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# The Northern Road / Bringelly Road Grade Separated Interchange Review of Environmental Factors

Roads and Maritime Services

November 2015





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# Executive summary

## The proposal

NSW Roads and Maritime Services (Roads and Maritime) is proposing a new grade separated interchange at The Northern Road and Bringelly Road, Bringelly ('the Proposal').

The Proposal involves The Northern Road passing under Bringelly Road and the Interchange being located about 300 metres east of the existing intersection of The Northern Road, Bringelly Road and Greendale Road. The Proposal also involves modifications to the existing intersection.

The key features of the proposal include:

- Widening and upgrading about 400 metres of Bringelly Road, between Kelvin Park Drive and Greendale Road, to provide:
  - Two 3.5 metre-wide traffic lanes in each direction between Kelvin Park Drive and The Northern Road/Bringelly Road interchange, with wide central medians for a future six lanes
  - Two 3.5 metre-wide traffic lanes in each direction on the western side of the interchange, transitioning to one lane in each direction to tie in to the existing intersection and Greendale Road
  - Two metre-wide shoulders in each direction
- Building a new section of The Northern Road east of the existing alignment, between about 200 metres south of Robinson Road and the southern abutment of the bridge over Thompsons Creek. The new section, to pass under Bringelly Road, would be about one kilometre long and around 50 metres wide (including embankments), and would include:
  - Two 3.5 metre-wide traffic lanes in each direction
  - Four metre-wide shoulders connecting to the on and off ramps of the interchange, allowing for future bus lanes
  - An underpass about 60 metres long under the upgraded section of Bringelly Road
  - 2.5 metre wide shoulders along The Northern Road under the interchange for about one kilometre
  - A wide central median to allow for a future six lanes
- Providing a new intersection with traffic lights on Bringelly Road over The Northern Road, with turning movements in all directions
- Dual right turn movements in all directions to and from The Northern Road and Bringelly Road, and dedicated left turn lanes in all directions
- Providing bus service facilities by:
  - Retaining bus stops on the existing The Northern Road and relocating bus stops on Bringelly Road to suit the interchange
  - Providing two new bus stops on The Northern Road northbound and southbound interchange on ramps
  - Providing a bus only lane north and south along The Northern Road at the traffic lights on Bringelly Road
- Three metre-wide shared paths for pedestrians and cyclists
- A new road connection between Robinson Road and The Northern Road by extending the realigned Belmore Road intersection, and building a cul-de-sac at the western end of Robinson Road

- Converting the existing The Northern Road (to the west of the new section) to a ‘no through road’, by providing cul-de-sacs at both the northern (at Thames Road) and southern ends (near Robinson Road).

The proposal would tie into The Northern Road Upgrade Stage 2A (Peter Brock Drive to Belmore Road) to the south, The Northern Road Upgrade Stage 2C (Thames Road to Mersey Road) to the north, and the Bringelly Road Upgrade Stage 2 (King Street to The Northern Road) to the east.

## Need for the Proposal

The Northern Road and Bringelly Road are principal arterial road corridors within the Western Sydney Priority Growth Area and the South West Priority Land Release Area. Substantial traffic growth is predicted in the next thirty years due to development of the:

- Western Sydney Priority Growth Area and the South West Priority Land Release Area
- Western Sydney Employment Area
- A western Sydney airport at Badgerys Creek
- Bringelly Brickworks expansion.

The proposal is one of a number of road improvement projects planned and underway to cater for increased traffic in south-western Sydney by improving road and intersection capacity. The Proposal will cater for the expected increase in traffic following The Northern Road and Bringelly Road upgrades.

A grade separated interchange would deliver free flowing traffic on The Northern Road and is a safe option as it would separate traffic flows on The Northern Road and Bringelly Road. A grade separated interchange would improve road capacity and safety, and the road network would be future proofed for expected future traffic growth.

## Proposal objectives

The objectives of the proposal are to:

- Improve transport connections to the proposed western Sydney airport and surrounding developments, including the Western Sydney Priority Growth Area, South West Priority Land Release Area and the Western Sydney Employment Area
- Improve the flow of traffic to provide more reliable journeys
- Support public and active transport to promote sustainable and efficient journeys
- Improve road safety for pedestrians, cyclists and motorists.

## Options considered

In 2012, a concept design for upgrading The Northern Road was prepared. The proposed upgrade of The Northern Road was assessed by *The Northern Road Upgrade, Narellan to Bringelly Review of Environmental Factors* (SKM, 2012). The Review of Environmental Factors considered a ‘do nothing’ option and a proposal to upgrade the intersection of The Northern Road, Bringelly Road and Greendale Road in its current location.

In April 2014, as part of the Western Sydney Infrastructure Plan, the (then) Prime Minister announced a proposal to upgrade the intersection of The Northern Road, Bringelly Road and Greendale Road by building a grade separated interchange between The Northern Road and Bringelly Road.

In February 2015, a preferred alignment for a grade separated interchange to the east of the existing intersection was developed after a number of options were assessed. The preferred alignment for the proposal was chosen because it reduces the impact on the existing Bringelly town centre and maintains access to the primary school, businesses and properties.

Roads and Maritime chose not to build the interchange at or near the current intersection of The Northern Road, Bringelly Road and Greendale Road because of the existing land use, and community and heritage constraints. In addition, locating the interchange away from the existing intersection would allow for safer heavy vehicle movements, particularly for trucks leaving the brickworks on Greendale Road.

In June 2015, Roads and Maritime engaged GHD to help identify a preferred design option for the interchange based on the preferred alignment option, and prepare the concept design and environmental assessment.

The preferred design involves a change to the vertical alignment of the preferred alignment, with The Northern Road now proposed to travel under Bringelly Road.

## Statutory and planning framework

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

As the proposal is for the purpose of a road and is to be carried out by Roads and Maritime, development consent from Liverpool and Camden councils is not required. The proposal can be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Review of Environmental Factors has been prepared as part of the assessment process.

## Community and stakeholder consultation

Consultation with potentially affected property owners, relevant government agencies and other stakeholders has been underway since February 2015. A community update newsletter was distributed in July 2015 to tell the community about the preferred alignment option for the proposal. The preferred alignment was displayed for community comment and six community information sessions were held in July and August 2015. Information about the proposal was placed on the Roads and Maritime project website. Feedback from community and stakeholder consultation was considered during development of the concept design and preparation of the Review of Environmental Factors.

Roads and Maritime also formally consulted Liverpool and Camden councils in August 2015 in accordance with the requirements of ISEPP. A value engineering and risk management workshop was held on 19 August 2015. The workshop provided an opportunity for key stakeholders to provide input to the design and assessment of the proposal.

Roads and Maritime will continue to consult with the community and stakeholders throughout the development of the proposal. In particular, this Review of Environmental Factors will be placed on public display and comments invited. Submissions received as a result of the display will be addressed in a formal submissions report and, if a decision is made to proceed with the proposal, will be considered during development of the detailed design.

## Environmental impacts

The benefits of the project include:

- Providing traffic capacity for future growth and development on The Northern Road and Bringelly Road corridors and surrounding areas
- Opportunities for improved public transport and an improved flow of traffic for road users
- Improved road safety for all road users by providing
  - An interchange to separate traffic on The Northern Road and Bringelly Road
  - Wide central medians on The Northern Road and Bringelly Road to separate opposing traffic flows
- Improved safety for pedestrians and cyclists from a shared path

- Increased connectivity for pedestrians by providing new footpaths
- Improved turning movements for heavy vehicles, in particular from Greendale Road onto The Northern Road.

The main potential environmental impacts during construction include:

- The partial or total acquisition of 35 properties
- Construction noise experienced by properties close to the proposal site
- Temporary disruptions to traffic flow and access
- Other amenity impacts, including the potential for dust generation and visual impacts
- Increase in traffic volumes along Robinson Road, Jersey Road and Carrington Road because of the proposed temporary diversion from Bringelly Road
- Impacts to six Aboriginal heritage sites (with four sites already assessed as part of adjoining upgrades)

The main potential environmental impacts during operation of the proposal include:

- Increased noise levels for properties close to the proposal site, with about 10 properties requiring additional noise mitigation
- Visual impacts associated with the presence of a large new structure in the landscape
- Reduction in passing trade for the shops located at Bringelly Village.

Adverse environmental effects would be adequately minimised, managed and mitigated by implementing safeguards outlined in this Review of Environmental Factors.

## Justification and conclusion

The Proposal is one of the key projects being developed as part of the Western Sydney Infrastructure Plan. The Plan will deliver major road infrastructure upgrades to support integrated transport for the region and capitalise on the economic benefits from developing a western Sydney airport. The Proposal is needed to cater for the anticipated increase in traffic that will use the intersection of The Northern Road and Bringelly Road following the upgrading of these roads.

While there would be some environmental impacts as a consequence of the Proposal, they have been avoided or minimised wherever possible through design and site-specific safeguards. The beneficial effects are considered to outweigh the adverse impacts and risks associated with the proposal.

The proposal is subject to assessment under Part 5 of the EP&A Act. This Review of Environmental Factors has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

The environmental impacts of the proposal are not likely to be significant and therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought for the proposal from the Minister for Planning under Part 5.1 of the EP&A Act. The Proposal is unlikely to affect threatened species, populations or ecological communities or their habitats, within the meaning of the *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994* and therefore a species impact statement is not required. The proposal is also unlikely to significantly impact the environment of Commonwealth land or any matters of national environmental significance. Therefore a referral to the Australian Department of the Environment for a decision by the Australian Minister for the Environment on whether assessment and approval is required under the *Environment Protection and Biodiversity Conservation Act 1999* is not required.

## Display of the review of environmental factors

The Review of Environmental Factors documents can be accessed in the following ways during the display of the Review of Environmental Factors and concept design.

### Internet

The documents will be available as pdf files on the Roads and Maritime website at:

<http://www.rms.nsw.gov.au/projects/sydney-west/bringelly-the-northern-road-upgrade/bringelly-road-interchange.html>

### Display

The review documents can be viewed at the following locations:

- Liverpool City Library  
170 George Street, Liverpool  
Monday to Friday between 9.30am and 8pm  
Saturday between 9.30am and 4pm  
Sunday between 12pm and 4pm
- Camden Council  
19 Queen Street, Narellan  
Monday to Friday between 8.30am and 5pm
- Narellan Library  
Corner of Queen Street and Elyard Street, Narellan  
Monday and Wednesday between 9.30am and 8pm  
Tuesday, Thursday and Friday between 9.30am and 5pm  
Saturday between 9am and 3pm

## How can I make a submission?

To make a submission on the proposal, please send your written comments to:

**Email** wsip@rms.nsw.gov.au

**Mail** The Northern Road and Bringelly Road Interchange  
Roads and Maritime Services  
PO Box 973 Parramatta NSW 2124

## Privacy information

All information included in submissions is collected for the sole purpose of assisting in the assessment of this proposal. The information may be used during the environmental impact assessment process by relevant Roads and Maritime Services staff and its contractors.

Where the respondent indicates at the time of supply of information that their submission should be kept confidential, Roads and Maritime will attempt to keep it confidential. However there may be legislative or legal justification for the release of the information, for example under the *Government Information (Public Access) Act 2009* or under subpoena or statutory instrument.

The supply of this information is voluntary. Each respondent has free access at all times to the information provided by that respondent but not to any identifying information provided by other respondents if a respondent has indicated that the representation should be kept confidential.

Any respondent may make a correction to the information that they have provided by writing to the same address the submission was sent.

The information will be held by the Roads and Maritime, 27-31 Argyle Street, Parramatta NSW 2150.

## What happens next?

Following the submissions period, Roads and Maritime will collate submissions. Acknowledgement letters will be sent to each respondent. The details of submission authors will be retained and authors will be subsequently advised when project information is released.

After consideration of community comments Roads and Maritime will determine whether the proposal should proceed as proposed, or whether any alterations to the proposal are necessary. The community will be kept informed regarding this Roads and Maritime determination.

If the proposal goes ahead, Roads and Maritime proceeds with final design and tenders are called for construction of the proposal.

If you have any queries, please contact the Roads and Maritime community information line:

**Phone** 1800 703 457

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# 1. Introduction

## 1.1 Proposal identification

Roads and Maritime Services (Roads and Maritime) is proposing a new grade separated interchange at The Northern Road and Bringelly Road, Bringelly (referred to as 'the proposal' for the purposes of this report). The proposal is located on the boundary of the Western Sydney Priority Growth Area and the South West Priority Land Release Area, about 45 km south-west of the Sydney central business district and 12 km west of Liverpool (refer to Figure 1.1).

The Northern Road and Bringelly Road are classified State Roads. The Northern Road forms part of route A9, which connects Campbelltown to Windsor. The Northern Road also provides connections between the Western Sydney Priority Growth Area, the Western Sydney Employment Area, the M4 Motorway, and the site for the proposed western Sydney airport at Badgerys Creek. Bringelly Road is one of the main road links within the Western Sydney Priority Growth Area. It provides a connection between The Northern Road at Bringelly to the west, and Leppington to the east.

The intersection of The Northern Road, Bringelly Road and Greendale Road is currently a four way, at-grade, traffic signal controlled intersection. The Northern Road, Bringelly Road and Greendale Road are all currently two lane, two way roads. Roads and Maritime is upgrading The Northern Road and Bringelly Road as part of the Australian and NSW governments' Western Sydney Infrastructure Plan, which will deliver \$3.6 billion in road infrastructure improvements over the next 10 years. The proposal was announced in April 2014 by the (then) Prime Minister as part of the Western Sydney Infrastructure Plan's program of works to support the proposed western Sydney airport at Badgerys Creek.

The proposal would tie into The Northern Road Upgrade Stage 2A (Peter Brock Drive to Belmore Road) to the south, The Northern Road Upgrade Stage 2C (Thames Road to Mersey Road) to the north, and the Bringelly Road Upgrade Stage 2 (King Street to The Northern Road) to the east (refer to Figure 2.1).

### 1.1.1 Key features

The grade separated interchange, which would involve The Northern Road passing under Bringelly Road, would be located about 300 m east of the existing intersection of The Northern Road, Bringelly Road and Greendale Road. The proposal also involves modifications to the existing intersection. The key features of the proposal are shown in Figure 1.2 and include:

- Widening and upgrading about 400 m of Bringelly Road, between Kelvin Park Drive and Greendale Road, to provide:
  - Two 3.5 metre-wide traffic lanes in each direction between Kelvin Park Drive and The Northern Road/Bringelly Road interchange, with wide central medians for a future six lanes
  - Two 3.5 metre-wide traffic lanes in each direction on the western side of the interchange, transitioning to one lane in each direction to tie in to the existing intersection and Greendale Road
  - Two metre-wide shoulders in each direction

- Building a new section of The Northern Road east of the existing alignment, between about 200 m south of Robinson Road and the southern abutment of the bridge over Thompsons Creek. The new section, to pass under Bringelly Road, would be about one kilometre long and around 50 m wide (including embankments), and would include:
  - Two 3.5 metre-wide traffic lanes in each direction
  - Four metre-wide shoulders connecting to the on and off ramps of the interchange, allowing for future bus lanes
  - An underpass about 60 m long under the upgraded section of Bringelly Road
  - 2.5 metre wide shoulders along The Northern Road under the interchange for about one kilometre
  - A wide central median to allow for a future six lanes
- Providing a new intersection with traffic lights on Bringelly Road over The Northern Road, with turning movements in all directions
- Dual right turn movements in all directions to and from The Northern Road and Bringelly Road, and dedicated left turn lanes in all directions
- Providing bus service facilities by:
  - Retaining bus stops on the existing The Northern Road and relocating bus stops on Bringelly Road to suit the interchange
  - Providing two new bus stops on The Northern Road northbound and southbound interchange on ramps
  - Providing a bus only lane north and south along The Northern Road at the traffic lights on Bringelly Road
- Three metre-wide shared paths for pedestrians and cyclists
- A new road connection between Robinson Road and The Northern Road by extending the realigned Belmore Road intersection, and building a cul-de-sac at the western end of Robinson Road
- Converting the existing The Northern Road (to the west of the new section) to a 'no through road', by providing cul-de-sacs at both the northern (at Thames Road) and southern ends (near Robinson Road).

It is anticipated that construction of the proposal would commence in late 2016 / early 2017 and would be open to traffic by the end of 2019.

#### 1.1.2 Location and context

The proposal is located at the boundary of the Liverpool and Camden local government areas, within the Roads and Maritime Sydney region. The boundary between the two local government areas runs along Bringelly Road and Greendale Road. The study area is dominated by rural and rural residential land uses. It also includes some commercial, educational, community and recreational land uses.

Further information on the existing environment of the study area and the proposal site is provided in section 6.

## 1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by GHD Pty Ltd on behalf of Roads and Maritime. Roads and Maritime is the proponent and the determining authority for the proposal under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

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

The description of the proposal and associated environmental impacts have been undertaken in context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the REF helps to fulfil the requirements of section 111 of the EP&A Act which requires Roads and Maritime to examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act
- The significance of any impact on threatened species as defined by the TSC Act or FM Act, and therefore the requirement for a species impact statement
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land, and therefore the need to make a referral to the Australian Government Department of the Environment (for a decision by the Australian Minister for the Environment) on whether assessment and approval is required under the EPBC Act

The following definitions have been used in this report:

- The 'proposal site' refers to the area that may be directly impacted by the proposal, in which construction activities would occur, including the location of the construction compound (refer to Figure 1.2)
- The 'study area' consists of land near, and including, the proposal site. The study area is a wider area surrounding the proposal site, including land that has the potential to be indirectly impacted by the proposal (for example, as a result of any noise impacts). The study area differs between the various specialist investigations.

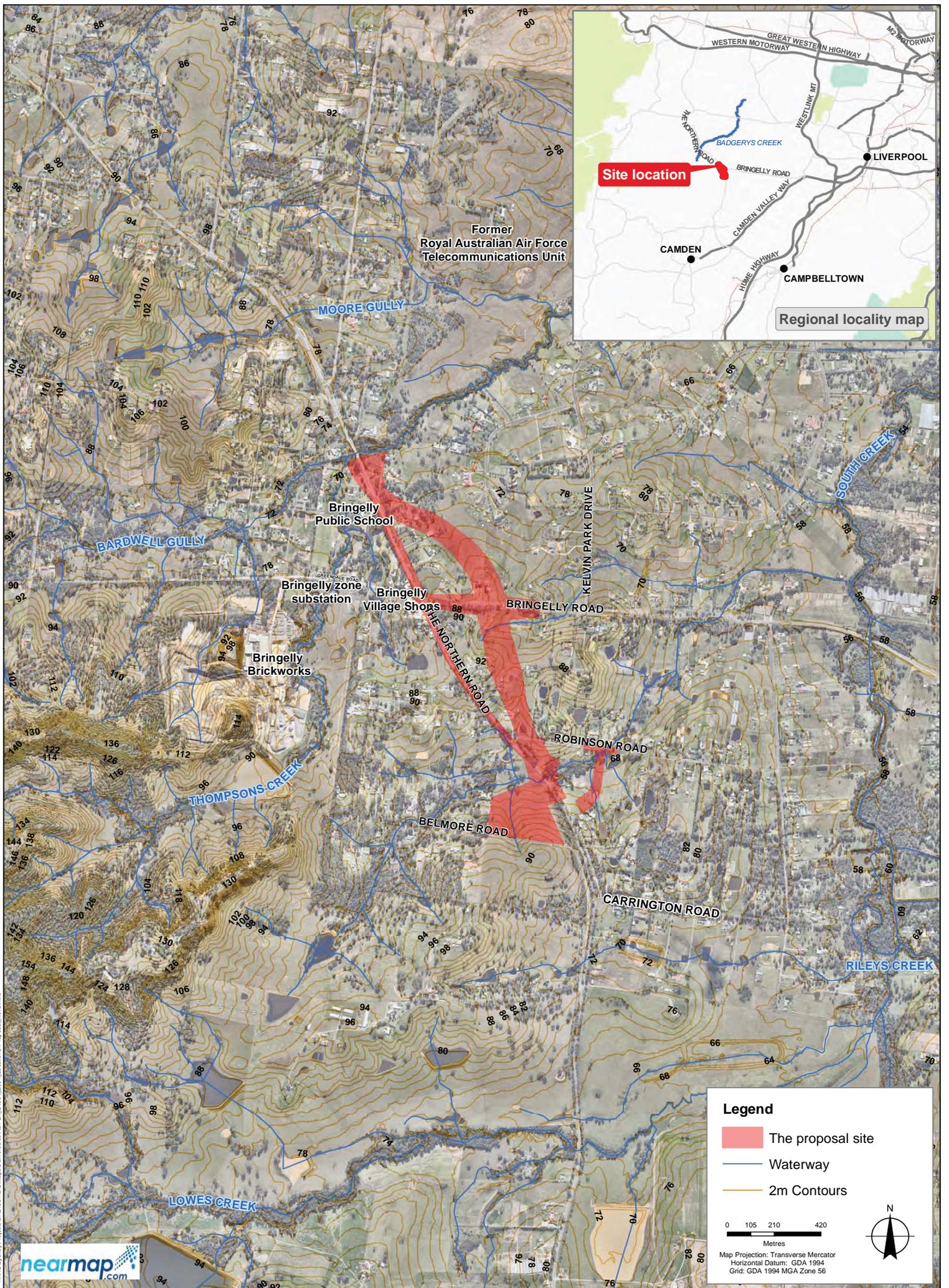


Figure 1.1 Location of the proposal

Data source: Nearmap, Aerial imagery, captured July 28.7.2015; LPI, Topographic base data, 2012. Created by jrichardson

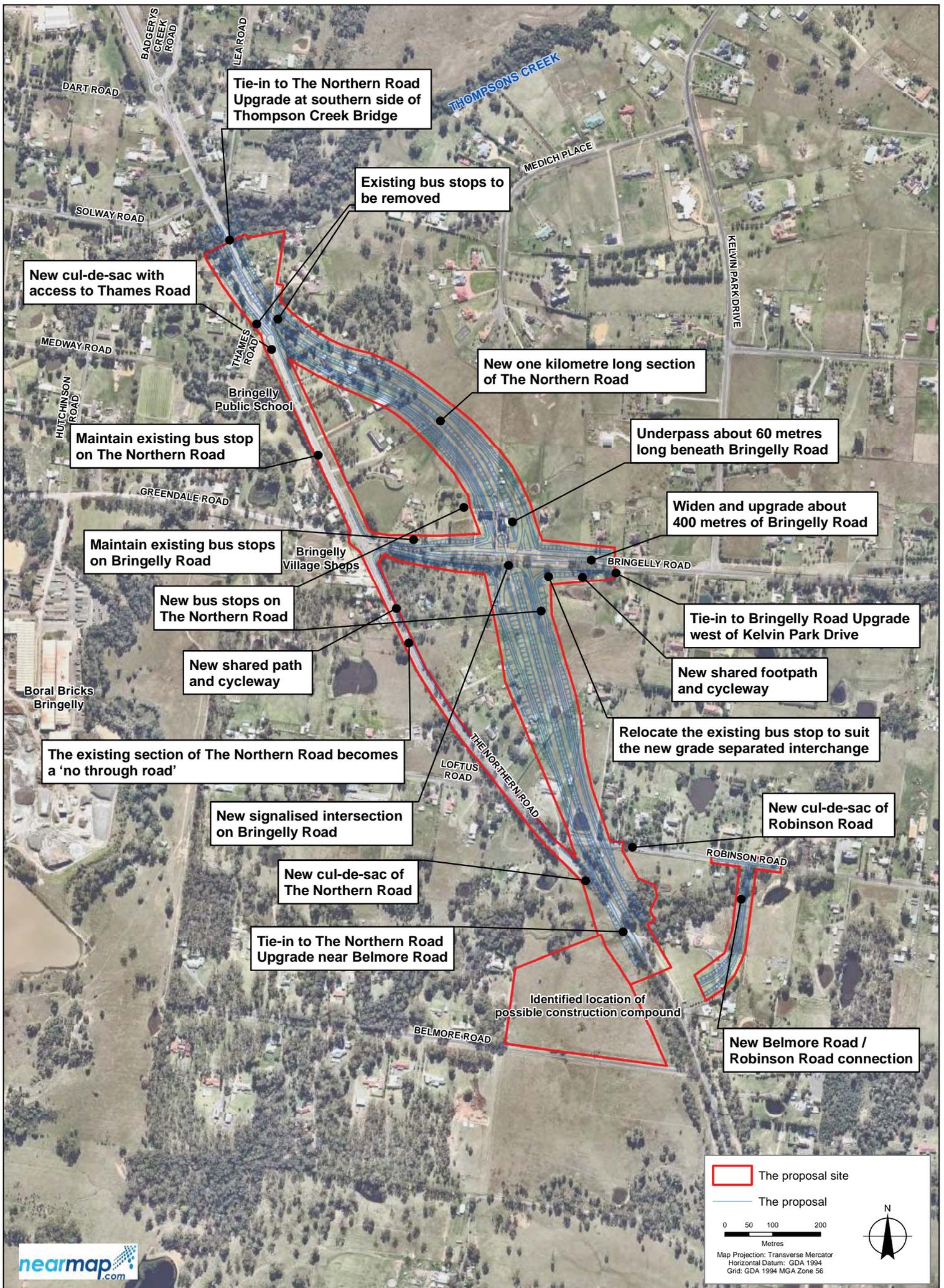


Figure 1.2 Key features of the proposal

Data source: Nearmap, Aerial imagery, captured July 28.7.2015; LPI, Topographic base data, 2012. Created by: MWearakon



## 2. Needs and options considered

### 2.1 Strategic need for the proposal

Roads and Maritime is working to plan and build the new and upgraded major arterial roads that will ensure road capacity meets the growth of western Sydney's population ahead. The Northern Road and Bringelly Road are principal arterial road corridors within the Western Sydney Priority Growth Area and the South West Priority Land Release Area. Currently, within the study area, both roads generally consist of a two-way sealed carriageway, about 10 m wide with one lane in each direction (refer to section 2.2). Substantial traffic growth is predicted along these roads in the next thirty years as a result of the development of the:

- Western Sydney Priority Growth Area and the South West Priority Land Release Area
- Western Sydney Employment Area
- Proposed western Sydney airport at Badgerys Creek
- Bringelly Brickworks expansion.

The location of these developments with respect to the proposal is shown in Figure 2.1.

The *Northern Road Corridor Strategy* (RTA, 2009b) noted that the forecast increase in population and traffic would exceed the overall carrying capacity along The Northern Road in peak periods, with almost all intersections providing inadequate service by 2026, resulting in severe congestion.

Roads and Maritime is upgrading The Northern Road and Bringelly Road to address these issues as part of the Australian and NSW governments' Western Sydney Infrastructure Plan. The proposal is one of a number of road improvement projects proposed and underway to cater for increased traffic volumes from the planned developments described above, by improving road and intersection capacity.

The proposal is needed to cater for the anticipated increase in traffic that will use the intersection of The Northern Road and Bringelly Road following the upgrading of these roads (described below). Replacing the existing intersection with a grade separated interchange would facilitate free flowing traffic on The Northern Road, and it is also a safer option as it would separate traffic flows on The Northern Road and Bringelly Road. By building a grade separated interchange, road capacity and safety would be improved, and the road network would provide for expected future traffic growth.

#### Upgrading The Northern Road

The Northern Road will form one of the main north–south arterial transport corridors within the Western Sydney Priority Growth Area and South West Priority Land Release Area. As residential and commercial development occurs, traffic volumes on The Northern Road are expected to increase. The Northern Road will be an important connection to the Western Sydney Employment Area; the proposed western Sydney airport; and regional centres, including Penrith, Campbelltown and Leppington.

The Northern Road is being upgraded from a generally two lane road to a four lane divided road, with a wide central median to allow for future widening. It is being upgraded in four stages:

- Stage 1 – The Old Northern Road, Narellan to Peter Brock Drive, Oran Park (3.3 km)
- Stage 2 – Peter Brock Drive, Oran Park to Mersey Road, Bringelly (10 km)
- Stage 3 – Littlefields Road, Luddenham to Jamison Road, Penrith (10 km)
- Stage 4 – Mersey Road, Bringelly to Littlefields Road, Luddenham (11 km).

Detailed designs for the upgrading of stages 1 and 2 are currently being finalised.

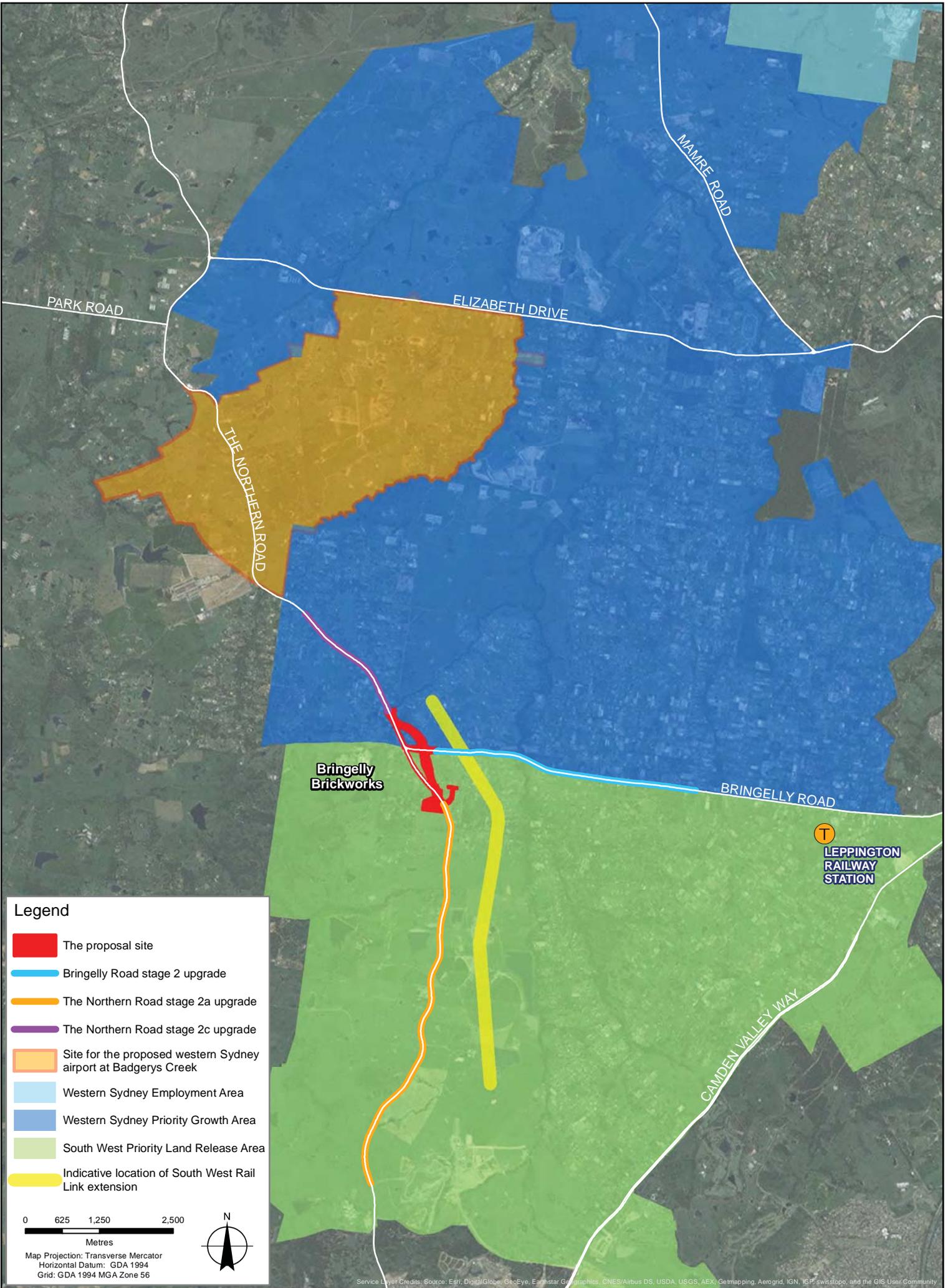


Figure 2.1  
Strategic context of the proposal

## Upgrading Bringelly Road

Bringelly Road will be one of the main east–west road links within the Western Sydney Priority Growth Area and South West Priority Land Release Area. It will link The Northern Road to the west with the Leppington major centre and Camden Valley Way to the east. To the east of the proposal study area, Bringelly Road will link Leppington to a future new north–south road link, which is included in the *Structure Plan for the South West Growth Centre* (described in section 2.1.1) to provide access to the Western Sydney Employment Area (to the north) and the Oran Park Town Centre (to the south). It will also provide access to employment and residential areas within the Bringelly precinct and precincts to the east (Department of Planning, 2010).

