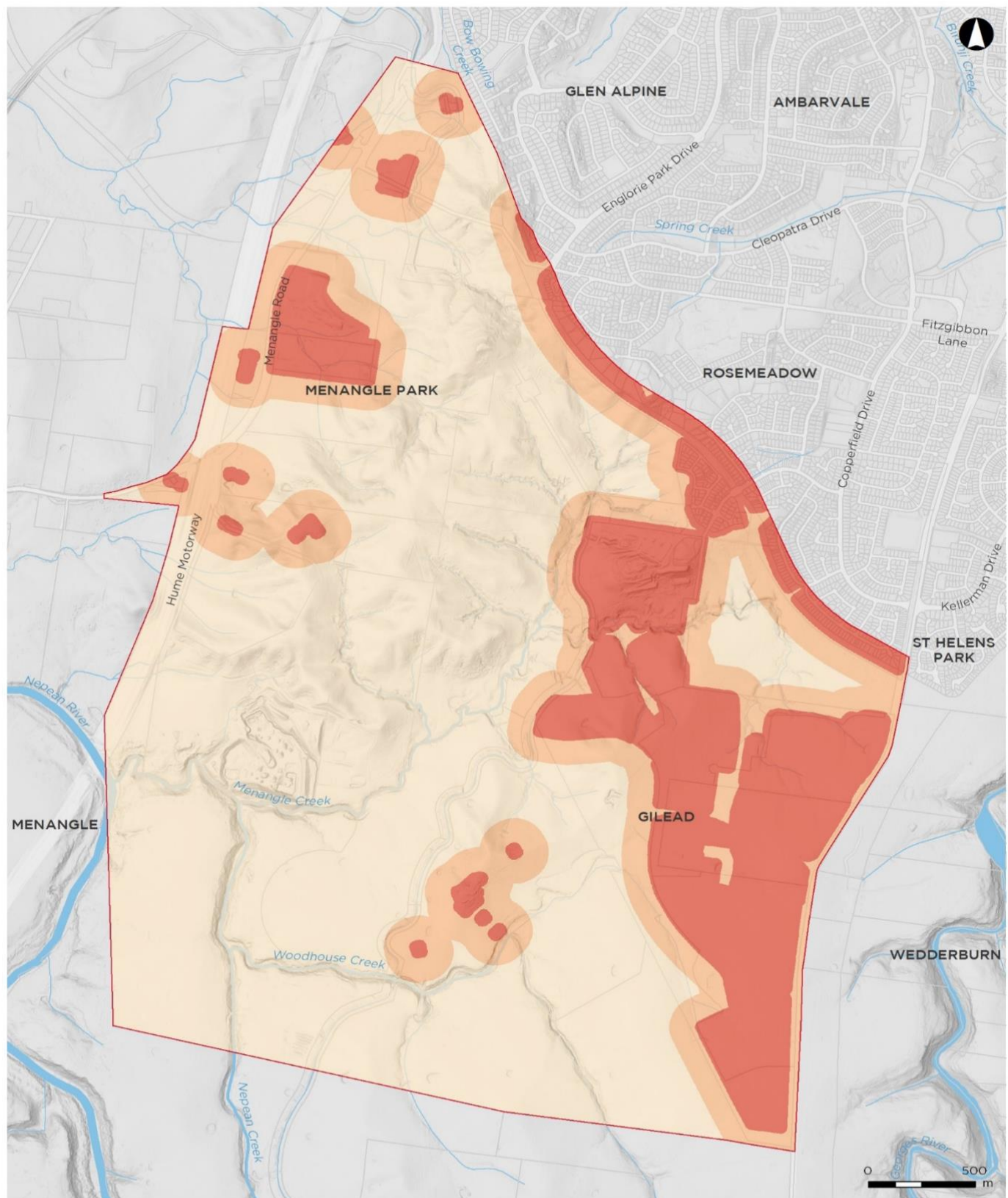
Noise-sensitive receivers include residential properties within the Mount Gilead stage 1 development, rural properties along Appin Road and Menangle Road, the Kilbride Nursing Home and the Broughton Anglican College. The main sensitive receivers exist next to the northern investigation area boundary. These residences are within the suburbs of Rosemeadow and Glen Alpine.

The noise constraint analysis focused on the location of noise-sensitive receivers. These receivers were identified through aerial photography and other mapping sources.

The analysis identified key constraints which have been classified and considered in Table 5-6. Noise constraints are shown in Figure 5-6.

Table 5-6 Noise constraint criteria and findings

Constraint level	Constraint	Findings
High	Within 30 metres of a sensitive receiver (including existing and zoned future residential properties and educational facilities).	- Areas of high constraint are correlated with the locations of the Kilbride Nursing Home, the Broughton Anglican College and isolated rural households - The northern boundary has been identified as a high constraint area due to the denser urban settlement of Rosemeadow and Glen Alpine - The Mount Gilead stage 1 development in the eastern portion of the investigation area represents a high constraint due to the future residential development proposed within the area.
Medium	30-150 metres from a sensitive receiver (including existing and future residential properties and educational facilities).	Moderate constraint areas buffer areas identified as high constraint.
Low	Greater than 150 metres from an existing or future sensitive receiver.	The north-western and southern sections of the investigation area are classified as low constraint due to the low concentration of sensitive receivers.



LEGEND

Noise constraints

- Low
- Medium
- High

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Figure 5-6 Noise constraints

5.6.2 Future investigations

A site-specific noise and vibration study will be needed as part of planning for any specific future road development. Noise modelling may be required depending on the type and location of future road development. A noise and vibration management plan may be required for future construction and operation of the Link Road.

It is possible that any future road would be developed before the development of the land release areas, and consequently would become a consideration for the land developer. Consultation with these land developers would be necessary in any further planning investigations.

5.7 Air quality

5.7.1 Mapping considerations

The air quality profile of the investigation area is likely typical of a mixed use rural and urban area and is likely to have reasonably unaffected background air quality. The background air quality is likely to be largely influenced by nearby road traffic and industrial land uses.

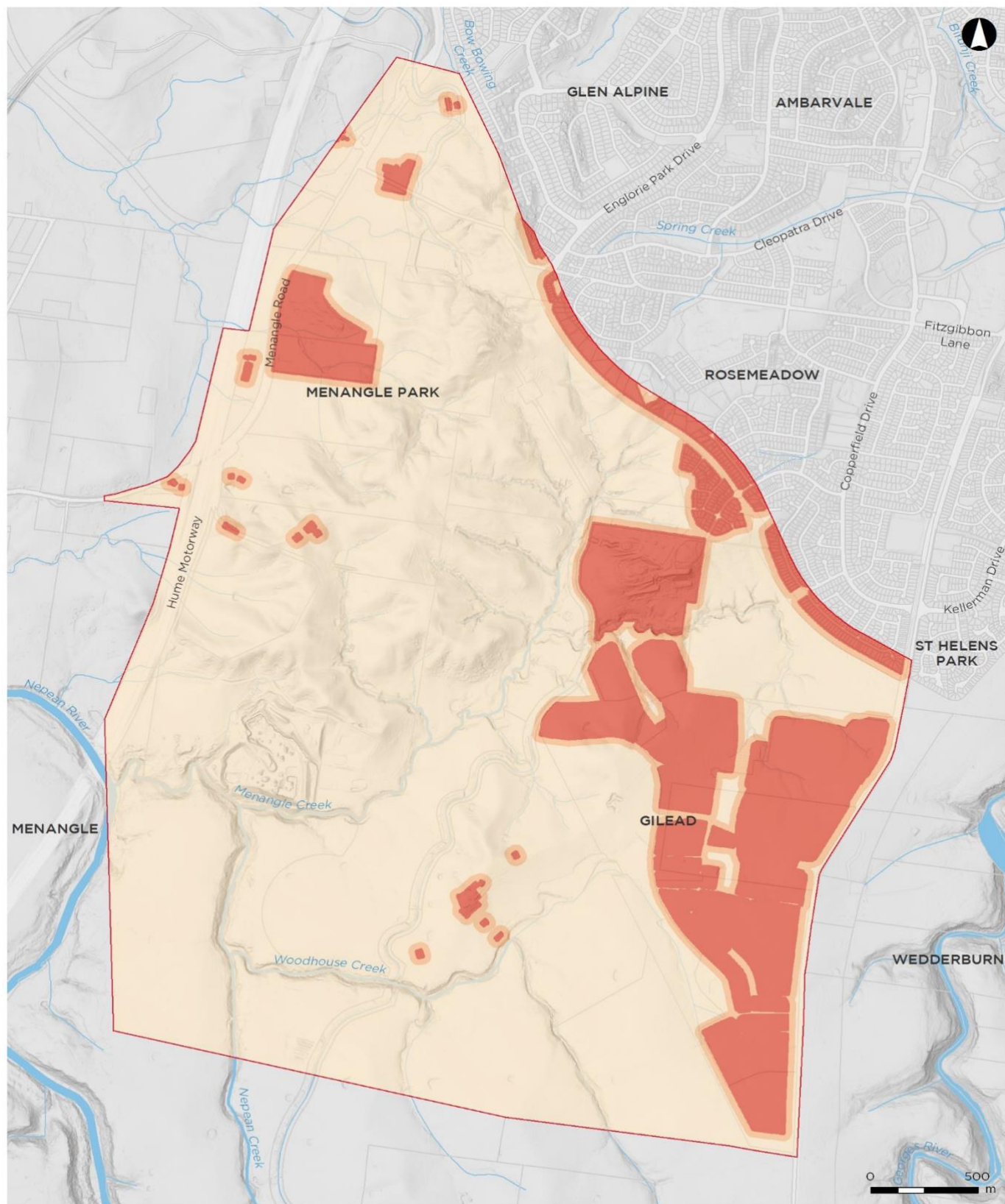
Sensitive receivers were identified based on existing mapping and analysis of aerial photography. Within the corridor, these include residences, the Broughton Anglican College, aged-care facilities and other community facilities. Air quality impacts dissipate over a smaller area than noise impacts, resulting in a smaller buffer distances from existing, and future, sensitive receivers.

The following buffer thresholds were applied for the air quality constraints map based on typical dispersion patterns of pollutants associated with major roads.

The analysis identified key constraints which have been classified and considered in Table 5-7. Air quality constraints are shown in Figure 5-7.

Table 5-7 Air quality constraint criteria and findings

Constraint level	Constraint	Findings
High	• Within 10 metres of a sensitive receiver (including existing and zoned future residential properties and educational facilities).	• High constraint areas reflect the settlement patterns of rural and urban residential areas.
Medium	• 10-40 metres from a sensitive receiver (including existing and future residential properties and educational facilities).	• Moderate constraint areas buffer areas identified as high constraint.
Low	• Greater than 40 metres from an existing or future sensitive receiver.	• Air quality is a low constraint across most of the investigation area because of the distribution of sensitive receptors and the generally small area of potential impact associated with air quality from roads in a rural environment.



LEGEND

Air quality constraints

- Low
- Medium
- High

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Figure 5-7 Air quality constraints

5.7.2 Future investigations

A site-specific air quality study may be required for future road development. This may require modelling of air quality impact if projected traffic volumes and the proximity of sensitive receivers warrant this.

5.8 Land use and property

5.8.1 Mapping considerations

The dominant land uses within the investigation area are primary production, public recreation, nature reserves, a school and low-density residential housing (including a retirement village). As part of the Greater Macarthur Growth Area, the Department of Planning, Industry and Environment recently rezoned much of the eastern portion of the investigation area from rural to low density residential. This specifically relates to the Mount Gilead stage 1 development which is proposed to be developed with about 1,700 new dwellings.

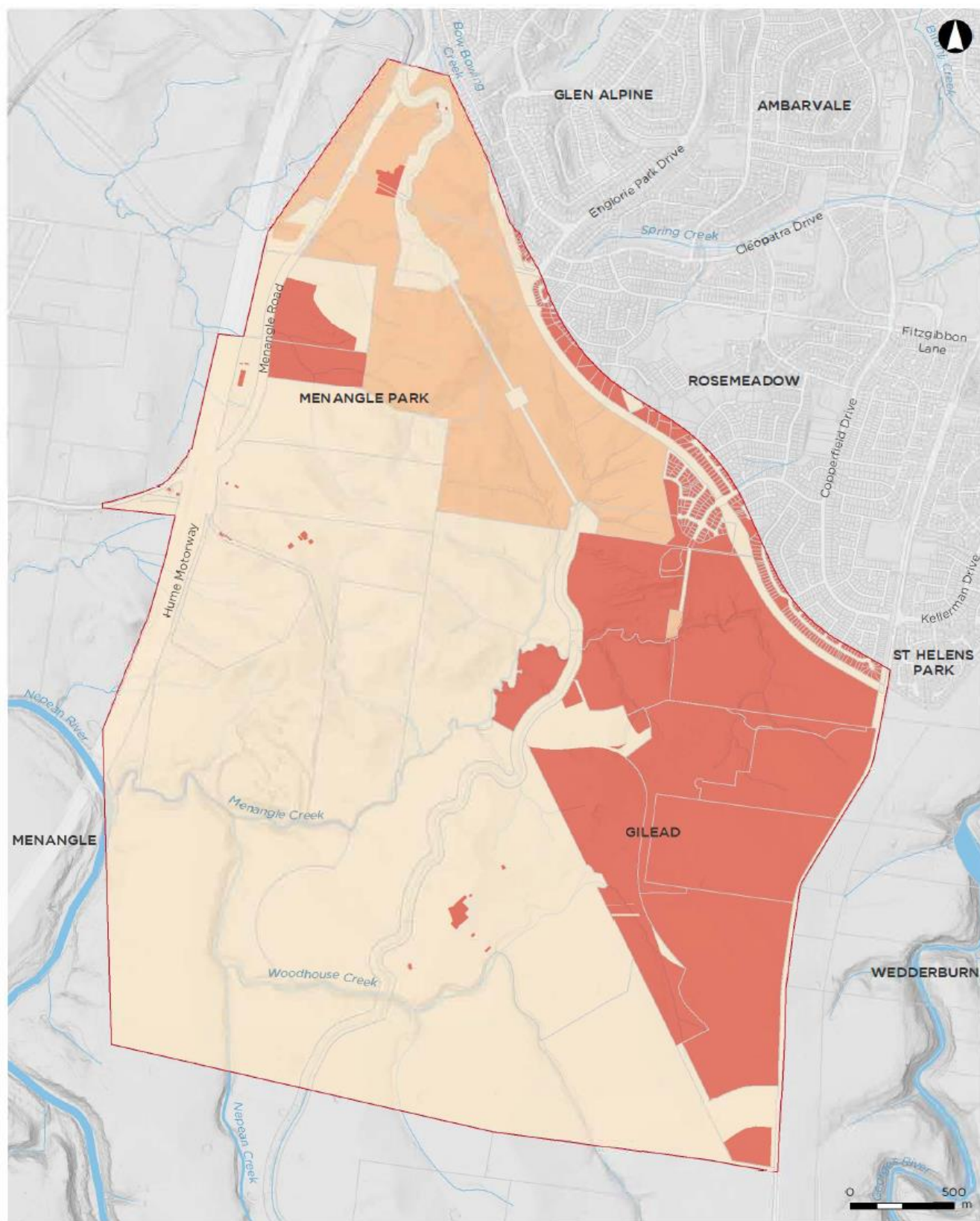
An existing east-west road reserve runs along the northern boundary of the investigation area. This road reserve was gazetted in the *Campbelltown Local Environmental Plan 2015* to preserve a corridor for the future link between Menangle Road and Appin Road.

The land use constraint analysis considered the impact of a future road development on current and future land uses. Multiple lots owned by a single landowner have been considered as a single property. Only areas with an identified masterplan/precinct plan have been considered within the future land release areas (i.e. Mount Gilead stage 1 and 2, Medhurst Road development). The existing road reserve has been considered a low constraint due to the beneficial applications to road development.

The analysis identified key constraints which have been classified and considered in Table 5-8. Land use constraints are shown in Figure 5-8.

Table 5-8 Land use constraint criteria and findings

Constraint level	Constraint	Findings
High	- Existing and zoned future residential and agricultural buildings - Community facilities (including educational and aged care facilities) - Open space; including environmental protection/management and, public recreation.	- High constraint areas are concentrated around the northern border of the investigation area and are associated with areas of dense residential development - The Mount Gilead stage 1 development area represents an area of high constraint - Smaller isolated areas of high constraint reflect rural buildings - The Noorumba Reserve and the Broughton Anglican College have also been identified as high constraint areas.
Medium	- Small rural properties (less than 10 hectares) - Private recreation.	The Sugarloaf Farm has also been identified as a moderate constraint.
Low	- Non-sensitive infrastructure - Commercial land uses - Large rural properties (greater than 10 hectares) - Other land uses.	Low constraint areas reflect the presence of large rural lots and other land uses.



LEGEND

Land use constraints

- Low
- Medium
- High

Figure 5-8 Land use constraints

5.8.2 Future investigations

The land use analysis represents a snapshot of current and known future land uses. Any future planning will need to consider any planned changes to land use likely to occur, including the alteration of existing zoning plans to accommodate future residential development.

5.9 Utilities

5.9.1 Mapping considerations

The investigation area contains several existing utilities and important State and local infrastructure. Major utilities are electricity transmission lines, including a 330 kilovolt line, 66 kilovolt lines and 11 kilovolt lines; and high pressure gas transmission lines, including the Jemena eastern gas pipeline which traverses the western parts of the investigation area. The WaterNSW upper canal traverses through the investigation area near Menangle Road. The Sydney Water and Trility DN1200 watermain traverses western parts of the study area and connects to the pumping station asset, located in the north-western portion of the investigation area. A quarry and gas plant adjoin the south-west portion of the investigation area.

The utility constraint mapping considered the impact of a future road development on existing utilities infrastructure within the investigation area. Buffers were applied to different utilities according to the relative important and safety hazard of this infrastructure.

The analysis identified key constraints which have been classified and considered in Table 5-9. Utility constraints are shown in Figure 5-9.

Table 5-9 Utilities constraint criteria and findings

Constraint level	Constraint	Findings
High	• Within 30 metres of a high voltage (330 kilovolts) overhead power line transmission towers • Within 10 metres of the Transmission gas pipeline easement • Within 10 metres of a WaterNSW supply channel, the Sydney Water pumping station and Sydney Water and Trility water mains • Within the footprint of the telecommunications tower.	• Areas of high constraint are correlated with the locations of significant utility assets including the Water NSW upper canal, Sydney Water and Trility water mains, Sydney Water pumping station, transmission gas pipelines, telecommunications tower and TransGrid 330kV powerlines.
Medium	• Within 10 metres of a high voltage (66 kilovolts) overhead power line • Within 5 metres of a gas gathering line • Telecommunication cables.	• Moderate constraint areas correlate with localised 66kV, gas and telecommunication utilities.
Low	• Greater than 5 metres from a utility.	• Low constraint areas are extensive across the entire investigation area and are associated with local utilities and in areas where no utilities exist.



5.9.2 Future investigations

The project has the potential to impact multiple utilities, particularly the electricity transmission lines and upper canal system which traverse the entire length of the investigation area. Direct impact to utilities may result in a need to move or decommission infrastructure resulting in potential disruption to services. Due to this potential impact, consultation with utility providers will need to be carried out during the concept design phase of the project.

5.10 Landscape character

5.10.1 Mapping considerations

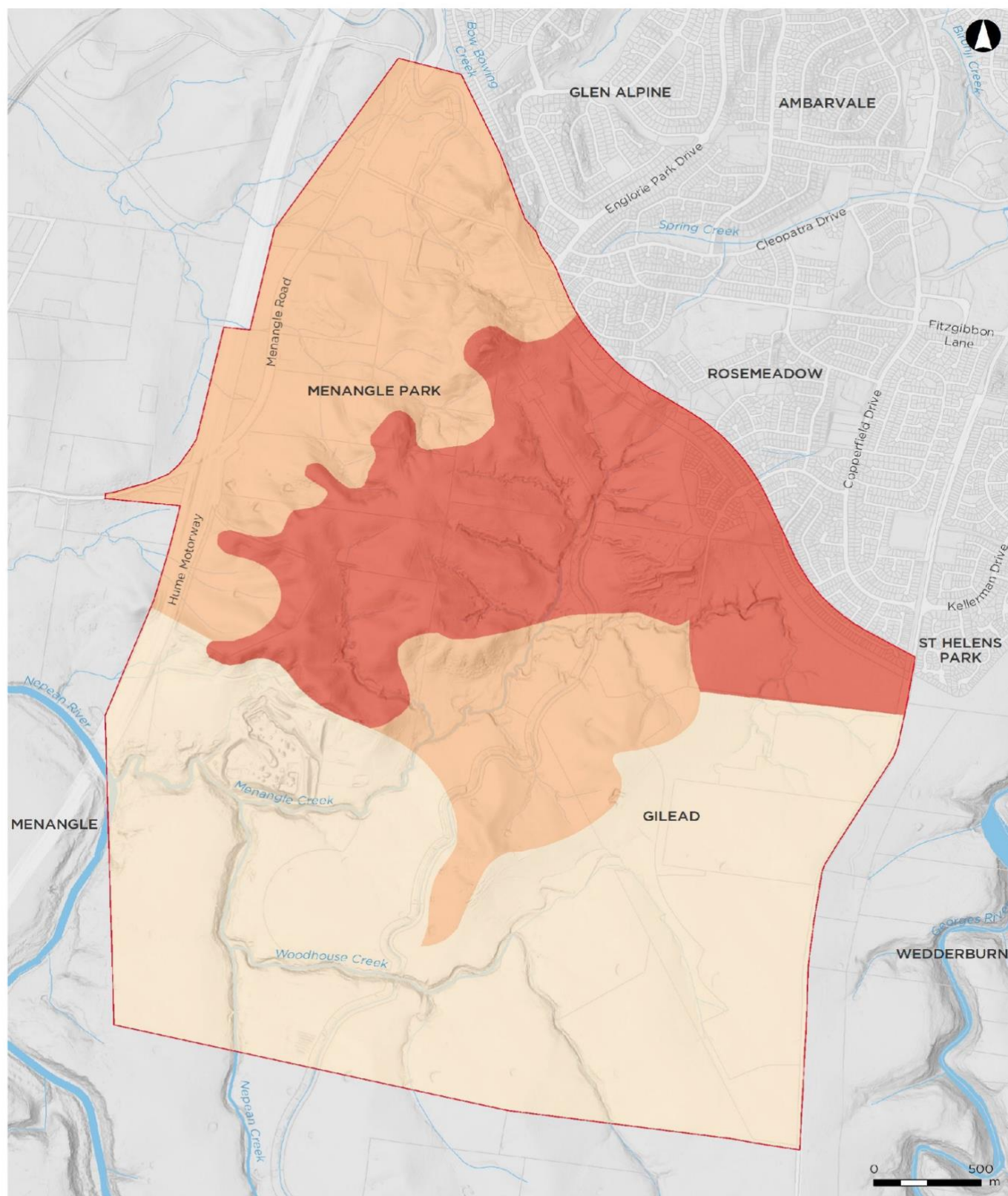
Landscape character is the aggregate of built, natural and cultural aspects that make up an area and provide its unique sense of place. The investigation area is a location of unique natural and cultural features and embodies the semi-rural character typical of the broader Macarthur area. The existing landscape character of the investigation area is strongly influenced by rural lands, low density residential lots and stands of natural vegetation. Residential development next to the northern boundary provides a transition to a more urban character. The analysis identified areas across the investigation area where the landscape character may be impacted by the project.

The analysis identified key constraints which have been classified and considered in Table 5-10. Landscape character constraints are shown in

Figure 5-10.

Table 5-10 Landscape character constraint criteria and findings

Constraint level	Constraint	Findings
High	• Areas where a future road would become the dominant feature in contrast with a landscape character assessed to be of high sensitivity • Areas where a future road would significantly adversely affect the current landscape character.	• Areas of high constraint cover the central portion of the investigation area near steep topography and visually prominent hills that would be significantly impacted by the construction of a road • The Noorumba Reserve represents a high constraint as it contains large areas of intact remnant vegetation.
Medium	• Areas where a future road would adversely change the current landscape character.	• Medium constraint areas cover the lower central and north-western sections that contain visually prominent topography and are of significantly rural character.
Low	• Areas where a future road would make up a minor physical component within the landscape • Areas where a future road would not substantially adversely alter the current landscape character.	• Areas of relatively open rural landscape character • Where the built environment is likely to change due to proposed residential development.



LEGEND

Landscape constraints

- Low
- Medium
- High

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Figure 5-10 Landscape character constraints

5.10.2 Future investigations

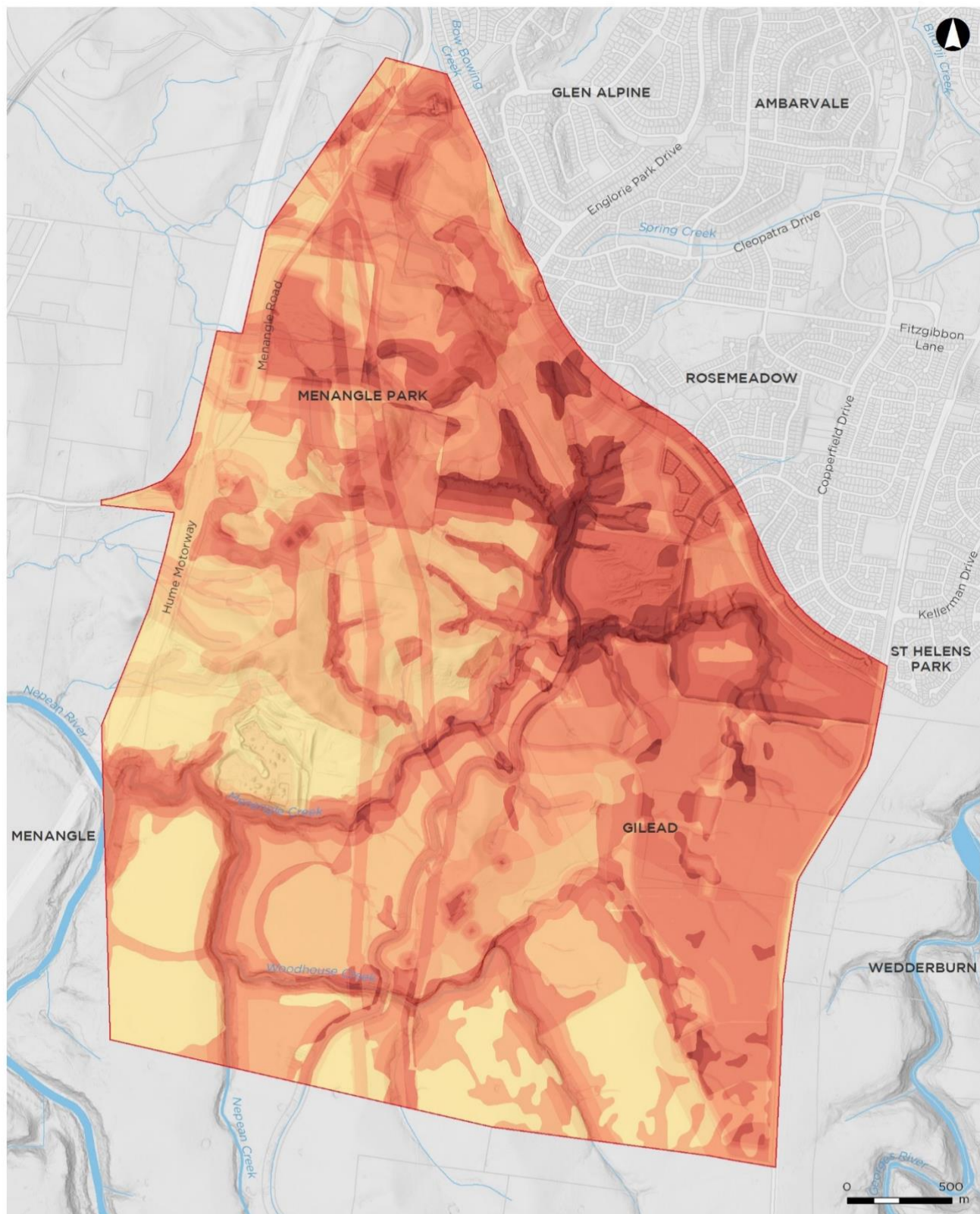
When planning for a future road development to support growth and change, detailed urban design investigations will be needed. An urban design framework for the corridor should be developed to incorporate the following objectives:

- Urban structure: Maintain and improve the urban structure of settlements that occur along the corridor
- Cultural elements: Maintain and improve those cultural elements within the corridor that contribute to the unique character of the Link Road
- Natural features: Maintain and improve the existing natural features within the corridor that contribute to its unique visual and landscape character including the Noorumba Reserve
- Views: Maintain and improve short and long-distance views, within the corridor and from surrounding major vantage points, that contribute to the unique visual character of the Link Road corridor
- Planning: Use the urban, landscape and visual assessment process to assist the selection and planning of the corridor.

5.11 Overview of constraints

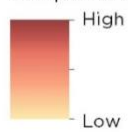
A combined constraints map was prepared from the 10 factors presented in Section 5.1 to 5.10 above. Equal weighting was given to all factors. The combined map, shown in Figure 5-11, indicates areas of higher and lower constraint on a graduated scale.

The combined constraint map shows that areas in the north-eastern portion of the investigation area are more highly constrained than other sections of the investigation area. Areas following the major creek lines, in particular the Nepean River, Menangle Creek and Woodhouse Creek and areas containing native vegetation are also shown to be more highly constrained. Challenges are presented in the eastern portion of the investigation area which is subject to residential development. Early planning for any future road development in this area will maximise opportunities to integrate the road development into future urban areas, minimising impact to those communities.