Roads and Maritime is upgrading Bringelly Road from a two lane road to a six lane divided road, between the eastern side of Upper Canal bridge and the western side of the Eastwood Road intersection, through the location of the future Leppington Town Centre. The rest of Bringelly Road will also be upgraded from two lanes to a four lane divided road with a central median, which would allow for widening to six lanes, when required. The Bringelly Road upgrade is being delivered in two stages:

- Stage 1 – from Camden Valley Way to King Street (5.7 km)
- Stage 2 – from King Street to 100 m west of Kelvin Park Drive (3.9 km).

Construction of stage 1 has commenced. The detailed design of stage 2 is currently being finalised.

### 2.1.1 Consistency with relevant strategic planning documents and significant developments in the study area

A review of relevant strategic planning documents was undertaken to identify whether the proposal is consistent with the aims and directions of these documents. The following sections provide a summary of the review.

## Strategic infrastructure and transport planning documents

### **State Priorities**

On 14 September 2015 the NSW Premier announced 30 priorities for the state to grow the economy, deliver infrastructure, protect the vulnerable, and improve health, education and public services across NSW. Collectively, these replace NSW 2021 as the new state plan.

Relevant priorities include:

- Reducing road fatalities
- 90% of peak travel on key road routes is on time
- Maintain or improve reliability of public transport services over the next four years

Together with the upgrades of The Northern Road and Bringelly Road, the proposal would provide adequate road capacity for projected population growth and would reduce travel time. The proposal would improve road safety by improving traffic flow and turning arrangements at the intersection of The Northern Road and Bringelly Road. The proposal has also been designed to minimise impacts on the natural environment as documented in this REF. For these reasons, the proposal is considered to be consistent with the new State priorities.

### **Rebuilding NSW - State Infrastructure Strategy**

*Rebuilding NSW - State Infrastructure Strategy* (NSW Government, 2014a) was prepared following consideration of the recommendations provided by Infrastructure NSW. It sets out infrastructure projects and initiatives that the NSW Government will prioritise for the short, medium and long term. The strategy highlights the importance of sustaining productivity growth in our major centres and our regional communities, and recognises the need for investment in key road projects.

Although the proposal is not explicitly included in the strategy, it is considered to be consistent with the strategy. In particular, the *Infrastructure NSW State Infrastructure Strategy Update 2014* report (Infrastructure NSW, 2014) notes that ‘...the NSW and Commonwealth Governments are delivering a \$3.5 billion program to upgrade major and local roads around the new Badgerys Creek Airport including upgrades to Bringelly Road, The Northern Road and the Elizabeth Drive Corridor’.

### ***NSW Long Term Transport Master Plan***

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) provides a framework for addressing transport challenges across NSW over the next 20 years. The master plan is designed to guide the allocation of available funds to deliver maximum benefits to the people of NSW. It integrates transport with wider land use planning, including the Sydney metropolitan strategy.

The proposal is consistent with the master plan as it supports one of the key measures, being ‘congestion management across greater Sydney’s road network with targeted measures to reduce congestion, better use existing road capacity and improve road safety’.

The transport objectives and network requirements for the South West Growth Centre are generally identified in the master plan. The proposal is consistent with the master plan as it would cater for the predicted increases in traffic, improve road safety and improve access through and to/from the South West Growth Centre.

### ***Sydney’s Cycling Future***

*Sydney’s Cycling Future* (Transport for NSW, 2013) is a plan to encourage people to ride more often and safely. It includes actions to promote and improve cycling which are relevant to the proposal. One of these actions includes providing shared off-road pedestrian and cycle facilities in appropriate locations as part of State road projects in the Sydney metropolitan region.

The proposal is consistent with this plan, as it includes a shared off-road footpath and cycleway.

### ***The Northern Road Corridor Strategy***

The *Northern Road Corridor Strategy* (RTA, 2009b) sets out the need and a vision for the upgrade of The Northern Road, as a principal transport corridor for the South West Growth Centre. The proposal is consistent with the strategy, as it is required in conjunction with the upgrade of The Northern Road.

### ***South West Rail Link Extension - Public transport corridor preservation***

In June 2015, Transport for NSW released for public consultation a map showing the proposed location of the corridor for the southern section of the South West Rail Link extension (Transport for NSW, 2015). The extension corridor is proposed to connect Leppington Station to Bringelly, and then head in two directions: north to the Western Line near St Marys, and south to Narellan. A train station is proposed to be located in Bringelly to the north-east of the proposal site. The location of the proposed extension corridor is shown on Figure 2.1. Following the receipt of community feedback and further investigations, the recommended corridor will be identified in 2016.

The concept design for the proposal has taken the proposed South West Rail Link Extension corridor into account.

## Consistency with relevant strategic land use planning

### ***A Plan for Growing Sydney - the Sydney metropolitan strategy***

*A Plan for Growing Sydney*, which was released in December 2014, is the NSW Government's 20 year plan for the Sydney metropolitan area. It provides direction for Sydney's productivity, environmental management, and liveability; and for the location of housing, employment, infrastructure and open space.

Relevant key directions of the plan include:

- Direction 1.4 'Transform the productivity of Western Sydney through growth and investment'. The plan notes that: 'Long-term planning in Western Sydney will be necessary to create a setting for jobs, infrastructure and services to meet the needs of current and future populations so that growth is targeted towards strategic centres across Western Sydney. This will include taking advantage of opportunities arising from new infrastructure investment such as ... upgrades to The Northern Road, Elizabeth Drive and Bringelly Road.' It also notes that: 'Western Sydney will require ... upgraded transport links to Western Sydney centres.'
- Direction 2.4 'Deliver timely and well planned greenfield precincts and housing'. The plan notes that: 'The Government has already committed considerable investment in major infrastructure to support housing growth in Growth Centres. This includes the South West Rail Link and North West Rail Link along with upgrades to Bringelly Road, The Northern Road.'

The strategy proposes two 'enterprise corridors' in Western Sydney. Enterprise corridors are defined as 'An area designed to attract investment and stimulate employment-generating development that is aligned with specific sections of rail or road transport infrastructure'. The proposal site is located within/adjoining the 'Bringelly Road Enterprise Corridor', which is proposed to be located along Bringelly Road and The Northern Road, between Leppington and the proposed western Sydney airport.

An action under direction 1.4 ('action 1.4.2') is to 'Develop new strategic employment corridors along transport infrastructure investments that will service Badgerys Creek Airport'. The plan notes that the airport will be the single largest infrastructure catalyst for employment growth in the history of Western Sydney, and that planning will direct economic growth to nominated areas, including the Bringelly Road Enterprise Corridor. Relevant to the proposal, for this action, the plan notes that the Government will:

- 'Facilitate an enterprise corridor from Leppington to Badgerys Creek Airport along Bringelly Road, potentially linked to a future extension of the South West Rail Link. A flexible and innovative regulatory environment will be developed to enable a wide range of commercial activities to take advantage of transport access to this precinct and its proximity to the airport, Leppington and the population growth of the South West Growth Centre
- Facilitate development opportunities that can leverage off improved transport connections, including improvements to Elizabeth Drive, The Northern Road and Bringelly Road'.

The proposal will improve traffic flows and access to, from and within the Bringelly precinct and the Western Sydney Priority Growth Area and South West Priority Land Release Area. For this reason, the proposal is considered to be consistent with *A Plan for Growing Sydney*.

### ***Subregional planning***

*A Plan for Growing Sydney* notes that 'Subregional planning is the link between the big picture planning directions set out in this Plan and detailed planning controls for local areas'. The plan sets the planning priorities for each subregion, along with the investigations required to develop subregional plans.

The proposal is located within the study area for the South West Subregional Strategy. Priorities noted by *A Plan for Growing Sydney* for this subregional strategy include:

- Investigate the long-term potential to locate a major enterprise corridor between Leppington and Bringelly, linked to the extension of the South West Rail Link
- Investigate pinch-point connections between north–south and east–west road links
- Strengthen the diverse benefits to the economy proposed by Badgerys Creek Airport.

The proposal is consistent with, and will support, the subregional planning priorities outlined above.

### ***South West Growth Centre Structure Plan***

The NSW Government established the North West Growth Centre and the South West Growth Centre in 2005 to manage the release of greenfield land for urban development, and coordinate the sustainable delivery of infrastructure over the next 25 to 30 years.

The South West Growth Centre, which was then predicted to accommodate about 110,000 new dwellings for 300,000 people, is located within the Liverpool, Camden and Campbelltown local government areas. It comprises about 17,000 hectares of land and 18 development precincts, of which eight whole or part precincts have now been released for planning and/or development. The proposal site is within the Bringelly precinct, which is located within the north-west of the growth area.

The *Structure Plan for the South West Growth Centre* was released in 2005. The structure plan provides guidance for the future planning of the growth centre and its key elements, including the location of the Leppington major centre and surrounding town and village centres. The Leppington major centre is located on Bringelly Road, about seven kilometres to the east of the proposal site.

The structure plan indicates that when the Bringelly precinct is fully developed, it will accommodate about 5,000 new dwellings for 14,000 people. It also indicates that there will be a 'town and village centre' at the existing intersection of The Northern Road and Bringelly Road.

The structure plan indicates that The Northern Road and Bringelly Road form two of the main arterial transport corridors in the South West Growth Centre. As a result, these roads need to cater for substantial traffic growth associated with development within and around the growth centre. The proposal is consistent with the structure plan, as it required in conjunction with the upgrades of The Northern Road and Bringelly Road. It would also benefit the development of a town and village centre at the existing intersection of The Northern Road and Bringelly Road by removing through regional traffic from this location.

The Department of Planning and Environment have recently released information about the Western Sydney Priority Growth Area and the South West Priority Land Release Area which incorporate the former South West Growth Centre. Further information and an updated structure plan are expected to be released later in 2015 about these areas.

### ***Western Sydney Employment Area***

The Western Sydney Employment Area is located to the north and west of the study area of the proposal. The Western Sydney Employment Area comprises a land area of about 10,690 hectares. It is expected to become the largest employment land area in NSW. About 57,000 new jobs are expected to be located in the area over the next 30 years, with a total of 212,000 new jobs in the area when it is fully developed beyond 2046.

The *Broader Western Sydney Employment Area Draft Structure Plan* (NSW Government, 2013) sets out the Government's vision for economic and infrastructure growth in the Western Sydney Employment Area. The southern portion of the employment area overlaps with the original South West Growth Centre area, and adjoins the Western Sydney Priority Growth Area. The *Broader Western Sydney Employment Area Draft Structure Plan* notes there are opportunities for linkages by road and rail into Leppington town centre, including east–west road connections such as Bringelly Road. The plan notes that transport, movement and access will be critical to the success of the employment area.

Although not specifically noted by the structure plan, the proposal is considered to be consistent with the plan as it would cater for the predicted increases in traffic and the need to improve access to the Western Sydney Employment Area from the south and south-east.

### **Proposed western Sydney airport**

In April 2014 the Australian Government announced that Badgerys Creek will be the site for the western Sydney airport. The Badgerys Creek site is located about 3.7 km north of the proposal site. Planning for the airport's development has commenced. Construction could commence as early as 2016, with airport operations expected to commence in the mid 2020s.

The airport is likely to service both domestic and international air traffic, with its development staged in response to passenger demand. The initial development of the airport would include a single runway and facilities capable of facilitating the movement of up to 10 million passengers per year. This is described further in the Australian Government Department of Infrastructure and Regional Development's *Western Sydney Airport Draft Environmental Impact Statement, 2015* (DIRD, 2015) currently on public display for comment.

The proposal allows for the upgrade of the interchange to support the predicted increase in traffic resulting from the proposed western Sydney airport.

## **2.2 Existing roads and infrastructure**

A description of the existing road and transport infrastructure in the study area is provided below. Key roads and transport infrastructure are shown in Figure 1.2. A summary of existing traffic volumes is provided in section 6.1.

### **2.2.1 The Northern Road**

The Northern Road functions as an arterial road (part of route A9) with a posted speed limit of 60 to 80 km/h. It extends for a distance of about 32 km from the intersection with Camden Valley Way at Narellan in the south, to the intersection with the M4 Western Motorway at South Penrith in the north. It passes through a number of suburbs including Harrington Park, Oran Park, Bringelly, Luddenham, Mulgoa and Glenmore Park. The Northern Road runs north–south through the Western Sydney Priority Growth Area and South West Priority Land Release Area, and currently travels through the proposed western Sydney airport site.

In the study area, The Northern Road generally consists of a two-way sealed carriageway, about 10 m wide with one lane in each direction (and additional turning lanes at the intersection with Bringelly Road/Greendale Road – refer section 2.2.3). The posted speed limit is 60 km/h, with a 40 km/h school zone in the vicinity of the Bringelly Public School. In the study area, The Northern Road intersects with Thames Road to the north, Greendale Road and Bringelly Road in the centre of the study area, and Loftus Road, Robinson Road and Belmore Road in the south.

Figure 2.2 shows The Northern Road facing south towards the Bringelly Village shops (shown to the centre-right of the image).



Figure 2.2 View of The Northern Road facing south at the intersection with Bringelly Road, Bringelly

In the study area, surface water runoff from The Northern Road is generally collected in informal table drains, located on either side of the pavement. There are six cross drainage structures located along The Northern Road within the study area as follows:

- A 450 mm diameter pipe culvert located about 160 m south of Thompsons Creek, which conveys water from east to west, discharging to a table drain running northward into Thompsons Creek
- A 375 mm diameter pipe culvert crossing located 180 m south of Thompsons Creek, which conveys water from east to west across The Northern Road
- A 375 mm diameter pipe culvert crossing located 340 m south of Thompsons Creek, which conveys water from east to west across The Northern Road
- A 450 mm pipe culvert at Robinsons Road, which allows water collected in the table drain on the east side of The Northern Road to pass to the south, finally discharging at the South Creek tributary
- A 375 mm pipe culvert under Robinsons Road, located immediately to the east of The Northern Road, which collects water draining from the catchment north of Robinsons Road and conveys water under the road toward the South Creek tributary
- A three cell, 1.8 m wide by 0.9 m high box culvert, which drains the South Creek tributary under The Northern Road.

### 2.2.2 Bringelly Road

Bringelly Road is a State road. It extends for a distance of about 10 km east–west across the Western Sydney Priority Growth Area and South West Priority Land Release Area, from the intersection of Cowpasture Road and Camden Valley Way in Leppington/Horningsea Park in the east, to The Northern Road in the west.

In the study area, Bringelly Road consists of a two-way sealed carriageway, about 10 m wide, with two lanes. The posted speed limit is 60 km/h, with a 40 km/h school zone in the vicinity of the intersection with The Northern Road. In the study area there is an intersection with The Northern Road to the west, and Kelvin Park Drive to the east.

Figure 2.3 shows Bringelly Road facing west towards the intersection with The Northern Road.



Figure 2.3 View of Bringelly Road facing west, Bringelly

In the study area, surface water runoff from Bringelly Road is collected in informal table drains, located on either side of the pavement. There are two cross drainage structures located along the length of Bringelly Road within the study area as follows:

- A 450 mm diameter culvert located 180 m east of The Northern Road, which drains north to Thompsons Creek
- Two 600 mm diameter culverts located 80 m west of Kelvin Park Drive, which drains east joining the South Creek tributary about 700 m east of Kelvin Park Drive.

### 2.2.3 The existing intersection of The Northern Road, Bringelly Road and Greendale Road

The existing intersection is a four way signalised intersection as shown in Figure 2.4. The turning movements at the existing intersection include the following:

- Shared northbound and left turn lane onto Greendale Road from The Northern Road
- Dedicated right turn lane onto Bringelly Road eastbound from The Northern Road
- Single southbound through lane on The Northern Road with a dedicated right turn lane onto Greendale Road, and a left turn slip lane onto Bringelly Road
- Single westbound through lane on Bringelly Road through to Greendale Road
- Dedicated right turn lane onto The Northern Road northbound and a left turn slip lane onto The Northern Road southbound from Bringelly Road
- Shared eastbound and right turn lane onto The Northern Road from Greendale Road
- Dedicated left turn lane onto The Northern Road northbound from Greendale Road.

Driveway access to the Bringelly Village shops is located off The Northern Road, about 70 m south of the intersection, and off Greendale Road, about 40 m west of the intersection.



Figure 2.4 View of the existing intersection facing north on The Northern Road, Bringelly

In the study area, Greendale Road is a two lane sealed road. It provides access to rural residential properties, Bringelly Public School (with the driveway located about 115 m to the west of the intersection), Bringelly Park, Bringelly Community Centre and the Bringelly Zone Substation (operated by Endeavour Energy), which are located about 270 m to the west of the intersection. The Bringelly Brickworks (owned and operated by Boral) is located about 615 m to the west of the intersection. Further to the north-west, Greendale Road travels through land used mainly for rural purposes and provides access to the village of Wallacia, located about 14 km to the north-west of the proposal site.

#### 2.2.4 Parking

No stopping signs are located on The Northern Road and Greendale Road in the vicinity of the intersection. Beyond the parking restrictions at the intersection, parking is generally unrestricted on The Northern Road, Bringelly Road and Greendale Road.

#### 2.2.5 Bus services

Bus stops and bus routes in the study area are listed in Table 2.1. Bus stops are shown on

Figure 2.5. Bus services in the study area (both school services and route 856) are operated by Interline Bus Services. Interline Bus Services provides school and route bus services in Sydney Metropolitan Bus Region 2 under contract with Transport NSW. A bus zone is located near bus stop number 2171178 and along Greendale Road near Bringelly Public School.

Table 2.1 Bus facilities in the study area

Bus stops		Bus routes	
Stop number	Location	Number	Route
2171443	The Northern Road near Thames Road	856	Bringelly to Liverpool via Prestons and Churchill Gardens
2171442	The Northern Road opposite Thames Road	856	Liverpool to Bringelly via Churchill Gardens and Prestons
2171178	The Northern Road near Bringelly Public School	856	Liverpool to Bringelly via Churchill Gardens and Prestons
2171180	Bringelly Road east of The Northern Road (eastbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens
2171422	Bringelly Road east of The Northern Road (westbound)	856	Liverpool to Bringelly via Churchill Gardens and Prestons
2171421	Near 971 Bringelly Road	856	Liverpool to Bringelly via Churchill Gardens and Prestons
2171181	Bringelly Road west of Kelvin Park Drive (eastbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens
2171177	Bringelly Road west Kelvin Park Drive (westbound)	856	Liverpool to Bringelly via Churchill Gardens and Prestons



The proposal site  
 The proposal  
B Bus stops

0 50 100 200  
 Metres

Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56

Figure 2.5 Transport facilities

## 2.2.6 Pedestrian and cyclist facilities

Pedestrian crossings are provided on the northern and western legs of the intersection of The Northern Road, Bringelly Road and Greendale Road. A pedestrian refuge is located on Greendale Road, about 150 m west of The Northern Road, to assist pedestrians crossing to and from Bringelly Public School.

Formalised pedestrian footpaths are limited within the study area, however a footpath is provided at the front of Bringelly Public School on Greendale Road and The Northern Road and a path exists on the west side of The Northern Road to serve the small businesses on the south western corner of the intersection. For the remainder of the study area, pedestrians are using grassed or gravel verges.

There are no dedicated cycling facilities in the study area however cyclists can travel within The Northern Road shoulder lanes.

## 2.3 Proposal objectives

The project specific objectives of the proposal are to:

- Improve transport connections to the proposed western Sydney airport and surrounding developments, including the Western Sydney Priority Growth Area and South West Priority Land Release Area and the Western Sydney Employment Area
- Improve the flow of traffic to provide more reliable journeys
- Support public and active transport to promote sustainable and efficient journeys
- Improve road safety for pedestrians, cyclists and motorists.

Program objectives for the Western Sydney Infrastructure Plan were developed in February 2015 by Roads and Maritime, Transport for NSW and the Australian Government. The four key focus areas for the Western Sydney Infrastructure Plan and associated program objectives are as follows:

- Development and demand – support the proposed western Sydney airport, land use change and residential growth; balancing functional, social, environmental and value for money considerations
- Connectivity to airport – provide a resilient connection for freight and people to the proposed western Sydney airport
- Integrated network – provide road improvements to support and integrate with the broader transport network
- Customer focus – provide meaningful engagement with customers and stakeholders throughout the program life.

## 2.4 Alternatives and options considered

### 2.4.1 Summary of alternatives and options considered

In 2012, a concept design for upgrading The Northern Road was prepared. The proposed upgrade of The Northern Road was assessed by *The Northern Road upgrade, Narellan to Bringelly Review of Environmental Factors* (SKM, 2012) ('The Northern Road upgrade REF'). The Northern Road upgrade REF considered a 'do nothing' option and a proposal to upgrade the intersection of The Northern Road, Bringelly Road and Greendale Road in its current location (considered to be the 'do minimum' option for the purpose of this REF).

In April 2014, the (then) Prime Minister announced a proposal to upgrade the intersection of The Northern Road, Bringelly Road and Greendale Road by building a grade separated interchange between The Northern Road and Bringelly Road. The grade separated interchange formed part of the Western Sydney Infrastructure Plan's program of road works to support development of the proposed western Sydney airport. As noted by the Australian Government Department of Infrastructure and Regional Development's factsheet, *The Northern Road Upgrade* (DIRD, 2014): 'The upgrade to The Northern Road will also include interchanges at Elizabeth Drive and Bringelly Road.'

In February 2015, Roads and Maritime engaged URS to assist with identifying a preferred alignment for a grade separated interchange. The option described as 'option 6', located to the east of the existing intersection, was identified by URS as the preferred alignment option for the interchange as outlined in *The Northern Road and Bringelly Road Grade Separated Interchange Options Report* (Roads and Maritime, 2015) ('the options report').

In June 2015, Roads and Maritime engaged GHD to identify a preferred design option for the interchange based on URS's preferred alignment option, and prepare the concept design and environmental assessment. The preferred design option developed by GHD involves a change to the vertical alignment of the option proposed by URS, with The Northern Road now proposed to travel under Bringelly Road. GHD also identified a preferred interchange layout, which involves a signalised diamond interchange. Refer to section 2.4.3 for more information about the alignment option selection.

Further information on the option development and assessment process, including the justification for selection of the preferred option, is provided in the following sections.

#### 2.4.2 The original proposal and the 'do nothing' option

As noted in section 2.1, *The Northern Road Corridor Strategy* (RTA, 2009b) sets out the need and a vision for the upgrade of The Northern Road, with the intention being that The Northern Road would be one of the main road transport corridors for the South West Growth Centre.

The proposal to upgrade The Northern Road in the study area was assessed in The Northern Road upgrade REF (SKM, 2012), which was determined by Roads and Maritime in March 2013. The determined REF includes an upgrade of the intersection of The Northern Road, Bringelly Road and Greendale Road in its current location, as an at-grade intersection. This would involve upgrades to two travel lanes in each direction at the intersection, provision of dedicated turning bays, signalised pedestrian crossings and a bus priority lane.

A 'do nothing' option was also considered in The Northern Road upgrade REF (SKM, 2012). This was described by the REF as: 'Option 1: 'Do nothing' option (base case) - This option would result in The Northern Road remaining a two-lane single carriageway road between The Old Northern Road, Narellan and Mersey Road, Bringelly. This would mean that the road would not be able to cater for the predicted traffic growth in the South West Growth Centre. Normal road maintenance would continue to be undertaken.'

The Northern Road upgrade REF (SKM, 2012) summarised the results of the options assessment, which concluded that the 'do nothing' option 'would not meet the proposal objectives or the broad objectives of the South West Growth Centre development and was therefore not considered further.'

The upgrade of the intersection of The Northern Road, Bringelly Road and Greendale Road in its current location, as an at-grade intersection (as defined by The Northern Road upgrade REF) is considered to be the 'do minimum' option for the purpose of this REF.

The proposed upgrade of The Northern Road was assessed by *Bringelly Road upgrade, Review of Environmental Factors* (nghenvironmental, 2011) ('The Bringelly Road upgrade REF'). The

Bringelly Road upgrade REF assessed the upgrade of Bringelly Road between Camden Valley Way, Leppington and The Northern Road, Bringelly. The REF did not assess The Northern Road intersection upgrade.

### 2.4.3 Alignment options

#### Methodology for selection of the preferred alignment option

The alignment options considered, and the options analysis methodology used to analyse the options, are detailed in the options report (Roads and Maritime, 2015). A summary of the options report is provided in Appendix B. The full report is available on Roads and Maritime's website for the Western Sydney Infrastructure Plan (via <http://www.rms.nsw.gov.au/projects/sydney-west/bringelly-the-northern-road-upgrade/bringelly-road-interchange.html>).

Eight alignment options and nine sub-options were identified by URS, as outlined below. Each option was analysed against the agreed project objectives and the following criteria:

- Land use:
  - Zoning, property and access
  - Utilities
- Environmental:
  - Heritage – Non-Aboriginal
  - Heritage – Aboriginal
  - Ecology/biodiversity
  - Water and hydrology
  - Noise
  - Visual
- Constructability:
  - Geotechnical
- Cost.

Weightings were allocated to each of the criteria during a series of workshops held with Roads and Maritime and URS design and environment staff. These are detailed in Appendix B.

#### Identified alignment options

The options report included one option that involved no deviation from the current alignment of the intersection (described by this REF as the 'do minimum' option) and seven options that deviated from the current alignment, either to the west, south or east, or a combination of both. The options considered by the options report are summarised below and shown in Figure 2.6.

##### **Option 0 – no deviation**

This option is described in section 2.4.2. This option would include the features described in section 2.4.2 and would involve widening Bringelly Road and The Northern Road to four through lanes (two lanes in each direction), with Greendale Road remaining with two through lanes (one lane in each direction).

##### **Option 1 – western route**

Option 1 would be located to about 500 m west of the existing intersection. The alignment of The Northern Road would divert west from The Northern Road at Loftus Road, travel over Greendale Road by means of a bridge, and re-join the existing The Northern Road at Dart Road.

### ***Option 2 – eastern route 1***

Option 2 would be located about 150 m east of the existing intersection. The alignment of The Northern Road would divert east from The Northern Road at Loftus Road, travel over Bringelly Road by means of a bridge located east of the existing intersection, and re-join the existing The Northern Road at Solway Road.

Two sub-options were considered, involving The Northern Road travelling over Bringelly Road (option 2a) or under Bringelly Road (option 2b).

### ***Option 3 – southern route 1***

Option 3 would be located about 100 m south of the existing intersection. For this option, The Northern Road would remain in its current location, with Bringelly Road and Greendale Road located on a new alignment to the south of the existing intersection. The alignment of Bringelly Road would divert to the south from its existing alignment from just west of Kelvin Park Drive, and would connect to Greendale Road at Medway Road on the western side of The Northern Road.

Three sub-options were considered, involving The Northern Road travelling over Bringelly Road (option 3a), The Northern Road travelling over a trenched Bringelly Road (option 3b), or Bringelly Road over travelling over The Northern Road (option 3c).

### ***Option 4 – southern route 2***

Option 4 would be located about 300 m south of the existing intersection. Option 4 is a variation of option 3, with the intersection located further to the south to minimise impacts on existing businesses and property accesses. The alignment of Bringelly Road would divert to the south from its existing alignment at Kelvin Park Drive, and would connect to Greendale Road about 600 m to the west of The Northern Road.

This option could accommodate similar sub-options as option 3.

### ***Option 5 – combination of options 2 and 4 (south-eastern route 1)***

Option 5 would be located about 170 m south-east of the existing intersection. This option would involve a combination of options 2 and 4. The alignments of Bringelly Road and Greendale Road would divert to the south, and the alignment of The Northern Road would divert to the east.

Four sub-options were considered, involving The Northern Road travelling over an at grade Bringelly Road (option 5a), The Northern Road travelling over a trenched Bringelly Road (option 5b), Bringelly Road travelling over an at grade The Northern Road (option 5c), and Bringelly Road travelling over a trenched The Northern Road (option 5d).

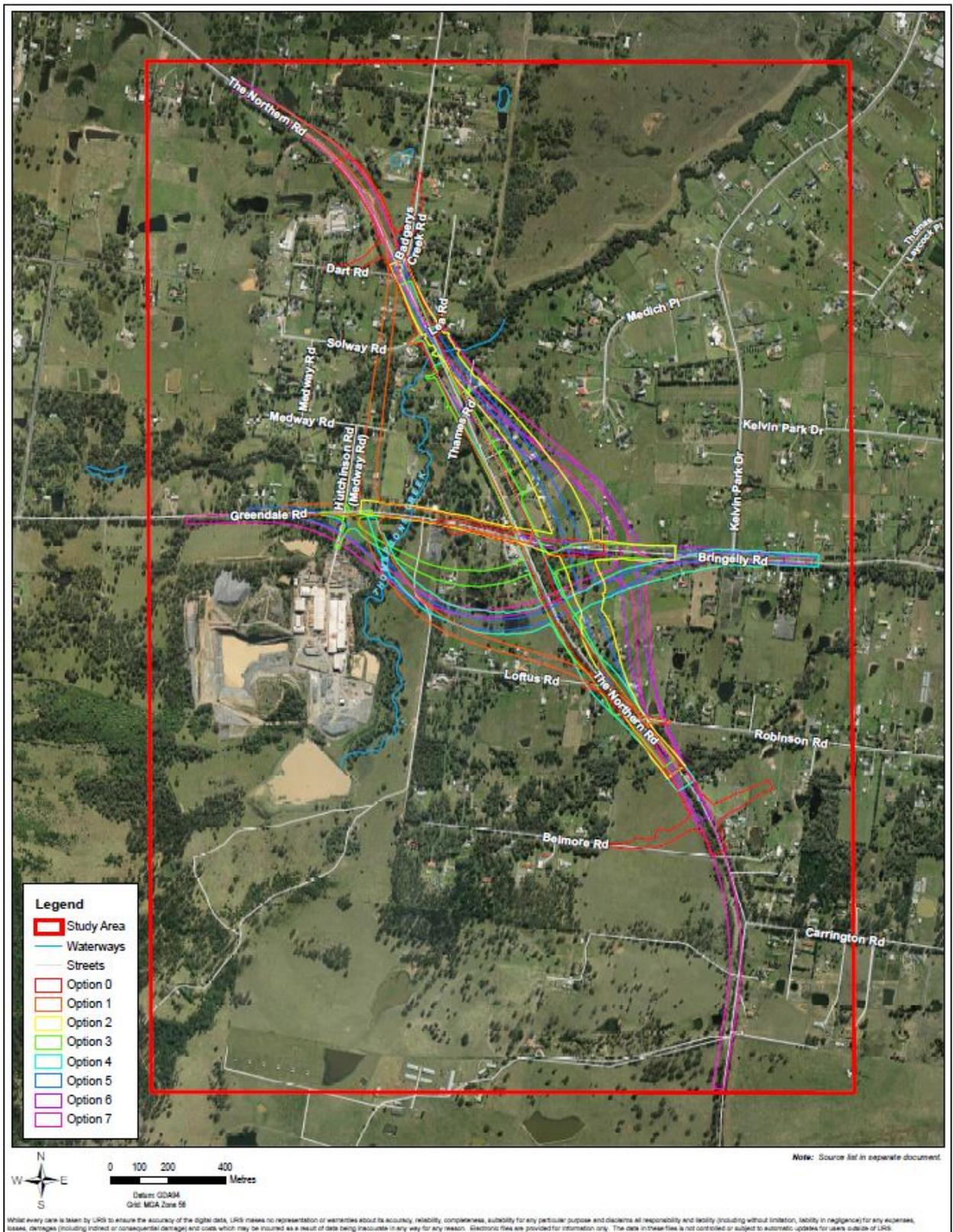
### ***Option 6 – eastern route 2***

Option 6 would be located about 400 m east of the existing intersection. The alignment of The Northern Road would divert east from The Northern Road, south of Solway Road, travel over Bringelly Road by means of a bridge located about 400 m east of the existing intersection, and re-join the existing The Northern Road at Robinson Road.

### ***Option 7 – combination of options 4 and 6 (south-eastern route 2)***

Option 7 would be located to the south-east of the existing intersection (about 400 m to the east and 50 m south). This option would involve a combination of options 4 and 6. The alignments of Bringelly Road and Greendale Road would divert to the south, and the alignment of The Northern Road would divert to the east. For this option, the intersection would be located about 400 m east and 50 m south of the existing intersection. The Northern Road would travel over Bringelly Road by means of a bridge.

The key constraints impacted and/or potential issues associated with each option are summarised in Table 2.2. Further information is provided in Appendix B.



(source: Roads and Maritime, 2015)

Figure 2.6 Alignment options identified in the options report

Table 2.2 Analysis of options (based on Roads and Maritime, 2015)

Option	Meets proposal objectives	Significant constructability issues	Land use – direct impacts				Heritage – direct impacts	
			Bringelly Brickworks	Bringelly Village	School	Bringelly Park	Aboriginal	Non-Aboriginal
Do minimum/ option 0	x	✓	x	✓	✓	x	✓	✓
1	✓	x	✓	x	✓	✓	✓	✓
2	✓	x	x	x	✓	✓	✓	✓
3	✓	✓	✓	✓	x	x	✓	✓
4	✓	✓	✓	x	x	x	✓	✓
5	✓	x	✓	x	x	x	✓	x
6	✓	x	x	x	x	x	✓	x
7	✓	x	✓	x	x	x	✓	x

Table 2.2 cont.