LEGEND

Composite constraints



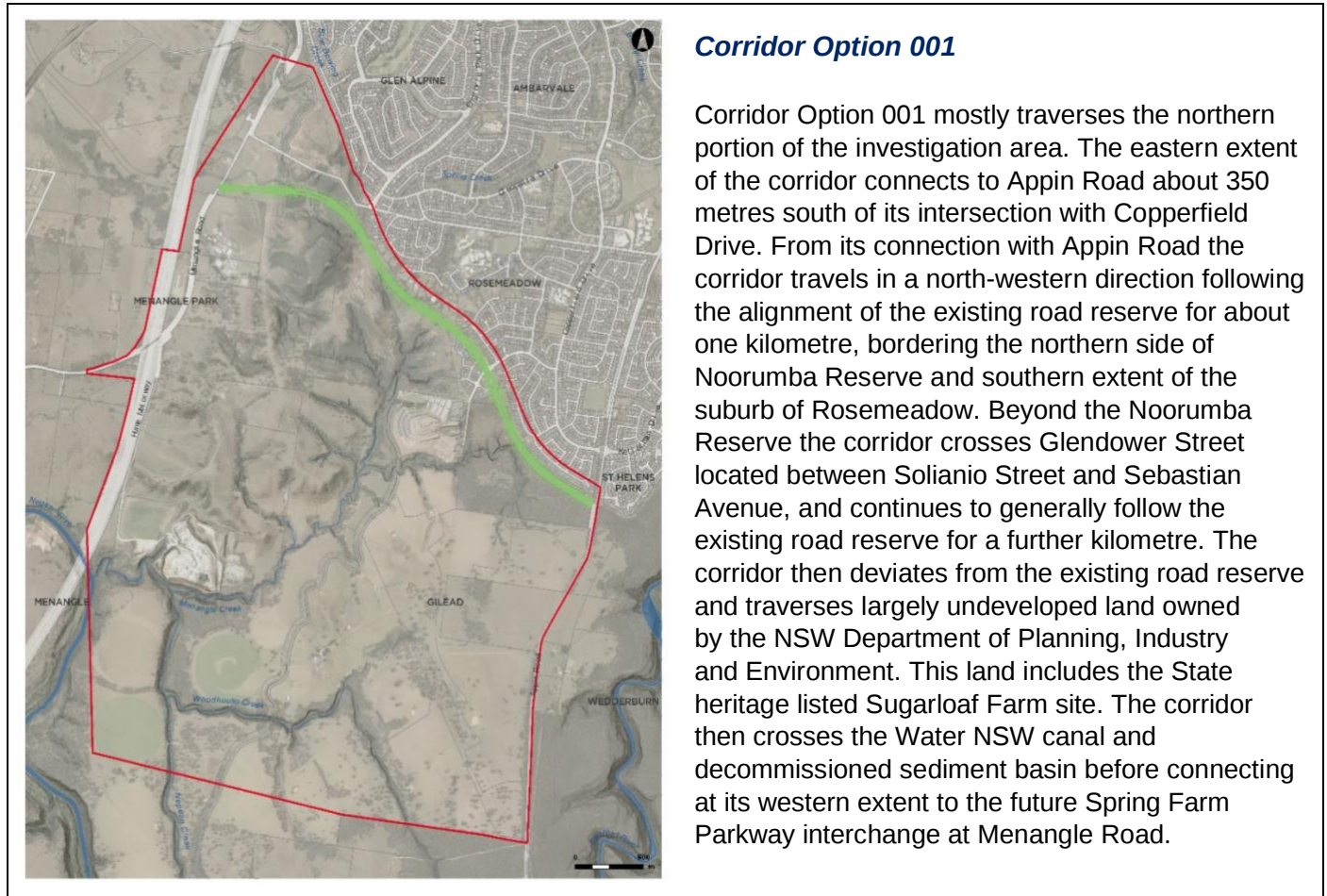
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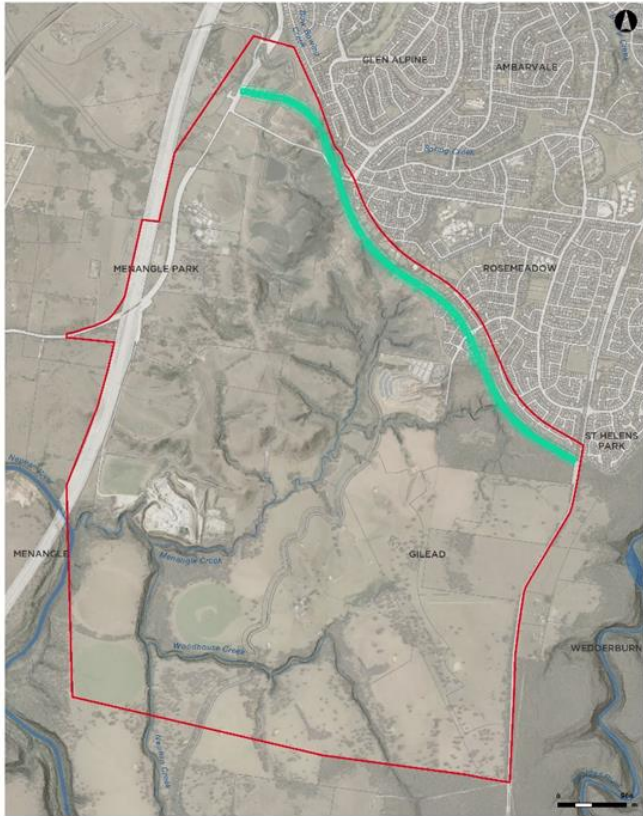
Figure 5-11 Combined constraints

6 Identification of long list options

Route options were initially identified by reviewing the constraints within the investigation area and determining routes between potential connection points along Appin Road and Menangle Road. A total of 23 potential route options were identified between the potential intersection locations along Appin Road and Menangle. Based on these pre-long list options, a long list of nine options was developed which represent the different ways in which the constraints within the investigation area can be responded to.

6.1 Long list options





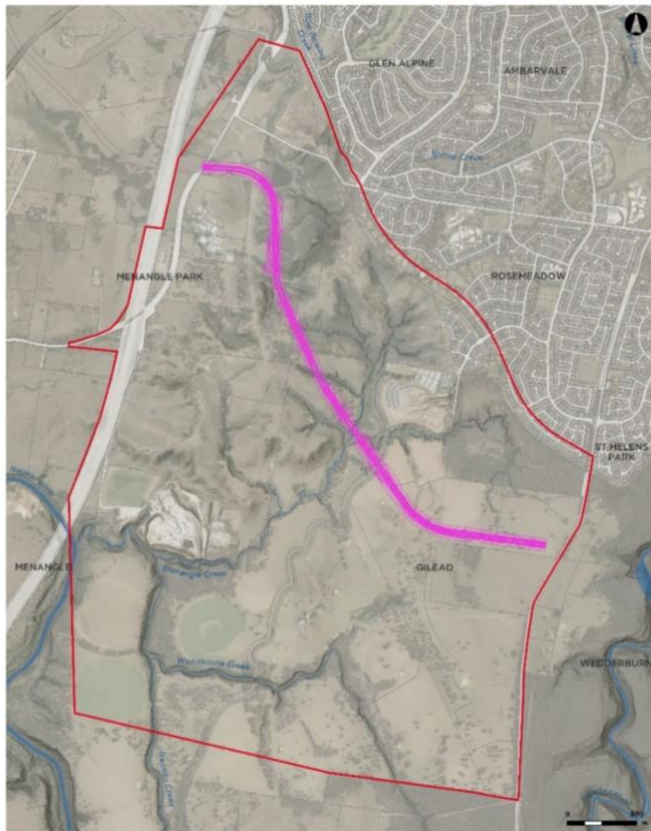
Corridor Option 002

Corridor Option 002 mostly traverses the northern portion of the investigation area. The eastern extent of the corridor connects to Appin Road about 350 metres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels in a north-western direction following the alignment of the existing road reserve for about one kilometre, bordering the northern side of Noorumba Reserve and southern extent of the suburb of Rosemeadow. Beyond the Noorumba Reserve the corridor crosses Glendower Street located between Soliano Street and Sebastian Avenue, and continues to generally follow the existing road reserve for a further kilometre. The corridor then traverses along the northern extent of largely undeveloped land owned by the NSW Department of Planning, Industry and Environment. This land includes the State heritage listed Sugarloaf Farm site. The corridor then crosses the Water NSW canal until it connects at its western extent about 600 metres north of the future Spring Farm Parkway interchange at Menangle Road.



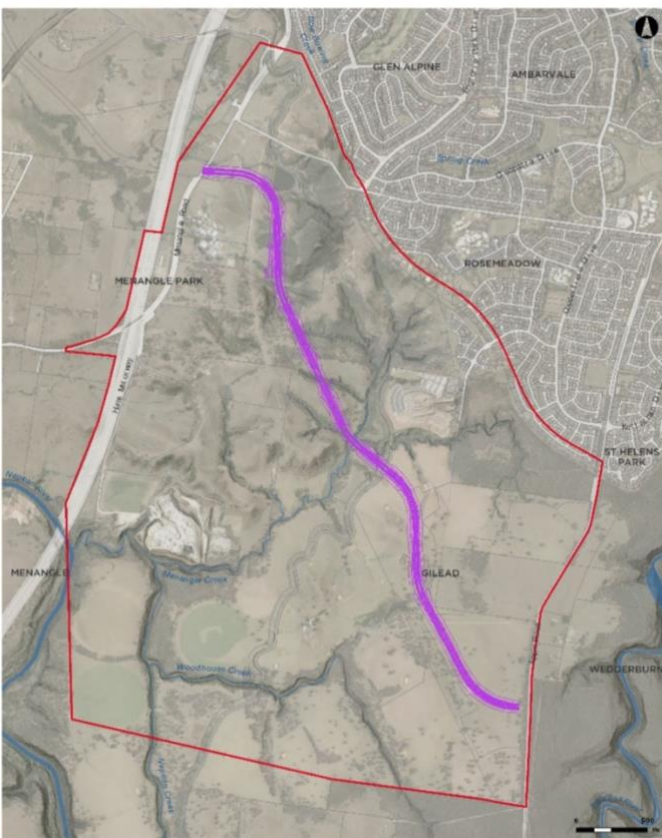
Corridor Option 113

Corridor Option 113 generally traverses the lower middle portion of the investigation area. The eastern extent of the corridor connects to Appin Road about 970 metres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west following the alignment of the Mount Gilead stage 1 proposed local road. The corridor then crosses the Water NSW canal and traverses largely through undeveloped privately-owned land until it connects at its western extent about 1 kilometre south of the future Spring Farm Parkway interchange at Menangle Road.



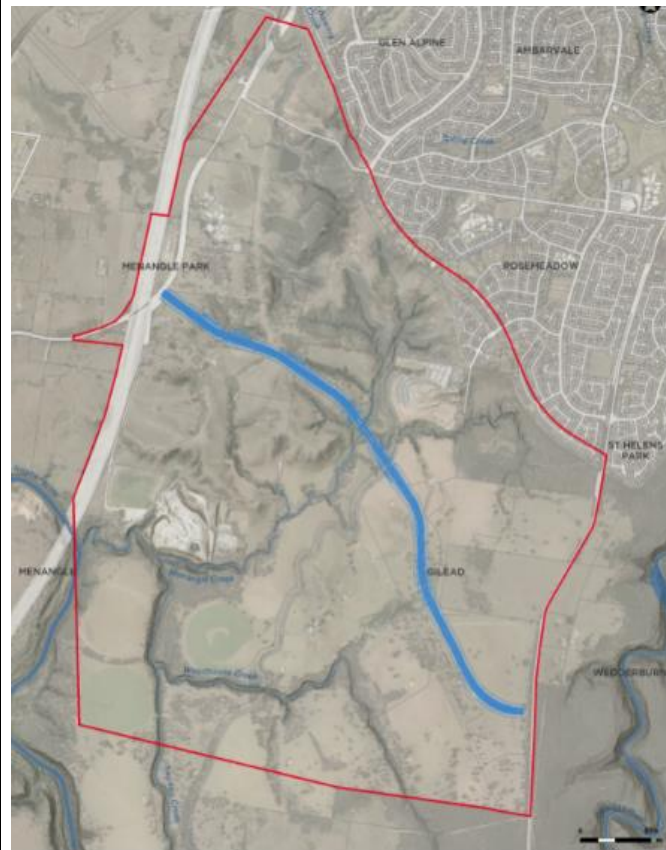
Corridor Option 121

Corridor Option 121 generally traverses the middle portion of the investigation area. The eastern extent of the corridor connects to Appin Road about 970 metres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west following the alignment of the Mount Gilead stage 1 proposed local road. The corridor then crosses over the Water NSW canal before it traverses through undeveloped privately-owned land, land owned by the NSW Department of Planning, Industry and Environment which includes the State heritage listed Sugarloaf Farm site. The corridor then passes between the northern property boundary of Broughton Anglican College and the Water NSW decommissioned sediment basin before connecting at its western extent to the future Spring Farm Parkway interchange at Menangle Road.



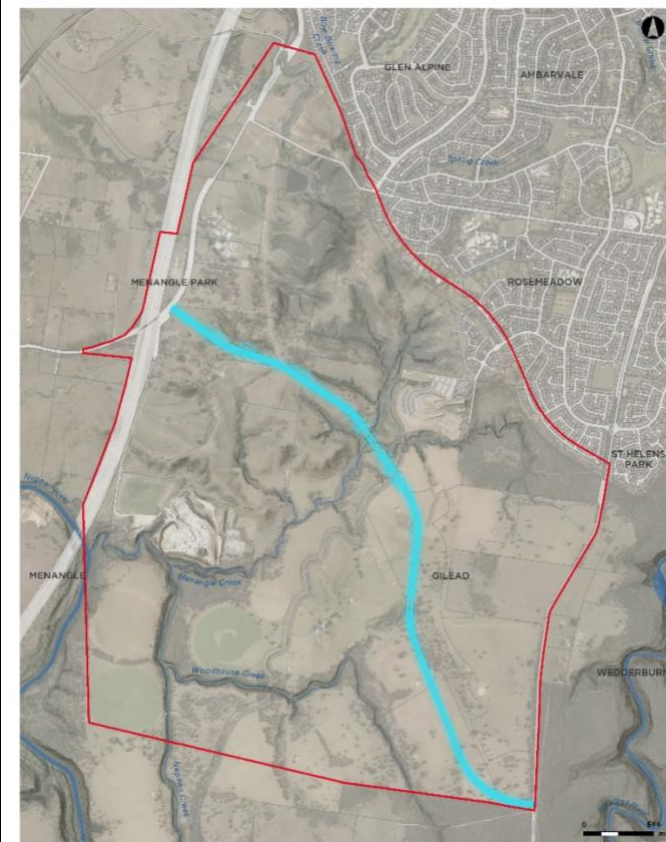
Corridor Option 301

Corridor Option 301 generally traverses the middle portion of the investigation area. The eastern extent of the corridor connects to Appin Road about 2.1 kilometres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west following the alignment of the Mount Gilead stage 1 proposed local road then diverts in a north-westerly direction on the western extents of Mount Gilead stage 1. The corridor then crosses through the State heritage listed Sugarloaf Farm and the Water NSW canal before it traverses through undeveloped privately-owned land and land owned by the NSW Department of Planning, Industry and Environment. The corridor then passes between the northern property boundary of Broughton Anglican College and the Water NSW decommissioned sediment basin before connecting at its western extent to the future Spring Farm Parkway interchange at Menangle Road.