Option	Other key environmental constraints/issues				Cost (relatively higher, similar or lower than other options)
	Creek crossing/s	Construction noise impacts (to village shops/school)	Visual impacts (relatively higher (↑), similar (-) or lower (↓) than other options)	Vegetation clearing (relatively higher, similar or lower than other options)	
Do minimum/ option 0	x	✓	↓	-	↓
1	✓	x	-	-	-
2	✓	✓	↑	-	↓
3	✓	✓	↑	-	-
4	✓	x	-	-	↑
5	✓	x	-	-	↑
6	x	x	-	↓	↓
7	✓	x	↑	↑	↑

### The preferred alignment option

Option 6 (eastern route 2) was selected by URS as the preferred alignment option for the interchange. The options report (Roads and Maritime, 2015) indicates that option 6 was selected as the preferred alignment option for the following reasons:

- Best meets the proposal objectives
- Minimises the potential impacts on identified environmental constraints
- Provides flexibility for future upgrades
- Provides benefits in terms of constructability.

It is noted that option 6 also offers a number of other benefits, including:

- Minimises impacts on existing land uses in the Bringelly town centre
- Retains access to the existing Bringelly Village shops
- Avoids impacts to the Bringelly Public School
- Avoids impacts to heritage listed items
- Minimises property impacts as much as possible.

For the above reasons, Roads and Maritime identified that the preferred alignment option for the interchange was to the east of the existing intersection, in the location described by URS as option 6.

#### 2.4.4 Design options

##### Methodology for selection of the preferred design option

A workshop was held on 26 June 2015 to:

- Review the preferred alignment option
- Review design options for the layout of the interchange
- Identify a preferred option to form the basis of concept design and environmental assessment process.

The workshop, which involved representatives of GHD's design and environmental teams and Roads and Maritime, involved an assessment of:

- Two options for the vertical alignment of the interchange
- Five options for the interchange layout.

The following assessment criteria were used to assess the options:

- Proposal objectives
- Land use/property:
  - Land acquisition
  - Flexibility in terms of future planning
- Environmental:
  - Landscape character impacts
  - Biodiversity
  - Heritage
  - Hydrology and drainage

- Performance/constructability:
  - Constructability
  - Earthmoving
  - Traffic performance/connectivity
  - Access
- Cost.

The advantages and disadvantages of each option were considered, and the options were scored against the assessment criteria using a simple multi-criteria assessment approach.

### Identified vertical alignment options

The following options for the vertical alignment of the interchange were considered:

- Option V1 – The Northern Road travels under Bringelly Road (a modification of the preferred alignment option (option 6))
- Option V2 – The Northern Road travels over Bringelly Road (as per option 6 described in section 2.4.3)

The advantages and disadvantages of the two alignment options are summarised in Table 2.3.

Table 2.3 Advantages and disadvantages of the vertical alignment options

Design options	Advantages	Disadvantages
V1 The Northern Road under Bringelly Road	<ul style="list-style-type: none"> <li>• Lower noise levels from traffic using The Northern Road (the busier road)</li> <li>• Embankment would be lower in height compared with option V2, which would reduce the visibility of the structure</li> <li>• Straight structure over Bringelly Road (crossing bridge)</li> <li>• Reduced visual impacts</li> <li>• Improved vehicle efficiency (vehicles travel uphill when stopping and downhill when accelerating)</li> <li>• Constructability on Bringelly Road.</li> </ul>	Larger volume of spoil would be generated by excavation compared with option V2
V2 The Northern Road over Bringelly Road	Vertical alignment would be synchronised with the horizontal alignment	<ul style="list-style-type: none"> <li>• A large amount of fill would need to be imported to the site</li> <li>• The embankment required to enable The Northern Road to pass over Bringelly Road would be substantially higher than for option V1, and would be much more visible from surrounding areas</li> <li>• Higher potential noise levels</li> <li>• Curve structure over Bringelly Road</li> <li>• Impact on intersection between Bringelly Road and Kelvin Park Drive.</li> </ul>

### Identified interchange layout options

The following options for the layout of the interchange were considered:

- Option A – clover interchange
- Option B – semi-clover interchange
- Option C – trumpet interchange
- Option D – signalised trumpet Interchange
- Option E – signalised diamond interchange.

An indication of the potential layout of these options is provided in Figure 2.7 to Figure 2.10. However, as discussed in Table 2.4, there were major disadvantages associated with option A (the clover interchange). As such, this was not investigated further and a layout was not prepared.

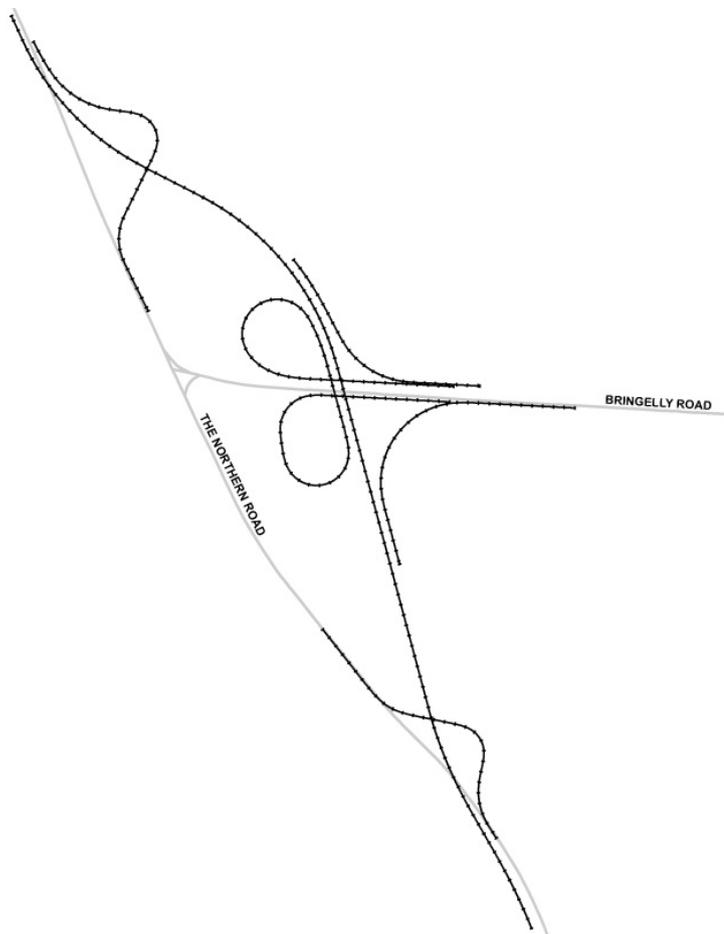


Figure 2.7 Option B – semi-clover interchange

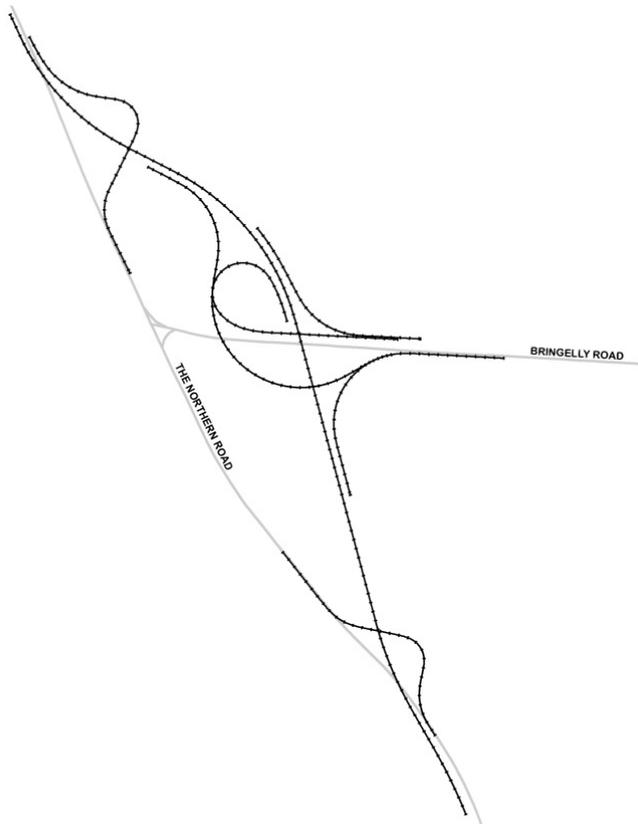


Figure 2.8 Option C - trumpet interchange

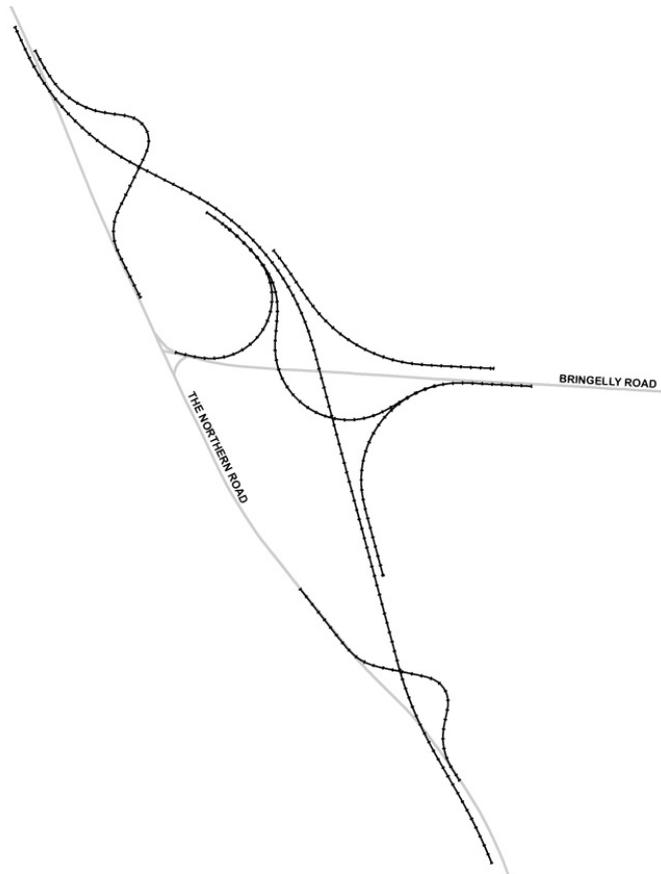


Figure 2.9 Option D - signalised trumpet interchange

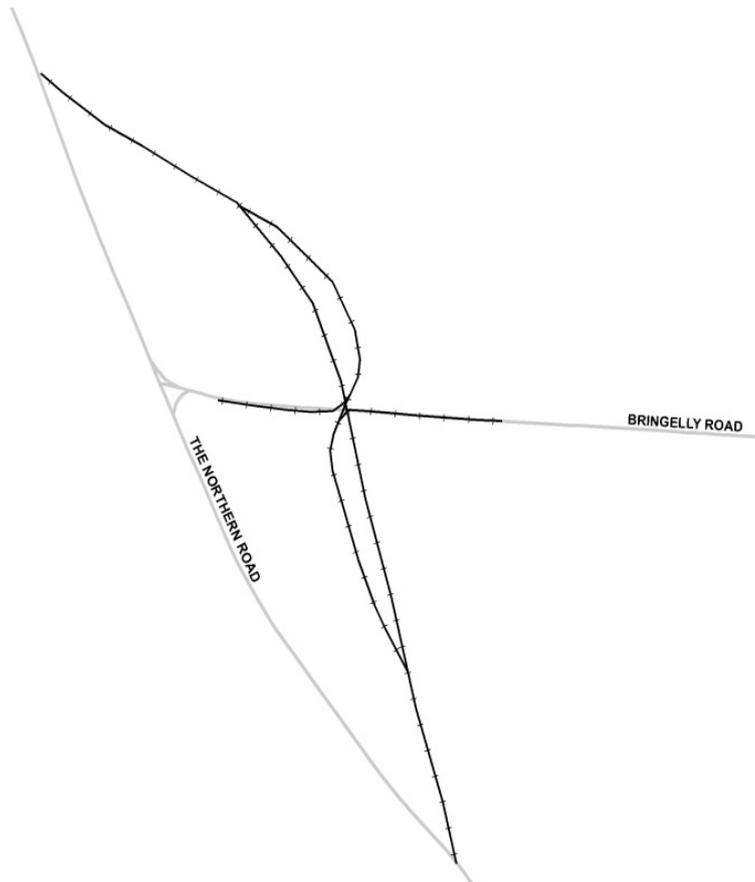


Figure 2.10 Option E – signalised diamond interchange

The advantages and disadvantages of each option are summarised in Table 2.4.

Table 2.4 Advantages and disadvantages of the interchange layout options

Design options	Advantages	Disadvantages
A Clover	<ul style="list-style-type: none"> <li>Enables free flow movements for all turns</li> </ul>	<ul style="list-style-type: none"> <li>Would require a very large footprint, which would impact on the intersections between Bringelly Road and Kelvin Park Drive, and Bringelly Road and the existing section of The Northern Road</li> <li>Potential for substantial visual impacts due to the amount of land required</li> </ul>
B Semi-clover	<ul style="list-style-type: none"> <li>Better vertical alignment for The Northern Road with no low point</li> <li>Less excavation required</li> <li>No signalised turn paths</li> <li>Fewer structures</li> <li>Opportunity to reconfigure existing lanes</li> </ul>	<ul style="list-style-type: none"> <li>Two loops required with a lower level of service and a short merging distance between loops</li> <li>A merge lane required on The Northern Road under Bringelly Road) is required</li> <li>Impacts on heritage items</li> <li>Impacts on local roads</li> </ul>
C Trumpet	<ul style="list-style-type: none"> <li>Less signalised turn paths</li> <li>Only one loop required compared to the semi-clover layout</li> <li>Free flowing movement from Bringelly Road to The Northern Road</li> <li>Higher level of service</li> <li>Opportunity to reconfigure existing lanes</li> </ul>	<ul style="list-style-type: none"> <li>Low point on The Northern Road</li> <li>Large amount of excavation required</li> <li>A loop is required</li> <li>More structures required</li> <li>Retaining wall required between the semi-direct ramp and loop</li> <li>Impacts on heritage items</li> <li>Impacts on local roads</li> </ul>

Design options	Advantages	Disadvantages
D Signalised Trumpet	<ul style="list-style-type: none"> <li>• Better turn radius for the direct ramps</li> <li>• No loops required</li> <li>• Better turn from Greendale Road to the northbound carriageway of The Northern Road</li> <li>• Opportunity to reconfigure existing lanes</li> </ul>	<ul style="list-style-type: none"> <li>• Low point in The Northern Road (slot section)</li> <li>• Large amount of excavation required</li> <li>• Crest required on the ramp from Bringelly Road to the southbound The Northern Road carriageway</li> <li>• The ramp from Greendale Road to the northbound The Northern Road carriageway would be very close to the existing intersection</li> <li>• Grade exceeds the maximum value</li> <li>• More structures required</li> <li>• One signalised turn path</li> <li>• Impacts on heritage items</li> <li>• Impacts on local roads</li> </ul>
E Signalised Diamond	<ul style="list-style-type: none"> <li>• Smallest footprint and land acquisition requirements</li> <li>• Only one structure is required</li> <li>• All movements catered for in the one intersection</li> <li>• Allows full closure of the existing alignment of The Northern Road, facilitating a lower speed environment around the Bringelly Village shops and Bringelly Public School and preventing through traffic</li> <li>• Reduced impact on heritage items</li> <li>• No loops required</li> <li>• Cost effective</li> <li>• Reduced visual impact</li> </ul>	<ul style="list-style-type: none"> <li>• Most turn paths are signalised</li> <li>• Very wide bridge on Bringelly Road, increases the structural complexity</li> <li>• Impacts on local roads</li> </ul>

### The preferred design option

As an outcome of the workshop the following options were identified to be the preferred options, based on the advantages summarised in Table 2.3 and Table 2.4:

- Vertical alignment: option V1 – The Northern Road travels under Bringelly Road
- Interchange layout: option E – signalised diamond interchange

The combination of a signalised diamond interchange and The Northern Road travelling under Bringelly Road has advantages over the other identified options. Compared with other options, this option improves vehicle efficiency, reduces the potential for noise and visual impacts, and reduces the amount of land acquisition required. The preferred options meet the proposal objectives by improving transport connections and the flow of traffic and by improving road safety.

## 2.5 Design refinements

The following design refinements were investigated and later adopted as part of the concept design:

- Reduction of shoulder widths from four metres to 2.5 m along The Northern Road under the interchange, as buses would be required to use the bus stops adjacent to Bringelly Road on The Northern Road on-ramps
- Reduction of the central median width along The Northern Road under the interchange to allow for a single span bridge structure. A single span bridge structure allows for a reduction in the median width by eliminating the need for a central median

- To the south of the proposal site, an intersection between The Northern Road and Belmore Road is being developed as part of the adjoining The Northern Road Upgrade Stage 2A project. A connection from Robinson Road to Belmore Road would allow for traffic movement between Robinson Road and The Northern Road, whilst minimising property impacts.

# 3. Description of the proposal

## 3.1 The proposal

The grade separated interchange, which would involve The Northern Road passing under Bringelly Road, would be located about 300 m east of the existing intersection of The Northern Road, Bringelly Road and Greendale Road. The key features of the proposal are shown in Figure 1.2 and include:

- Widening and upgrading about 400 m of Bringelly Road, between Kelvin Park Drive and Greendale Road, to provide:
  - Two 3.5 metre-wide traffic lanes in each direction between Kelvin Park Drive and The Northern Road/Bringelly Road interchange, with wide central medians for a future six lanes
  - Two 3.5 metre-wide traffic lanes in each direction on the western side of the interchange, transitioning to one lane in each direction to tie in to the existing intersection and Greendale Road
  - Two metre-wide shoulders in each direction
- Building a new section of The Northern Road east of the existing alignment, between about 200 m south of Robinson Road and the southern abutment of the bridge over Thompsons Creek. The new section, to pass under Bringelly Road, would be about one kilometre long and around 50 m wide (including embankments), and would include:
  - Two 3.5 metre-wide traffic lanes in each direction
  - Four metre-wide shoulders connecting to the on and off ramps of the interchange, allowing for future bus lanes
  - An underpass about 60 m long under the upgraded section of Bringelly Road
  - 2.5 metre-wide shoulders along The Northern Road under the interchange for about one kilometre
  - A wide central median to allow for a future six lanes
- Providing a new intersection with traffic lights on Bringelly Road over The Northern Road, with turning movements in all directions
- Dual right turn movements in all directions to and from The Northern Road and Bringelly Road, and dedicated left turn lanes in all directions
- Providing bus service facilities by:
  - Retaining bus stops on the existing The Northern Road and relocating bus stops on Bringelly Road to suit the interchange
  - Providing two new bus stops on The Northern Road northbound and southbound interchange on ramps
  - Providing a bus only lane north and south along The Northern Road at the traffic lights on Bringelly Road
- Three metre-wide shared paths for pedestrians and cyclists
- A new road connection between Robinson Road and The Northern Road by extending the realigned Belmore Road intersection, and building a cul-de-sac at the western end of Robinson Road

- Converting the existing The Northern Road (to the west of the new section) to a 'no through road', by providing cul-de-sacs at both the northern (at Thames Road) and southern ends (near Robinson Road).

## 3.2 Design

A description of the proposal design is provided in the following sections. Concept design plans are included in Appendix C.

### 3.2.1 Design criteria

The proposal design was prepared in accordance with a Design Management System certified under *AS/NZS ISO 9001:2008 Quality Management Systems – requirements*, and with reference to:

- *Guide to Road Design – Austroads* (Austroads, 2009) including Roads and Maritime Supplements
- *Beyond the Pavement - Roads and Traffic Authority of NSW urban design policy, procedure and design principles* (RTA, 2009a).

The design criteria for the proposal are summarised in Table 3.1.

Table 3.1 Design criteria

Criteria	Description
Carriageway	<ul style="list-style-type: none"> <li>• The Northern Road - Four lane divided road with a wide median to allow for a future six lane divided road, and 4 m shoulders to allow for future bus lanes (shoulders reduce to 2.5 m width under interchange)</li> <li>• Bringelly Road - Four lane divided road with a wider median to allow for a future six-lane divided road, with two metre wide shoulders</li> </ul>
Design speed	<ul style="list-style-type: none"> <li>• 90 km/h for The Northern Road and Bringelly Road</li> <li>• 70 km/h for local roads and intersecting side streets</li> </ul>
Proposed posted speed	<ul style="list-style-type: none"> <li>• 80 km/h for The Northern Road</li> <li>• 60 km/h for Bringelly Road</li> <li>• 50 km/h or 60 km/h for local roads (depending on location)</li> <li>• 40 km/h within the Bringelly Public School zone</li> </ul>
Lane widths	<ul style="list-style-type: none"> <li>• 3.5 m traffic lanes (measured to face of kerb)</li> <li>• 3.3 to 4.5 m turning lanes</li> </ul>
Median	<ul style="list-style-type: none"> <li>• Varies in width with minimum being 10.5 m</li> </ul>
Minimum horizontal curve radii	<ul style="list-style-type: none"> <li>• 255 m minimum</li> </ul>
Design vehicles for turning at intersections	<ul style="list-style-type: none"> <li>• 19 m long semi-trailer with the checking vehicle being a 25 m long B-double</li> <li>• 30 m long B-double for the right turn movement from Bringelly Road to The Northern Road (northbound) and the left turn movement from The Northern Road (southbound) to Bringelly Road.</li> </ul>
Shared footpath and cycleway	<ul style="list-style-type: none"> <li>• Minimum width of three metres</li> </ul>
Cross drainage	<ul style="list-style-type: none"> <li>• 1 in 100 year average recurrence interval (ARI)</li> </ul>
Pavement drainage	<ul style="list-style-type: none"> <li>• 1 in 10 year ARI</li> </ul>
Pavement type	<ul style="list-style-type: none"> <li>• Asphalt with a concrete sub-base</li> </ul>
Grades	<ul style="list-style-type: none"> <li>• Maximum five per cent</li> </ul>
Batters	<ul style="list-style-type: none"> <li>• 4:1 batter slopes where available</li> <li>• 2:1 batter slopes where the proposal is constrained</li> </ul>

### 3.2.2 Engineering constraints

The engineering constraints to the design and construction of the proposal include:

- Existing utilities, in particular the overhead 132 kV utilities and the high pressure gas main
- Minimising property acquisition requirements
- Maintaining access to existing properties
- Taking into account heritage items in the vicinity of the proposal site (described in sections 6.5.1 and 6.7)
- Intersection level of service (LoS) and truck turning movements with possibility for increased volume due to surrounding industry expansion
- Future use of the 'bypassed' or remaining section of The Northern Road
- Maintaining traffic flow during construction
- Future development in the Western Sydney Priority Growth Area and South West Priority Land Release Area (Bringelly precinct)
- Location of the proposed South West Rail Link Extension
- Vertical alignment of the intersection and associated flooding and visual impacts
- Urban design considerations for the new structures
- Constructability.

### 3.2.3 Major design features

The proposal involves constructing a grade separated interchange about 300 m east of the existing intersection of The Northern Road, Bringelly Road and Greendale Road. This would involve widening and upgrading about 400 m of Bringelly Road, constructing a new section of The Northern Road for a length of about one kilometre, and providing a new signalised intersection on Bringelly Road over The Northern Road, with turning movements provided in all directions.

The main features of the proposal are described below and the proposed interchange layout is illustrated in Figure 3.1.

#### Horizontal alignment

##### ***The Northern Road***

The new section of The Northern Road would be about 50 m wide including embankments. In the north, it would tie in with the southern abutment of Thompsons Creek Bridge, which would be constructed as part of the upgrade of The Northern Road to the north of the proposal site (The Northern Road Upgrade Stage 2C). From there, it would travel south-east for a distance of about 500 m, passing beneath Bringelly Road. The new section of road would be below the existing ground surface for about 300 m on either side of Bringelly Road in a cutting. It would continue south of Bringelly Road for about 500 m, before re-joining the existing alignment of The Northern Road between Robinson Road and Belmore Road.

The new section of The Northern Road would consist of two traffic lanes and a four metre wide shoulder in each direction (which can be used as future bus lanes), with a wide median to allow for a future third traffic lane.

Under the interchange, the shoulder width would be reduced to 2.5 m as buses would be required to use the bus stops adjacent to Bringelly Road on The Northern Road on-ramps. The 2.5 m wide shoulders would allow for vehicle breakdowns. The median under the interchange would remain a minimum seven metre width to allow for a future third traffic lane.

On and off ramps would connect The Northern Road to Bringelly Road in all directions. All vehicle turning movements would be catered for at the intersection with Bringelly Road.

### ***Bringelly Road***

The proposal would involve upgrading Bringelly Road from a two lane, two way road to a four lane, dual carriageway, with a wide median to allow for future construction of a third lane in each direction. The works that form part of this proposal would commence about 100 m west of Kelvin Park Drive with a tie-in to Bringelly Road Upgrade Stage 2. A bridge would be constructed to enable Bringelly Road to pass over the new section of The Northern Road. A signalised intersection would be constructed on the bridge.

West of the interchange, Bringelly Road would taper back to one lane in each direction, and would tie in with the existing intersection of the bypassed section of The Northern Road and Greendale Road.

### ***Interchange layout***

The proposed interchange would be signalised and operate using double diamond phasing, as shown in Figure 3.1.

In addition to the through movement on Bringelly Road, the following movements would be provided for:

- Dual right turns in each direction, from Bringelly Road and The Northern Road, allowing a B-double truck and a car to turn simultaneously
- Dedicated left turn lanes in each direction, with signalised pedestrian crossings
- A bus only lane in each direction, crossing Bringelly Road, to allow for future bus routes travelling along The Northern Road to stop at the interchange, with indented bus bays on the northbound and southbound on ramps to The Northern Road
- CCTV cameras at the intersection for traffic management.

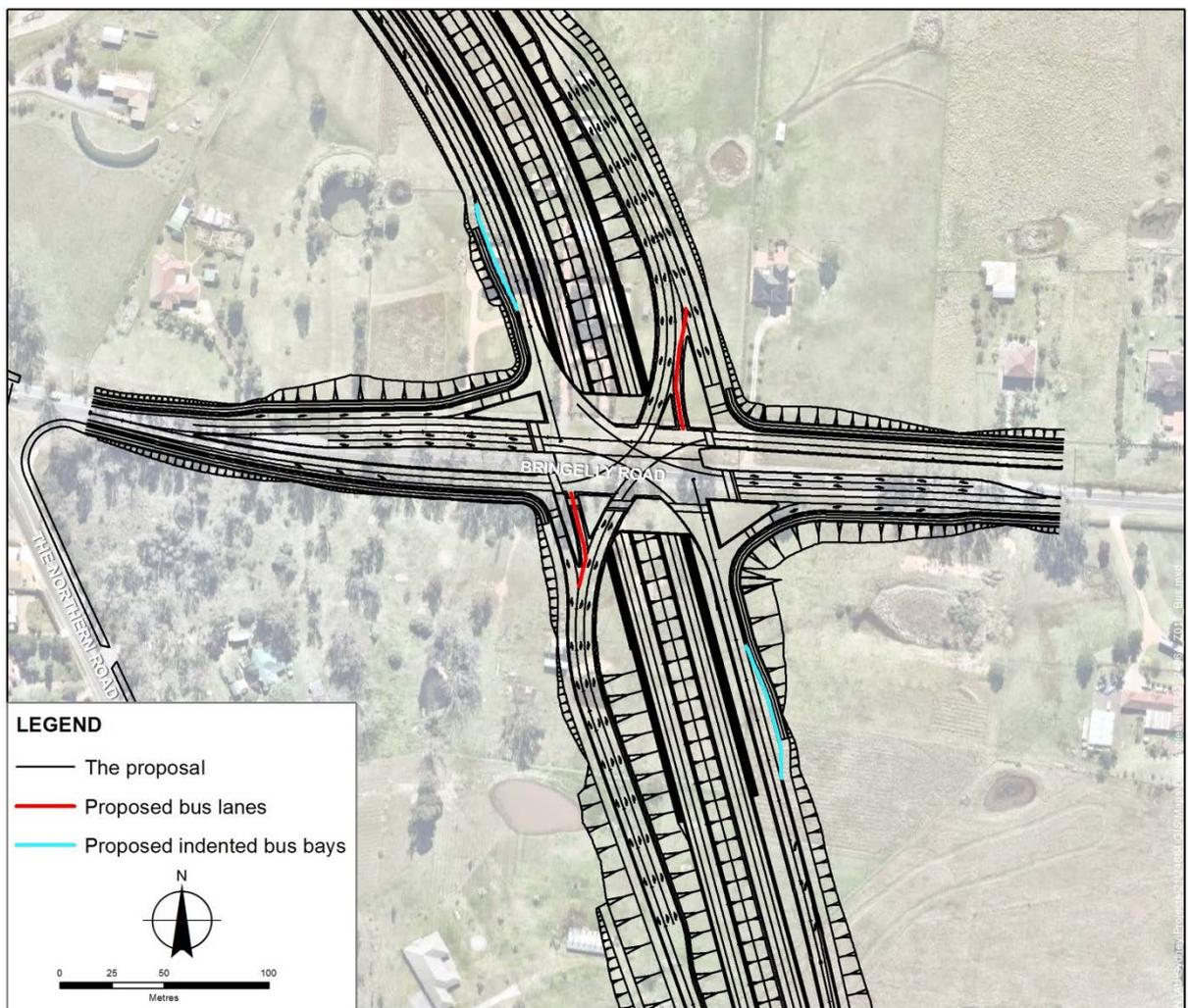


Figure 3.1 Proposed interchange layout

***Belmore Road / Robinson Road connection to/from The Northern Road***

To allow for safe access between Robinson Road and The Northern Road, the proposal involves closing the existing intersection between Robinson Road and The Northern Road and constructing a cul-de-sac. A new connection between Robinson Road and the realigned Belmore Road (constructed as part The Northern Road Upgrade Stage 2A) would be established. Vehicles travelling between Robinson Road and The Northern Road would need to use the new connection. The connection would be a two way single carriageway with a total width of about nine metres.

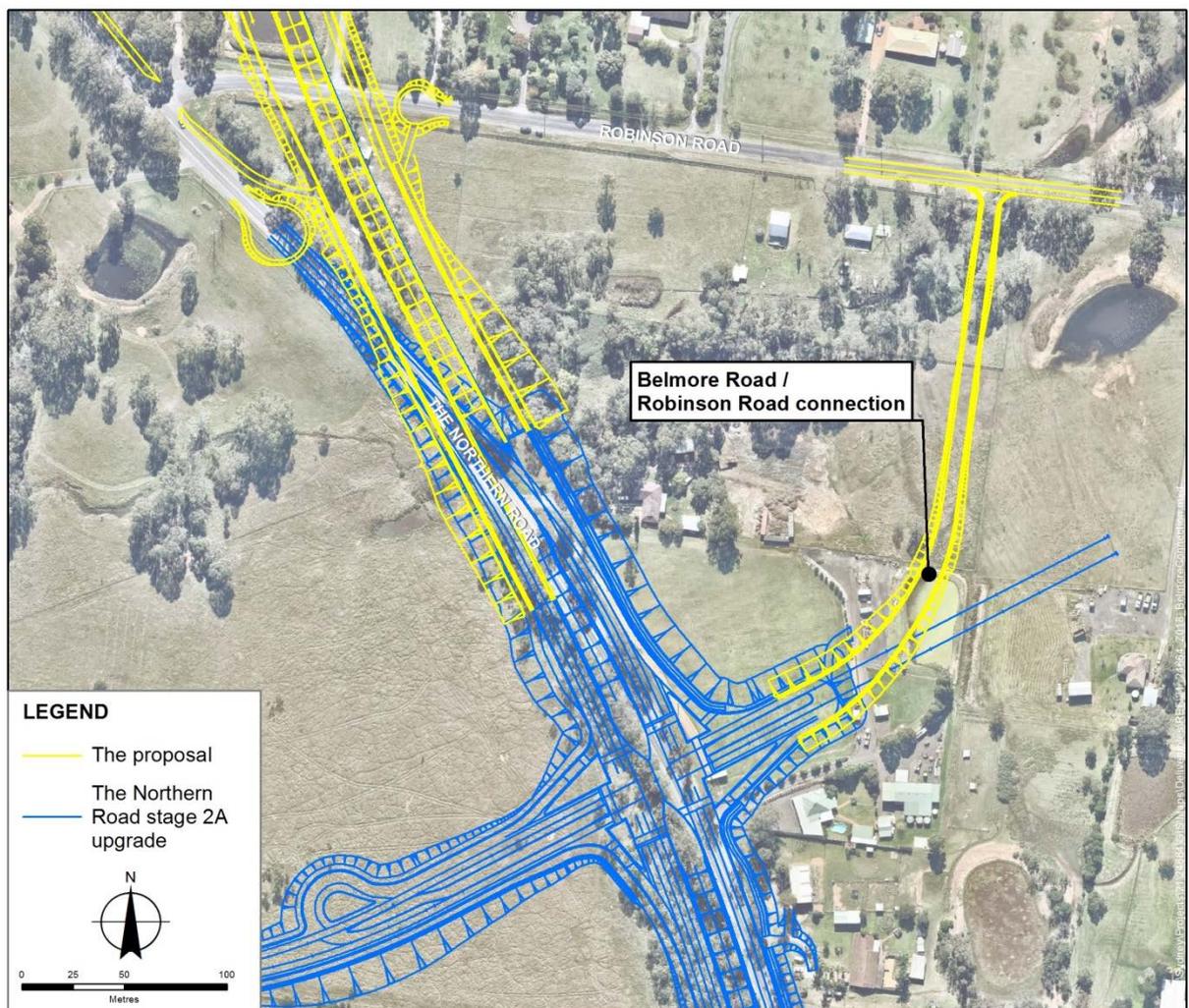


Figure 3.2 Belmore Road / Robinson Road connection

### Vertical alignment

#### ***The Northern Road***

The proposed vertical alignment of The Northern Road consists of generally flat grades. From Robinson Road to Bringelly Road, The Northern Road climbs at 1.2 per cent, with a broad vertical curve (greatest grade being 1.2 per cent) under Bringelly Road. It then falls from Bringelly Road towards Thompsons Creek at a grade of 0.5 per cent. The deepest cut is located about 200 m south of Bringelly Road, at a depth of about 12 m.

#### ***Bringelly Road***

Bringelly Road generally remains close to the existing vertical alignment. The vertical alignment climbs to between 0.5 and one per cent to the west; however, the alignment would be levelled out with small cuts and fills along the length.

#### ***Belmore Road / Robinson Road connection to/from The Northern Road***

The vertical alignment of Belmore Road is greater than that of Robinson Road. The connection would transition at a maximum five per cent grade between Belmore Road and Robinson Road.

### **Typical cross section**

The typical cross section consists of two 3.5 m wide traffic lanes and two to four metre wide shoulders in each direction, with a grassed median for future widening and a three metre wide shared path.

#### ***The Northern Road***

A typical cross section for The Northern Road is shown in Figure 3.3 and Figure 3.4. It consists of two traffic lanes in each direction with a grassed median located between the northbound and southbound carriageways. The general traffic lanes would be 3.5 m wide, with a 2.5 m wide shoulder in each direction under the interchange. A four metre wide shoulder would be provided in each direction for the rest of The Northern Road allowing for a future bus lane. Provision for a three metre wide shared path would also be provided along the eastern side of The Northern Road for the future construction of a shared path.

#### ***Bringelly Road***

A typical cross section for Bringelly Road is shown in Figure 3.5. It consists of two traffic lanes in each direction with a wide raised median between the eastbound and westbound carriageways. On approach to the existing intersection with The Northern Road, the lanes would transition into one lane in each direction to tie in to Greendale Road. The general traffic lanes would be 3.5 m wide with a two metre wide shoulder. A three metre wide shared path would also be provided in each direction. There would be two dedicated right turn lanes in each direction and left turn slip lanes for entry and exit to the upgraded The Northern Road from the interchange.

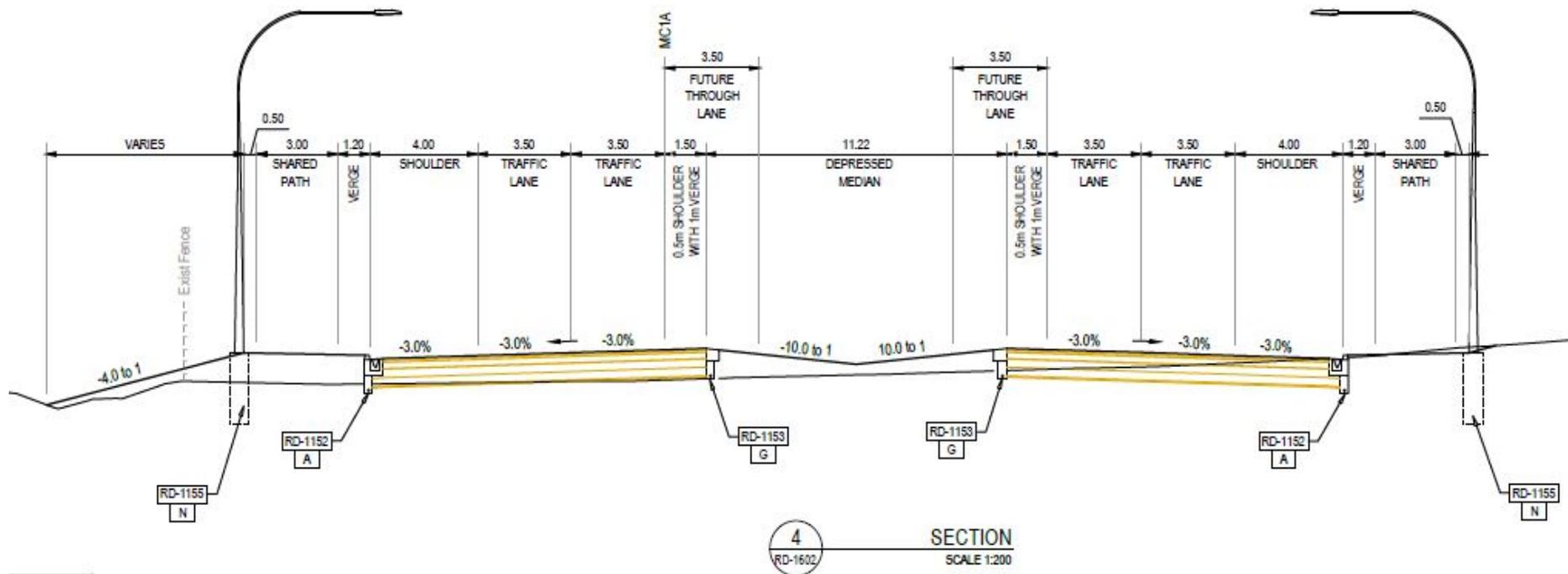


Figure 3.3 Typical cross section - The Northern Road (about 700 m south of Bringelly Road)

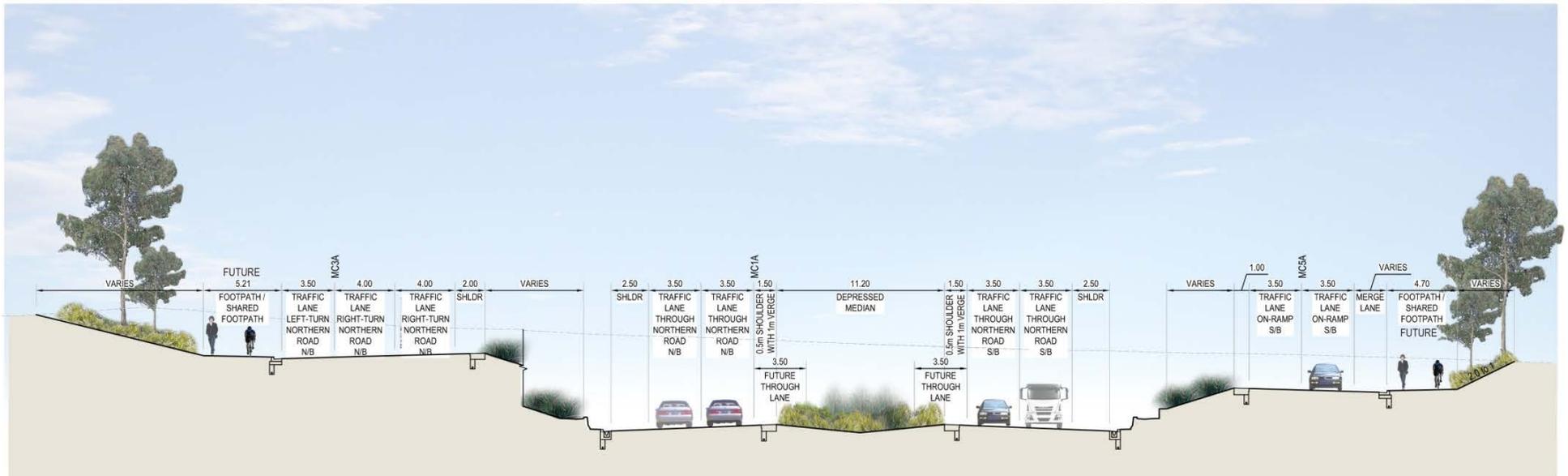


Figure 3.4 Typical cross section – The Northern Road (in the cutting)

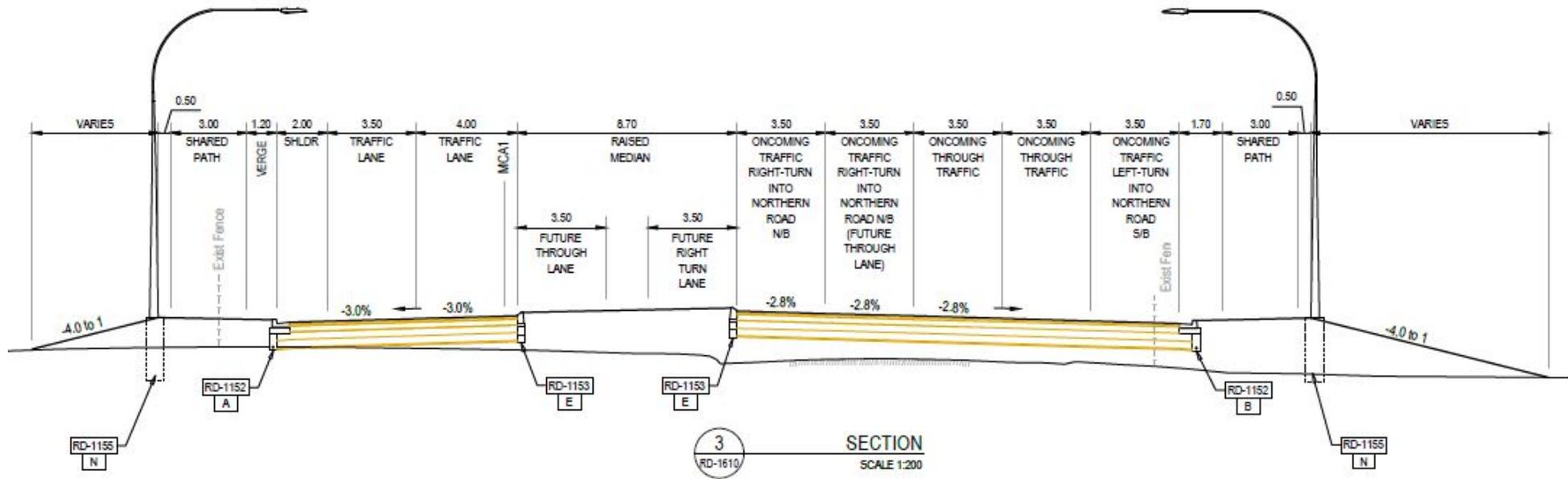


Figure 3.5 Typical cross section – Bringelly Road (about 380 m east of the existing The Northern Road / Bringelly Road intersection)

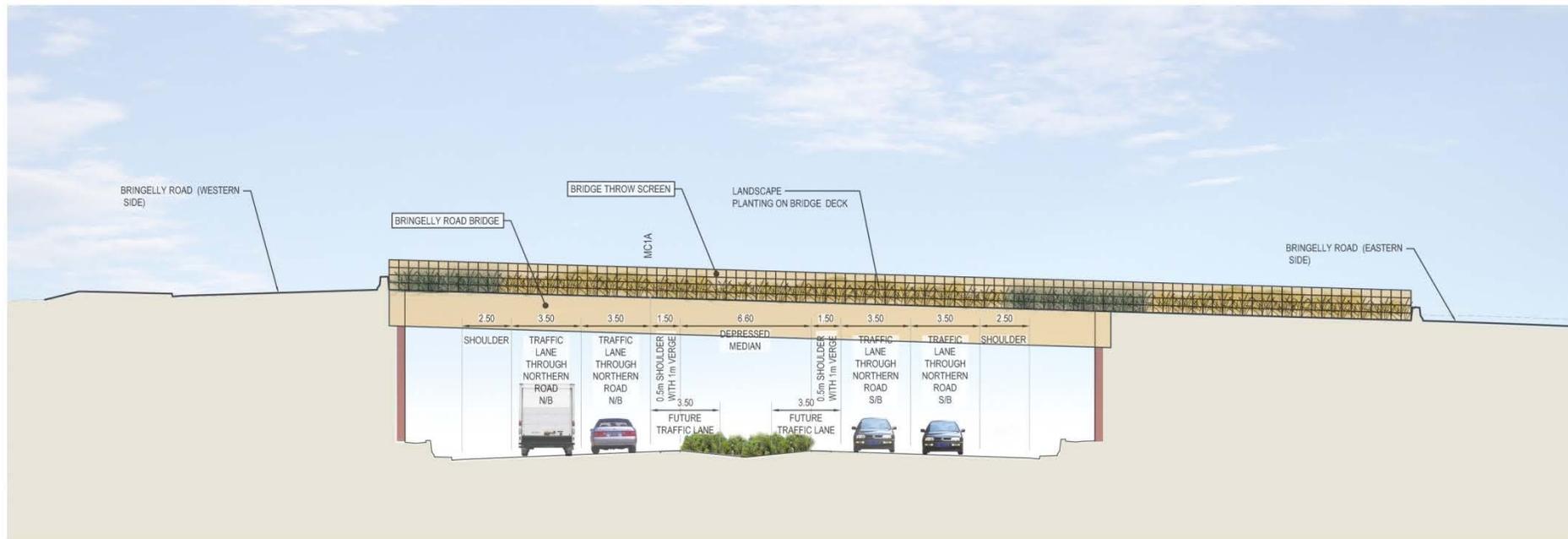


Figure 3.6 Typical cross section – Bringelly Road / The Northern Road (at the grade separated interchange bridge)

## Tie-ins

At the start and end points of the proposal, the work would tie-in to the upgraded alignment of The Northern Road and Bringelly Road. Activities to tie the proposal into the alignment would include pavement work to create consistent levels between existing and new surfaces. An additional connection between Belmore Road intersection and Robinson Road would be constructed near the southern tie-in to facilitate all movement access between The Northern Road and Robinson Road.

The extent of tie-in work would be determined during detailed design.

## Bridge

The bridge structure to enable Bringelly Road to travel over the new section of The Northern Road would consist of single 33 m span super T girders with an overall bridge width of about 60 m. There would be a minimum vertical clearance of 5.4 m. On and off ramps would allow for both northbound and southbound travel. The ramps provide a left turn movement and right turn movement on approach to the intersection. A bus only through lane is also provided.

A cross section of the bridge is also shown in Figure 3.6.

## Embankments and cut batters

Fill embankments would generally be provided at a grade of 4:1 up to two metres high. Where heights are greater than two metres, the grade would be steepened. The highest fill embankments are about 2.5 metres at the northern and southern tie ins near Thompsons Creek and the Belmore Road intersection.

Cut batters are provided at a grade of 4:1 up to two metres high or where constrained by space limitations. Cuttings greater than two metres in depth are generally supported by a combination of a 4:1 batter and retaining walls. The deepest cut is located about 200 m south of Bringelly Road, at a depth of about 12 m.

The locations of embankments and cut batters are shown in Table 3.2 and shown in Figure 3.7.

Table 3.2 Details of embankments and cut batters

Location (chainage)	Type	Length (m)	Maximum grade	Depth
Northbound Carriageway				
0 - 200	Fill embankment	200	4:1	Maximum 3 m
200 - 420	Cut-Fill transition	220	4:1	Less than 1 m
420 - 800	Cut batter	380	2:1	Maximum 12 m (with bench)
1100 - 1300	Fill embankment	200	4:1	Maximum 1.5 m
1300 - 1500	Cut-Fill transition	200	4:1	Less than 1 m
1500 - 1820	Fill embankment	320	2:1	Maximum 3.5 m
Southbound Carriageway				
0 - 180	Fill embankment	180	2:1	Maximum 2 m
180 - 400	Cut-Fill transition	220	4:1	Less than 1 m
400 - 740	Cut batter	340	2:1	Maximum 7 m
1040 - 1280	Cut batter	240	4:1	Maximum 7 m
1280 - 1820	Fill embankment	540	4:1	Maximum 2 m

Location (chainage)	Type	Length (m)	Maximum grade	Depth
Bringelly Road				
Eastbound (east of interchange)	Fill embankment	250	4:1	Maximum 2.5 m
Westbound (east of interchange)	Fill embankment	250	4:1	Maximum 2.5 m
Eastbound (west of interchange)	Fill embankment	250	4:1	Maximum 2.5 m
Westbound (west of interchange)	Cut-Fill transition	250	4:1	Maximum 1.5 m
Belmore Road / Robinson Road connection				
Southern end (northbound and southbound)	Fill embankment	150	2:1	Maximum 4 m
Northern end (northbound and southbound)	Cut-Fill transition	100	4:1	Maximum 1.5 m

### Retaining walls

Retaining walls would be constructed between The Northern Road and at the entry and exit ramps on approach to Bringelly Road. The retaining walls are expected to be up to 400 metres in length and up to five metres in height and are likely to consist of precast concrete panels in front of a rock bolt supported face. The details of the retaining walls would be confirmed during detailed design.

The locations of embankments and cut batters are shown in

Table 3.3 and shown in Figure 3.7.

Table 3.3 Details of retaining walls

Location	Chainage	Approximate dimensions
Northbound off ramp	800 - 880	80 m in length and maximum six metres in height
Southbound off ramp	920 - 1040	120 m in length and maximum six metres in height
Northbound on ramp	940 - 1340	400 m in length and maximum five metres in height
Southbound on ramp	740 - 860	120 m in length and maximum three metres in height

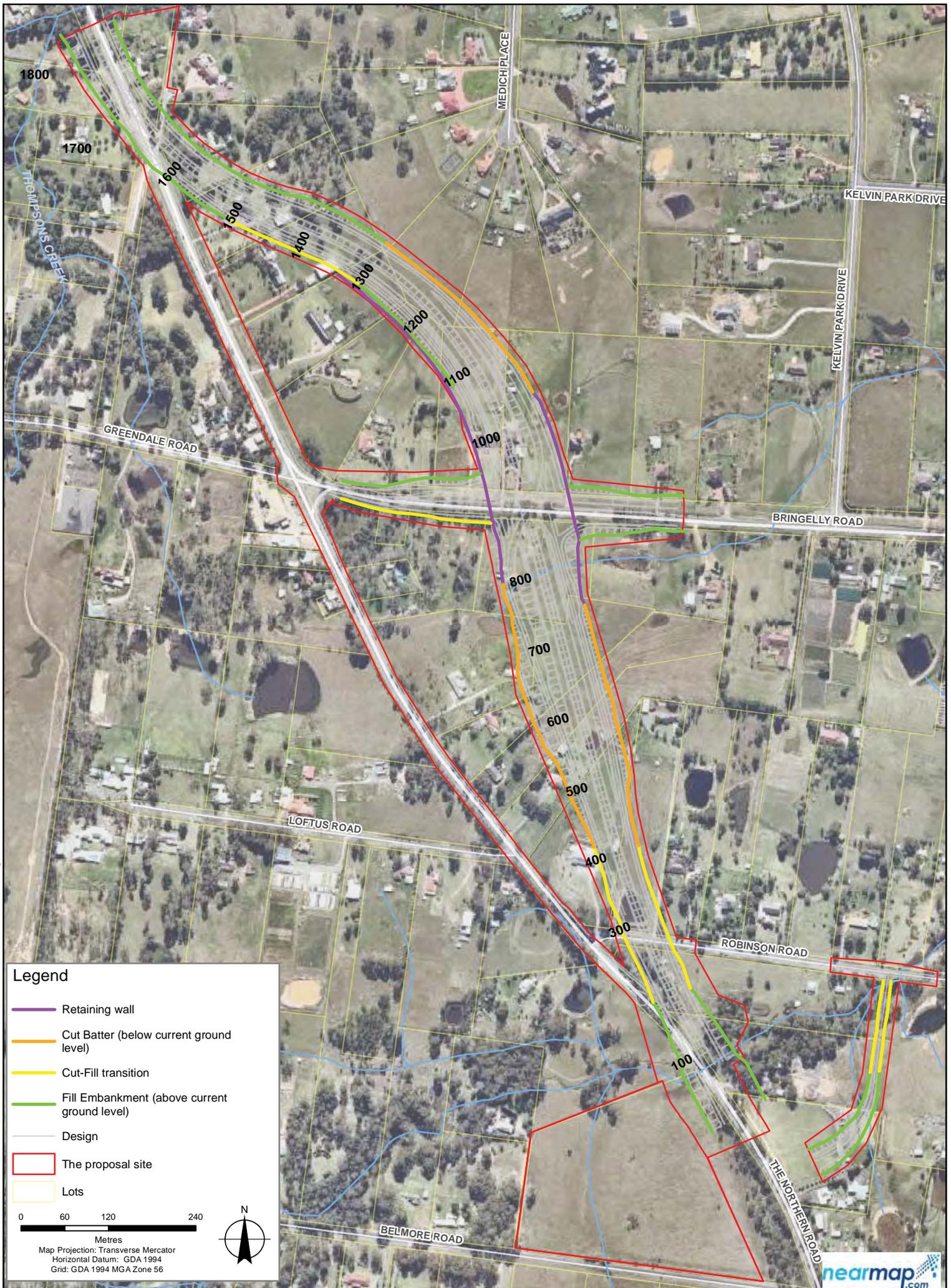
#### 3.2.4 Pedestrian and cyclist facilities

The proposal would include a three metre wide shared path at:

- The eastern side of the existing section of The Northern Road, linking to the Bringelly Village shops and Bringelly Public School
- The western side of The Northern Road, from the Belmore Road intersection to the southern cul-de-sac on the existing alignment of The Northern Road

- The western side of The Northern Road from the northern cul-de-sac on the existing alignment of The Northern Road to the shared path to be provided as part of The Northern Road Upgrade Stage 2C
- Both sides of Bringelly Road, linking to the proposed shared path on the existing section of The Northern Road and the shared path to be provided as part of the Bringelly Road upgrade
- Allowing for the future construction of a shared path on the eastern side of the upgraded The Northern Road corridor to connect the Stage 2C upgrade with Bringelly Road and the Stage 2A upgrade to the south at Belmore Road.

The pedestrian and cyclist facilities are shown on Figure 3.8 below.



**Figure 3.7**  
Locations of embankments, cut batters and retaining walls

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by:qjchung



### 3.2.5 Bus facilities

The proposal would include the following new facilities:

- Two new indented bus bays on The Northern Road northbound and southbound interchange on ramps (departure side of the interchange)
- A bus only lane at the signalised intersection on Bringelly Road for northbound and southbound bus movements across Bringelly Road.

The proposed bus facilities are shown on Figure 3.8 above.

Some existing bus stops would be relocated or retained in their current position as discussed in Table 3.4 and shown in Figure 3.8. The construction and operational impacts to bus services are discussed in section 6.1.

Table 3.4 Proposed bus stop arrangements and operation impacts

Bus stop reference	Location	Route	Route description	Operation impacts
2171443	The Northern Road near Thames Road	856	Bringelly to Liverpool via Prestons and Churchill Gardens	Removed
2171442	The Northern Road opposite Thames Road	856	Liverpool to Bringelly via Churchill Gardens and Prestons	Removed
2171178	The Northern Road near Bringelly Public School	856	Liverpool to Bringelly via Churchill Gardens and Prestons	Retained as a bus school service stop
2171180	Bringelly Road east of the Northern Road (eastbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens	No impact - retained
2171422	Bringelly Road east of the Northern Road (westbound)	856	Liverpool to Bringelly via Churchill Gardens and Prestons	No impact - retained
2171421	971 Bringelly Road	856	Liverpool to Bringelly via Churchill Gardens and Prestons	No impact - retained
2171181	Bringelly Road west of Kelvin Park Drive (eastbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens	No impact - retained
2171177	Bringelly Road west Kelvin Park Drive (westbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens	No impact - retained
New	The Northern Road northbound realigned	856	Liverpool to Bringelly via Churchill Gardens and Prestons	New bus stop at the interchange
New	The Northern Road southbound realigned	856	Bringelly to Liverpool via Prestons and Churchill Gardens	New bus stop at the interchange

### 3.2.6 Property access

The proposal would maintain driveway access to all existing properties along the bypassed section of The Northern Road, Bringelly Road and Robinson Road.

A property access strategy has been prepared to outline the proposed access arrangements for each property affected by the proposal. This is provided in Appendix F of Appendix D. The property access strategy outlines travel routes for properties along the proposal site. It also includes travel distances northbound to Solway Road, and southbound to Belmore Road, as a result of the change in access arrangements associated with the restrictions to access along the new section of The Northern Road.

A summary of property access arrangements when the proposal is operational is provided below:

- Some accesses to Robinson Road may need to be modified as a result of the proposed Belmore Road/Robinson Road connection
- A shared left in-left out driveway access would be required for some properties south of Thompsons Creek to enable them to safely access The Northern Road
- Properties on Thames Road would require access to The Northern Road via a connection to the proposed cul-de-sac on the existing alignment of The Northern Road
- Existing driveways on Bringelly Road would be reconfigured to suit the proposal with left in-left out access
- Properties facing the existing alignment of The Northern Road would retain access and would access the main alignment of The Northern Road via the existing intersection and the proposed interchange.

The potential impacts to property access are discussed in section 6.1.3.

### 3.2.7 Other design features

#### **Changes to the existing intersection of The Northern Road, Bringelly Road and Greendale Road**

The existing intersection of The Northern Road, Bringelly Road and Greendale Road would be modified by:

- Removing the existing left turn slip lane from Bringelly Road to the existing alignment of The Northern Road as it does not comply with the current design standards and is no longer required with the reduced traffic volumes
- Providing connectivity to the new shared pedestrian and cyclist path along The Northern Road
- Adjusting the lane configuration to suit the reduced traffic volumes on the existing alignment of The Northern Road.

#### **Northern end of the old section of The Northern Road**

At the northern end, the existing alignment of The Northern Road would be turned into a cul-de-sac near Thames Road as shown in Figure 3.9. Connectivity would still be provided to Thames Road. The cul-de-sac would be about 17 m in diameter and would include kerb and gutter.

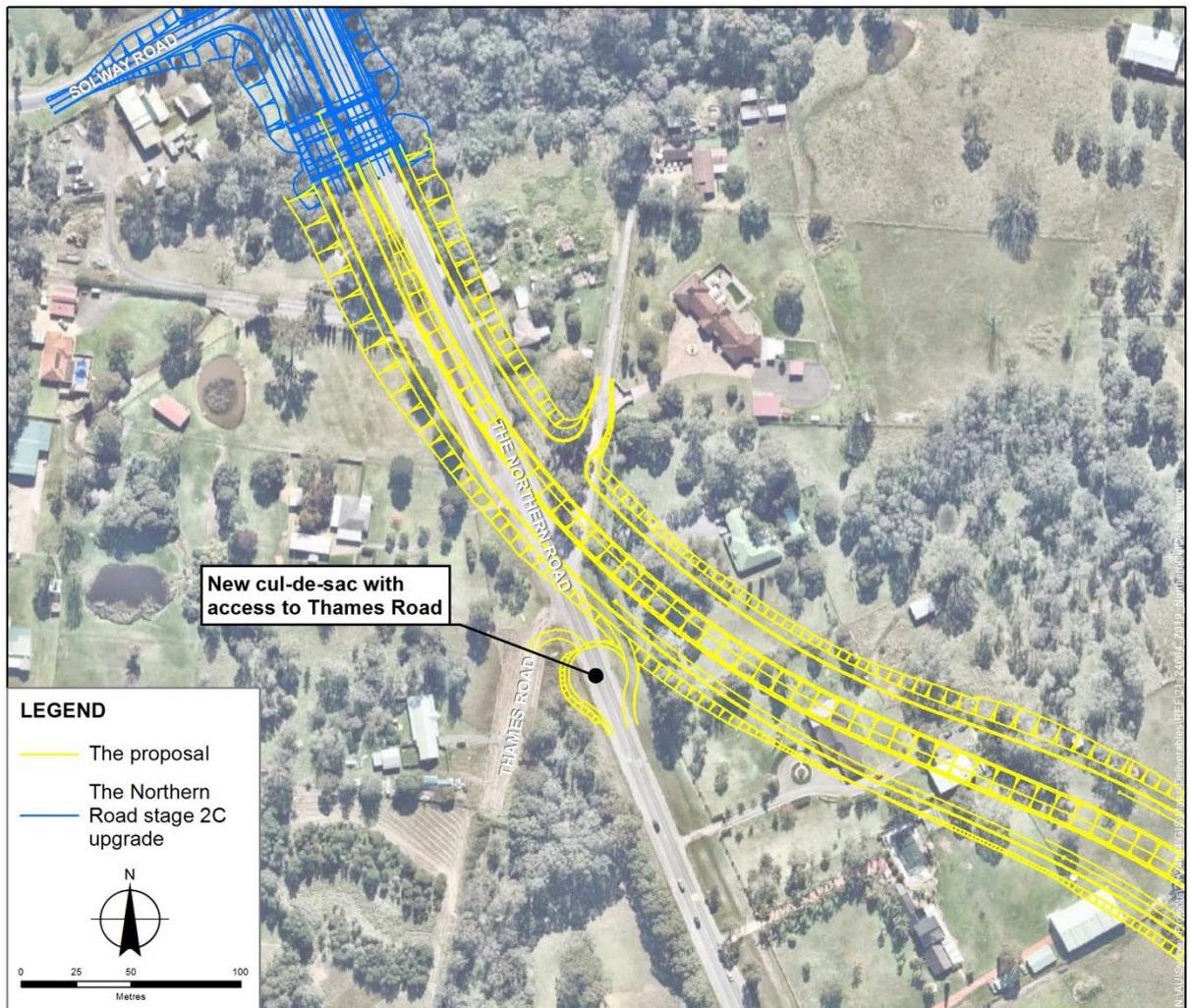


Figure 3.9 The old The Northern Road northern cul-de-sac

### Southern end of the old section of The Northern Road

At the southern end, the existing alignment of The Northern Road would be turned into a cul-de-sac, with access to be retained for each of the residential properties as shown in Figure 3.10. The cul-de-sac would be about 17 m in diameter and would include kerb and gutter.