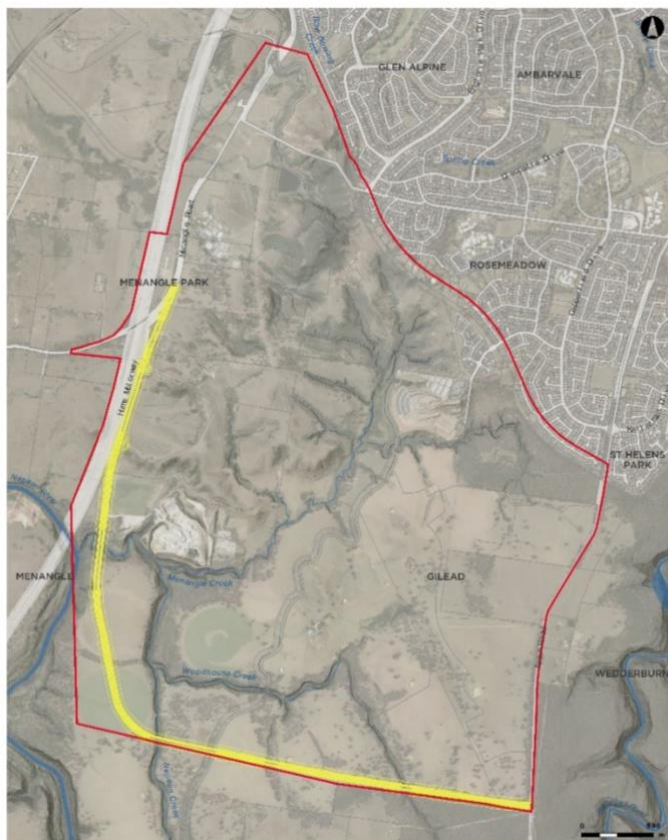
Corridor Option 303

Corridor Option 303 generally traverses the lower middle portion of the investigation area. The eastern extent of the corridor connects to Appin Road about 2.1 kilometres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west following the alignment of the Mount Gilead stage 1 proposed local road then diverts in a north-westerly direction on the western extents of Mount Gilead stage 1. The corridor then crosses the Water NSW canal and traverses largely through undeveloped privately-owned land until it connects at its western extent about 1 kilometre south of the future Spring Farm Parkway interchange at Menangle Road.



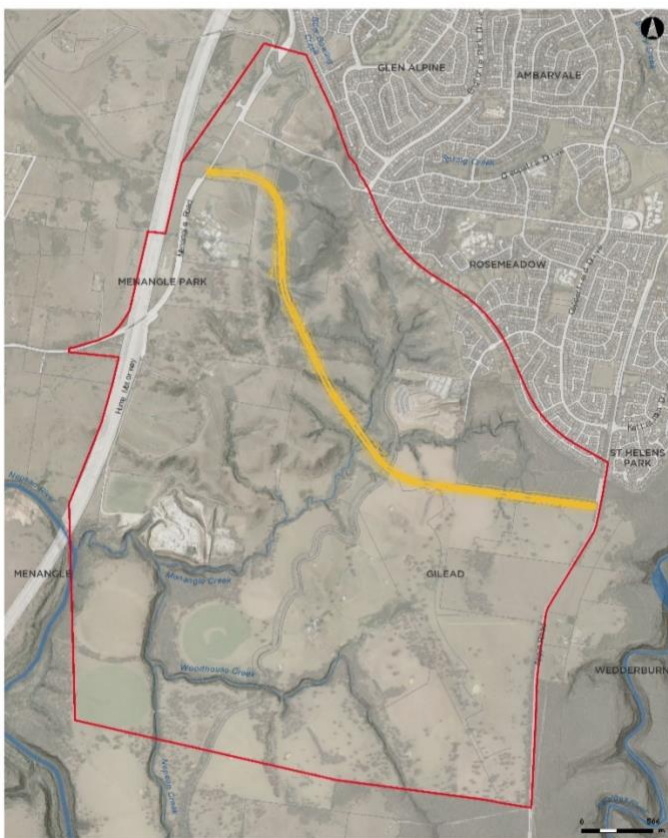
Corridor Option 403

Corridor Option 403 connects to Appin Road at the southern end of Mount Gilead stage 1 and at the south-east most corner of the investigation area. The eastern extent of the corridor connects to Appin Road about 2.8 kilometres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west then diverts in a north-westerly direction outside the western extents of Mount Gilead stage 1. The corridor then enters the western part of the Mount Gilead stage 1 and crosses the Water NSW canal and traverses largely through undeveloped privately-owned land until it connects at its western extent about 1 kilometre south of the future Spring Farm Parkway interchange at Menangle Road.



Corridor Option 424

Corridor Option 424 connects to Appin Road at the southern end of Mount Gilead stage 1 and at the south-east most corner of the investigation area. The eastern extent of the corridor connects to Appin Road about 2.8 kilometres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west along the southern extents of the investigation area through privately-owned land until it crosses the Water NSW canal. The corridor continues west until it meets the Nepean River where the corridor diverts north and along the alignment of Medhurst Road until it connects at its western extent about 800 metres south of the future Spring Farm Parkway interchange at Menangle Road.



Corridor Option 511

Corridor Option 511 connects to Appin Road south of the Noorumba Reserve in the north-eastern portion of the investigation area. The eastern extent of the corridor connects to Appin Road about 600 metres south of its intersection with Copperfield Drive. From its connection with Appin Road the corridor travels west, south of Noorumba Reserve, and along the northern border of Mount Gilead stage 1. The corridor then crosses the Water NSW canal before diverting in a north-westerly direction through privately-owned land. Following this, the corridor traverses through land owned by the NSW Department of Planning, Industry and Environment which includes the State heritage listed Sugarloaf Farm site. The corridor then passes between the northern property boundary of Broughton Anglican College and the Water NSW decommissioned sediment basin before connecting at its western extent to the future Spring Farm Parkway interchange at Menangle Road.

7 Identification of short list options

A short list was identified in two stages. The first was the development of key performance indicators (KPIs) for each project objective, while the second involved scoring each long-listed option against these KPIs. The outcomes of each of these two stages were arrived at via workshops with key stakeholders.

KPIs represent the various factors that contribute to meeting an objective. They are framed in a way that can be realistically measured (either qualitatively or quantitatively). Like the project objectives, it is intended that KPIs will be used through all stages of project development (not only in the corridor options assessment phase). The ways in which they are measured may however change as the project develops.

7.1 Development of key performance indicators

Draft KPIs were developed by the project team under each objective. These were then taken to a workshop with key stakeholders on 28 November 2018. Each key performance objective was discussed with the workshop group with various additions and refinements made until general agreement was reached. In some cases, key performance indicators were further refined throughout the options selection process. The agreed KPIs are listed in Table 7-1.

Table 7-1 Project objectives and key performance indicators

Objective	Description	Key Performance Indicator
1. Provide an efficient east-west link across the Greater Macarthur Growth Area	Provision of one connection between Appin Road and Menangle Road within the central Greater Macarthur Growth Area and south of the existing developments, in the context of additional proposed east-west connections to the south. The connection is to maximise broader network efficiency and reliability and be compatible with other planned road network upgrades.	1.1 Provide the most efficient travel connections for developments at Gilead, Spring Farm, Menangle Park and the broader network
		1.2 Performance of intersections immediately connected to the corridor
		1.3 Compatibility with other planned road projects
		1.4 Provide reliable journeys
		1.5 Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)
2. Cater for active and public transport	Provision of integrated active transportation, considering future planned corridors. Accommodation of future public transport including safe and efficient bus stops and (if appropriate) bus lanes, transitways and/or light rail.	2.1 Provide functional and desirable active transport corridor
		2.2 Enable connection to the surrounding active and public transport network
		2.3 Cater for the crossing of a new north-south transit route which could include bus and/or light rail
3. Integrate with existing and future land uses	Ensuring that the proposed Link Road corridor minimises adverse impacts on current land uses and is consistent with land use planning for the corridor and aligns with the Greater Macarthur Structure Plan.	3.1 Impact on zoned future residential development areas
		3.2 Impact on unzoned future residential development areas
		3.3 Impact on existing sensitive land uses (residential, recreational, school etc)
		3.4 Maximise use of existing road corridor
4. Minimise environmental impact	Minimisation of impact to areas of ecological and cultural sensitivity, as well as to the existing and future communities in the growth corridor.	4.1 Impact on native vegetation and fauna habitat
		4.2 Impact on fauna connectivity
		4.3 Impact of noise on sensitive receivers

Objective	Description	Key Performance Indicator
		4.4 Impact on non-Aboriginal heritage
		4.5 Impact on Aboriginal heritage
		4.6 Impact on landscape character
		4.7 Social impact of property acquisition
		5.1 Achieving an optimum road design
		5.2 A safe and efficient corridor for all road corridor users and stakeholders (during construction)
		5.3 A safe and efficient corridor for all road corridor users and stakeholders (during operation and maintenance)
5. Ensure the safety for all users	Ensuring that the proposed Link Road corridor is safe for all its users (including road users, construction workers and maintenance workers) across its entire life cycle.	5.4 Minimise conflict points
6. Maximise value for money	Provide the best value for money across the life of the project with consideration of the other project objectives and wider economic benefits.	6.1 Cost estimate
		6.2 Benefit cost ratio

7.2 Evaluation of long list options

Transport for NSW held a short-listing workshop on 25 February 2019. The workshop was attended by representatives from Transport for NSW, Campbelltown City Council, Department of Planning, Industry and Environment, and the Office of Strategic Lands. The purpose of this workshop was to undertake a multi-criteria analysis of each of the nine long-listed corridor options and agree on a set of short-listed options to be taken through to strategic design and further assessment.

Transport for NSW provided the workshop participants with an overview of the project background and recent developments, agreed decision making process and project objectives. Participants were also given an overview of the long-listed corridor options and existing key constraints. This workshop group was given an opportunity to provide comment and raise any issues or concerns regarding the process and option development. The project team provided responses on how issues and concerns identified were being addressed and highlighted items for further consideration as the project planning proceeded.

The initial assessment of the long-listed corridor options used information from preliminary traffic modelling, Transport for NSW design guidelines, geotechnical surveys, preliminary flood investigations, the locations of major public utilities and an understanding of key environmental and socio-economic constraints (presented in Section 5). The data sheets presented at the short-listing workshop are presented in 0. The data presented for each aspect has been identified based on the full corridor width for each long list option (ranging from 80 metres to 120 metres).

Subject matter experts presented on each key performance indicator (presented in Table 7-1), discussing the key considerations and provided a recommended score, between one and 10, for each of the long-listed corridor options. A score of 10 indicated that a corridor option comprehensively fulfilled all the requirements of the key performance indicator. A score of one indicated that a corridor option performed extremely poorly against a key performance indicator.

Following this, the recommended key performance indicator scores were discussed, adjusted and agreed by the workshop group. Table 7-2 summarises the results of this scoring assessment. A full list of scoring considerations is presented in 0. Several key performance indicators were agreed by the workshop group to be scored at a later stage due to information being limited.

Table 7-2 Short-listing Workshop multi-criteria analysis scoring

Objective	Key performance indicator (KPI)	Scoring 10 = Comprehensive, 5 = Partial, 1 Minimal achievement								
		001	002	131	121	301	303	403	424	511
1. Provide an efficient east-west link across the Greater Macarthur Growth Area	1.1 Provide the most efficient travel connections for developments at Gilead, Spring Farm and Menangle Park and the broader network	10	7	8	10	10	9	9	7	10
	1.2 Performance of intersections immediately connected to the corridor	KPI to be considered in evaluation of shortlist options								
	1.3 Compatibility with other planned road projects	5	3	3	6	7	4	3	3	5
	1.4 Provide reliable journeys	KPI to be considered in future assessment								
	1.5 Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)	KPI to be considered in evaluation of shortlist options								
2. Cater for active and public transport	2.1 Provide functional and desirable active transport corridor	3	2	2	3	2	1	1	2	4
	2.2 Enable connection to the surrounding active and public transport network	KPI to be considered in future assessment								
	2.3 Cater for the crossing of a new north-south transit route which could include bus and/or light rail	5	5	5	5	5	5	5	5	5
3. Integrate with existing and future land uses	3.1 Impact on zoned future residential development areas	10	10	2	2	3	3	6	10	2
	3.2 Impact on unzoned future residential development areas	KPI to be considered in evaluation of shortlist options								
	3.3 Impact on existing sensitive land uses (residential, recreational, school etc)	5	5	5	5	2	3	5	9	3
	3.4 Maximise use of existing road corridor	8	9	1	1	1	1	1	1	1

Objective	Key performance indicator (KPI)	Scoring 10 = Comprehensive, 5 = Partial, 1 Minimal achievement								
		001	002	131	121	301	303	403	424	511
4. Minimise environmental impact	4.1 Impact on native vegetation and fauna habitat	4	6	6	4	4	5	2	1	3
	4.2 Impact on fauna connectivity	9	10	6	2	2	6	6	2	2
	4.3 Impact of noise or reduced air quality on sensitive receivers	5	4	4	4	4	4	8	10	6
	4.4 Impact on non-Aboriginal heritage	3	4	8	3	3	8	7	8	3
	4.5 Impact on Aboriginal heritage	6	7	5	4	4	5	5	6	3
	4.6 Impact on landscape character	3	3	4	5	5	4	4	9	5
	4.7 Social impact of property acquisition	1	1	8	8	8	8	8	8	8
5. Ensure the safety for all users	5.1 Achieving an optimum road design	9	1	7	9	9	7	7	10	9
	5.2 A safe and efficient corridor for all road corridor users and stakeholders (during construction)	6	8	7	7	7	7	7	8	7
	5.3 A safe and efficient corridor for all road corridor users and stakeholders (during operation and maintenance)	KPI to be considered in evaluation of shortlist options								
	5.4 Minimise conflict points	KPI to be considered in future assessment								
6. Maximise value for money	6.1 Cost estimate	6	8	6	2	2	5	8	2	2
	6.2 Benefit cost ratio	KPI to be considered in evaluation of shortlist options								

7.3 Identification of short list options

Based on the agreed multi-criteria analysis scores options were ranked, with one being the best performing option and nine ranking as the worst performing option. Table 7-4 shows the scores and rank of each option from the multi-criteria analysis.

Table 7-3 Multi-criteria analysis raw results

Analysis results	001	002	131	121	301	303	403	424	511
Total score	37.1	34.0	30.5	29.0	28.3	29.5	33.7	32.5	28.3
Rank	1	2	5	7	8	6	3	4	8

The workshop attendees identified that some objectives and key performance indicators may be more important than others. The attendees identified scenarios to be tested to determine how sensitive the rankings of each option were if objectives and key performance indicators were considered relatively more or less important. The scenarios were tested by changing the weightings of one or more objective or key performance indicator relative to the others. The options that ranked consistently well under different weighting scenarios were deemed by the workshop participants to be the most suitable for short-listing.

Rankings under each of the scenarios are shown in Table 7-4.