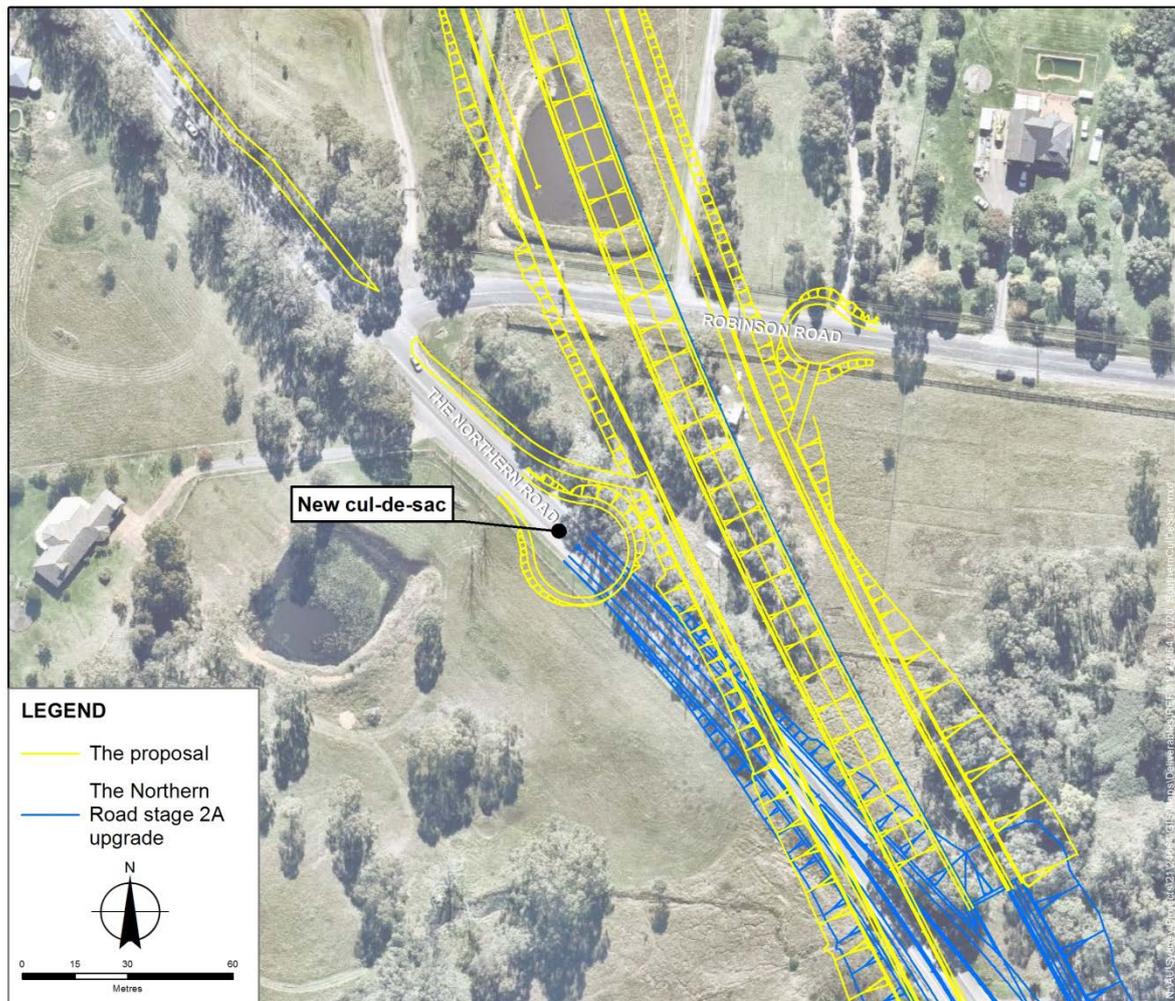


Figure 3.10 The old The Northern Road southern cul-de-sac

### Drainage

The pavement drainage along The Northern Road would generally drain away from Bringelly Road. It would discharge, via a new kerbed pit and piped drainage system, to Thompsons Creek to the north and to the South Creek tributary to the south. Grass or concrete lined swales would divert water away from the proposal site to discharge to existing drainage system.

Drainage at the interchange bridge structure and Bringelly Road would also include a kerbed pit and piped drainage system draining away from the structure. Drainage to the east of the structure would discharge to the drainage network constructed as part of the Bringelly Road Upgrade Stage 2. Drainage to the west would discharge to existing open drains along Bringelly Road.

Drainage along cut batters would be collected either in swales at the base of the cuts, or in the pit and pipe drainage network. This would be determined during detailed design.

The existing three cell 1.8 m high by 0.9 m wide reinforced concrete box culvert, located on the South Creek tributary between Belmore Road and Robinson Road, would be replaced with a five cell 2.4 m high by 2.1 m wide reinforced concrete box culvert. Scour protection may be required at the outlet of the culvert. This could include the provision of a rock mattress or energy dissipaters at outlets, and would be determined during detailed design.

Temporary construction basins were included in the proposal described by the REF for the upgrading of The Northern Road REF (SKM, 2012). Near the proposal site, these were located at the northern and southern tie-ins - to the north-east of the proposal site near Thompsons Creek, and at the South Creek tributary, respectively. These basins were sized for a five day design event

during construction in accordance with *Soils and Construction – Managing Urban Stormwater Volume 1 ‘the Blue Book’* (Landcom, 2004).

Operational spill basins are also proposed at these locations, for a spill capacity of 20 cubic metres. The temporary construction basins would be reduced in size and retained during operation of the proposal once construction is complete. The requirement for the spill basins were identified during a risk assessment undertaken as part of The Northern Road REF (SKM, 2012). The assessment considered the risk of spills and the sensitivity of downstream waterways. The basins were designed to contain spills in dry weather or during small storm events. Following containment, the pollutant would be pumped out and the spill disposed of in an appropriate manner. High fencing would be required around all spill basins for public safety.

Due to the change in the proposal scope from that assessed in The Northern Road REF (SKM, 2012), the final location and size of the temporary sediment basins and operational spill basins would be confirmed during the development of the detailed design.

The assessment of the potential water quality impacts are discussed in section 6.4 and the indicative basin locations are shown in design drawings provided in Appendix C.

### Lighting

All lighting for the proposal has been designed in accordance with *Australian Standard 1158: Lighting for roads and public spaces*. This includes lighting for the interchange and for shared pedestrian and cyclist paths.

### Parking restrictions

Existing parking restrictions near the Bringelly Village shops would be maintained during the operation of the proposal. Parking along the new The Northern Road and along Bringelly Road would not be permitted.

Parking restriction signage and line marking would be adjusted to suit the new pavement and kerb and gutter.

## 3.3 Urban and landscape design

An urban design report was prepared by GHD to inform the concept design and is provided in Appendix I. A landscape character and visual impact assessment was also prepared by Spackman Mossop and Michaels (SMM) and is provided in Appendix I. The following urban design objectives and principles were developed for the proposal:

- Provide an elegant road alignment that is responsive to, and integrated with the natural and built landscape
- Facilitate the provision of good urban design outcomes to future growth and development areas adjoining the road
- Protect and enhance existing views, character, heritage and cultural values of the corridor.

These objectives and associated principles were developed into a set of more specific recommendations for design strategies and initiatives relating to:

- Design The Northern Road into a cutting to minimise the visual impact
- Construct retaining walls under the interchange that are graded less than vertical to avoid the perception of the walls falling inward
- Construct a single span bridge to provide an open feel for motorists traveling along The Northern Road

- Extend retaining wall height under the interchange to act as a safety fence for maintenance access
- Extend the bridge so abutments are visually hidden behind the retaining wall
- Where retaining walls are required between the main carriageway and the ramps, they are to be constructed adjacent to the main carriageway allowing the provision of landscaped batters between the ramps and the main carriageway.

These principles and design features have been integrated into the concept design and would be considered further in the detailed design phase of the proposal.

## 3.4 Construction activities

### 3.4.1 Work methodology

Construction activities would be guided by a construction environmental management plan (CEMP) to ensure work is carried out to Roads and Maritime specifications within the specified work area. Detailed work methodologies would be identified by the construction contractor.

A key consideration for construction planning is the proposed temporary closure of Bringelly Road between Kelvin Park Drive and The Northern Road during construction. Access would be maintained for private properties on Bringelly Road and Kelvin Park Drive. Traffic on Bringelly Road would be diverted via Jersey Road and Robinson Road, connecting to The Northern Road via the new Belmore Road intersection (to be constructed as part of The Northern Road Upgrade Stage 2A). An alternative route would also be provided via Carrington Road connecting with the existing The Northern Road. Further information on the proposed diversion is provided in section 3.4.7.

The proposal is anticipated to involve the following general work methodology and sequencing:

- Establishment of temporary fencing
- Installation of erosion and sediment controls
- Establishment of construction compound site
- Utility relocations
- Vegetation clearing and grubbing
- Stripping, stockpiling and management of topsoil and unsuitable material
- Earthworks preparation
- Bulk earthworks
- Structural work
- Drainage work
- Pavement and median construction
- Landscaping
- Installation of permanent traffic control signals
- Finishing work including installation of safety barriers, fencing, pavement marking, signposting, and street lights
- Removal of construction compound and site tidy up.

## **Construction phases**

The following describes the indicative construction phases. The final work methodology for the proposal would be refined and determined by the construction contractor.

### ***Site establishment***

Site establishment would include:

- Mobilise to site
- Setting up the site compound
- Service protection
- Temporary road closures where required
- Installing traffic and pedestrian management measures including temporary traffic signs, barricades, etc
- Marking trees that would need to be removed or trimmed, and any 'no-go' areas
- Undertaking any additional surveys and investigations
- Installing temporary erosion, sediment and water quality controls, including silt fences, and protection around existing stormwater drainage inlets
- Undertake operational noise at-home treatments where required.

### ***Utility relocations and property adjustments***

- Remove existing fences/boundary features as part of the property adjustments
- Construct new fences, retaining walls, driveways, etc as part of the property adjustments
- Relocate existing 33kV overhead / underground electrical line to pass within the bridge structure
- Relocate the existing Sydney Water and Telstra assets along Bringelly Road.

### ***Earthworks and drainage***

- Clear and grub vegetation, including the removal and/or trimming of vegetation
- Excavate and fill to the road formation levels, including excavations for embankments and cuttings and boxing out the new pavement
- Dispose of unsuitable and/or surplus material from the proposal site
- Install new drainage lines, pits and subsoil drains to connect into the existing drainage lines within the road formation.
- Structural works associated with the interchange.

### ***Retaining wall***

- Trench base of retaining wall
- Install subsurface drainage
- Install vertical supporting posts and retaining wall
- Add subgrade and backfill retaining wall with fill material.

### **Bridge works**

Following diversion of traffic during construction (refer to section 3.4.4 and 3.4.7 below), the new bridge for the interchange can be constructed in a single stage. The following construction methodology would be followed:

- Construct cast-in-place piles at abutments and piers
- Construct reinforced concrete abutments, column extensions and pier headstocks
- Install super-T girders and construct reinforced concrete deck including end diaphragms
- Construct triangular cast in-situ segments on the four corners of the bridge structure
- Place precast barriers and complete in-situ stitch pour
- Construct reinforced concrete approach slabs
- Construct throw screens
- Install expansion joints and steel traffic barrier railing
- Install waterproof membrane and asphalt.

### **Pavement works**

- Install new kerb and gutter including driveway crossings where required
- Install new concrete medians
- Construct new pavement, including placing and compacting select fill, sub base and asphalt wearing surface.

### **Finishing and landscaping**

- Adjust the existing traffic lights at the intersection
- Install new street lights
- Rehabilitate disturbed areas and landscape in accordance with the landscaping plan
- Line marking and sign posting
- Final site clean-up.

#### 3.4.2 Workforce

The construction workforce is expected to fluctuate, depending on the stage of construction and associated activities. The workforce would be expected to peak at about 60 personnel per day. On either side of this peak period, daily workforce numbers would fluctuate between about 20 and 40 personnel at any given time during the construction period.

The final number of construction workers would be identified by the construction contractor.

#### 3.4.3 Construction hours and duration

Construction is anticipated to commence in late 2016 / early 2017 and would be open to traffic by the end of 2019, weather permitting.

The *Interim Construction Noise Guideline* (DECC, 2009) (ICNG) defines standard construction working hours as follows:

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

To minimise disruption to daily traffic on two major road corridors and disturbance to surrounding businesses, it is anticipated that some of the work would be carried out outside standard construction hours. If required, work times would be confirmed by the contractor, and are likely to be between Monday to Friday 8 pm to 5 am. Weekend work is also likely to be required, subject to permitted road occupancy licences and construction staging. This would be necessary to minimise traffic disruptions.

The works would be undertaken in accordance with the *Interim Construction Noise Guideline* and the *Environmental Noise Management Manual (RTA, 2001): Practice Note vii – Road works outside normal working hours*. Prior advice would be given to the community regarding work hours.

#### 3.4.4 Staging

It is possible that the proposal would be constructed with adjacent projects such as The Northern Road Upgrade Stage 2C and/or Stage 2A or Bringelly Road Upgrade Stage 2. The final staging methodology for the proposal would be refined and identified during the detailed design and construction planning phases.

#### 3.4.5 Plant and equipment

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be identified by the construction contractor. An indicative list of plant and equipment that would be used for each construction stage is provided in Table 3.5.

Table 3.5 Indicative construction plant and equipment

Construction phase	Plant and equipment
Establishment	<ul style="list-style-type: none"> <li>• Trucks</li> <li>• Trucks with Hiab</li> <li>• Cranes</li> <li>• Clearance equipment such as chainsaws and chippers</li> </ul>
Utility relocations and property adjustments	<ul style="list-style-type: none"> <li>• Excavators</li> <li>• Rigid and articulated trucks</li> <li>• Jackhammers</li> <li>• Cranes</li> <li>• Concrete pumps</li> <li>• Welding equipment</li> <li>• Concrete saws</li> <li>• Light vehicles</li> <li>• Concrete trucks</li> <li>• Generators</li> <li>• Oxy-cutting equipment</li> </ul>
Earthworks and drainage	<ul style="list-style-type: none"> <li>• Excavator</li> <li>• Jackhammers</li> <li>• Rigid and articulated trucks</li> <li>• Compactors</li> <li>• Water carts</li> <li>• Concrete trucks</li> <li>• Generators</li> <li>• Bulldozers</li> <li>• Boring machines</li> <li>• Graders</li> <li>• Profilers</li> <li>• Vibrating rollers</li> <li>• Concrete pumps</li> <li>• Welding equipment</li> <li>• Cranes</li> </ul>

Construction phase	Plant and equipment
Bridgeworks	<ul style="list-style-type: none"> <li>• Excavators</li> <li>• Rigid and articulated trucks</li> <li>• Drilling Rigs and Boring Machines</li> <li>• Cranes</li> <li>• Water carts</li> <li>• Concrete trucks</li> <li>• Generators</li> <li>• Concrete Pumps</li> <li>• Welding equipment</li> </ul>
Pavement works	<ul style="list-style-type: none"> <li>• Rigid and articulated trucks</li> <li>• Compactors</li> <li>• Water carts</li> <li>• Graders</li> <li>• Paving machines</li> <li>• Light vehicles</li> <li>• Concrete trucks</li> <li>• Slip-forming machines</li> <li>• Vibrating rollers</li> <li>• Generators</li> <li>• Compressors</li> <li>• Welding equipment</li> </ul>
Finishing and landscaping	<ul style="list-style-type: none"> <li>• Milling machines</li> <li>• Piling machines</li> <li>• Concrete pumps</li> <li>• Cranes</li> <li>• Welding equipment</li> <li>• Trucks</li> <li>• Rollers</li> <li>• Road marking machine</li> <li>• Concrete trucks</li> <li>• Generators</li> <li>• Oxy-cutting equipment</li> <li>• Sprayers</li> <li>• Light vehicles</li> </ul>

#### 3.4.6 Earthworks – source and quantity of materials

The proposal would involve minor earthworks. The estimated quantities of materials associated with earthworks are provided in Table 3.6.

Table 3.6 Indicative earthwork quantities

Material	m <sup>3</sup>
Spoil (removal)	7,000
Imported select fill	22,000

Earthwork requirements would be confirmed during detailed design. About 17,000 cubic metres of concrete and 14,000 cubic metres of asphalt would be required. Materials would be sourced from appropriately licensed facilities. Wherever possible, materials would be sourced from commercial suppliers in nearby areas. None of the materials proposed to be used are considered to be in short supply.

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

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

### 3.4.7 Traffic management and access

#### Construction traffic numbers

Construction of the proposal would generate heavy vehicle movements. These heavy vehicle movements would mainly be associated with:

- Delivery of construction materials
- Spoil removal
- Delivery and removal of construction equipment and machinery.

Light vehicle movements would be required for the movement of construction personnel, including contractors, site labour force and specialist supervisory personnel.

Estimated construction traffic numbers are provided in Table 3.7.

Table 3.7 Construction traffic estimates

Vehicle type	Total number of vehicles per day (average)	Total vehicle movements per day (average)	Vehicles per day at peak construction periods
Employee cars	30	60	60
Light construction vehicles/utilities	40	80	80
Heavy vehicles/trucks	25	50	100

It is possible that the proposal may be constructed concurrently with The Northern Road Upgrade Stage 2C or Bringelly Road Upgrade Stage 2. As a result, there may be an increase in construction traffic between the multiple sites. This may increase the traffic numbers provided in Table 3.7 by up to about 20 per cent.

#### Site access for construction vehicles

Construction vehicles would access the site via The Northern Road and Bringelly Road.

Employee vehicles would park at the main site compound facility on The Northern Road at the southern end of the proposal site.

#### Construction diversions for local and through traffic

During construction, Bringelly Road traffic would be diverted from the proposal site to a temporary diversion through Jersey Road / Carrington Road and Robinson Road for a period of 12 to 18 months (refer to Figure 3.11). Vehicles needing to access Bringelly Road from The Northern Road, or needing to access The Northern Road from Bringelly Road, would be required to travel via this diversion. However, access would be maintained for private properties on Bringelly Road and Kelvin Park Drive.

The proposed diversion offers a number of benefits to the proposal and the community, including:

- Allowing offline construction of the interchange, minimising construction traffic impacts on road users
- Reducing safety issues associated with the construction and community interface
- Accelerating the construction program, resulting in a possible earlier completion date

- Simplifying construction staging as traffic switches on Bringelly Road would not be required
- Simplifying the bridge construction as it would not need to be constructed in stages.

Temporary traffic signals would be provided at the intersection of The Northern Road and Robinson Road to provide a safe turning environment for local traffic. Turning bays would also be provided on The Northern Road, and lighting would be provided. The pavement width at the intersection would be confirmed during detailed design to ensure heavy vehicles are accommodated.

Linemarking would be provided at the intersections of Robinson Road/Jersey Road, Jersey Road/Bringelly Road and Carrington Road/Jersey Road.

Robinson Road is subject to flooding. In the event of any flooding during operation of the temporary diversion, traffic would be temporarily diverted onto Carrington Road.

The speed limit of the local roads is currently sign posted at 80 km/h. Depending on the results of a speed limit review, a reduced speed limit of 60 km/h is likely to apply to the diversion.

The diversion is not proposed to be used by construction traffic.

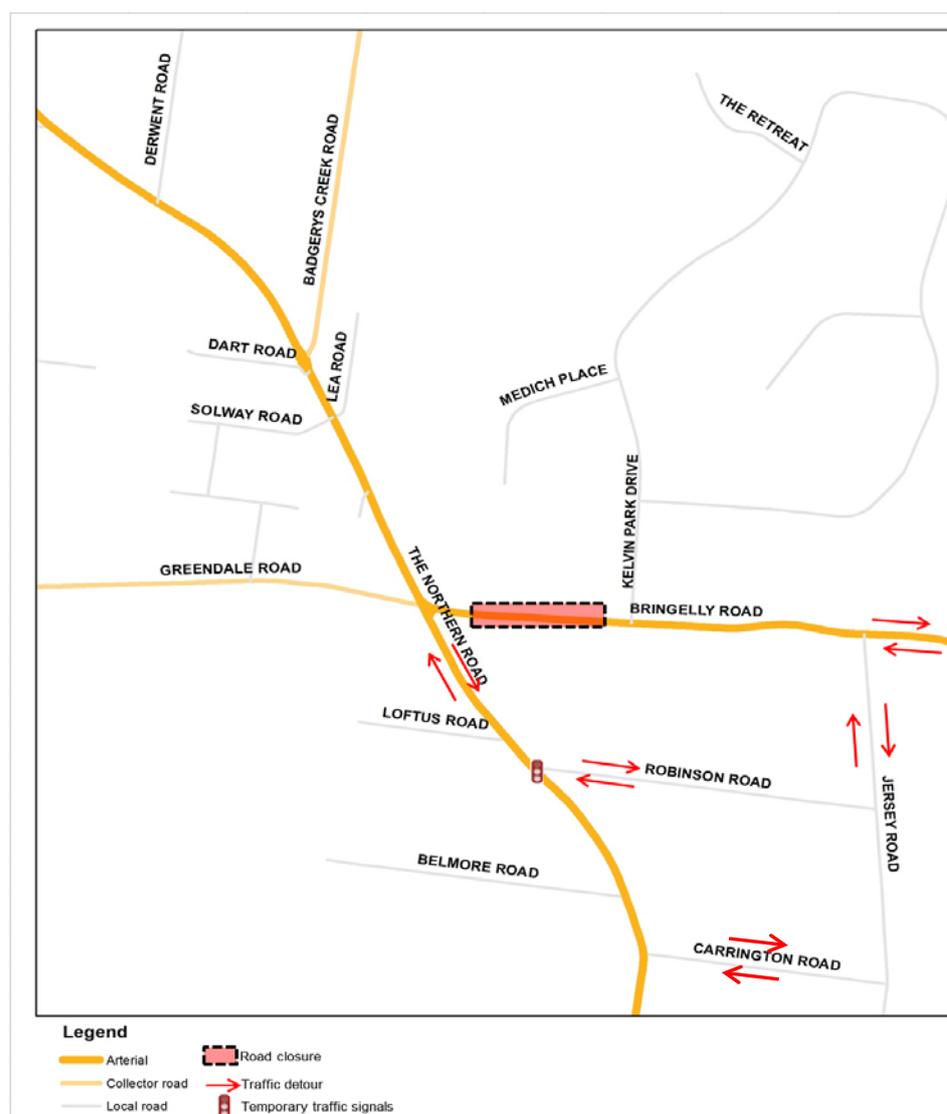


Figure 3.11 Proposed traffic diversion during the closure of Bringelly Road

## Construction traffic management plan

A detailed construction traffic management plan would be prepared in accordance with the *Traffic Control at Work Sites Manual Version 4* (RTA, 2010) and *RMS Specification G10 – Control of Traffic* (RTA, 2006) and approved by Roads and Maritime before implementation. The construction traffic management plan would provide details of the traffic management to be implemented during construction to ensure traffic flow on the surrounding network is maintained where possible.

## Access management

The final construction traffic management and construction access arrangements would be identified by the construction contractor. All property accesses would be maintained during construction.

## 3.5 Ancillary facilities

A possible site compound has been identified on land owned by Roads and Maritime on the north-western corner of The Northern Road and Belmore Road, as shown in Figure 1.2. However, this is likely to be used during The Northern Road Upgrade Stage 2A and may not be available during construction of the proposal. If this site is not available for use as a compound for the proposal, alternative locations would be investigated during detailed design. Alternative locations for the compound could include residual areas of acquired properties where these areas are deemed suitable by the contractor and comply with the key criteria outlined below.

The main site compound would include portable buildings with amenities (such as lunch facilities and toilets), secure and bunded storage areas for site materials, including fuel and chemicals, office space for on-site personnel, and associated parking.

The main site compound would also be the nominated stockpile area. Stockpiling near residential properties would be avoided wherever possible to avoid potential dust and erosion impacts. Stockpiles would be required to store materials such as spoil, stripped topsoil, excavated rock and building materials.

The stockpile areas would be established and managed in accordance with the Roads and Maritime *Stockpile Site Management Guideline* (RMS, 2015).

The site location criteria for stockpiles and compound sites are set out below:

- Not prone to flash flooding and more than 40 metres from a watercourse
- More than 50 metres from residential dwellings
- In previously disturbed areas that do not require the clearing of native vegetation
- In plain view of the public to deter theft and illegal dumping
- Outside the drip line of trees and on level ground wherever possible.

They would also be located on relatively level ground and away from areas of heritage conservation value.

Sites would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions. Upon completion of construction, the temporary site compound, work areas and stockpiles would be removed, the site cleared of all rubbish and materials and rehabilitated.

Once the location of the site compound and any stockpile areas are identified, consultation with the Roads and Maritime Senior Environmental Officer would be undertaken to confirm the suitability of the locations and whether any additional environmental assessment is required.

## 3.6 Public utility adjustment

Consultation with public utility authorities is being undertaken as part of the design process to identify and locate existing utilities, and incorporate utility authority requirements for relocations and/or adjustments. This is discussed further in section 5.

Preliminary investigations have indicated that a number of utilities would need to be relocated or adjusted as part of the proposal. This would be undertaken in consultation with the utility authorities during detailed design. As ongoing consultation is required with utility providers to finalise the utility designs, consultation with the Roads and Maritime Senior Environmental Officer would be undertaken to seek advice of further assessment requirements should the design be located outside the proposal footprint not assessed as part of this REF.

### 3.6.1 Electrical transmission lines

There is existing 33kV overhead and underground electricity lines that are located on Bringelly Road. These would be relocated to suit the proposal and would pass within the interchange bridge structure along Bringelly Road. Existing 11 kV and 415 kV overhead distribution assets affected by the works would be relocated as required.

### 3.6.2 Telecommunications

It is likely that minor Telstra assets would be required to be relocated as a result of the proposal. Provision for telecommunications conduits would be made within the interchange bridge structure.

### 3.6.3 Gas

An existing medium pressure gas main located along Bringelly Road would require relocation. The gas main would pass within the bridge structure of the interchange.

### 3.6.4 Potable water mains

An existing water main near Thames Road would require relocation and an existing water main on the northern side of Bringelly Road would be relocated to suit the new road alignment.

Existing assets at the intersection of Bringelly Road, Greendale Road and The Northern Road would remain undisturbed as a result of the proposal.

### 3.6.5 Wastewater mains

There are no wastewater mains in the vicinity of the proposal.

## 3.7 Property acquisition, adjustments and leasing

The proposal would require:

- Total acquisition of 10 properties
- Partial acquisition of or adjustments to up to 25 properties - due to their proximity to an additional road boundary, up to 14 of these properties would be subject to a dual offer of either total or partial acquisition.

Properties impacted by acquisition or adjustments are listed in Table 3.8 and are shown in Figure 3.12. The extent of property impacts would be refined and confirmed during detailed design in consultation with the property owners. For partial acquisitions, property adjustment plans would be developed in consultation with the property owner. All properties affected by acquisition are zoned RU4 (Primary Production Small Lots).

Leasing requirements are unknown at this stage. The need for lease arrangements will be confirmed by the contractor and consultation regarding agreements would be undertaken with the identified landowners and Roads and Maritime prior to works commencing.

All acquisitions would be conducted in accordance with the Roads and Maritime Land Acquisition Policy, and compensation would be based on the requirements of the *Land Acquisition (Just Terms) Compensation Act 1991*.

Table 3.8 Property acquisition required for the proposal

Location	Lot and DP	Acquisition type
The Northern Road	1 / A / 2650	Total
The Northern Road	2 / A 2650	Total
The Northern Road	2 / 712840	Partial
The Northern Road	3 / 712840	Total
The Northern Road	4 / 712840	Total
The Northern Road	5 / 712840	Dual offer / partial
The Northern Road	6 / 712840	Dual offer / partial
The Northern Road	7 / 712840	Dual offer / partial
The Northern Road	8 / 712840	Dual offer / partial
Bringelly Road	9 / 712840	Total
Bringelly Road	10 / 712840	Total
Bringelly Road	11 / 712840	Dual offer / partial
Bringelly Road	12 / 712840	Partial
Medich Place	910 / 803166	Dual offer / partial
Medich Place	911 / 803166	Dual offer / partial
Medich Place	912 / 803166	Dual offer / partial
Bringelly Road	121 / 794437	Partial
Bringelly Road	120 / 794437	Total
The Northern Road	10 / 812153	Partial
Bringelly Road	2 / 918331	Total
The Northern Road	5 / 233637	Dual offer / partial
The Northern Road	4 / 233637	Dual offer / partial
The Northern Road	3 / 233637	Dual offer / partial
The Northern Road	2 / 233637	Total
Robinson Road	1 / 233637	Total
Robinson Road	4 / 232188	Dual offer / partial
Robinson Road	5 / 232188	Dual offer / partial
Robinson Road	6 / 773405	Partial
The Northern Road	2/11/2650	Dual offer / partial
The Northern Road	3/ 11/ 2650	Total
The Northern Road	B / 414758	Partial
The Northern Road	101 / 826948	Partial

Location	Lot and DP	Acquisition type
The Northern Road	2 / D / 2650	Partial
The Northern Road	3 / D / 2650	Partial
Solway Road	4 / D / 2650	Partial

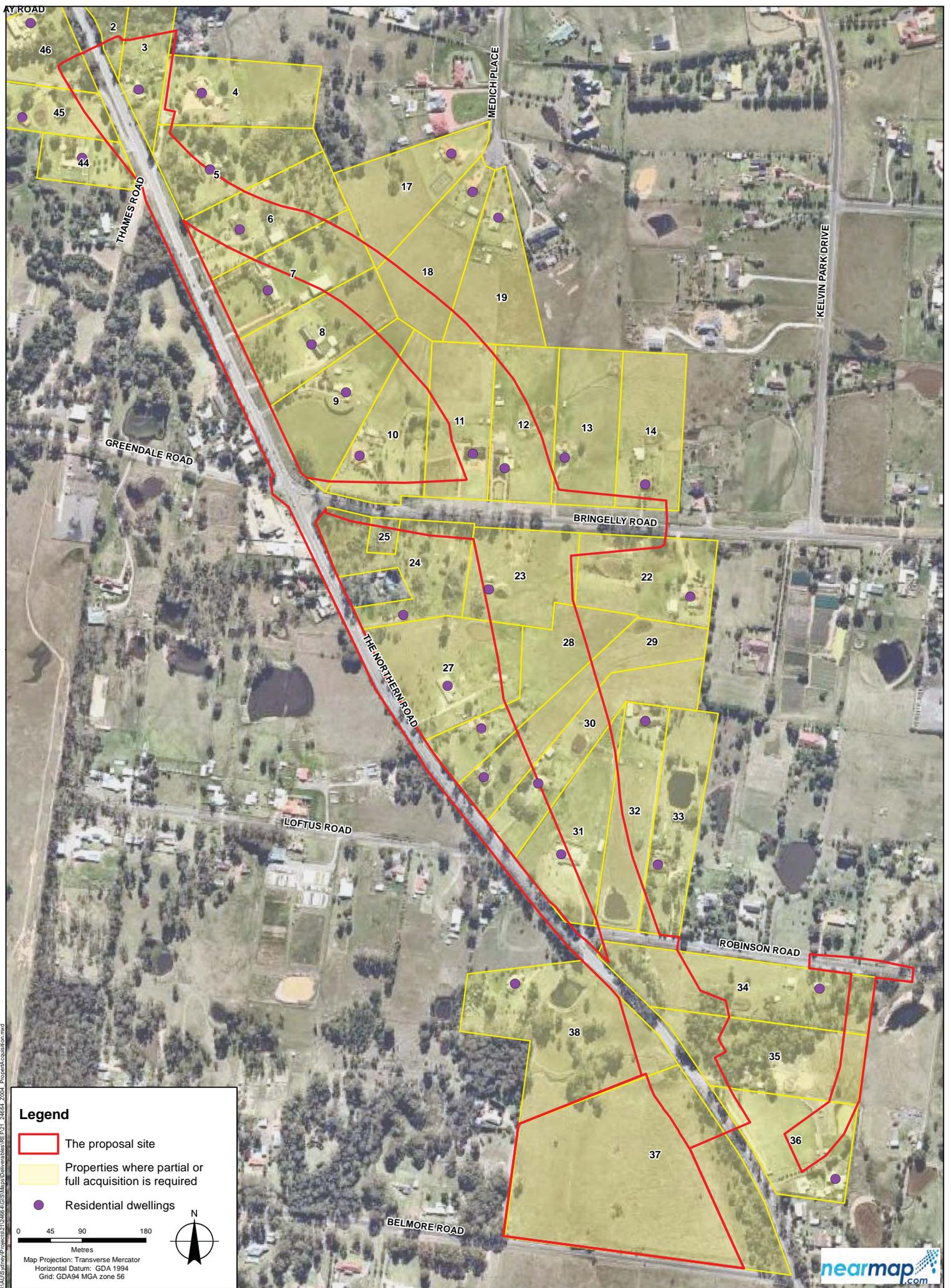


Figure 3.12  
Property acquisition required for the proposal

## 4. Statutory and planning framework

### 4.1 Overview

The EP&A Act provides the statutory basis for planning and environmental assessment in NSW. The Act provides the framework for environmental planning and development approvals, and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision making process. As noted below, the proposal is subject to assessment under Part 5 of the EP&A Act. The planning and assessment framework for the proposal is outlined in the following sections.

### 4.2 State Environmental Planning Policies

#### 4.2.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. ISEPP sets out the consent arrangements for certain infrastructure projects.

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

As the proposal is for a road and 'road infrastructure facilities' and is being carried out by Roads and Maritime, it can be assessed under Part 5 of the EP&A Act. Development consent from Liverpool and Camden councils is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by State Environmental Planning Policy No. 14 - Coastal Wetlands, State Environmental Planning Policy No. 26 - Littoral Rainforests, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Development) 2005.

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

#### 4.2.2 State Environment Planning Policy (Sydney Region Growth Centres) 2006

##### **Permissibility**

The proposal site is located within land subject to State Environment Planning Policy (Sydney Region Growth Centres) 2006 (the Growth Centres SEPP). The Growth Centres SEPP establishes the broad framework for development of the North West and South West Growth Centres.

Clause 18A(1) of the Growth Centres SEPP relates to public utility undertakings and states that 'Development for public utility undertakings (other than electricity generating works or water recycling facilities) may be carried out without consent on land to which this Policy applies'. As the proposal is a public utility undertaking, it is permissible without consent under the Growth Centres SEPP.