Table 7-4 Short-listing workshop sensitivity test options rankings

ID	Objective	KPI	Relative weighting	001	002	131	121	301	303	403	424	511
A	-	All	Equal	2	3	5	7	8	6	4	1	8
B	1. Efficient east-west link	--	x 3	1	5	9	4	3	7	2	8	6
C	1. Efficient east-west link	-	x 0	1	2	5	7	9	6	3	4	8
D	2.Active and public transport	-	x 0	1	3	5	7	8	6	2	4	9
E	4. Environmental impact	-	x 2	1	3	5	7	8	6	2	4	8
F	5. Safety	-	x 2	1	4	5	6	8	7	3	2	8
G	6.Value for money	-	x 2	1	2	4	7	8	5	3	6	8
H	6.Value for money	-	x 0	1	6	9	3	4	8	7	2	4
I	2. Active and public transport	-	x 2	1	4	5	6	8	9	3	2	7
	5. Safety	-	x 2									

At the conclusion of the sensitivity tests, a clear trend was established, and four corridor options were short-listed for further development and design refinement. These corridor options were 001, 002, 403 and 424.

Following the selection of short-listed options, the workshop group identified areas for improvement or concern related to the design of each short-listed option. In general, the identified areas for improvement or concern were:

- Steepness of grade approaching intersections provided concerns over safety
- Lack of intersection performance modelling at intersections
- Sag locations at bridges for all corridor options
- Safety considerations associated with operations and maintenance of road assets.

The workshop group agreed that these issues would be addressed during design refinements prior to further evaluation of the short-listed options.

8 Evaluation of short list options

8.1 Development of short list options

Several actions were identified during the short-listing workshop, including a need to carry out design refinements for each of the four short-listed options. This provided opportunities to refine the grade and intersection tie-ins with the existing road network of each of the options.

In conjunction with design refinements, more detailed investigations were carried out including additional traffic and noise assessments and refinement of cost estimates to support the multi-criteria analysis for the evaluation of the short list of options. Consultation with key stakeholders including major landowners, Department of Planning, Industry and Environment, Department of Premier and Cabinet (Heritage), and Transport for NSW internal stakeholders provided additional information for consideration.

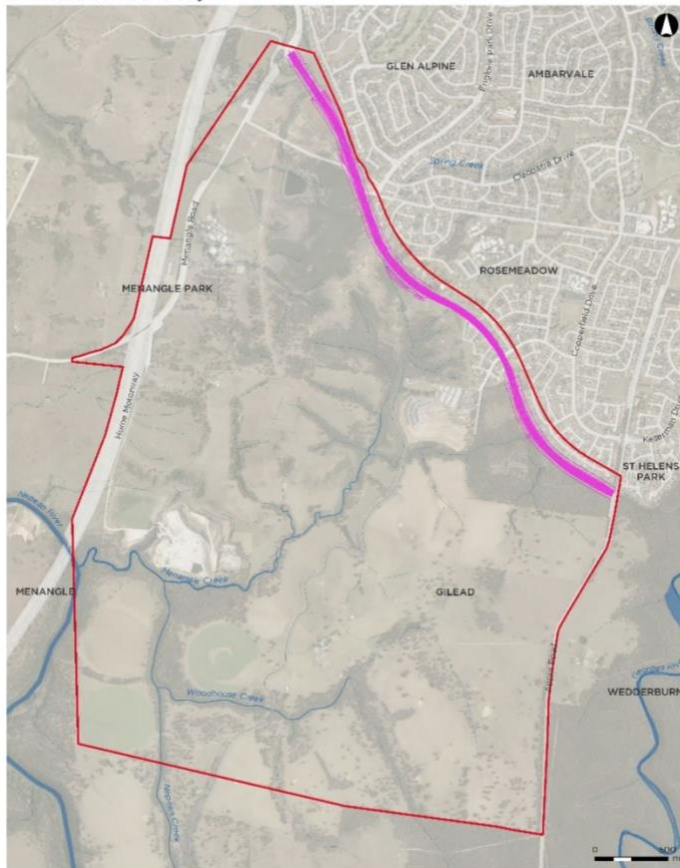
The design refinements for each option are described below.



Corridor Option 001

Design refinements were carried out to:

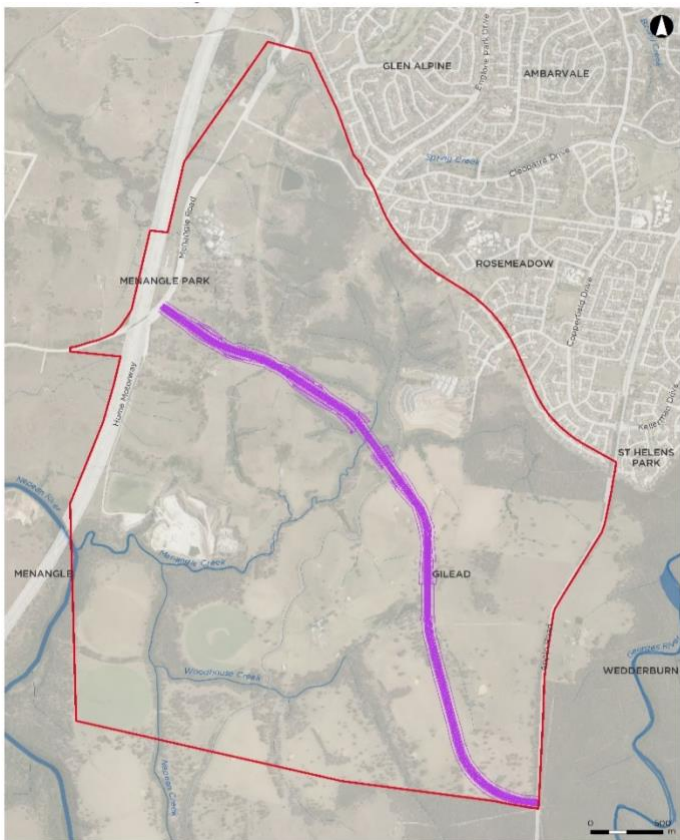
- More efficiently utilise the existing road reserve
- Introduce retaining walls to reduce the footprint adjacent to private properties to the north and south of the alignment (Rosemeadow)
- Enable the introduction of a future intersection at Englorie Park Drive
- Reduce grades on approach to intersections
- Improve bridge alignments
- Provide an overbridge over Glendower Street.



Corridor Option 002

Design refinements were carried out to:

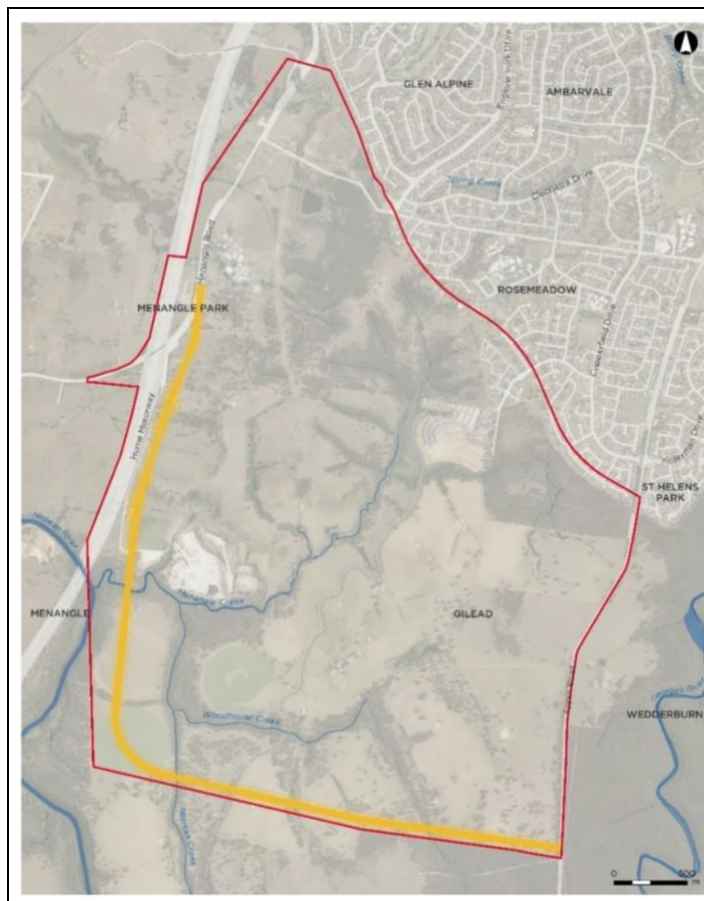
- More efficiently utilise the existing road reserve
- Introduce retaining walls to reduce the footprint adjacent to private properties to the north and south of the alignment (Rosemeadow)
- Enable the introduction of a future intersection at Englorie Park Drive
- Reduce grades on approach to Menangle Road intersection by relocating the tie-in location to the highest point on Menangle Road, 1km north of the future Spring Farm Parkway interchange
- Improve bridge alignments
- Provide an overbridge over Glendower Street.



Corridor Option 403

Design refinements were carried out to:

- Avoid impact to One Tree Hill
- Reduce grades along the length of the alignment
- Reduce grades on approach to intersections
- Improve bridge alignments
- Enable intersection access into future subdivisions.



Corridor Option 424

Design refinements were carried out to:

- Maximise the use of Medhurst Road corridor
- Realign the connection with Menangle Road to improve a future intersection layout
- Reduce grades on approach to intersections
- Improve bridge alignments
- Enable intersection access into future subdivisions.

8.2 Evaluation of short list options

Transport for NSW held an evaluation of short list options workshop across two days on 14 May and 19 June 2019. This workshop was attended by project team members and key stakeholders including Transport for NSW, Campbelltown City Council and the Department of Planning, Industry and Environment. The purpose of this workshop was to present the assessment and design refinements carried out following the short-listing workshop and to evaluate the short list of options and identify a recommended corridor option.

This workshop followed a similar process to the short-listing workshop. This involved the project team presenting a summary of each short-listed option including the design improvements that had been undertaken. Subject matter experts presented on individual key performance indicators, outlined additional information gathered since the last workshop as well as any changes since the short-listing workshop, and made a scoring recommendation. Following this, the workshop group discussed the suitability of each corridor option in reference to the featured key performance indicator and agreed on a score. Some key performance indicators were not scored when the workshop group determined that it was either not relevant to this stage of project development or did not contribute to differentiation of options.

Table 8-1 outlines the results of this scoring process. The data sheets and workshop scoring considerations are presented in 0. The data presented for each aspect has been identified based on the full corridor width for each option (ranging from 40 metres to 150 metres). Variations in data between the evaluation of long-list and short-list options are due to design refinements presented in Section 8.1.

Table 8-1 Evaluation of short list options multi-criteria analysis scoring

Objective	Key performance indicator (KPI)	Scoring 10 = Comprehensive, 5 = Partial, 1 Minimal achievement			
		001	002	403	424
1. Provide an efficient east-west link across the Greater Macarthur Growth Area	1.1 Provide the most efficient travel connections for developments at Gilead, Spring Farm and Menangle Park and the broader network	10	7	8	7
	1.2 Performance of intersections immediately connected to the corridor	9	9	10	10
	1.3 Compatibility with other planned road projects	KPI could not differentiate between options			
	1.4 Provide reliable journeys	KPI to be considered in future assessment			
	1.5 Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)	KPI to be considered in future assessment			
2. Cater for active and public transport	2.1 Provide functional and desirable active transport corridor	3	5	1	4
	2.2 Enable connection to the surrounding active and public transport network	KPI to be considered in future assessment			
	2.3 Cater for the crossing of a new north-south transit route which could include bus and/or light rail	5	5	5	5
3. Integrate with existing and future land uses	3.1 Impact on zoned future residential development areas	10	8	6	10
	3.2 Impact on unzoned future residential development areas	10	10	9	7
	3.3 Impact on existing sensitive land uses (residential, recreational, school etc)	7	6	5	9
	3.4 Maximise use of existing road corridor	8	10	1	1
	4.1 Impact on native vegetation and fauna habitat	4	6	2	1

Objective	Key performance indicator (KPI)	Scoring 10 = Comprehensive, 5 = Partial, 1 Minimal achievement			
		001	002	403	424
4. Minimise environmental impact	4.2 Impact on fauna connectivity	9	10	6	2
	4.3 Impact of noise or reduced air quality on sensitive receivers	5	4	5	8
	4.4 Impact on non-Aboriginal heritage	2	4	7	8
	4.5 Impact on Aboriginal heritage	6	7	5	5
	4.6 Impact on landscape character	5	5	4	9
	4.7 Social impact of property acquisition	5	4	8	8
5. Ensure the safety for all users	5.1 Achieving an optimum road design	8	7	8	9
	5.2 A safe and efficient corridor for all road corridor users and stakeholders (during construction)	6	8	4	6
	5.3 A safe and efficient corridor for all road corridor users and stakeholders (during operation and maintenance)	5	5	5	5
	5.4 Minimise conflict points	KPI to be considered in future assessment			
6. Maximise value for money	6.1 Cost estimate	7	7	8	5
	6.2 Benefit cost ratio	9	7	8	6

Based on the agreed multi-criteria analysis scores the short-listed options were ranked. Table 8-2 shows the scores and rank of each option from the multi-criteria analysis.

Table 8-2 Multi-criteria analysis raw results

Analysis results	001	002	403	424
Total score	41.7	40.9	36.2	37.8
Rank	1	2	4	3

As per the process followed to identify the short-listed options, the workshop attendees identified a number of scenarios to be tested to determine how sensitive the rankings of the short list options were to prioritising the importance of objectives and/or key performance indicators relative to others. The scenarios were tested by changing the weightings of individual or multiple objectives or key performance indicators relative to the others.

Rankings under each of the scenarios are shown in Table 8-3.