## Biodiversity certification

An order conferring biodiversity certification on the Growth Centres SEPP was made in December 2007 under section 126G of the TSC Act. In July 2008, the certification was validated by the *Threatened Species Conservation Amendment (Special Provisions) Act 2008*. The amendment is now incorporated into Part 7 of Schedule 7 of the TSC Act. Certification applies to all proposed developments and activities carried out under the Growth Centres SEPP or other environmental planning instruments such as LEPs or other SEPPs.

Most of the proposal site (with the exception of a small section in the north-east corner) is located within the biodiversity certified land. In relation to Part 5 activities undertaken on biodiversity certified land, sections 126I(4) and (5) of the TSC Act provide that:

- activities are taken to be not likely to significantly affect any threatened species, population or ecological community
- a determining authority is not required to consider the effect on biodiversity values of the activity (despite section 111 of the EP&A Act).

In accordance with the biodiversity certification, ecological impacts within the South West Growth Centre certified lands would be offset by the mechanisms contained in the Growth Centres Conservation Plan.

To enable development to proceed in the Sydney Growth Centres while protecting Sydney's precious environment, the NSW Government undertook a Strategic Assessment of the Growth Centres under the EPBC Act. The Australian Government Environment Minister has endorsed the Sydney Growth Centres Strategic Assessment Program, and approved all actions associated with development of the Sydney Growth Centres as described in the Program Report.

Further information on the potential biodiversity impacts of the proposal is provided in section 6.5.

## Public utility undertakings and the clearing of native vegetation

The proposal would not trigger consultation requirements under clause 18A as it would not involve clearing of native vegetation on land that is not subject land.

### 4.2.3 Sydney Regional Environmental Plan No. 20 – Hawkesbury Nepean River

The proposal is located on land to which the deemed SEPP, *Sydney Regional Environmental Plan No. 20 – Hawkesbury Nepean River (No.2 – 1997)* (SREP 20) applies. The proposal does not require consent under SREP 20. However, under clause 4(1)(b), the matters listed under clauses 5 and 6 that apply to a proposal must be considered by a public authority or State owned corporation carrying out development that does not require consent. Table 4.1 addresses these matters as they apply to the proposal.

Table 4.1 Consideration of the provisions of SREP 20

Consideration	Comment
<b>Clause 5</b>	
5(a) The aim of this plan which is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context	This REF assesses the impacts of the proposal and takes into account the potential regional impacts. The proposal is not anticipated to have any significant and/or regional level impacts on the Hawkesbury-Nepean River system.
5(b) The strategies listed in the Action Plan of the Hawkesbury-Nepean Environmental Planning Strategy	The proposal is not inconsistent with any of the strategies listed in the Action Plan.

Consideration	Comment
5(c) Whether there are any feasible alternatives to the development or other proposal concerned	The need for the proposal and the options considered are discussed in section 2 of this REF.
5(d) The relationship between the different impacts of the development or other proposal and the environment, and how those impacts would be addressed and monitored.	Chapter 6 provides an assessment of the potential impacts of the proposal including cumulative impacts and identifies mitigation measures to minimise these impacts.
<b>Clause 6</b>	
6(1) Total catchment management is to be integrated with environmental planning for the catchment	Section 6 provides an assessment of the potential impacts of the proposal. The proposal would not result in any significant impacts on the catchment. Drainage and water quality requirements have been considered as part of the concept design (refer to section 3.2.7) with the future development of the catchment in mind.
6(2) The environmental quality of environmentally sensitive areas must be protected and enhanced through careful control of future land use changes and through management and (where necessary) remediation of existing uses	Mitigation measures and environmental management plans, listed in sections 6 and 7, would be implemented to minimise impacts on environmentally sensitive areas such as waterways (refer to section 6.4 for further detail).
6(3) Future development must not prejudice the achievement of the goals of use of the river for primary contact recreation (being recreational activities involving direct water contact, such as swimming) and aquatic ecosystem protection in the river system.	Mitigation measures and environmental management plans, listed in sections 6 and 7, would be implemented to minimise impacts on water quality (refer section 6.4 for further detail).
6(4) Aquatic ecosystems must not be adversely affected by development which changes the flow characteristics of surface or groundwater in the catchment.	The proposal would not adversely impact (either directly or indirectly) the ecosystems of waterways in the study area. Biodiversity impacts are considered in section 6.5.
6(5) The importance of the river in contributing to the significance of items and places of cultural heritage significance should be recognised, and these items and places should be protected and sensitively managed and, if appropriate, enhanced.	The proposal would not impact on the cultural heritage significance of the river, either directly or indirectly. An assessment of the potential for heritage impacts was undertaken, and the results are summarised in section 6.6.
6(6) Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced	The proposal has considered biodiversity impacts and measures to minimise impacts in are summarised in section 6.5.
6(7) The scenic quality of the riverine corridor must be protected.	The proposal would not impact on the scenic quality of the Nepean River.
6(8) Agriculture must be planned and managed to minimise adverse environmental impacts and be protected from adverse impacts of other forms of development.	The proposal would require the acquisition of a number of properties zoned RU4 (Primary Production Small Lots). Further information is provided in sections 3.7 and 6.10). Measures identified in this REF would help minimise impacts to surrounding land uses including agriculture.

Consideration	Comment
6(9) Rural residential development should not reduce agricultural sustainability, contribute to urban sprawl, or have adverse environmental impacts	Not applicable to the proposal.
6(10) All potential adverse environmental impacts of urban development must be assessed and controlled.	This REF has assessed and has provided measures to avoid or mitigate potential impacts from the proposal.
6(11) The value of the riverine corridor as a significant recreational and tourist asset must be protected.	The proposal would not impact upon any recreational land or tourism operations.
6(12) Development should complement the vision, goal, key principles and action plan of the Metropolitan Strategy	As described in section 2.1.1, the proposal is consistent with the Metropolitan Strategy.

### 4.3 Local environmental plans

The Liverpool Local Environmental Plan 2008 (the Liverpool LEP) applies to land within the Liverpool local government area. The Camden Local Environmental Plan 2010 (the Camden LEP) applies to land within the Camden local government area. The majority of the proposal site is located within land zoned RU4 (Primary Production Small Lots). The proposal site also crosses and impacts on land zoned SP2 (Infrastructure – Classified Road).

The zone provisions provide that the proposal would be permitted with consent in both zones. However, clause 5.12 of both LEPs states that ‘...this Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007’.

As the proposal is permitted without consent under ISEPP (refer section 5), the consent requirements of the LEP do not apply.

### 4.4 Other relevant legislation

Other NSW environmental legislation that is directly relevant to the approval and/or assessment of the proposal is considered in Table 4.2.

Table 4.2 Consideration of relevant legislation

Act	Potential approval requirement	Relevance to the proposal
<i>Protection of the Environment Operations Act 1997 (POEO Act)</i>	<p>An environment protection licence (EPL) is required for scheduled activities or scheduled development work. Road construction is a scheduled activity under Schedule 1 of the Act if it results in four or more traffic lanes (not including bicycle lanes or lanes used for entry or exit), where the road is classified or proposed to be classified as a main road for at least three kilometres of its length in the metropolitan area, and for at least five kilometres in any other area.</p> <p>Extractive activities are also a scheduled activity under Schedule 1 of the Act if it results in the extraction, processing or storage of more than 30,000 tonnes per year of extractive materials.</p>	<p>The proposal is not considered to be a scheduled activity as it is less than five kilometres long. However, it is likely that the proposal would result in the extraction of about 200,000 tonnes of material. The proposal may also be constructed with adjacent projects as discussed in section 3.4.4. As such, an EPL will be required.</p>
<i>Threatened Species Conservation Act 1995 (TSC Act)</i>	<p>The TSC Act lists threatened species, populations or ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats. If a significant impact is likely, an assessment of significance that addresses the requirements of section 5A of the EP&amp;A Act must be completed.</p> <p>Biodiversity certification of the Growth Centres SEPP is confirmed by Part 7 of Schedule 7 of the TSC Act.</p>	<p>The majority of the proposal site has been cleared in the past and subject to previous disturbance. The proposal would not result in significant impacts to any listed flora, fauna or communities, and a species impact statement is not required. Further information is provided in section 6.5.</p> <p>Further information on the proposal with respect to certified lands is provided in section 4.2.2.</p>
<i>Noxious Weeds Act 1993</i>	<p>Under Part 3 Division 1 of the Act, all private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land.</p>	<p>Noxious weeds were identified within the study area and would be managed in accordance with the requirements of the Act. Further information is provided in section 6.5.</p>
<i>National Parks and Wildlife Act 1977</i>	<p>An Aboriginal heritage impact permit (AHIP) is required under section 90 of the Act to harm or desecrate an Aboriginal heritage object.</p>	<p>An Aboriginal heritage due diligence assessment of the proposal was undertaken. The assessment identified that the proposal would impact on six Aboriginal sites. Four of these sites are subject to an existing AHIP.</p> <p>An AHIP may need to be obtained for impacts to the sites not currently subject to the existing AHIP. This will be determined following further investigations.</p> <p>Further information is provided in section 6.6.</p>
<i>Heritage Act 1977</i>	<p>Approval under section 57(1) is required for works to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register.</p> <p>An excavation permit is required under section 139 to disturb or excavate any land containing or likely to contain a relic.</p>	<p>No listed items would be impacted by the proposal.</p> <p>Further information is provided in section 6.7.</p>

## 4.5 Commonwealth legislation

### 4.5.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act a referral is required to the Australian Minister for the Environment for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land.

The biodiversity assessment undertaken as part of the REF identifies that no significant impact is likely on any matters of national environmental significance. No Commonwealth land would be affected by the proposal. No other matters of national environmental significance would be impacted by the proposal (refer to section 6.5 and Appendix A).

Accordingly, the proposal has not been referred to the Australian Government Department of Environment.

## 4.6 Confirmation of statutory position

The proponent and determining authority for the proposal is Roads and Maritime. Clause 94 of the ISEPP provides that the proposal may be carried out without the need for development consent. The proposal is therefore subject to assessment and determination under Part 5 of the EP&A Act.

An Aboriginal heritage impact permit (AHIP) may be required under section 90 of the *National Parks and Wildlife Act 1977*. An EPL will also be required in accordance with the *Protection of the Environment Operations Act 1997*.

## 5. Stakeholder and community consultation

### 5.1 Consultation strategy

Consultation with potentially affected property owners, relevant government agencies and other stakeholders has been undertaken by Roads and Maritime during the proposal development and concept design phase. The purpose of consultation has been to:

- Inform the community and key stakeholders of the proposal
- Canvas comments and issues about the proposal from those who may be affected
- Advise potentially directly affected community members of the potential property impacts
- Advise the community and key stakeholders how they may obtain further information or communicate concerns, complaints or suggestions.

A summary of consultation undertaken to date is provided in sections 5.2 to 0.

### 5.2 Community involvement

Consultation with the community to date has involved the following activities:

- Consultation with affected property owners commenced in mid-2015 and included face to face meetings with property owners as part of the land acquisition process
- Information on the proposal has been placed on the Roads and Maritime website, including background information, the latest news on the proposal, the Options Report (refer to section 2.4) and community contact information
- The proposal was displayed for public comment in July and August 2015
- A community update was distributed in July 2015
- Six community sessions providing information about the proposal and other Western Sydney Infrastructure Plan projects were held in July and August 2015, including a session at Bringelly Community Centre
- Consultation with individual members of the community has been undertaken during the concept design process.

The results of community consultation to date for the proposal and other Western Sydney Infrastructure Plan projects are summarised in the *Western Sydney Infrastructure Plan Community Consultation Report* (Roads and Maritime, 2015). An extract from the report noting the issues raised by the community and Roads and Maritime's responses to these issues is provided in Appendix K. Key issues raised by community members to date are summarised in Table 5.1

Table 5.1 Summary of issues raised by the local community

Issue category	Issue raised	Addressed in the REF
Consultation	Unsure what properties are affected by the interchange.	Section 3.7 and 6.10
	Concerned about the change in design from the community update in July 2015.	Appendix K
	Concern about timeframes, process and lack of understanding of impact on properties.	Appendix K
Design	Dual turning lanes are required from Bringelly Road onto the Northern Road.	Section —
	Need for flyover ramp below the intersection bridge to allow movements between Leppington and the airport.	Section —
	Design should not include traffic lights as the topography lends itself to an overpass.	Section —
	Design needs to minimise impacts to landowners.	Sections — and 3.7
	Concerns about the height of interchange and proximity to residents.	Sections —, 6.10 and 6.11
	Design needs to maintain access to Bringelly Public School. What is the access strategy for buses and cars at the school?	Appendix K and sections — and 6.1
	Consider the location of Boral Brickworks as an alignment to the west.	Section 2.4
Traffic	Speed limit should be 80 km/h.	Section —
	Impacts to the Belmore Road access.	Section —
	Impact to Solway Road.	Section —
Pedestrian access	Impacts to pedestrian access at school.	Section 3.2.4
Property	How will the proposal impact on property values?	Section 6.10
	Property acquisition concerns.	Section 3.7
	Some properties are impacted by both the proposal and other infrastructure projects.	Sections 6.11, 6.10 and 3.7
	Will all partially acquired properties have access to the new The Northern Road?	Sections 0
	When will extent of acquisition be confirmed?	Section 3.7
	Sterilisation of the remaining land after partial acquisition.	Section 6.11
	Impacted residents are prevented from capitalising on growth and redevelopment occurring in the area.	Appendix K
Noise and air quality	What are the predicted traffic noise levels and the mitigation measures proposed?	Section 6.2
	Impact on air quality and mitigation measures	Section 6.9
Construction impacts	Disruption to buses from Greendale Road /Bringelly Road	Section 6.1
	Concern about potential impacts on the local community and businesses during construction, such as property damage, property access, dust and reduced speed zones.	Section 6.11
	Compensation to businesses to cover loss of trade during construction.	Appendix K and section 6.11
	What mitigation measures would be implemented during construction?	Section 7.2

### 5.3 Aboriginal community involvement

As part of the Aboriginal heritage investigations for the preparation of this REF, an archaeological field survey of the proposal site was undertaken on 15 and 24 July 2015 and 30 September 2015 by Artefact Heritage with members from Tharawal Local Aboriginal Land Council and Gandangara Local Aboriginal Land Council. The results of the survey are discussed in section 6.6 and Appendix G.

### 5.4 ISEPP consultation

Clauses 13 to 16 of the Infrastructure SEPP specify the requirements for consultation with councils and other public authorities for infrastructure development carried out by or on behalf of a public authority. Consultation is required in relation to specified development (clause 16) or development that impacts on:

- Council related infrastructure or services (Clause 13)
- Local heritage (Clause 14)
- Flood liable land (Clause 15).

As the proposal has the potential to impact on the local road network and local heritage items, and it would require a connection to a council owned water supply system, consultation in accordance with ISEPP was undertaken with Liverpool and Camden councils. A letter was sent to both councils on 11 August 2015. The letter provided information on the proposal and requested input in terms of any issues or concerns. A summary of the response received from Camden Council and Liverpool City Council on 3 September 2015 and 18 September 2015 respectively, and issues raised is provided in Table 5.2. A copy of the letters sent and the response received are provided in Appendix L.

### 5.5 Government agency and stakeholder involvement

As noted above, Roads and Maritime has consulted with Liverpool and Camden councils during the development of the proposal. Consultation with Transport for NSW has also been undertaken in relation to bus routes and road closures.

A value engineering and risk management workshop was held on 19 August 2015. The purpose of the workshop was for the design team and key stakeholders to provide input to, and refine the preferred option for, the proposal. The workshop also included a risk assessment with actions to be carried out through the development of the design. Representatives of GHD, Roads and Maritime, Liverpool City Council and Camden Council attended the workshop.

Utility providers have been consulted regarding utility relocation requirements between June and September 2015. Consultation is ongoing and will continue throughout the development of detailed design.

Key issues raised relevant to the environmental assessment are summarised in Table 5.2.

Table 5.2 Summary of issues raised by government agencies

Agency	Issue raised	Response
Camden Council	Cumulative impacts resulting from the following projects: <ul style="list-style-type: none"> <li>• The Northern Road upgrade</li> <li>• Bringelly Road upgrade</li> <li>• M12 Motorway</li> <li>• Badgerys Creek airport</li> <li>• South West Rail extension corridor</li> <li>• Boral Bringelly Brickworks extension and operation</li> </ul>	Cumulative impacts resulting from other projects in the surrounding area are discussed in section 6.15.
	Ongoing consultation for Bringelly Public School and local residents adjacent to and within the proposal site boundary.	Roads and Maritime will continue consultation with the community and Bringelly Public School.
	Ongoing consultation for the local community and Camden Council.	Roads and Maritime will continue consultation with the community and Camden Council.
Liverpool City Council	Land use planning	Impacts on land use are discussed in section 6.10. Roads and Maritime will continue land use planning discussions with both councils throughout development of the proposal.
	Need for construction traffic management plan	A construction traffic management plan will be required as detailed in section 6.1.4.
	Impacts to Aboriginal heritage items	Impacts to Aboriginal heritage items are discussed in section 6.6.
	Impacts to non-Aboriginal heritage items	Impacts to non-Aboriginal heritage items are discussed in section 6.7.
	Naming of the existing The Northern Road	This would be determined by the relevant local council.
Camden Council and Liverpool City Council as part of the workshop	Land use planning	Impacts on land use are discussed in section 6.10. Roads and Maritime will continue land use planning discussions with both councils throughout development of the proposal.
	Cumulative construction noise and traffic impacts	Cumulative impacts resulting from other projects in the surrounding area including for construction noise and traffic impacts are discussed in section 6.15.
	Impacts to Aboriginal heritage items	Impacts to Aboriginal heritage items are discussed in section 6.6.
	Impacts to non-Aboriginal heritage items	Impacts to non-Aboriginal heritage items are discussed in section 6.7.

## 5.6 Ongoing or future consultation

Roads and Maritime will continue to consult with the community and relevant stakeholders during the design and construction of the proposal. The REF will be placed on public display and comments invited. Following public display, submissions will be collated and a submissions report prepared to address any issues raised by stakeholders. The submissions report will be made available to the public via the Roads and Maritime website. The community will be informed of any major design changes that are required to address community concerns. In addition, the following consultation activities will be undertaken as required:

- Meetings with councils and other relevant stakeholders, including government agencies, utility providers, bus operators, adjacent landowners and community stakeholders
- Providing project updates to the local community during the construction planning phase and construction period
- Updating the Roads and Maritime project webpage.

# 6. Environmental assessment

## 6.1 Traffic and access

### 6.1.1 Overview

This section summarises the results of the traffic and transport assessment for the proposal undertaken by GHD as an input to the REF. The full report is provided in Appendix D. The scope of assessment included:

- Reviewing existing road features, traffic volumes, bus services, pedestrian and cyclist facilities, and traffic survey data provided by Roads and Maritime
- Evaluating the intersection and network performance of the proposal in accordance with the design criteria under future traffic conditions
- Assessing the impacts of the construction and operation of the proposal on the road network
- Providing mitigation measures to manage the potential impacts of the proposal.

A detailed description of the methodology is provided in Appendix D.

### 6.1.2 Existing environment

#### Existing road and transport network

A description of the key roads and transport infrastructure (including public transport and pedestrian/cycle facilities) in the study area is provided in section 2.2.1. Other roads that cross the proposal site are described below:

##### **Robinson Road**

Robinson Road is a local road under the care and control of Camden Council. It intersects with The Northern Road towards the southern end of the proposal site at a give-way controlled intersection. Robinson Road travels for about 1.2 km between The Northern Road in the west, and Jersey Road in the east. It has an undivided carriageway with one lane in each direction and unsealed shoulders. The sealed carriageway is about seven metres wide.

##### **Jersey Road**

Jersey Road is a local road under the care and control of Camden Council. It intersects with Bringelly Road to the east of the proposal site at a give-way controlled intersection. Jersey Road intersects with Robinson Road and Carrington Road at uncontrolled T-intersections at the eastern end of both these roads. Jersey Road is about 1.6 km long. It has an undivided carriageway with one lane in each direction, and unsealed shoulders. The sealed carriageway is about seven metres wide.

##### **Belmore Road**

Belmore Road is a local road under the care and control of Camden Council. It intersects with The Northern Road south of the proposal site at a give-way controlled intersection. Belmore Road is a no-through road and travels for about one kilometre west of The Northern Road. It has an undivided carriageway with one lane in each direction and unsealed shoulders. The sealed carriageway is about six metres wide. The intersection with Robinson Road is proposed to be relocated further north as part of The Northern Road Upgrade Stage 2A.

### **Carrington Road**

Carrington Road is a local road under the care and control of Camden Council. It intersects with The Northern Road to the south of the proposal site at an uncontrolled intersection. Carrington Road travels for about 850 m between The Northern Road in the west, and Jersey Road in the east. It has an undivided carriageway with one lane in each direction and unsealed shoulders. The sealed carriageway is about six metres wide.

### **Existing traffic volumes**

The classification of roads within the study area can be used as an indication of the functional role each road plays with respect to the volume of traffic they carry. Roads and Maritime has developed a set of road hierarchy classifications which indicates typical nominal average annual daily traffic (AADT) volumes for various classes of roads.

Table 6.1 summarises the surveyed traffic volumes based on traffic counts undertaken between 16 and 22 June 2015. Based on the existing traffic volumes, all roads within the study area are within the expected functional classification.

Table 6.1 Surveyed traffic volumes per day

Road	Direction	Weekdays (average vehicles per day)	Saturdays (average vehicles per day)
The Northern Road	Northbound	8,389	6,442
	Southbound	8,526	6,533
Bringelly Road	Eastbound	3,237	2,747
	Westbound	3,225	2,749
Greendale Road	Eastbound	1,079	1,204
	Westbound	1,068	1,253
Robinson Road	Eastbound	125	112
	Westbound	144	140
Jersey Road	Northbound	932	629
	Southbound	1,011	653

Table 6.2 outlines the existing peak hour traffic volumes and the heavy vehicle percentages within the proposal site.

Table 6.2 Peak hour traffic volumes

Road section	Morning peak (7 - 8 am)		Evening peak (4 - 5 pm)		Saturday peak (11 – 12 pm)	
	Total vehicles (vph) <sup>1</sup>	HCV <sup>2</sup> (%)	Total vehicles (vph)	HCV (%)	Total vehicles (vph)	HCV (%)
The Northern Road north of Bringelly Road	1,635	3	1,592	3	1,024	3
The Northern Road south of Bringelly Road	1,348	4	1,371	3	946	3
The Bringelly Road east of The Northern Road	574	3	616	3	427	4
Greendale Road west of The Northern Road	181	8	190	5	272	1

Notes: 1. vph – vehicles per hour  
2. HCV – heavy commercial vehicles

### Intersection performance

The performance of the road network is largely dependent on the operating performance of intersections, which form critical capacity control points on the road network. The level of service is the standard measure used to assess the operational performance of the network and intersections. There are six levels of service, ranging from level of service A (the best performance) to level of service F (the worst performance). A level of service D or better is considered to be an acceptable level of service for an intersection.

The intersection modelling results for the existing intersection of The Northern Road, Bringelly Road and Greendale Road are provided in Table 6.3. The results indicate that the existing intersection operates at an acceptable level of service (level of service C) during both the morning and evening peak periods. Although the operation of the intersection itself is satisfactory, the results provided in in Table 6.3 show that there are substantial traffic queues on The Northern Road. The degree of saturation is a measure of how much demand an intersection is experiencing compared to its total capacity. The degree of saturation is a ratio of demand to capacity on each approach to the junction, with a value of one meaning that demand and capacity are equal and no further traffic is able to progress through the junction. Values over 0.85 are typically regarded as suffering from traffic congestion, with queues of vehicles beginning to form.

Table 6.3 Existing intersection base traffic flows

Year	Morning peak				Evening peak			
	LoS <sup>1</sup>	Average Delay	Queue length (m)	Degree of Saturation	LoS	Average Delay	Queue length (m)	Degree of Saturation
2015	C	33	388 (S)	0.862	C	41	309(N)	1.014

Note: 1. LoS – level of service

### Public transport

As noted in section 2.2.5, bus route 856 and school bus services for Bringelly Public School operate through the proposal site, travelling through the existing intersection of The Northern Road, Bringelly Road and Greendale Road. Existing bus stops are described in section 2.2.5 and are shown Figure 2.5.

The Bringelly to Liverpool service for bus route 856 operates seven services per day with the Liverpool to Bringelly service operating five services per day.

Within and in the vicinity of the proposal site, school bus services for Bringelly Public School travel along Bringelly Road, Jersey Road, Carrington Road, Greendale Road and The Northern Road.

School bus services for Rossmore Public School operate to the east of the proposal site.

### Pedestrian and cyclist facilities

The existing pedestrian and cyclist facilities within and around the proposal site are described in section 2.2.6.

### Local access and parking

Properties with access to local roads that may be impacted by construction and operation of the proposal are shown in Figure 6.1. Existing on-street parking arrangements within the proposal site are described in section 2.2.4.

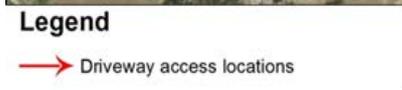


Figure 6.1 Existing property access within the study area

### Crash history

A total of 27 crashes were recorded between July 2009 and June 2014 in the study area. The main crash types were as follows:

- 13 crashes resulted in casualties (48 per cent)
- 10 crashes were rear end crashes (37 per cent)
- Eight crashes were a result of vehicles leaving the carriageway (29 per cent).

### 6.1.3 Potential impacts

#### Construction

The proposed construction activities are outlined in section 3.4. Potential construction related impacts are generally associated with the introduction of construction traffic onto the local road network, and changes to traffic flow and access arrangements during the construction period.

#### **Construction traffic generation and impacts on the road network**

As described in section 3.4.7, construction would generate around 50 heavy vehicle and around 80 light vehicles movements per day. The majority of these movements would take place outside the peak periods.

For the worst case scenario, it is estimated that about 10 heavy vehicles would access the proposal site in the morning and evening peak periods. This number of vehicles would be a very small proportion of the existing traffic volumes (shown in Table 6.1) and no substantial impacts are anticipated.

The arrival and departure periods for the construction workforce represent the peak construction traffic periods. As the workforce construction traffic peaks would occur outside the existing road network morning and evening traffic peaks, and the number of light vehicles would be a very small proportion of the existing traffic volumes, no substantial impacts are anticipated.

Construction vehicles would access the proposal site via The Northern Road (north and south from the proposal site), Bringelly Road and Badgerys Creek Road. As these roads already carry high volumes of traffic, the additional vehicle traffic generated by construction of the proposal would have a negligible impact on the operation of these roads. The additional vehicle traffic associated with construction would be within the range of daily variation in traffic volumes on these roads.

#### **Proposed traffic diversion during construction**

As noted in section 3.4.7 it is proposed to divert through traffic from Bringelly Road to a temporary diversion through Jersey Road / Carrington Road and Robinson Road for a period of about 12 to 18 months. Bringelly Road would be closed to through traffic between The Northern Road and Kelvin Park Drive for this period. Access for local residents would be provided.

Table 6.4 shows the predicted peak hour increase in traffic on local roads during the operation of the temporary diversion.

Table 6.4 Proposed traffic increase in the peak hour

Road	Existing average weekday traffic volumes (vph) <sup>1</sup>	Construction traffic (vph)	Diverted traffic (vph)	Total traffic (vph)	% increase
Robinson Road	30	16	334	380	1166
Jersey Road	226	16	231	473	109

Note: 1. vph – vehicles per hour

As shown in Table 6.4 the temporary diversion would result in a large increase in the volume of traffic along Robinson Road and Jersey Road. The temporary diversion would also result in minor traffic delays for motorists travelling through the study area.

However, even with the operation of the diversion, the peak hour traffic volumes for these roads would remain within reasonable operational limits for local roads, based on the typical capacity for a local road (described in section 3.2.1 of Appendix D). Potential impacts on the operation of these roads would be temporary and managed through the implementation of measures provided in

section 6.1.4. Improvements would be made as required to provide safe access during the construction period.

During the closure of Bringelly Road, traffic will need to travel a longer distance through the traffic diversion. Table 6.5 provides a comparison between the existing and proposed diversion in terms of distance and travel time.

Table 6.5 Traffic diversion – additional distance and travel time

From	To	Travel distance (km)	Travel time (minutes)
The Northern Road / Bringelly Road intersection	The Bringelly Road / Jersey Road intersection	1.6	1.6
Thames Road at The Northern Road	The Northern Road / Badgerys Creek Road	2.7	2

The majority of the section of Bringelly Road to be closed currently has a sign posted speed of 60 km/h. The section of the proposed diversion currently has a sign posted speed limit of 80 km/h. Therefore the proposed diversion travel time is not significantly longer than the existing travel time. However if the speed limit was to be reduced during the construction period to 60 km/h on the diversion roads the travel time would increase to 2.7 minutes and would result in around one minute of additional travel time.

To address the potential impacts resulting from the diversion, the intersection of The Northern Road and Robinson Road would include the following:

- Temporary traffic signals to provide a safe turning environment for local traffic
- The provision of turning bays on The Northern Road
- Further investigation into pavement width at the intersection to accommodate heavy vehicle turning paths and bus service diversions.

It is expected that temporary road priority changes would need to be made at the following intersections:

- Robinson Road / Jersey Road
- Jersey Road / Bringelly Road.

It is noted that Robinson Road is subject to flooding. In the event that this occurs during the diversion, traffic would be temporarily diverted on to Carrington Road. This is considered further in section 4.2.1 of Appendix D.

A speed limit review of the traffic diversion through Robinson Road and Jersey Road would be undertaken to determine if a temporary speed reduction is required during the temporary diversion.

All of the above measures will form part of the traffic management plan discussed in section 6.1.4.

### **Intersection performance**

The potential performance of intersections during construction was modelled, based on the operation of the proposed diversion. Table 6.6 provides a summary of the modelling results. The results indicate that the intersection of The Northern Road and Bringelly Road would operate satisfactorily (at a level of service B) in the morning and evening peak periods. The proposed diversion would redirect traffic through the intersection of The Northern Road and Robinson Road, which would operate with spare capacity in the morning peak (level of service B) and over capacity in the evening peak period (level of service F and a degree of saturation of over one). The potential

for impacts would be minimised by implemented the construction traffic management plan, including the measures listed in section 6.1.4.

Table 6.6 Intersection performance during construction (2016)

Intersection	Priority type	Morning peak				Evening peak			
		LoS	Av delay (secs)	Queue	Degree of saturation	LoS	Av delay (secs)	Queue	Degree of saturation
The Northern Road/Bringelly Road	Signals	B	15	191 (south)	0.767	B	18	307(north)	0.758
The Northern Road/Robinson Road	Signals	B	24	297(south)	0.929	F	364	1495(south)	1.585

### **Local access, connectivity and parking**

As the majority of the proposal is outside the existing road corridor, there would be minimal impacts to existing property access for those properties not subject to acquisition. Impacts associated with partial property acquisition/adjustment would include the need to relocate some property accesses. Property adjustment plans would be developed in consultation with the affected property owners. Prior to any unavoidable disruption to access, consultation would be undertaken with the affected property owners and/or occupants.

The construction diversion would result in additional traffic and noise impacts for residents of Robinson Road, Jersey Road and Carrington Road, as discussed above and in section 6.2.5. The implementation of the mitigation measures provided in section 6.1.4 and section 6.2.6 would reduce the traffic and noise impacts.

Construction may result in some traffic delays, which could impact the movement of emergency vehicles through the proposal site. However, emergency services would be notified of the changes as part of the construction traffic management plan.

Access for vehicles, pedestrians and cyclists to and from the Bringelly Public School and the Bringelly Village shops would be maintained during construction. However, some sections of the footpath along The Northern Road and Bringelly Road may need to be closed temporarily for safety reasons. This is not expected to result in a substantial impact as it would be temporary and localised.

Informal on-street parking would not be available in the vicinity of work sites during construction. Given the availability of off-street parking within local properties, this would not be a substantial impact.

### **Public transport**

During operation of the temporary diversion, buses would be diverted from Bringelly Road through Robinson Road and Jersey Road. The bus stops located on Bringelly Road between Jersey Road and The Northern Road would need to be closed. The closest stops are those located on Bringelly Road near Jersey Road, and on The Northern Road near Bringelly Public School.

Bus stops that would be impacted by construction are listed in Table 6.7.

Table 6.7 Bus stops that would be unavailable during construction

Bus stop reference	Location	Route	Route description
2171180	Bringelly Road east of the Northern Road (eastbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens
2171422	Bringelly Road east of the Northern Road (westbound)	856	Liverpool to Bringelly via Churchill Gardens and Prestons
2171421	971 Bringelly Road	856	Liverpool to Bringelly via Churchill Gardens and Prestons
2171181	Bringelly Road west of Kelvin Park Drive (eastbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens
2171177	Bringelly Road west Kelvin Park Drive (westbound)	856	Bringelly to Liverpool via Prestons and Churchill Gardens

Potential impacts to bus stops and the provision of replacement stops would be determined in consultation with Interline Bus Services. Alternative arrangements for buses during construction would be specified in the construction traffic management plan.

#### **Cumulative construction traffic impacts**

As noted in section 3.4.3, construction of the proposal is expected to commence in late 2016 or early 2017 and take a minimum of 24 months. A number of major developments and road upgrade projects are proposed within the Western Sydney Priority Growth Area and South West Priority Land Release Area, including those being undertaken as part of the Western Sydney Infrastructure Plan (refer to section 2.1). Construction of some of these projects may occur at the same time as the proposal, which could result in cumulative construction traffic impacts. Projects with the potential to interact with the proposal are considered in Table 6.8.

Table 6.8 Projects considered for cumulative construction traffic impacts

Project	Description	Likelihood of interaction
The Northern Road stage 2A upgrade (Peter Brock Drive to Belmore Road)	<p><b>Construction period:</b> Mid 2016 – mid 2019</p> <p><b>Construction duration:</b> 36 months</p> <p><b>Description:</b> The Northern Road is being upgraded from a generally two lane road to a four lane divided road, with a wide central median to allow for future widening. The Northern Road upgrade project is about 35 km in length, and extends from The Old Northern Road, Narellan to Jamison Road, Penrith. It is being planned in four stages. Stage 2A, which forms part of the stage 2 upgrade, extends from Peter Brock Drive to Belmore Road, with a length of about 7 km.</p>	High – concurrent with the proposal with potential increases to peak period traffic volumes
The Northern Road stage 2C upgrade (Thames Road to Mersey Road)	<p><b>Construction period:</b> Mid 2016 – mid 2019</p> <p><b>Construction duration:</b> 36 months</p> <p><b>Description:</b> Stage 2C, which forms part of the stage 2 upgrade, extends from Thames Road to Mersey Road, with a length of about 3 km.</p>	High – concurrent with the proposal with potential increases to peak period traffic volumes

Project	Description	Likelihood of interaction
The Northern Road stage 3 upgrade (Littlefields Road to Jamison Road)	<p><b>Construction period:</b> Late 2017 – late 2019</p> <p><b>Construction duration:</b> 24 months</p> <p><b>Description:</b> Stage 3 extends from Littlefields Road to Jamison Road with a length of about 10 km. Stage 3 is generally a three to four lane widening in each direction.</p>	High – concurrent with the proposal with potential increases to peak period traffic volumes
The Northern Road stage 4 upgrade (Mersey Road to Littlefields Road)	<p><b>Construction period:</b> Late 2017 – late 2019</p> <p><b>Construction duration:</b> 24 months</p> <p><b>Description:</b> Stage 4 extends from Mersey Road to Littlefields Road with a length of about 11 km. The project will be split in two sections being a diversion around the proposed western Sydney airport site at Badgerys Creek and passing through or around Luddenham town centre.</p>	High – concurrent with the proposal with potential increases to peak period traffic volumes
Bringelly Road stage 2 upgrade (King Street to The Northern Road)	<p><b>Construction period:</b> Early 2017 – mid 2019</p> <p><b>Construction duration:</b> 30 months</p> <p><b>Description:</b> Bringelly Road is being upgraded over a length of 4.7 km from a two lane road to a four lane divided road, with a wide central median to allow for widening to six lanes in the future.</p>	High – concurrent with the proposal with potential increases to peak period traffic volumes
Proposed western Sydney airport at Badgerys Creek	<p><b>Construction period:</b> Early 2016 - mid 2020</p> <p><b>Construction duration:</b> 54 months</p> <p><b>Description:</b> The proposed western Sydney airport was announced in April 2014 and planning for the development has commenced. The site is located about 3.7 km north of the proposal site.</p>	High – concurrent with the proposal with potential increases to peak period traffic volumes
Bringelly Brickworks expansion	<p><b>Construction period:</b> Details not yet known</p> <p><b>Construction duration:</b> Details not yet known</p> <p><b>Description:</b> In March 2015, the Minister for Planning approved an application to extend the Bringelly Brickworks operation. This involves an increase in processing and transporting up to 160,000 tonnes of bricks a year and up to 78 heavy vehicle movements and 55 light vehicle movements a day (into and out of the site).</p>	Moderate – although the timing of construction of the expansion is unknown, it is located in close proximity to the proposal site and has the potential to increase peak period traffic volumes

As noted in Table 6.8 the construction periods for a number of other projects in the surrounding area are likely to overlap with the construction of the proposal. The overlap of construction could potentially result in cumulative impacts for users of the existing road network and those living and working in and around the proposal study area, with potential impacts including:

- Increased number of construction related vehicles on roads in the study area
- The potential for a temporary shift in traffic movements from roads within the area to alternative routes, particularly during peak periods, as motorists try to avoid congestion caused by road works
- Temporary disruptions and delays to traffic, and difficulties accessing properties, due to the narrowing of lanes, speed restrictions, additional spoil and truck movements and temporary road closures.

The construction traffic management plan for the proposal (refer to section 6.1.4) would consider the potential for cumulative impacts. The plan would focus on maintaining general traffic flow and specifying appropriate site accesses and construction traffic routes.

## Operation

### ***Future intersection performance***

The potential operational performance of The Northern Road and Bringelly Road was modelled using SIDRA for the following scenarios:

- 2019, 2029 and 2039 – performance of the existing intersection without the proposal (the 'do nothing' scenario)
- 2019, 2029 and 2039 – performance of the proposal
- 2019, 2029 and 2039 – performance of the existing intersection once the proposal is operational.

The modelling results summarised in Table 6.9 (and provided in full in Appendix D) indicate that:

- If the proposal was not undertaken, with the forecasted growth rate figures for the surrounding area, the existing intersection of the Northern Road, Bringelly Road and Greendale Road would operate over capacity (level of service F) during both the morning and evening peaks in 2019, 2029 and 2039, resulting in lengthy queues and extended delays
- The proposal would operate satisfactorily at LoS B in the AM and PM peaks in 2019 and at LoS C in the AM and PM peaks for both 2029 and 2039
- The existing intersection (once the proposal is operational) would operate satisfactorily, with a level of service B in the AM and PM peak in 2019, at LoS B in the AM peak for 2029 and LoS C in the AM peak for 2039. Both the PM peaks in 2029 and 2039 will operate over capacity at LoS F even with the operation of the bypass due to increased traffic volumes as a result of land release in the area.

Based on the current configuration of the intersection of Greendale Road, Bringelly Road and the existing alignment of The Northern Road, Greendale Road will be operating above capacity in 2029 due to predicted development to the west of Bringelly. It is anticipated that upgrade works would be required along Greendale Road to improve the capacity to coincide with the additional land development.

Table 6.9 The Northern Road and Bringelly Road intersection performance

Year	Existing intersection (no upgrade)				The proposal				Existing intersection with the proposal			
	Morning peak		Evening peak		Morning peak		Evening peak		Morning peak		Evening peak	
	LoS	Avg delay (s)	LoS	Avg delay (s)	LoS	Avg delay (s)	LoS	Avg delay (s)	LoS	Avg delay (s)	LoS	Avg delay (s)
2019	<b>F</b>	324	<b>F</b>	2205	B	28	B	25	B	17	B	17
2029	<b>F</b>	1039	<b>F</b>	4780	C	29	C	29	B	23	F	112
2039	<b>F</b>	2898	<b>F</b>	3154	C	35	C	33	C	40	F	1,221

Note: Bold font indicates operation over capacity.

### **Impacts on property access and local traffic movements**

As discussed in section 0, driveway access to all existing properties along the bypassed section of The Northern Road, Bringelly Road and Robinson Road would be retained.

A property access strategy has been prepared to outline the proposed access arrangements for each property affected by the proposal. This is provided in Appendix F of Appendix D. The property access strategy outlines travel routes for properties along the proposal site. It also includes travel distances northbound to Solway Road, and southbound to Belmore Road, as a result of the change in access arrangements associated with the restrictions to access along the new section of The Northern Road.

Additionally, the conversion of the existing section of The Northern Road to a 'no through road' would require some local traffic to use alternative routes to access The Northern Road and Bringelly Road. This has the potential to change average distances travelled. Estimated travel distances during operation for properties on Robinson Road and Thames Road are summarised in Table 6.10.

Table 6.10 Proposed average travel distances from Robinson Road and Thames Road

From	To	Additional travel distance (km)	Additional travel time (minutes)
Robinson Road at The Northern Road	The Northern Road / Carrington Road Intersection	2.7	2
	The Northern Road / Bringelly Road Intersection	3.4	2.6
	The Northern Road / Loftus Road Intersection	4	3
Thames Road at The Northern Road	The Northern Road / Badgerys Creek Road	1.5	0.8

Note: \*Based on the existing posted speed limit of 80 km/h

A summary of property access arrangements when the proposal is operational is provided below:

- Some property accesses to Robinson Road may need to be modified as a result of the proposed Belmore Road/Robinson Road connection
- A shared left in-left out driveway access would be required for some properties south of Thompsons Creek to enable them to safely access The Northern Road
- Properties on Thames Road would require access to The Northern Road via a connection to the proposed cul-de-sac on the existing alignment of The Northern Road
- Existing driveways on Bringelly Road would be reconfigured to suit the proposal with left in-left out access
- Properties facing the existing alignment of The Northern Road would retain access and would access the main alignment of The Northern Road via the existing intersection and the proposed interchange.

Implementation of the property access strategy would ensure safe and legal access is provided for all properties with access to The Northern Road and Bringelly Road. Roads and Maritime would consult with individual property owners to identify appropriate access arrangements that are consistent with the proposal.

## Parking

Existing parking restrictions would be unaffected by the proposal. Parking restriction signage and line marking would be adjusted to suit the new pavement and kerb and gutter.

## Public transport

The proposed arrangements for bus services are shown in Figure 6.2. Changes to bus stop locations and/or new stops are listed in Table 3.4. It is anticipated that bus route 856 would operate along the new section of The Northern Road.

An additional bus route named as route 2-3 is expected to have seven buses in each direction during peak periods (as advised by Transport for NSW). This bus route is a result of planned future development in the Western Sydney Priority Growth Area and South West Priority Land Release Area.

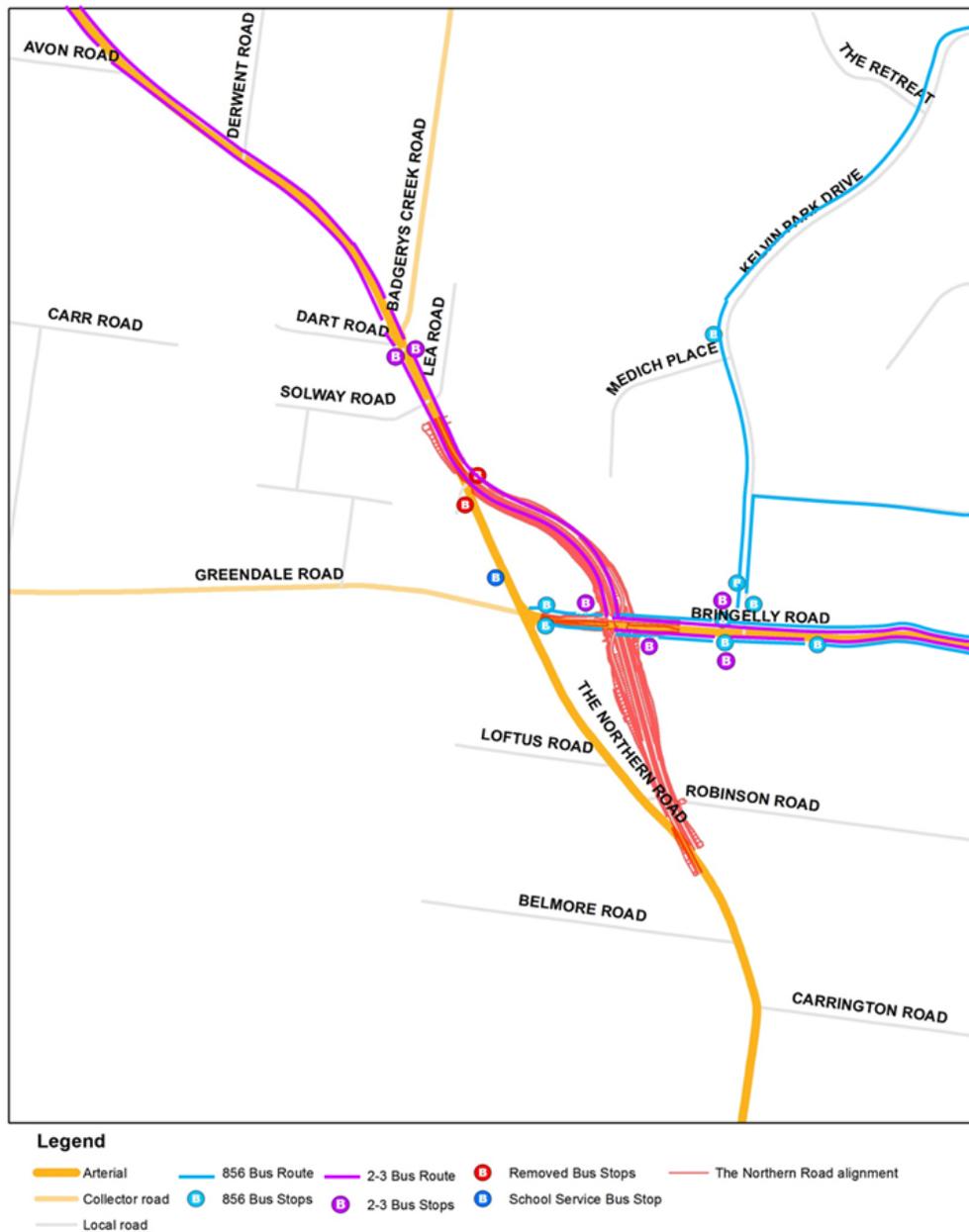


Figure 6.2 Proposed future bus routes

### **Pedestrian and cyclist facilities**

As the Western Sydney Priority Growth Area and South West Priority Land Release Area develops, additional cycleways will be built and an integrated cycle network will be developed. By 2018, the upgrade of Bringelly Road would deliver more than 10 km of shared pedestrian and cyclist paths between Leppington and The Northern Road. By 2019 The Northern Road is expected to have shared pedestrian and cyclist paths between Narellan and beyond the M4 Motorway.

The proposal would improve walking and cycling access within the local area by providing shared paths along the existing section of The Northern Road and Bringelly Road and provision for future shared paths along the upgraded The Northern Road (refer to section 3.2.4 and Figure 6.3).

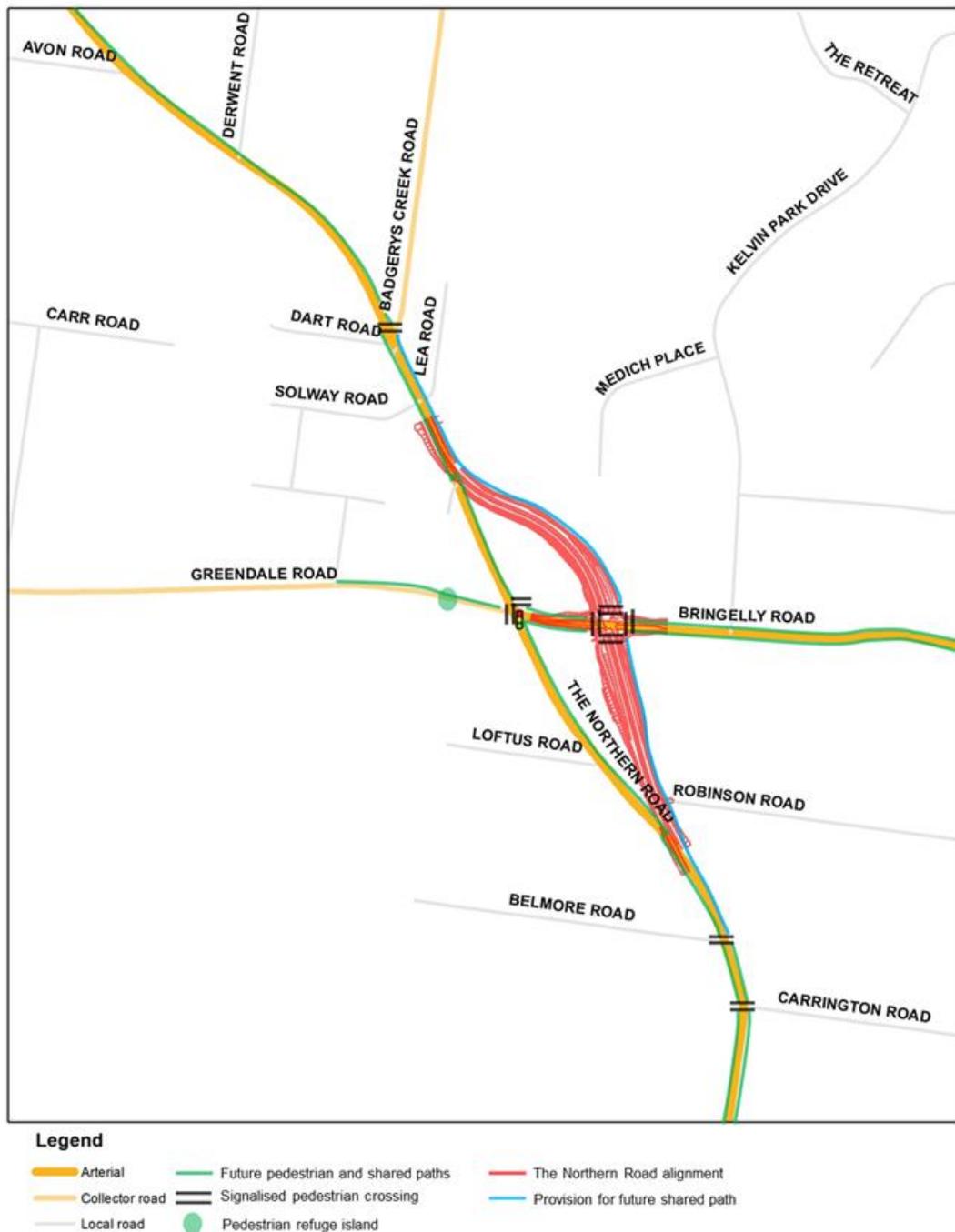


Figure 6.3 Proposed future pedestrian and cyclist facilities/movements

#### 6.1.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Pre-construction</b>			
Construction traffic management	A detailed traffic management plan would be prepared in accordance with <i>Traffic Control at Work Sites</i> (RTA, 2010) and Specification G10 - <i>Control of Traffic</i> . The plan would be approved by Roads and Maritime before implementation to provide a comprehensive and objective approach to minimise any potential impacts on road and pedestrian operations during construction.	Construction contractor	Pre-construction
	<p>The plan would be submitted in stages to reflect the progress of work and would:</p> <ul style="list-style-type: none"> <li>Identify the traffic management requirements during construction, particularly for the traffic diversion</li> <li>Describe the general approach and procedures to be adopted when producing specific traffic control plans</li> <li>Ensure the continuous, safe and efficient movement of traffic for both the public and construction workers</li> <li>Maintain the capacity of local roads</li> <li>Determine temporary speed restrictions to ensure safe driving environments around work zones</li> <li>Undertake a speed limit review of local roads associated with the traffic diversion</li> <li>Minimise impacts on existing roads and local traffic</li> <li>Provide access to local roads and properties, including the use of temporary turnaround bays</li> <li>Provide temporary works and traffic signals</li> <li>Determine the number and width of traffic lanes in operation</li> <li>Identify traffic barrier requirements and placement</li> <li>Include the need to consult with emergency services on access changes</li> <li>Include methods for implementing the traffic management plan</li> <li>Include methods for minimising road user delays</li> <li>Provide appropriate warning and advisory signposting</li> <li>Consider other developments that may also be under construction, to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic</li> <li>Maintain designated pedestrian and cyclist access for safe movements in the study area.</li> </ul>	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	Consultation would be undertaken with Interline Bus Services before and during construction to confirm bus diversions and bus stop closures.	Roads and Maritime	Pre-construction and construction
	A speed limit review of the traffic diversion through Robinson Road and Jersey Road would be undertaken to determine if a temporary speed reduction is required during the diversion	Roads and Maritime	Pre-construction and construction
	Consultation with the Transport Management Centre would be undertaken to manage cumulative construction traffic impacts	Roads and Maritime	Pre-construction and construction
	Consultation would be undertaken with Bringelly Public School to ensure safe walking to School can be maintained during construction	Roads and Maritime	Pre-construction and construction
	The community would be kept informed about construction through advertisements in the local media and by prominently placed advisory notices or variable message signs.	Roads and Maritime	Pre-construction and construction
<b>Construction</b>			
Congestion and safety	Traffic control would be provided to manage and regulate traffic movements during construction. For example, construction and delivery vehicles entering or leaving the site compound would use arterial roads. These movements would be restricted to non-peak traffic periods wherever possible.	Construction contractor	Construction
	Disruption to all road users during the construction period would be kept to a minimum.	Construction contractor	Construction
	Clear signage would be provided if traffic or footpath diversions are required.	Construction contractor	Construction
Access to properties	Property access would be maintained throughout the construction period with suitable alternative access arrangements provided.	Construction contractor and Roads and Maritime	Construction
	Where changes to access arrangements are necessary, Roads and Maritime would advise owners and tenants and consult with them in advance regarding alternate access arrangements.	Construction contractor and Roads and Maritime	Construction

## 6.2 Noise and vibration

### 6.2.1 Overview

This section provides the results of a noise and vibration assessment of the proposal undertaken by GHD. The assessment involved:

- Identifying sensitive receivers
- Undertaking unattended background noise monitoring
- Establishing the noise and vibration assessment criteria for the proposal
- Modelling construction noise using the computer aided noise abatement model (CadnaA)

- Assessing the potential construction noise and vibration impacts by comparing the predictions with the criteria
- Assessing the potential for operational noise impacts
- Providing mitigation measures, where required.

The assessment was undertaken in accordance with the following guidelines:

- *Road Noise Policy (RNP)* (DECCW, 2011)
- *Noise Criteria Guideline (NCG)* (RMS, 2014)
- *Noise Mitigation Guideline (NMG)* (RMS, 2014)
- *Interim Construction Noise Guideline (ICNG)* (DECC, 2009)
- *Assessing Vibration: A Technical Guideline* (DEC, 2006)
- *DIN 4150, Part 3: Structural Vibration in Buildings – Effects on Structures* (German Standard, 1999).

## 6.2.2 Existing environment

### **Sensitive receivers**

A total of 118 receivers have been identified within 600 m of the proposal site. The locations of these receivers are shown in Figure 6.4.

### **Existing noise environment**

The dominant influence on ambient noise levels is road traffic along The Northern Road and Bringelly Road.

Noise monitoring was undertaken between 15 and 27 July 2015 at six locations to determine the background noise levels in the vicinity of the proposal site. Monitoring locations are shown on Figure 6.4. Each of the six monitoring locations was selected as it is considered to be representative of noise levels resulting from road traffic noise and to provide background noise levels.

A summary of the monitoring results is provided in Table 6.11.

Table 6.11 Summary of noise monitoring results, dB(A)

Monitoring location	Address	Background noise descriptors			Road traffic noise descriptors		
		L <sub>A90</sub> (Day)	L <sub>A90</sub> (Evening)	L <sub>A90</sub> (Day)	L <sub>Aeq</sub> (15hr)	L <sub>Aeq</sub> (9hr)	L <sub>A10</sub> (18hr)
		7 am to 6 pm, Monday to Saturday; 8 am to 6 pm Sundays & Public Holidays	6 pm to 10 pm, Monday to Sunday & Public Holidays	7 am to 6 pm, Monday to Saturday; 8 am to 6 pm Sundays & Public Holidays	7 am to 10 pm weekdays	10 pm to 7 am weekdays	6 am to 12 am weekdays
L1	1262 The Northern Road	50	44	33	65	59	65
L2	1178 The Northern Road	45	43	37	62	53	60
L3	1202 Bringelly Road	42	41	37	54	49	55
L4	25 Medich Place	40	40	33	52	52	51
L5	1089 The Northern Road	43	41	36	59	48	54
L6	105 Robinson Road	39	39	34	55	48	52



### 6.2.3 Noise and vibration criteria - construction

#### Construction noise management levels

Proposal specific construction noise management levels were developed in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) for each identified sensitive receiver.

For work during recommended standard hours:

- The 'noise affected level' represents the point above which there may be some community reaction to noise. The noise affected level is calculated by adding 10 dB(A) to the rating background level. For this assessment, the measured short-term background noise levels have been used.
- The 'highly noise affected level' represents the point above which there may be strong community reaction to noise. The ICNG specifies that the highly noise affected level is 75 dB(A).

For any work outside recommended standard hours:

- A strong justification would typically be required for works outside the recommended standard hours
- The proponent should apply all feasible and reasonable work practices to meet the noise affected level
- Where all feasible and reasonable practices have been applied and noise is more than five dB(A) above the noise affected level, the proponent should negotiate with the community.

For work outside recommended standard hours, the construction noise management level is calculated by adding five dB(A) to the rating background level. The noise management level for sleep disturbance is based on a maximum internal noise level of 55 dB(A)  $L_{Amax}$  as recommended by the *Road Noise Policy* and a 10 dB(A) reduction in noise from outside the building.

The *Road Noise Policy* acknowledges that one or two noise events per night with maximum external noise levels of 75 to 80 dB(A) are unlikely to significantly affect health and wellbeing.

The proposal specific construction noise management levels and sleep disturbance criteria are provided in Table 6.12.

Table 6.12 Proposal specific construction noise management levels

Receiver	Construction noise management level, $L_{Aeq(15min)}$ (dB(A))					Sleep disturbance
	During standard construction hours		Outside standard construction hours <sup>2</sup>			$L_{Amax}$ (dB(A))
	Noise affected level	Highly noise affected level	Day 7am to 8am and 1pm to 6pm Saturday, 8am to 6pm Sunday & public holidays	Evening 6pm to 10pm Monday to Sunday & public holidays	Night 10pm to 7am, Monday to Saturday; 10pm to 8am Sunday & public holidays	Night 10pm to 7am, Monday to Saturday; 10pm to 8am Sunday & public holidays
Residents	53	75	48	46	40	60 to 65
Bringelly School (R009)	45 (internal noise level) <sup>2</sup>					
Commercial premises (R011 & R012)	70 (external noise level) <sup>2</sup>					

Note: 1 - External noise level based on RNP guidance and assuming windows partially open with 10 dB(A) reduction in noise from outside the building to inside the bedroom.  
 2 - Applies when properties are being used.

### Construction vibration criteria

#### Human comfort criteria

Human comfort vibration criteria have been set with consideration to *Assessing Vibration: A Technical Guideline* and British Standard (BS) 6472 – 1992, *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* which is recognised by the Office of Environment and Heritage as the preferred standard for assessing ‘human comfort’ in relation to potential vibration impacts.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 6.13 for sensitive receivers.

Table 6.13 Human comfort intermittent vibration limits (BS 6472-1992)

Receiver type	Period	Intermittent vibration dose value ( $m/s^{1.75}$ )	
		Preferred value	Maximum value
Residential	Day (7am and 10pm)	0.2	0.4
	Night (10pm and 7am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

Humans are capable of detecting vibration at levels which are well below those that could cause damage to a building. The degrees of perception for humans are shown in Table 6.14.

Table 6.14 Guidance on effects of vibration levels for human comfort (BS 5228.2-2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

### Structural damage criteria

Table 6.15 presents the German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* minimum safe levels of vibration at different frequencies for commercial, residential buildings. Based on DIN 4150-3, a measured value exceeding those listed in Table 6.15 “...does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.”

Table 6.15 Guideline values for short term vibration on structures

Line	Type of structure	Guideline values for velocity, (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz <sup>1</sup>
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (eg listed buildings under preservation order).	3	3 to 8	8 to 10

Note: At frequencies above 100 Hz the values given in this column may be used as minimum values.

## 6.2.4 Noise and vibration criteria - operation

### Road noise policy and noise criteria guidelines

The RNP provides non-mandatory traffic noise assessment criteria for residential receivers and sensitive land uses near new roads and redevelopments of existing arterial roads. The NCG provides guidance on how to apply the RNP. The target levels should aim to be achieved 10 years after the proposal opening.

The RNP and NCG road traffic noise assessment criteria are presented in Table 6.16. Where residences are exposed to both new and existing roads, the NCG provides transition zone criteria. Further discussion of the transition zone criteria is provided in section 4.1.1 of Appendix E. Two transition zones have been identified in the vicinity of the proposal site; these are located at the following road junctions:

- The Northern Road (existing) to The Northern Road (new alignment) - there are two transition zones, one at each end of the proposal site. The noise criteria would be between the new and redeveloped RNP noise criteria at residences identified within the transition zone
- The new intersection between the proposal and Bringelly Road.

For the purposes of the assessment, The Northern Road and Bringelly Road are arterial roads. Greendale Road is a collector road and is assessed using sub-arterial road criteria. The location of new road corridors and existing roads as discussed in Table 6.16 are shown on Figure 6.5.

Table 6.16 Road traffic noise assessment criteria for residential land uses,  $L_{Aeq(period)}$ , dB(A)

Road category	Type of project	Assessment criteria (external)	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Arterial roads / sub-arterial roads	Existing residences affected by noise from new arterial road corridors	$L_{Aeq(15hr)}$ 55	$L_{Aeq(9hr)}$ 50
	Existing residences affected by noise from redevelopment of an existing arterial road	$L_{Aeq(15hr)}$ 60	$L_{Aeq(9hr)}$ 55
	Existing residences affected by both new roads and the redevelopment of existing arterial/sub-arterial roads in a Transition Zone	Between $L_{Aeq(15hr)}$ 55-60 (external)	Between $L_{Aeq(9hr)}$ 50-55 (external)
	Existing residences affected by increases in traffic noise of 12dBA or more from new arterial/sub-arterial roads	Between $L_{Aeq(15hr)}$ 42-55 (external)	Between $L_{Aeq(9hr)}$ 42-50 (external)
	Existing residences affected by increases in traffic noise of 12dBA or more from redevelopment of existing arterial/sub-arterial roads	Between $L_{Aeq(15hr)}$ 42-60 (external)	Between $L_{Aeq(9hr)}$ 42-55 (external)

Bringelly Public School is located adjacent to The Northern Road. The NCG internal criteria for school classrooms during the day is 40 dB(A). The relevant external criteria for assessment purposes is 50 dB(A), which assumes a 10 dB(A) difference between internal and external noise levels for buildings other than residences as per guidance in the ICNG.

Where existing noise levels are above the criteria, the RNP relative increase criterion is used. The relative increase criteria is exceeded if the 'build option' noise levels increase by more than 12 dB(A) above the 'no-build option' noise levels.

### Sleep disturbance

The RNP provides a literature review for the assessment of sleep arousal due to traffic noise, however it does not provide a specific sleep disturbance assessment criterion. Sleep disturbance impacts are likely to depend on the following:

- Maximum noise level of an event
- Number of occurrences
- Duration of the event
- Level above background or ambient noise levels.

For continuous rather than intermittent traffic flow, the ENMM recommends  $L_{Amax}$  noise pass-by events should not exceed  $L_{Aeq(1hr)}$  noise levels by more than 15 dB(A). The ENMM advises that maximum noise levels can be used as a tool to prioritise and rank mitigation strategies, but should not be applied as a decisive criterion in itself.

### Proposal specific operational noise criteria

The proposal specific operational noise criteria have been based on the above criteria. This includes the application of receivers within the transition zone and other receivers. The proposal specific operational criteria for the day and night time periods for all receivers are shown on Figure 6.5 and Figure 6.6 respectively.

#### 6.2.5 Potential impacts

##### Construction noise

Construction activities would result in a short-term increase in localised noise levels, particularly for residences close to the proposal site. For the purposes of the noise assessment, construction activities have been grouped into eight possible scenarios. The scenarios, construction equipment and estimated combined sound power level of each scenario are outlined in Table 6.17.