Table 8-3 Evaluation of Short List Options Workshop sensitivity tests options rankings

Scenario	Objective	Key Performance Indicator	Relative weighting	001	002	403	424
A	1. Efficient east-west link	-	x 2	1	2	4	3
B	1. Efficient east-west link	-	x 3	1	2	4	3
C	1. Efficient east-west link	-	x 0	2	1	4	3
D	4. Environmental impact	-	x 2	1	2	4	3
E	4. Environmental impact	-	x 3	2	1	4	3
F	6. Value for money	-	x 0	2	1	4	3
G	6. Value for money	-	x 2	1	2	3	4
H	5. Safety	-	x 2	1	2	4	3
I	5. Safety	-	x 3	1	2	4	3
J	3. Land use	-	x 2	1	2	4	3
K	3. Land use	-	x 3	1	2	4	3
L	2. Active and public transport	-	x 2	2	1	4	3
M	2. Active and public transport	-	x 0	1	2	4	3
N	1. Efficient east-west link	-	x 2	1	2	4	3
	3. Land use	-	x 2				

Scenario	Objective	Key Performance Indicator	Relative weighting	001	002	403	424
O	4. Environmental impact	-	x 0	1	2	3	3
	5. Safety	-	x 0				
P	1. Efficient east-west link	-	x 2	1	2	4	3
	4. Environmental impact	-	x 2				
Q	1. Efficient east-west link	-	x 2	1	2	4	3
	4. Environmental impact	-	x 3				
R	1. Efficient east-west link	-	x 2	1	2	3	4
	4. Environmental impact	-	x 2				
	6. Value for money	-	x 2				
S	1. Efficient east-west link		x 2	1	2	4	3
	3. Land use		x 2				
	6. Value for money		x 2				
T	3. Land use	-	x 2	1	2	4	3
	4. Environmental impact	-	x 2				
U	-	All	Equal	2	1	4	3
V	1. Efficient east-west link	-	x 2	1	2	4	3
		1.1 Efficient connections to broader network	x 3				
W	-	6.1 Cost	x 0	1	2	4	3
X	-	All	Equal	2	1	4	3
	-	6.1 Cost	x 0				
Y	-	1.1 Efficient connections to broader network	x 2	1	2	4	3
Z	-	All	Equal	1	2	4	3
	-	1.1 Efficient connections to broader network	x 2				
AA	All		Equal	1	2	4	3
BB	-	1.1 Efficient connections to broader network	x 2	1	2	4	3
	-	3.3 Impact on existing land uses	x 2				

Scenario	Objective	Key Performance Indicator	Relative weighting	001	002	403	424
CC	4. Environmental impact	-	x 2	1	2	4	3
	-	4.7 Social impact from property acquisition	x 2				
	-	4.3 Impact of noise and reduce air quality	x 2				

8.3 Other considerations

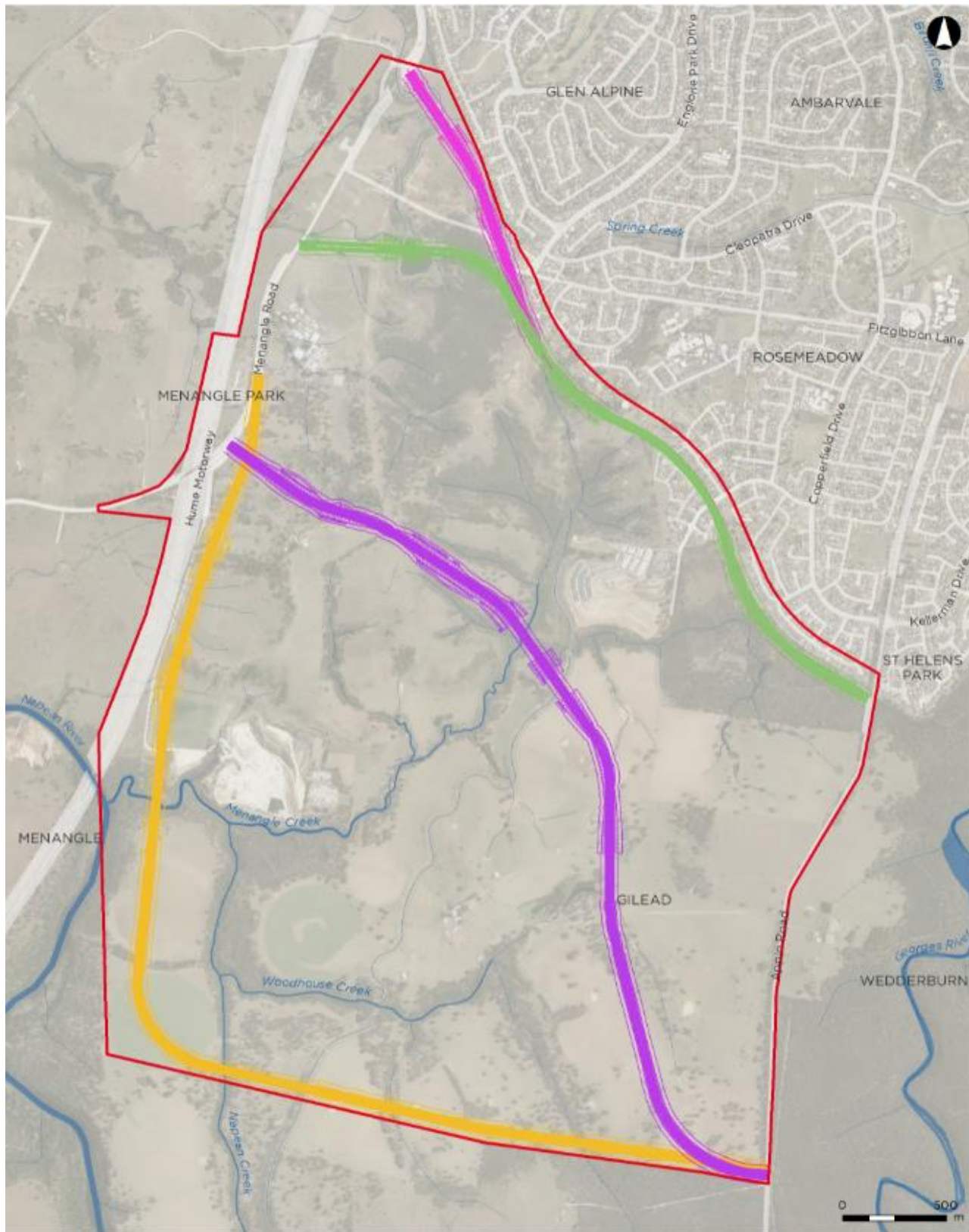
Options 001 and 002 were identified as the most desirable options following the sensitivity analysis. A discussion of other considerations associated with Options 001 and 002 was then carried out to evaluate additional considerations that were not captured in the multi-criteria analysis. The following considerations were identified during workshop discussions:

- Option 002 was identified as being likely to have complex construction interaction with critical utilities. In particular, the option would require bridging over the Water NSW and Sydney Water assets. Sydney Water are proposing upgrades to their assets by 2021, including developing a re-chlorination plant, duplication of a 1200mm treated water gravity main from Appin to Sugarloaf and construction of new water mains to the Sydney Water pumping station
- Option 002 is likely to interact with the Water NSW canal in a third location, on the western side of Menangle Road (currently outside the investigation area), in the development of the intersection between the road corridor and Menangle Road. This intersection footprint would also be likely to impact the existing Menangle Road bridge.

8.4 Identification of a recommended option

At the conclusion of the assessment process the workshop participants agreed that Option 001 was their recommended option for the project. Option 001 and Option 002 were found to score and rank better than the other options consistently across the various sensitivity tests with Option 001 most often being the first ranked option. Option 002 was also noted as having additional complexities resulting from other considerations not captured in the multi-criteria analysis. Two of the 26 workshop participants did not agree that Option 001 be the recommended option citing its potential significant impacts on the Sugarloaf Farm State heritage item as a key concern. However, the other 24 workshop participants concluded that Option 001 best fulfilled the project objectives and the purpose of the project.

Prior to Transport for NSW selecting a preferred option it was determined that feedback would be sought from the community. Community feedback is now being sought on the four short-listed options.



LEGEND

- ▭ Investigation area
- Option 001
- Option 002
- Option 403
- Option 424

Figure 8-1 Link Road Shortlist Options for Community Comment

9 Next steps

The four short-listed options will go on display for community comment in November 2020. This will provide an opportunity for the community to review the short list options and provide feedback. Transport for NSW will use this information to select and refine a preferred option.

10 References

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Appendix A

10.1 Short-listing Data Sheets

Objective	Description	Key Performance Indicator (KPI)	Measurement	Assessment Stage	Constraint Bracket (high, Medium)	Option 001	Option 002	Option 113	Option 121	Option 301	Option 303	Option 403	Option 424	Option 511	Comments		
Provide an efficient east-west link across the Greater Macarthur Growth Area	Provision of one connection between Appin Road and Menangle Road within the central Greater Macarthur Growth Area and south of the existing developments, in the context of additional proposed east-west connections to the south. The connection is to maximise broader network efficiency and reliability, and be compatible with other planned road network upgrades.	Provide the most efficient travel connections for developments at Gilead, Spring Farm and Menangle Park and the broader network.	VKT Savings AM	Longlist & Shortlist	-	21,691,000	14,501,000	14,795,000	21,691,000	21,691,000	18,092,000	18,092,000	18,092,000	21,691,000	Vehicle Kilometres Travelled (VKT) savings during peak (two hour). Network savings related to the whole Sydney network.		
		VKT Savings PM	Longlist & Shortlist	-	22,808,000	16,739,000	22,808,000	22,808,000	22,808,000	19,861,000	19,861,000	19,861,000	22,808,000	Vehicle Kilometres Travelled (VKT) savings during peak (two hour). Network savings related to the whole Sydney network.			
		VHT Savings AM	Longlist & Shortlist	-	1,475,000	885,000	1,016,000	1,475,000	1,475,000	1,092,000	1,092,000	1,092,000	1,475,000	Vehicle Hours Travelled (VHT) savings during peak (two hour). Network savings related to the whole Sydney network.			
		VHT Savings PM	Longlist & Shortlist	-	1,496,000	1,079,000	1,171,000	1,496,000	1,496,000	1,163,000	1,163,000	1,163,000	1,496,000	Vehicle Hours Travelled (VHT) savings during peak (two hour). Network savings related to the whole Sydney network.			
		Performance of intersections immediately connected to the corridor.	Level of service	Shortlisting Stage Only	-												
		Compatibility with other planned road projects	Ties in to known planned projects	Longlist & Shortlist	-	Ties in to Spring Farm Parkway but does not tie in to planned intersection at Appin Road	Doesn't tie in to Spring Farm Parkway or planned intersection at Appin Road	Ties in to planned intersection at Appin Road but not Spring Farm Parkway	Ties in to Spring Farm Parkway and planned intersection at Appin Road	Ties in to Spring Farm Parkway and planned intersection at Appin Road	Ties in to Spring Farm Parkway and planned intersection at Appin Road	Doesn't tie in to Spring Farm Parkway or planned intersection at Appin Road	Doesn't tie in to Spring Farm Parkway or planned intersection at Appin Road	Ties in to Spring Farm Parkway but does not tie in to planned intersection at Appin Road			
		Provide reliable journeys	Network Reserve Capacity	Future	-												
Cater for active and public transport	Provision of integrated active transportation, considering future planned corridors. Accommodation of future public transport including safe and efficient bus stops and (if appropriate) bus lanes, transitways and/or light rail.	Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)	-	Shortlisting Stage Only	-												
		Provide functional and desirable active transport corridor	Metres of alignment >5% Grade	Longlist & Shortlist	-	Slope 1: 949m at 5.8%	Slope 1: 520m at 9%	Slope 1: 345m at 5.78% Slope 2: 291m at 6.79% Slope 3: 627m at 7.34%	Slope 1: 345m at 5.78% Slope 2: 291m at 6.79% Slope 3: 429m at 5.8%	Slope 1: 478m at 5.7% Slope 2: 447m at 5.2% Slope 3: 429m at 5.8%	Slope 1: 478m at 5.78% Slope 2: 411m at 6.79% Slope 3: 626m at 7.34%	Slope 1: 490m at 5.78% Slope 2: 411m at 6.79% Slope 3: 626m at 7.35%	Slope 1: 303m at 6% Slope 2: 293m at 6% Slope 3: 510m at 9% Slope 4: 150m at 9%	Slope 1: 278m at 6.79% Slope 2: 429m at 5.8%	Metres of alignment >5% Grade (Uphill/ Downhill) Vertical grade on alignment for Shared User Paths - Austroads Part 6A - Section 5.4.2		
		Cater for the crossing of a new north-south transit route which could include bus and/or light rail	-	Longlist & Shortlist	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	All options are equal		
Integrate with existing and future land uses	Ensuring that the proposed Link Road corridor minimises adverse impacts on current land uses and is consistent with land use planning for the corridor and aligns with the Greater Macarthur Structure Plan.	Impact on zoned future residential development areas	Hectares impacted	Longlist & Shortlist	-	0	0	12	12	14	14	5	0	7	Data includes zones within M/Gilead development stage 1 which have R2 residential zoning as per LEP.		
		Impact on existing sensitive land uses (residential, recreational, school etc)	Hectares (high, med)	Longlist & Shortlist	High Medium	8 15	9 14	12 0	13 13	19 13	19 0	13 0	1 0	15 13	Note: the higher the number the worse the option performs Note: the higher the number the worse the option performs		
		Number of properties impacted	-	-	-	48	46	6	8	9	7	6	10	9	Note: the higher the number the worse the option performs		
		Maximise use of existing road corridor	Length within road reserve (km)	Longlist & Shortlist	-	2.76m of 3.8km	3.2km of 3.9km	0km of 3.5km	0km of 4.1km	0km of 4.8km	0km of 4.1km	0km of 4.8km	0km of 6.2km	0.1km of 4.2km	Note: the higher the number the better the option performs		
Minimise environmental impact	Minimisation of impact to areas of ecological and cultural sensitivity, as well as to the existing and future communities in the growth corridor.	Impact on native vegetation and fauna habitat	Hectares of Threatened Ecological Communities (TECs) impacted	Longlist & Shortlist	-	13	10	9	13	14	11	17	19	15	Note: the higher the number the worse the option performs		
		Number of major connectivity links severed	-	-	-	0	0	1	1	1	1	1	2	1	Based on the number of times a corridor wholly severed a major connectivity link (depicted by the OEH opportunity mapping for connectivity corridors).		
		Impact on fauna connectivity	Number of additional patches created from severing habitat corridors	Longlist & Shortlist	-	1	0	2	6	6	2	2	4	6	Note: the higher the number the worse the option performs Number of additional patches was determined by counting the total number of whole patches of mapped native vegetation/habitat corridors that each option passes through and subtracting from the number of whole patches created following clearing for the option.		
		Impact of noise or reduced air quality on sensitive receivers	Number of properties within high and medium constraint areas	Longlist & Shortlist	High Medium	151 347	187 420	233 348	233 343	211 269	197 287	77 230	6 22	139 243	Note: the higher the number the worse the option performs Note: the higher the number the worse the option performs		
		Impact on non-Aboriginal heritage	Hectares	Longlist & Shortlist	High High	20 3	17 8	1 12	14 12	14 12	1 8	2 10	0.4 7	14 14	Note: the higher the number the worse the option performs Note: the higher the number the worse the option performs		
		Impact on Aboriginal heritage	Hectares (high, med)	Longlist & Shortlist	High Medium	24 9	23 7	13 3	10 4	10 6	13 6	13 10	0 13	12 6	Note: the higher the number the worse the option performs Note: the higher the number the worse the option performs		
		Impact on landscape character	Hectares (high, med)	Longlist & Shortlist	High Medium	24 13	23 14	13 13	10 22	10 22	13 12	13 12	0 11	12 22	Note: the higher the number the worse the option performs Note: the higher the number the worse the option performs		
		Social impact of property acquisition	No. of dwellings impacted	Longlist & Shortlist	-	41	41	0	0	0	0	0	0	0	Note: the higher the number the worse the option performs		
		Ensure the safety for all users	Ensuring that the proposed link road corridor is safe for all its users (including road users, construction workers and maintenance workers) across its entire life cycle.	Achieving an optimum road design	Number of locations with compounded minimum / maximum design criteria in the same location.	Longlist & Shortlist	-	No locations with compound min/max design criteria	1 Location 9% Max downgrade to Menangle Road	1 Location 7.34% downgrade to Menangle Road	No locations with compound min/max design criteria	No locations with compound min/max design criteria	7.34% downgrade to Menangle Road	1 Location 7.34% downgrade to Menangle Road	No locations with compound min/max design criteria	No locations with compound min/max design criteria	Note: the higher the number of locations, the worse the option performs.
				A safe and efficient corridor for all road corridor users and stakeholders (during construction)	Major hazard creator scores from Shortlisting Workshop 1	Longlist & Shortlist	-	172	122	157	158	156	155	156	149	159	Note: the higher the number the worse the option performs
Maximise Value for Money	Provide the best value for money across the life of the project with consideration of the other project objectives and wider economic benefits.	Cost Estimate	2018 AUD (Total Estimate / \$m)	Longlist & Shortlist	-	1.24X	1X	1.31X	1.88X	2.06X	1.48X	1.1X	1.95X	1.81X	Longlist (Global Estimate) based on: Cost per lane km; Bridges per sq m; Earthworks (cost of importing fill); Land acquisition costs; Biodiversity offset costs		
		Benefit Cost Ratio	Benefit Cost Ratio	Shortlisting Stage Only	-												

10.2 Short-listing Workshop – MCA scoring and considerations

Objective: Provide an efficient east-west link across the Greater Macarthur Growth Area

KPI: Provide the most efficient travel connections for developments at Gilead, Spring Farm and Menangle Park and the broader network.								
Key scoring inputs: Four EMME test cases were modelled and tested for Vehicle Kilometres Travelled (VKT) and Vehicle Hours Travelled (VHT). Each corridor option was mapped to the most similar EMME test case.								
Moderating factors: Option 424 was deducted 2 points from its most similar test case which was scored a 9, due to the additional length and associated travel time.								
Outcome: The workshop group agreed all corridor options were beneficial with scores between 7 and 10.								
001	002	113	121	301	303	403	424	511
10	7	8	10	10	9	9	7	10

KPI: Compatibility with other planned road projects								
Key scoring inputs: Impacts to Appin Road – new intersection = 3, upgrade of a proposed intersection = 2 Impacts to Spring Farm Interchange – tie-in at the intersection = 3, connect elsewhere on Menangle Road = 2								
Moderating factors: The workshop group considered other known road projects; Appin Road Upgrade and Spring Farm Interchange. Introduction of a new intersection in close proximity to an existing or proposed intersection (<500m) was also considered in the scoring.								
Outcome: The workshop agreed the majority of corridor options were not well aligned with planned projects, with scores ranging between 3 and 7.								
001	002	113	121	301	303	403	424	511
5	3	3	6	7	4	3	3	5

KPI: Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)								
Key scoring inputs: Four EMME test cases were modelled and tested for Average Weekday Daily Traffic volume impacts on 10 key road corridors nearby.								
Moderating factors: Nil								
Outcome: The workshop group agreed that more information such as the Degree of Saturation on these existing roads is required to score this KPI It is intended that this KPI will be scored at the next stage.								
001	002	113	121	301	303	403	424	511
-	-	-	-	-	-	-	-	-

Objective: Cater for active and public transport

KPI: Provide functional and desirable active transport corridor								
Key scoring inputs: Metres of alignment >5% Grade								
Moderating factors: Severity and length of some individual road grades.								
Outcome: The workshop group agreed that no options performed well for this KPI due to the extent of relatively steep grade.								
001	002	113	121	301	303	403	424	511
3	2	2	3	2	1	1	2	4

KPI: Cater for the crossing of a new north-south transit route which could include bus and/or light rail								
Key scoring inputs: Minimal detail is available on the proposed north-south transit corridor. All options are able to cater for a future interface.								
Moderating factors: Nil								
Outcome: The workshop group agreed to score all options equally (with a mid-range score) based on the lack of detail available regarding the north-south transit corridor.								
001	002	113	121	301	303	403	424	511
5	5	5	5	5	5	5	5	5

Objective: Integrate with existing and future land uses

KPI: Impact on zoned future residential development areas								
Key scoring inputs: Extent of corridor within on zoned future residential development areas								
Moderating factors: Potential to result in land sterilisation should also be considered								
Outcome: The workshop group agreed that options 001, 002 and 424 were the better options. Options 113, 121 and 511 were scored down further as the workshop group noted the options connecting into the northern section of the Mount Gilead stage 1 development were impacting on areas that currently have Development Applications being approved.								
001	002	113	121	301	303	403	424	511
10	10	2	2	3	3	6	10	2

KPI: Impact on unzoned future residential development areas								
Key scoring inputs: Impact on unzoned future residential development areas								
Moderating factors: Nil								
Outcome: The workshop group agreed that this KPI could not be scored at this stage without more information on the viability of unzoned land for future development.								
001	002	113	121	301	303	403	424	511
-	-	-	-	-	-	-	-	-

KPI: Impact on existing sensitive land uses (residential, recreational, school etc)								
Key scoring inputs: Extent of option within high sensitivity land uses.								
Moderating factors: Nil								
Outcome: The workshop group agreed that Option 424 performed well because it largely avoids sensitive land uses. Poor performance of options was mainly due to traversing Mt Gilead land release and/or existing residential.								
001	002	113	121	301	303	403	424	511
5	5	5	5	2	3	5	9	3

KPI: Maximise use of existing road corridor								
Key scoring inputs: Length of option using the existing road reserve.								
Moderating factors: Nil								
Outcome: The workshop group scored options 001 and 002 highest due to their use of the existing road reserve. All other options are entirely outside the existing road reserve.								
001	002	113	121	301	303	403	424	511
8	9	1	1	1	1	1	1	1

Objective: Minimise environmental impact

KPI: Impact on native vegetation and fauna habitat								
Key scoring inputs: Hectare impact on threatened ecological community (TEC).								
Moderating factors: Nil.								
Outcome: All options were found to have an impact on TEC such that none were scored greater than 6. Impact to 19 (option 424) hectares was considered substantial and scored as a 1.								
001	002	113	121	301	303	403	424	511
4	6	6	4	4	5	2	1	3

KPI: Impact on fauna connectivity								
Key scoring inputs: Impact to major connectivity links was considered likely to have a potential impact to fauna connectivity								
Moderating factors: Generation of additional patches of vegetation.								
Outcome: The workshop group agreed on the following scoring which was largely aligned to the workshop inputs.								
001	002	113	121	301	303	403	424	511
9	10	6	2	2	6	6	2	2

KPI: Impact of noise or reduced air quality on sensitive receivers								
Key scoring inputs: Number of sensitive receivers within 30 metres of the corridor.								
Moderating factors: Number of sensitive receivers between 30 and 150 metres of the corridor.								
Outcome: A minimum score of 4 was agreed at the workshop due to the rapidly dispersing nature of road related air emissions. Options scoring highly had very low numbers or receivers in close proximity.								
001	002	113	121	301	303	403	424	511
5	4	4	4	4	4	8	10	6

KPI: Impact on non-Aboriginal heritage								
Key scoring inputs: Hectare impact on non-Aboriginal heritage items								
Moderating factors: Nil								
Outcome: The scoring generally followed the extent of area traversing Non-Aboriginal heritage items. Option 403 also considered its proximity (and therefore potential visual impact) to the Mt Gilead heritage curtilage and was scored slightly lower.								
001	002	113	121	301	303	403	424	511
3	4	8	3	3	8	7	8	3

KPI: Impact on Aboriginal heritage								
Key scoring inputs: Corridors with a larger impact to high Aboriginal constraint areas scored poorly. Note that constraint levels are based on the potential for Aboriginal heritage to occur.								
Moderating factors: The extent of impact on medium Aboriginal constraint areas was considered within the scores.								
Outcome: All options traverse an area of high and medium Aboriginal heritage constraint areas. Some to a greater extent than others.								
001	002	113	121	301	303	403	424	511
6	7	5	4	4	5	5	6	3

KPI: Impact on landscape character								
Key scoring inputs: Extent within high landscape character value areas								
Moderating factors: Extent of impact on medium landscape character value areas. The extent of cut for each corridor was also considered.								
Outcome: The workshop scoring generally aligned with the workshop scoring inputs. Option 001 and 002 were also located within an existing road corridor, slightly improving their scores.								
001	002	113	121	301	303	403	424	511
3	3	4	5	5	4	4	9	5

KPI: Social impact of property acquisition								
Key scoring inputs: Number of dwellings potentially requiring acquisition.								
Moderating factors: Nil								
Outcome: Options that did not directly impact on a dwelling were scored as an 8, there may still be a social impact as a result of acquisition of other land uses. Option 001 and Option 002 would impact a large number of dwellings and this level of impact was considered substantial and was agreed by the workshop to be scored as a 1.								
001	002	113	121	301	303	403	424	511
1	1	8	8	8	8	8	8	8

Objective: Ensure the safety for all users

KPI: Achieving an optimum road design								
Key scoring inputs: Road alignments have compound minimum/maximum design criteria at the same location.								
Moderating factors: Nil								
Outcome: Options 002, 113, 303 and 403 have grades exceeding maximum desirable (grade > 6% over 300m) on approach to an intersection. The workshop group agreed that the steep descent to Menangle Road for Option 002 was highly undesirable and should therefore be scored a 1. Options 001, 121, 301, 424 and 511 were the most favourable as they do not have compounded maximums/minimum design criteria in any locations throughout their alignments. Option 424 was agreed to be scored highest because it is most capable of achieving a higher design speed (90km/h) providing a better road safety outcome.								
001	002	113	121	301	303	403	424	511
9	1	7	9	9	7	7	10	9

KPI: A safe and efficient corridor for all road corridor users and stakeholders (during construction)								
Key scoring inputs: Major Hazard Creator scores								
Moderating factors: Nil								
Outcome: Option 001 rated poorest when assessing Major Hazard Creators, however the workshop group agreed to improve the MCA score because it was not intuitively less safe than the other route options. Option 002 rated best when assessing Major Hazard Creators, however the workshop group agreed to reduce the MCA score, even though the route has lesser need for works near utilities. The workshop group agreed that scoring between 6 and 8 for the options was appropriate on the basis that the differences were not substantial.								
001	002	113	121	301	303	403	424	511
6	8	7	7	7	7	7	8	7

KPI: A safe and efficient corridor for all road corridor users and stakeholders (during operation and maintenance)								
Key scoring inputs: NA								
Moderating factors: Nil								
Outcome: No score was proposed for operation and maintenance phase due to project being in the inception phase. Further assessment was required to better inform the decision. This item was agreed not to be scored.								
001	002	113	121	301	303	403	424	511
-	-	-	-	-	-	-	-	-

Objective: Maximise value for money

KPI: Cost estimate								
Key scoring inputs: Global strategic estimates presented in term of relativity to the lowest cost option.								
Moderating factors: Nil								
Outcome: The workshop group agreed to allocate the scores between 2 and 8 on a proportional basis using the relative cost estimates.								
001	002	113	121	301	303	403	424	511
6	8	6	2	2	5	8	2	2

Appendix B

10.3Evaluation of Short List Options Workshop Data Sheets

Objective	Description	Key Performance Indicator (KPI)	Measurement	Assessment Stage	Constraint Bracket (High, Medium)	Option 001	Option 002	Option 403	Option 424	Comments
Provide an efficient east-west link across the Greater Macarthur Growth Area	Provision of one connection between Appin Road and Menangle Road within the central Greater Macarthur Growth Area and south of the existing developments, in the context of additional proposed east west connections to the south. The connection is to maximise broader network efficiency and reliability, and be compatible with other planned road network upgrades.	Provide the most efficient travel connections for developments at Gilead, Spring Farm and Menangle Park and the broader network.	VKT Savings Annual	Shortlisting Stage Only	-	40,744,431	35,408,851	39,878,798	36,866,496	Annual Vehicle Kilometres Travelled (VKT) savings during peak (two hour). Network savings related to the whole Sydney network.
		VHT Savings Annual	Shortlisting Stage Only	-	2,783,457	2,091,945	2,164,082	2,096,920	Annual Vehicle Hours Travelled (VHT) savings during peak (two hour). Network savings related to the whole Sydney network.	
		Performance of intersections immediately connected to the corridor.	Level of service (LOS)	Shortlisting Stage Only	-	B to D	B to D	C	B to C	Level of Service (LOS) AM PEAK
					-	C to D	B to D	B to C	C	Level of Service (LOS) PM PEAK
		Compatibility with other planned road projects	Ties in to known planned project/s	Longlist & Shortlist	-					Appin Road – all new intersections required. Menangle Road – upgrades are considered in cost 002, 403, 424. Spring Farm Parkway – impacts are assessed and scored via SIDRA (Level of Service KPI)
		Provide reliable journeys	Network Reserve Capacity	Future	-					
		Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)	Volume/ capacity ratios	Shortlisting Stage Only	-					All options were found to have spare capacity on the broader road network
Cater for active and public transport	Provision of integrated active transportation, considering future planned corridors. Accommodation of future public transport including safe and efficient bus stops and (if appropriate) bus lanes, transitways and/or light rail.	Provide functional and desirable active transport corridor	Metres of alignment >5% Grade Width of SUPs	Longlist & Shortlist	-	Slope 1: 250m at 5% Slope 2: 680m at 7% 3m wide on south for a section (approx 1km)	Slope 1: 250m at 5% Slope2:150m at 6% 3m wide on south for a section (approx 1km)	Slope 1: 470m at 5% Slope 2: 430m at 5.83% Slope 3: 650m at 7% 5m on both sides for full length of option	Slope 1: 270m at 5.79% Slope 2: 300m at 6% 5m on both sides for full length of option	Metres of alignment >5% Grade (Uphill/ Downhill) Vertical grade on alignment for Shared User Paths (SUP) - Austroads Part 6A - Section 5.4.2 Width of SUP
		Enable connection to the surrounding active and public transport network	Connectivity with existing public transport and network connections - Yes or no	Future						
		Cater for the crossing of a new north-south transit route which could include bus and/or light rail	-	Longlist & Shortlist	-	Yes	Yes	Yes	Yes	All options are equal
Integrate with existing and future land uses	Ensuring that the proposed link road minimises adverse impacts on current land uses, and is consistent with land use planning for the corridor and the Greater Macarthur Sturture Plan.	Impact on zoned future residential development areas	Hectares impacted	Longlist & Shortlist	-	0	0	5	0	Data includes zones within Mt Gilead development stage 1 which have R2 residential zoning as per LEP.
		Impact on unzoned future residential development areas	Hectares impacted	Shortlisting Stage Only	High and medium density	0	0	0	25	Unzoned future residential land uses have been based on advice from the Department of Planning, Industry and Environment which included areas designated for high, medium, low and very low density housing.
					Low and very low density	0	0	10	18	
		Impact on existing sensitive land uses (residential, recreational, school etc)	Hectares (high, med)	Longlist & Shortlist	High	6	6	14	2	Note: the higher the number the worse the option performs
					Medium	14	12	0	0	Note: the higher the number the worse the option performs
		Number of properties impacted			-	11	12	6	10	Note: the higher the number the worse the option performs
Maximise use of existing road corridor	Length	Longlist & Shortlist	-	2.8km of 3.8km	3.3km of 3.9km	0km of 4.8km	0km of 6.3km	Note: the higher the number the better the option performs		
	Percentage of corridor within the road reserve	Shortlist	-	29.8	38.3	0	0	Note: the higher the number the better the option performs		
Minimise environmental impact	Minimisation of impact to areas of ecological and cultural sensitivity, as well as to the existing and future communities in the growth corridor.	Impact on native vegetation and fauna habitat	Hectares of Endangered Ecological Communities (EECs) impacted	Longlist & Shortlist	-	12.94	10.07	17.98	21.26	Note: the higher the number the worse the option performs
		Impact on fauna connectivity	Number of major connectivity links severed	Longlist & Shortlist	-	0	0	1	2	Based on the number of times a corridor wholly severed a major connectivity link (depicted by the OEH opportunity mapping for connectivity corridors).
			Number of additional patches created from severing habitat corridors		-	1	0	2	4	Note: the higher the number the worse the option performs Number of additional patches was determined by counting the total number of whole patches of mapped native vegetation/habitat corridors that each option passes through and subtracting from the number of whole patches created following clearing for the option.
		Impact of noise or reduced air quality on sensitive receivers	Indicative number of property treatments (with mitigation)	Longlist & Shortlist		147	171	188	17	
			Number of existing properties impacted		Within 30m	126	173	0	1	Note: the higher the number the worse the option performs
					30-150m	390	476	5	4	Note: the higher the number the worse the option performs
			Number of zoned future properties		Within 30m	0	0	53	7	Note: the higher the number the worse the option performs
					30-150m	0	0	226	26	Note: the higher the number the worse the option performs
			Number of unzoned future properties		Within 30m	0	0	67	489	Note: the higher the number the worse the option performs
					30-150m	0	1	274	1569	Note: the higher the number the worse the option performs
		Impact on non-Aboriginal heritage	Hectares	Longlist & Shortlist	High	18	15	2	1	Note: the higher the number the worse the option performs
		Impact on Aboriginal heritage	Hectares (high, med)	Longlist & Shortlist	High	4	4	10	8	Note: the higher the number the worse the option performs

Objective	Description	Key Performance Indicator (KPI)	Measurement	Assessment Stage	Constraint Bracket (High, Medium)	Option 001	Option 002	Option 403	Option 424	Comments
					Medium	9	7	11	14	Note: the higher the number the worse the option performs
		Impact on landscape character	Hectares (high, med)	Longlist & Shortlist	High	19	19	15	1	Note: the higher the number the worse the option performs
					Medium	13	14	12	12	Note: the higher the number the worse the option performs
		Social impact of property acquisition	No. of dwellings impacted	Longlist & Shortlist	-	4	7	0	0	Note: the higher the number the worse the option performs
Ensure the safety for all users	Ensuring that the proposed link road corridor is safe for all its users (including road users, construction workers and maintenance workers) across its entire life cycle.	Achieving an optimum road design	Number of locations with compounded minimum / maximum design criteria in the same location.	Longlist & Shortlist		No locations with compound min/max design criteria	No locations with compound min/max design criteria	No locations with compound min/max design criteria	No locations with compound min/max design criteria	
		A safe and efficient corridor for all road corridor users and stakeholders (during construction)	Major hazard creator scores	Longlist & Shortlist	-	78	59	100	88	Scores updated in collaboration with RMS against the latest design inclusions. Note: the higher the number the worse the option performs
			Constructability score	Shortlisting Stage Only		42	50	26	29	Constructability scores provided in collaboration with RMS and constructability specialist against the latest design inclusions. Note: the higher the number the worse the option performs
		A safe and efficient corridor for all road corridor users and stakeholders (during operation and maintenance)	Length of high maintenance corridor assets	Shortlisting Stage Only	-	Bridges: 831m Retaining Walls: 1250m Earthworks over 5m: 340m Noise Walls: 3800m	Bridges: 663m Retaining Walls: 1250m Earthworks over 5m: 390m Noise Walls: 4900m	Bridges: 550m Retaining Walls: None Earthworks over 5m: 1115m Noise Walls: 4900m	Bridges: 1420m Retaining Walls: None Earthworks over 5m: 325m Noise Walls: 500m	Length of high maintenance corridor assets
		Minimise conflict points	Number of uncontrolled intersections/median openings.	Future						
Maximise Value for Money	Provide the best value for money across the life of the project with consideration of the other project objectives and wider economic benefits.	Cost Estimate	2019 AUD (Total Estimate / \$m)	Longlist & Shortlist	-	1.12X	1.08X	1X	1.28X	Strategic Estimate - presented in multiples of the lowest cost option
		Benefit Cost Ratio	Benefit Cost Ratio	Shortlisting Stage Only	P50	2.1	1.7	1.9	1.4	A figure of less than 1.0 suggests that the project is uneconomic.
					P90	1.9	1.6	1.7	1.3	

10.4 Evaluation of Short List Options Workshop

– MCA scoring and considerations

Objective: Provide an efficient east-west link across the Greater Macarthur Growth Area

KPI: Provide the most efficient travel connections for developments at Gilead, Spring Farm and Menangle Park and the broader network.			
Key scoring inputs: Four EMME test cases were modelled and tested for Vehicle Kilometres Travelled (VKT) and Vehicle Hours Travelled (VHT).			
Moderating factors: Nil.			
Outcome: The workshop group agreed that Option 002 and Option 424 would be scored equally due to similar VHT and VKT annual savings. Option 403 was considered to have performed marginally better than Options 002 and 424 and therefore received an improved score.			
001	002	403	424
10	7	8	7

KPI: Performance of intersections immediately connected to the corridor			
Key scoring inputs: Level of Service (LoS) SIDRA Network models were tested for each corridor option.			
Moderating factors: Assumption that the Menangle Road alignment would remain unchanged for Options 002, 403 and 424. Alternative Menangle Road intersections considered for Options 001 including: - Relocation of the south facing ramps from Spring Farm Interchange to Menangle Road bridge over the Hume Highway - Menangle Road is realigned behind Broughton Anglican College, increasing the distance between signalised intersections to 500m.			
Outcome: Options 403 and 424 attained LoS of C or above. Options 001 and 002 attained a LoS of D or above which was considered marginally less desirable than Option 403 and 424 and therefore received slightly lower scores.			
001	002	403	424
9	9	10	10

KPI: Compatibility with other planned road projects			
Key scoring inputs: Appin Road – new intersections are required for each option. Menangle Road – upgrades are considered in cost estimates for 002, 403, 424. Spring Farm Parkway interchange impacts were assessed and scored via SIDRA Network models and no options proposed modifications of the two intersections on the interchange.			
Moderating factors: Nil			
Outcome: The workshop group agreed that the KPI would not be scored due to the lack of differentiation between options (i.e. no significant impacts to any project were found).			
001	002	403	424
-	-	-	-

KPI: Traffic impacts on other road network assets (considers broader network e.g. intersections, other roads)			
Key scoring inputs: Volume/Capacity ratios compared to a 'no Link Road' scenario for 2036			
Moderating factors: Nil			
Outcome: All options were found to have spare capacity on the broader road network and therefore the workshop agreed to not score this KPI due to the lack of differentiation between options.			
001	002	403	424
-	-	-	-

Objective: Cater for active and public transport

KPI: Provide functional and desirable active transport corridor			
Key scoring inputs: Metres of alignment >5% Grade and width of Shared User Paths (SUPs).			
Moderating factors: Desirable maximum grade is 3% grade for cyclists with a 5% grade provision acceptable as per Austroads Guide to Road Design (AGRD) requirements.			
Outcome: The workshop group agreed that Option 002 outperformed others due to the shorter extent of grades >5% along the corridor. Option 403 performed poorly due to the excessive length at a grade of >5% and Options 001 and 424 were scored relative to this.			
001	002	403	424
3	5	1	4

KPI: Cater for the crossing of a new north-south transit route which could include bus and/or light rail			
Key scoring inputs: Minimal detail is available on the proposed north-south transit corridor. All options are able to cater for a future interface.			
Moderating factors: Nil.			
Outcome: The workshop group agreed to score all options equally (with a mid-range score) based on the lack of detail available regarding the north-south transit corridor.			
001	002	403	424
5	5	5	5

Objective: Integrate with existing and future land uses

KPI: Impact on zoned future residential development areas			
Key scoring inputs: Extent of corridor within zoned future residential development areas.			
Moderating factors: The connection of Option 002 on Menangle Road is located within a constrained planning area at Glenlee Road.			
Outcome: Options 001 and 424 were considered the best options due to the lack of interaction with highly constrained land use areas. Option 002 was scored lower as council had advised the Glenlee subdivision had been zoned and Menangle Road had poor vertical alignment at this location. Option 403 was scored down due to the impact on zoned future residential development areas of the Mt Gilead development.			
001	002	403	424
10	8	6	10

KPI: Impact on unzoned future residential development areas			
Key scoring inputs: Hectare impact on unzoned future residential development areas.			
Moderating factors: Future land use zoning remains uncertain.			
Outcome: The workshop group agreed that Option 424 would have the highest impact on future unzoned areas and was scored the lowest. Options 001, 002 have no impact on unzoned future development. Option 424 was considered to perform the poorest. However, due to the uncertainties related to future zoning from council and associated impact on connection into the Greater Macarthur road network the workshop agreed to not score the option below a 7.			
001	002	403	424
10	10	9	7

KPI: Impact on existing sensitive land uses (residential, recreational, school etc)			
Key scoring inputs: Extent of option within high sensitivity land uses and number of properties impacted.			
Moderating factors: Uncertainty in legal obligations of impact on Sydney Water pumping station by Option 002.			
Outcome: The workshop group agreed that Option 002 would be scored marginally less than Option 001 due to interaction with Sydney Water pumping station. Option 403 performed poor as it had the largest impact to existing sensitive land uses identified as a high constraint. Option 424 performed well because it largely avoids sensitive land uses.			
001	002	403	424
7	6	5	9

KPI: Maximise use of existing road corridor			
Key scoring inputs: Length of option using the existing road reserve.			
Moderating factors: Nil.			
Outcome: The workshop group scored Option 002 higher than Option 001 as the design uses a higher proportion of the existing road reserve. Options 403 and 424 are entirely outside the existing road reserve.			
001	002	403	424
8	10	1	1

Objective: Minimise environmental impact

KPI: Impact on native vegetation and fauna habitat			
Key scoring inputs: Hectare impact on threatened ecological community (TEC).			
Moderating factors: Nil.			
Outcome: All options were found to have an impact on TEC such that none were scored greater than 6. Option 424 was scored as a 1 as an impact to 21 hectares was considered substantial. Option 001, 002 and 403 were scored relative to this.			
001	002	403	424
4	6	2	1

KPI: Impact on fauna connectivity			
Key scoring inputs: Number of major connectivity links severed, and number of additional patches created from severing habitat corridors.			
Moderating factors: Nil.			
Outcome: The workshop agreed that scoring adequately aligned with the workshop inputs. Options that generated a greater number of additional patches were scored lower.			
001	002	403	424
9	10	6	2

KPI: Impact of noise or reduced air quality on sensitive receivers			
Key scoring inputs: Indicative number of existing and zoned properties requiring treatment based on noise modelling.			
Moderating factors: Number of sensitive receivers within 30 metres of the corridor and within 30m-150m of the corridor. Kilbride Nursing Home and schools considered sensitive receivers of high importance due to density of affected receivers.			
Outcome: Options with a greater number of receivers requiring at property treatment scored lower. Scores for Option 001 and 002 were further reduced due to the proximity of the Kilbride Nursing Home and several schools to the north of the road corridor.			
001	002	403	424
5	4	5	8

KPI: Impact on non-Aboriginal heritage			
Key scoring inputs: Hectare impact on non-Aboriginal heritage items.			
Moderating factors: Visual impact and impact to high significance areas within the Sugarloaf farm and individual landscape elements considered.			
Outcome: Option 001 and 002 were scored poorly as both impacted highly significant areas of Sugarloaf farm. Option 001 scored lower due to the greater impact to Sugarloaf farm. Options 403 and 424 were scored based on relative extent of area traversing Non-Aboriginal heritage items.			
001	002	403	424
2	4	7	8

KPI: Impact on Aboriginal heritage			
Key scoring inputs: Hectare impact on high and medium constraint Aboriginal heritage areas.			
Moderating factors: Note that constraint levels are based on the potential for Aboriginal heritage to occur, because ground-truthing of location and significance of Aboriginal heritage items and places has not yet occurred.			
Outcome: All options traverse high and medium Aboriginal heritage constraint areas. Options that traversed greater extents of high constraint areas were scored lower.			
001	002	403	424
6	7	5	5

KPI: Impact on landscape character			
Key scoring inputs: Extent within high and medium landscape character value areas.			
Moderating factors: The location of the severance of a landscape character zone (i.e. edge or centre of area) was also considered.			
Outcome: The workshop group agreed that scoring generally aligned with the workshop scoring inputs. Option 001 and 002 scores were slightly improved as they are located on the edge (and not centre) of a high landscape character zone.			
001	002	403	424
5	5	4	9

KPI: Social impact of property acquisition			
Key scoring inputs: Number of dwellings potentially requiring acquisition.			
Moderating factors: Number of impacted dwelling has reduced considerably for Options 001 and 002 as a result of design refinements.			
Outcome: Options that did not directly impact on a dwelling were scored as an 8, there may still be a social impact as a result of acquisition of other land uses. Although option 403 impacted on land zoned as residential, the dwellings have not been constructed yet and so Option 403 was scored as an 8. Option 001 and Option 002 would impact a small number of dwellings and the workshop group agreed that these options would score between 4 and 5.			
001	002	403	424
5	4	8	8

Objective: Ensure the safety for all users

KPI: Achieving an optimum road design			
Key scoring inputs: Road alignments have compound minimum/maximum design criteria at the same location.			
Moderating factors: Sections with maximum grade (7%) and exceed maximum desirable lengths of steep grade ($g > 6\% = 300\text{m}$).			
Outcome: All options are conforming to an 80km/h speed limit. Options 001 and 403 have sections with maximum grade (7%) and exceed maximum desirable lengths of steep grade ($g > 6\% = 300\text{m}$). The workshop agreed that the steep descent to Menangle Road for Option 002 had been sufficiently reduced in the revised design of the intersection with Menangle Road. However, the workshop group was still concerned with the location of the connection due to a crest and horizontal curve in Menangle Road at the proposed intersection location and therefore was considered the least favourable option.			
001	002	403	424
8	7	8	9

KPI: A safe and efficient corridor for all road corridor users and stakeholders (during construction)			
Key scoring inputs: Major Hazard Creator scores.			
Moderating factors:			
Outcome: The workshop group agreed that scoring between 4 and 8 for the options was an appropriate reflection of the spread of Major Hazard Creator scores.			
001	002	403	424
6	8	4	6

KPI: A safe and efficient corridor for all road corridor users and stakeholders (during operation and maintenance)			
Key scoring inputs: Total length of high maintenance assets including bridges, retaining walls, earthworks ($> 5\text{m}$) and noise walls			
Moderating factors: Nil			
Outcome: The workshop group agreed to score all the options equally (mid-range scores) due to the similarities in the overall maintenance requirements of each option.			
001	002	403	424
5	5	5	5

Objective: Maximise value for money

KPI: Cost estimate			
Key scoring inputs: Strategic cost estimates presented in term of relativity to the lowest cost option (P90).			
Moderating factors: Nil.			
Outcome: The workshop group agreed to allocate the scores between 5 and 8 on a proportional basis using the relative cost estimates.			
001	002	403	424
7	7	8	5

KPI: Benefit Cost Ratio			
Key scoring inputs: Cost Benefit Analysis of each option			
Moderating factors: Nil.			
Outcome: The workshop group agreed to allocate the scores between 6 and 9 on a proportional basis to appropriately reflect the spread of the benefit cost ratio.			
001	002	403	424
9	7	8	6

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