Table 6.17 Construction activities and equipment sound power levels

Construction activity scenario	Loudest construction equipment and sound power level (dB(A))	Combined sound power level during scenario (dB(A))
Scenario 1 - Site compound	Trucks - 108 Hand tools - 118	118
Scenario 2 - Site establishment	Trucks – 108 Crane – 110	112
Scenario 3 - Utility relocations and property adjustments	Excavator 20 tonne – 105 Jackhammer - 113	114
Scenario 4 - Earthworks and drainage	Excavator 30 tonne – 110 Dozer D9 - 120	120
Scenario 5 - Retaining wall	FE loader – 111 Excavator 10 tonne - 100	111
Scenario 6 - Bridge works	Concrete truck – 112 Vibratory pile driver - 121	122
Scenario 7 - Pavement works	Vibratory roller – 114 Asphalt rotomill – 111	116
Scenario 8 - Finishing and landscaping	Compressor 1500 CFM – 105 Scraper - 116	116

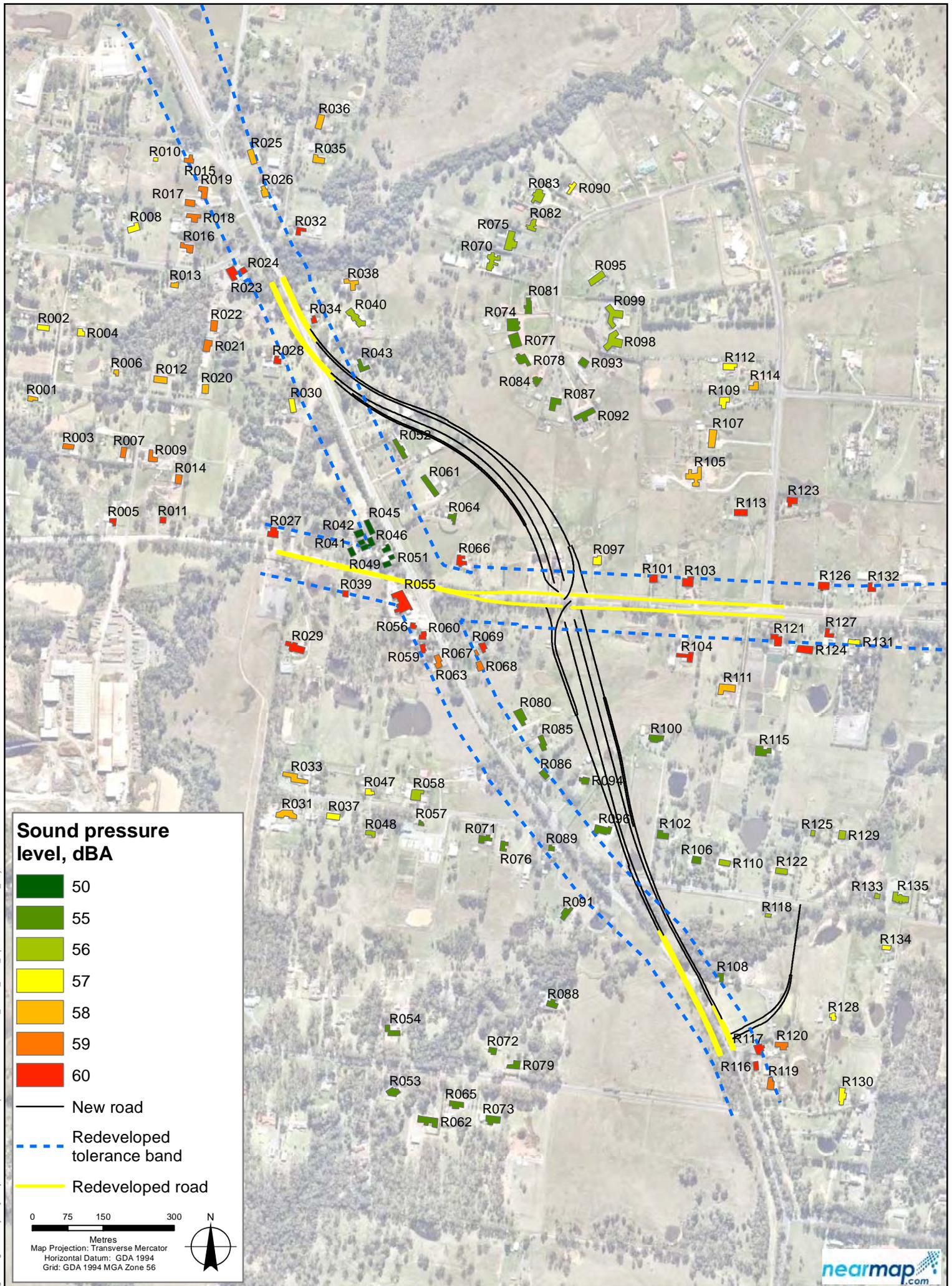
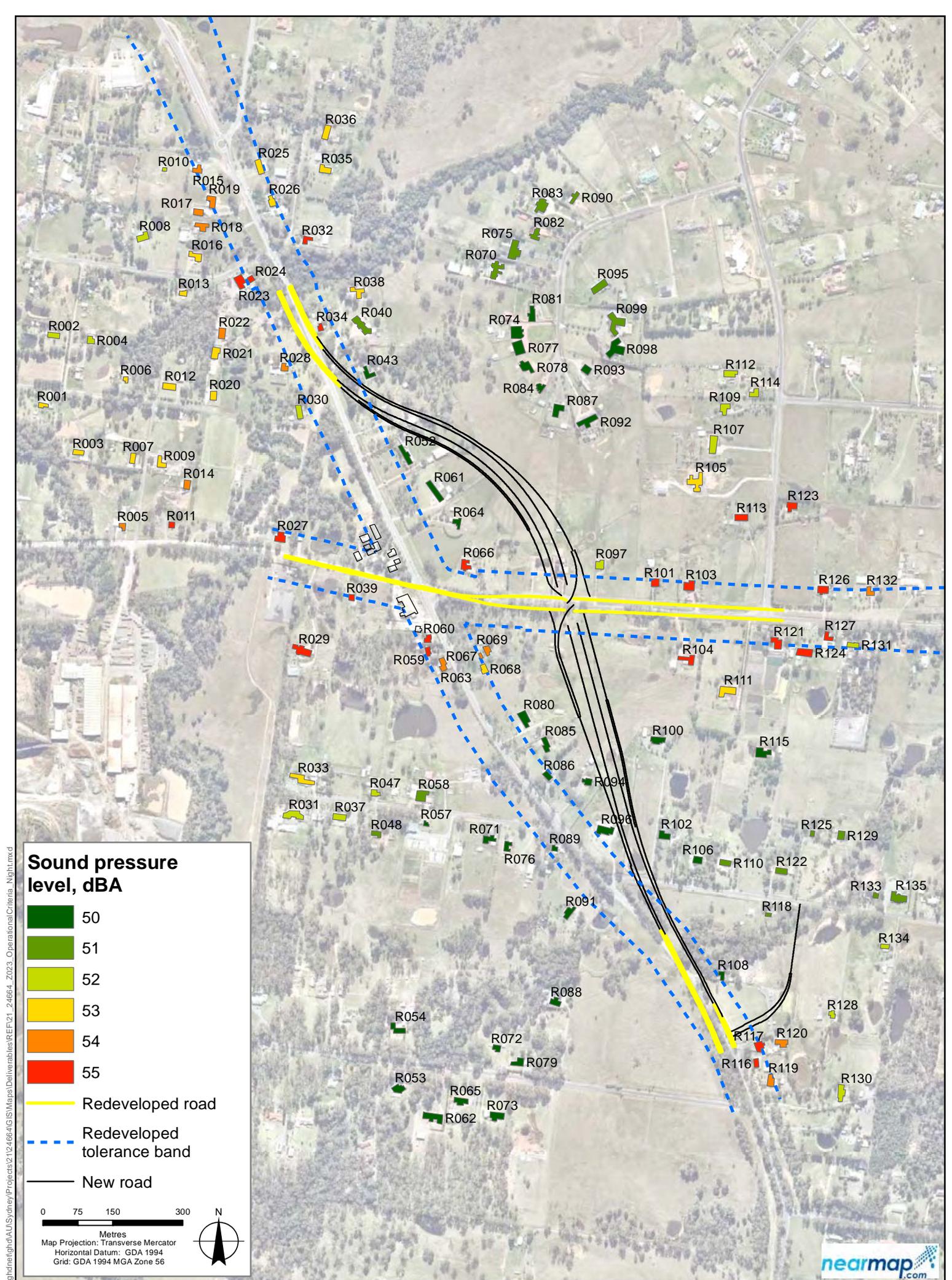


Figure 6.5  
Operational criteria - daytime period



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Figure 6.6  
Operational criteria - night-time period

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by: MWeerakoon



Construction of the proposal would be undertaken mainly during standard hours, however some works would be required to be undertaken outside standard hours to minimise safety risks and impacts on the operation of the existing road network. Under the *Interim Construction Noise Guideline* (DECC, 2009), these works would be classified as 'works for which it can be demonstrated that there is a need to operate outside the recommended standard hours'.

Figure 6.7 to Figure 6.13 provide a summary of the receivers where exceedances of the construction criteria are expected for each construction scenarios (exceedances are shown as red). Detailed construction noise levels for each receiver are provided in Appendix F of Appendix E.

The results provided in these tables indicate that, without mitigation, construction noise may exceed the noise management levels at up to 110 sensitive receivers during standard construction hours. The highly noise affected criteria is predicted to be exceeded at up to 13 sensitive receivers.

Outside standard construction hours, construction noise is predicted to exceed the noise affected noise management level at most residential receivers.

The above results provide a worst case scenario. Construction noise levels were predicted based on the assumption that equipment would operate at maximum sound power levels in one location without any noise management controls. In reality, construction would move around the proposal site during the construction period. This would alter noise impacts with respect to individual receivers. Therefore, the actual noise generated by construction would generally be less than the predicted noise levels.

During any given period, equipment would operate at maximum sound power levels for only brief periods. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is likely that certain types of construction machinery would be present within the proposal site for only brief periods during construction. Therefore, noise predictions are considered to be conservative.

Mitigation measures and safeguards detailed in section 6.2.6 would be implemented where feasible and reasonable to reduce noise impacts.

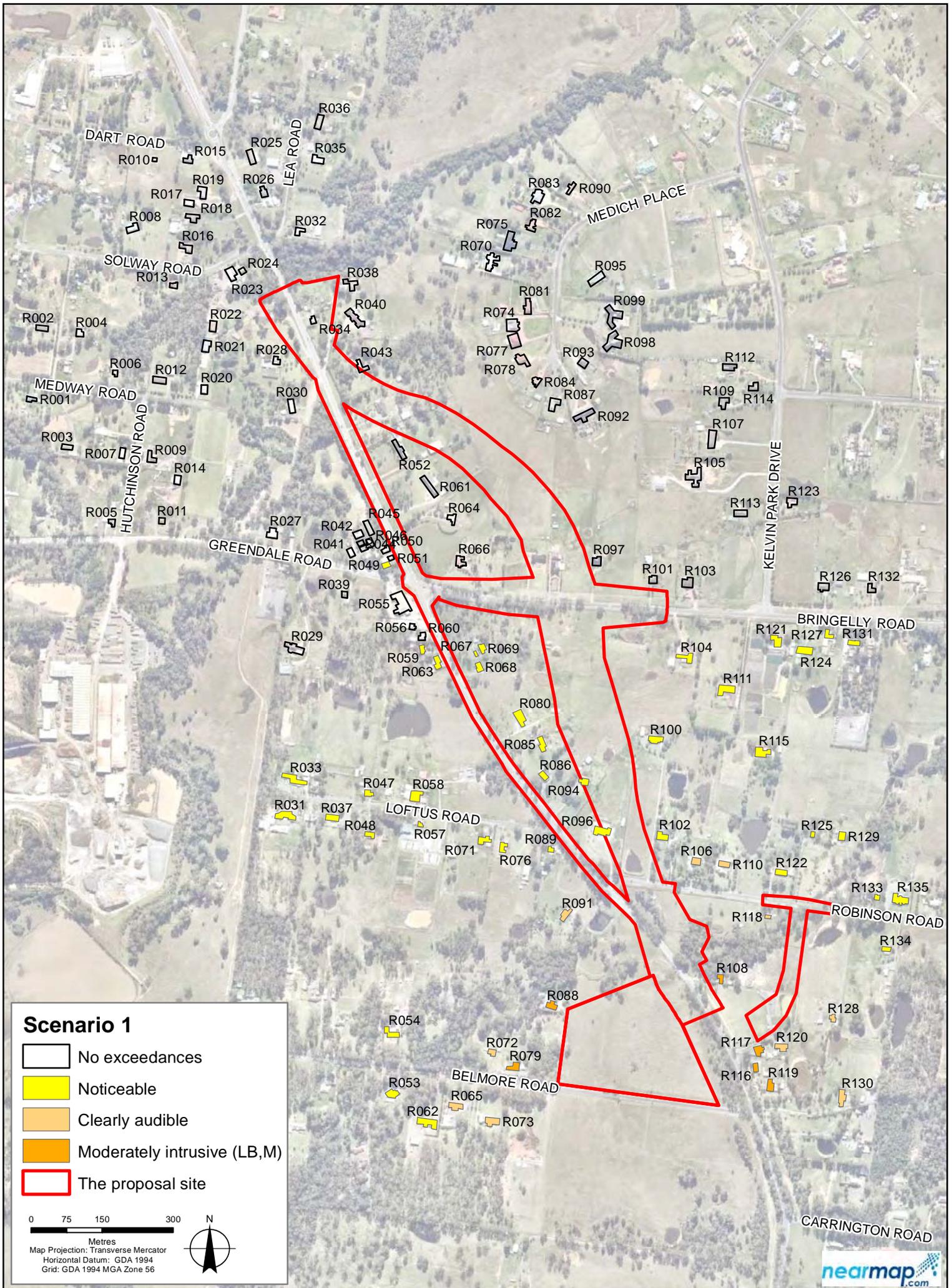


Figure 6.7  
 Predicted day-time noise exceedances - construction scenario 1

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by jrjrichardson

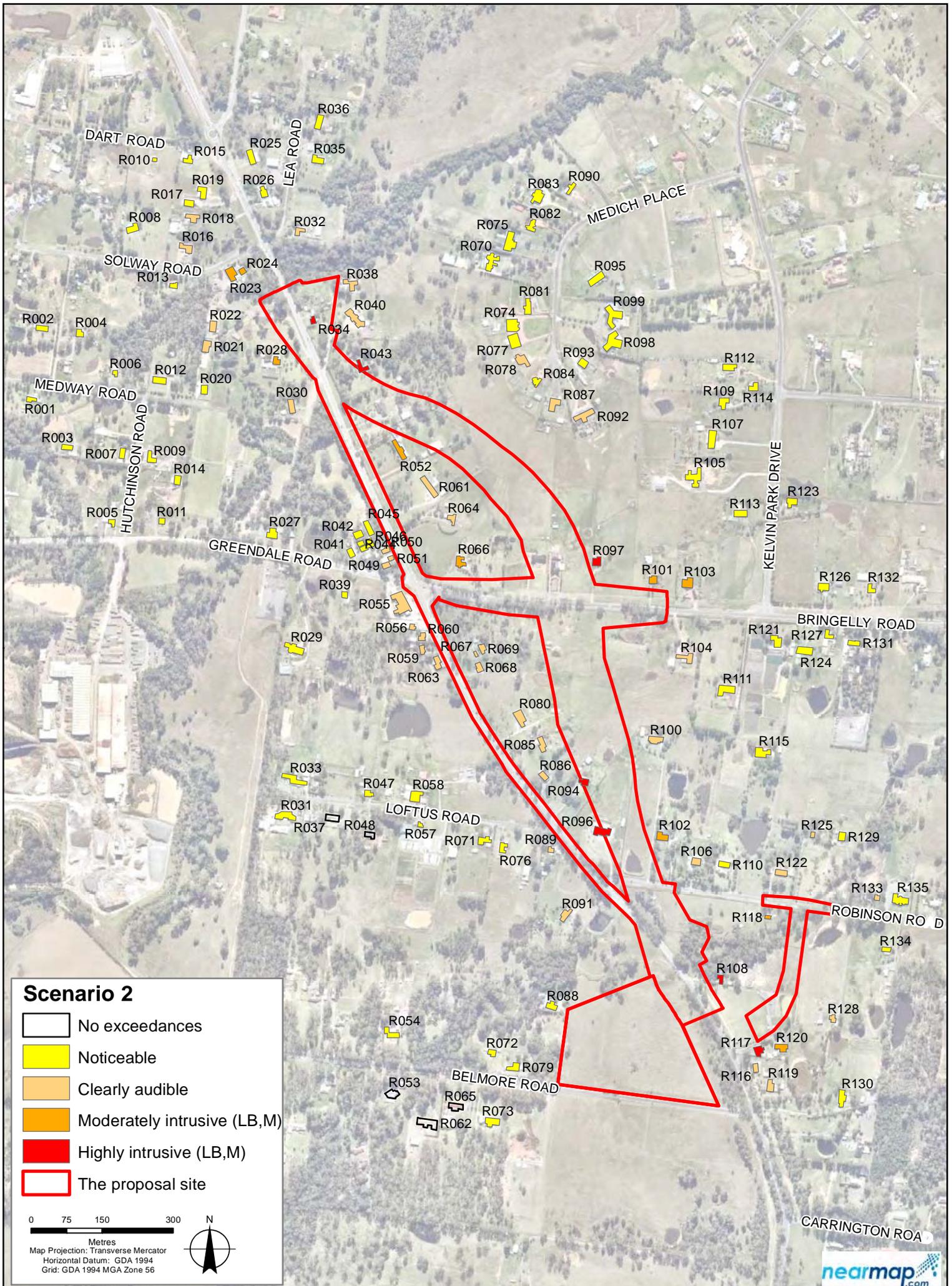


Figure 6.8  
 Predicted day-time noise exceedances - construction scenario 2

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by jrjrichardson

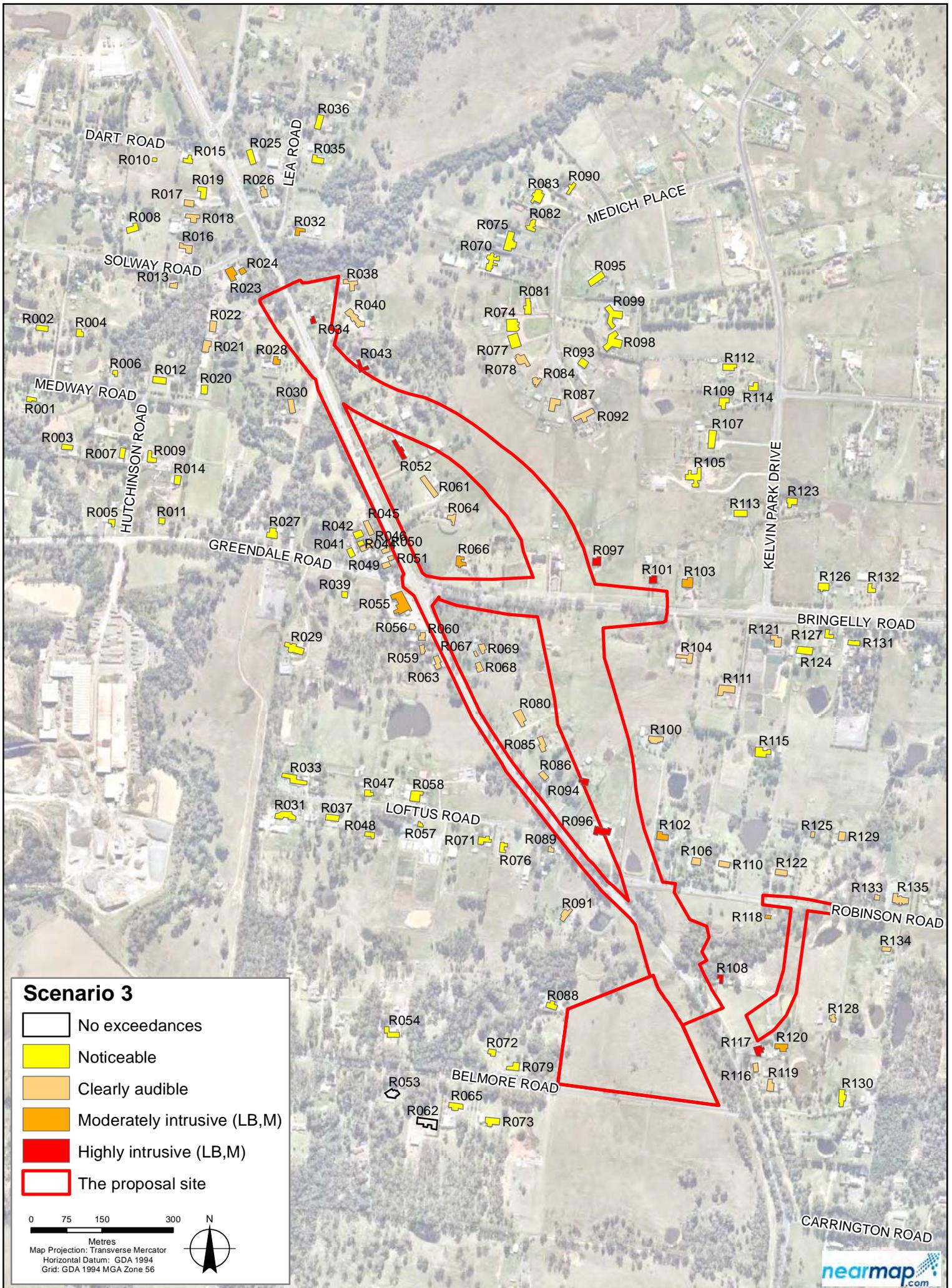


Figure 6.9  
 Predicted day-time noise exceedances - construction scenario 3

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by jrjrichardson

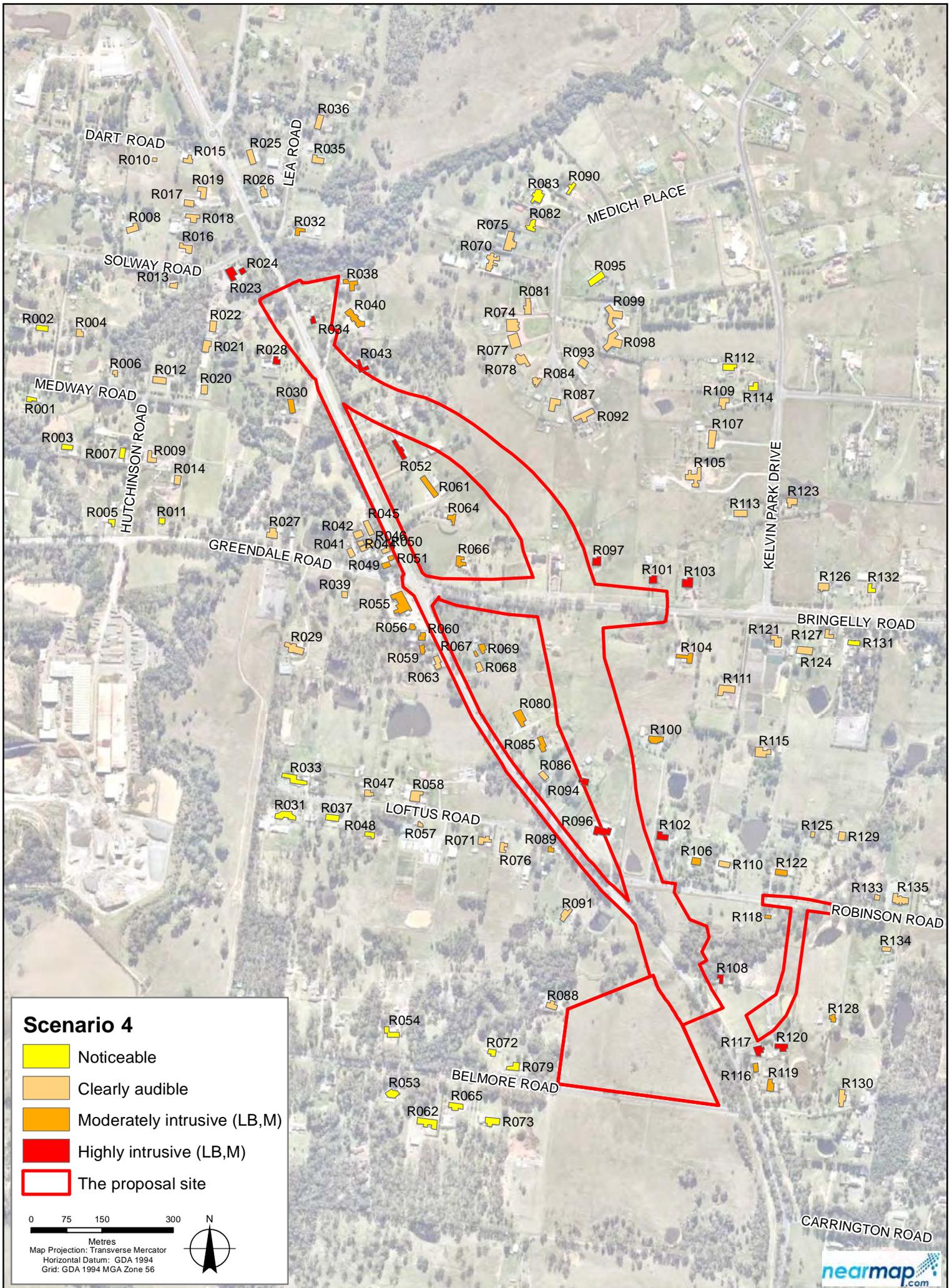


Figure 6.10  
 Predicted day-time noise exceedances - construction scenario 4

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by jrjrichardson

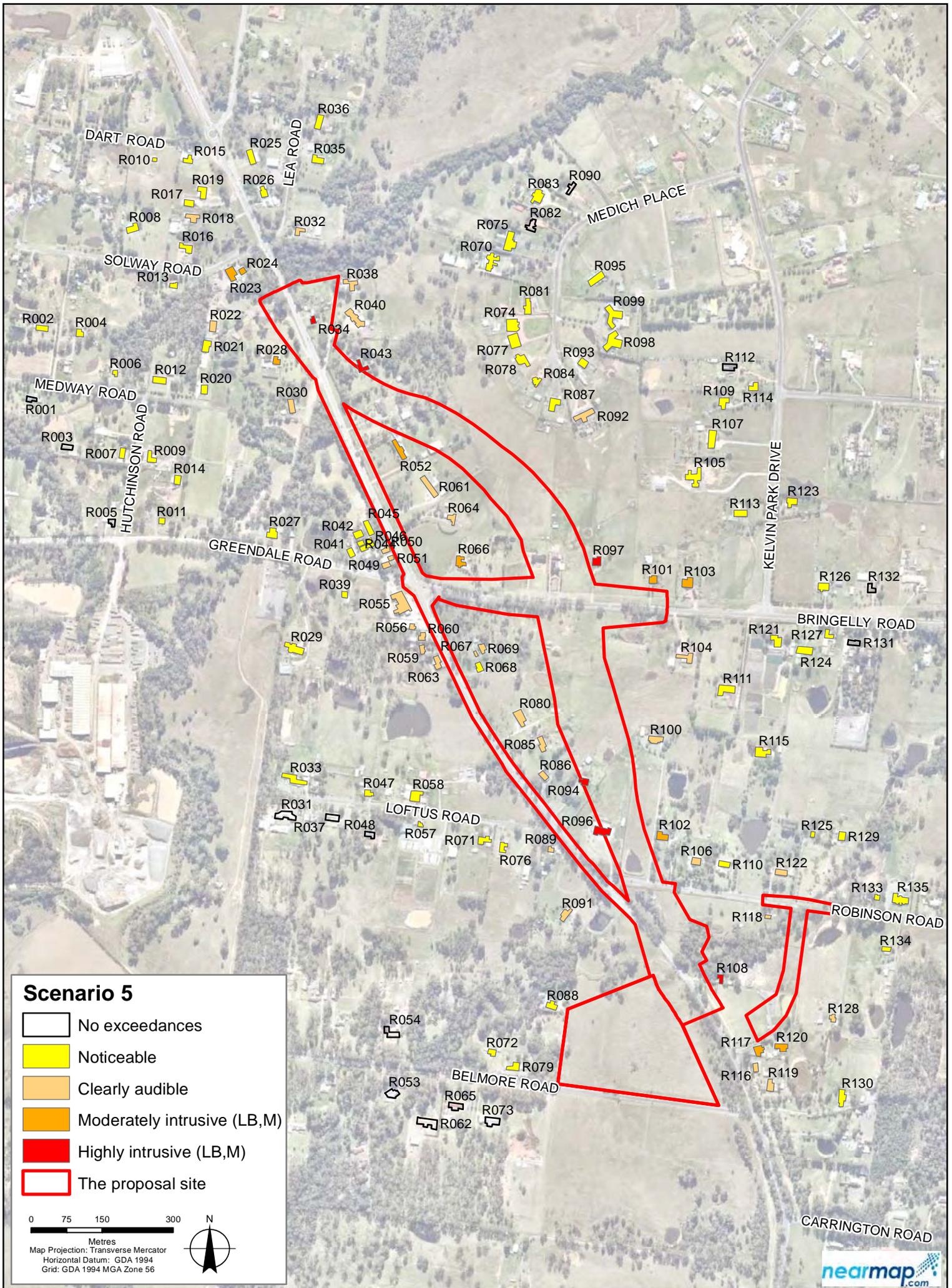


Figure 6.11  
 Predicted day-time noise exceedances - construction scenario 5

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by jrjrichardson

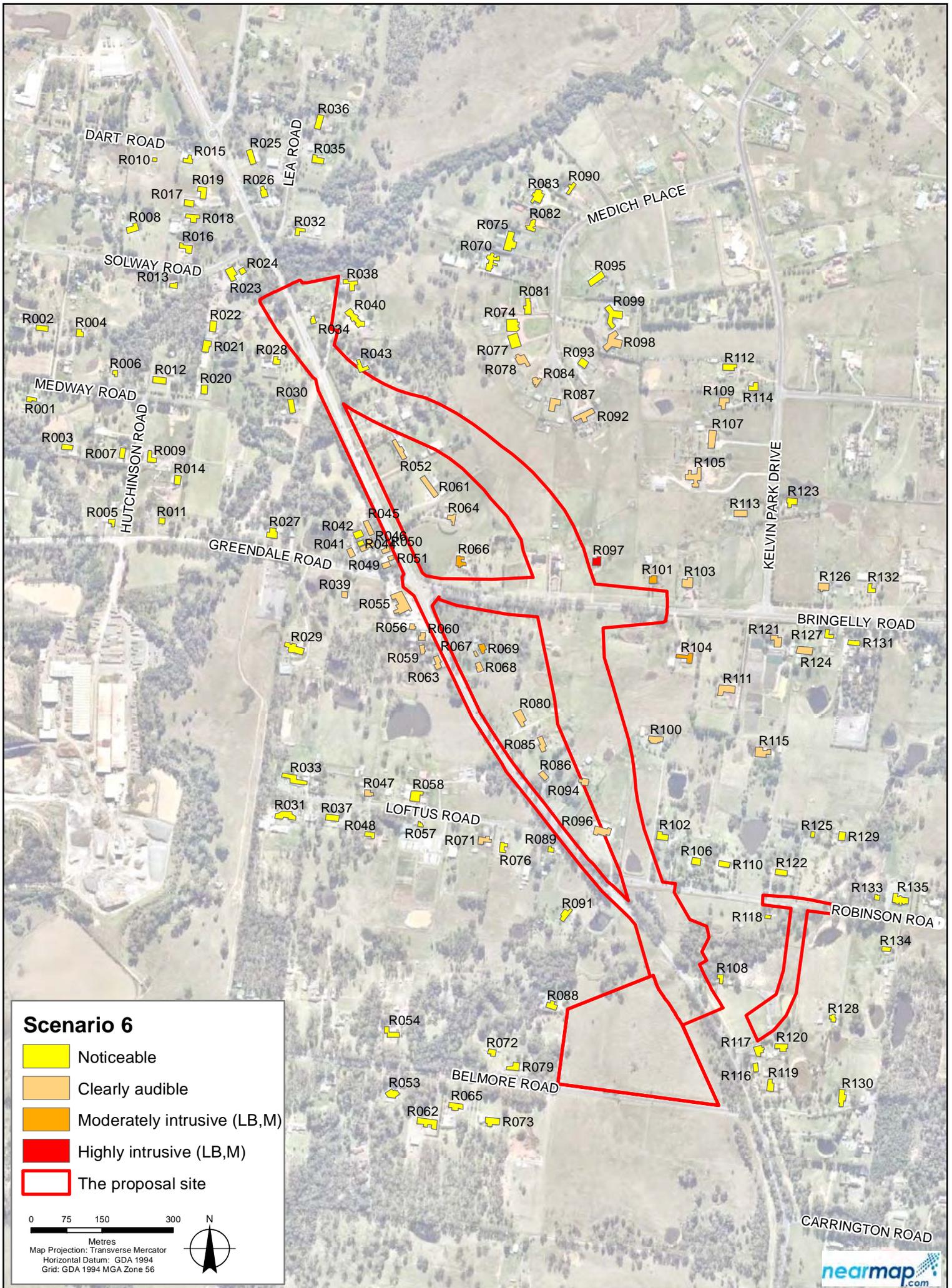


Figure 6.12  
Predicted day-time noise exceedances - construction scenario 6

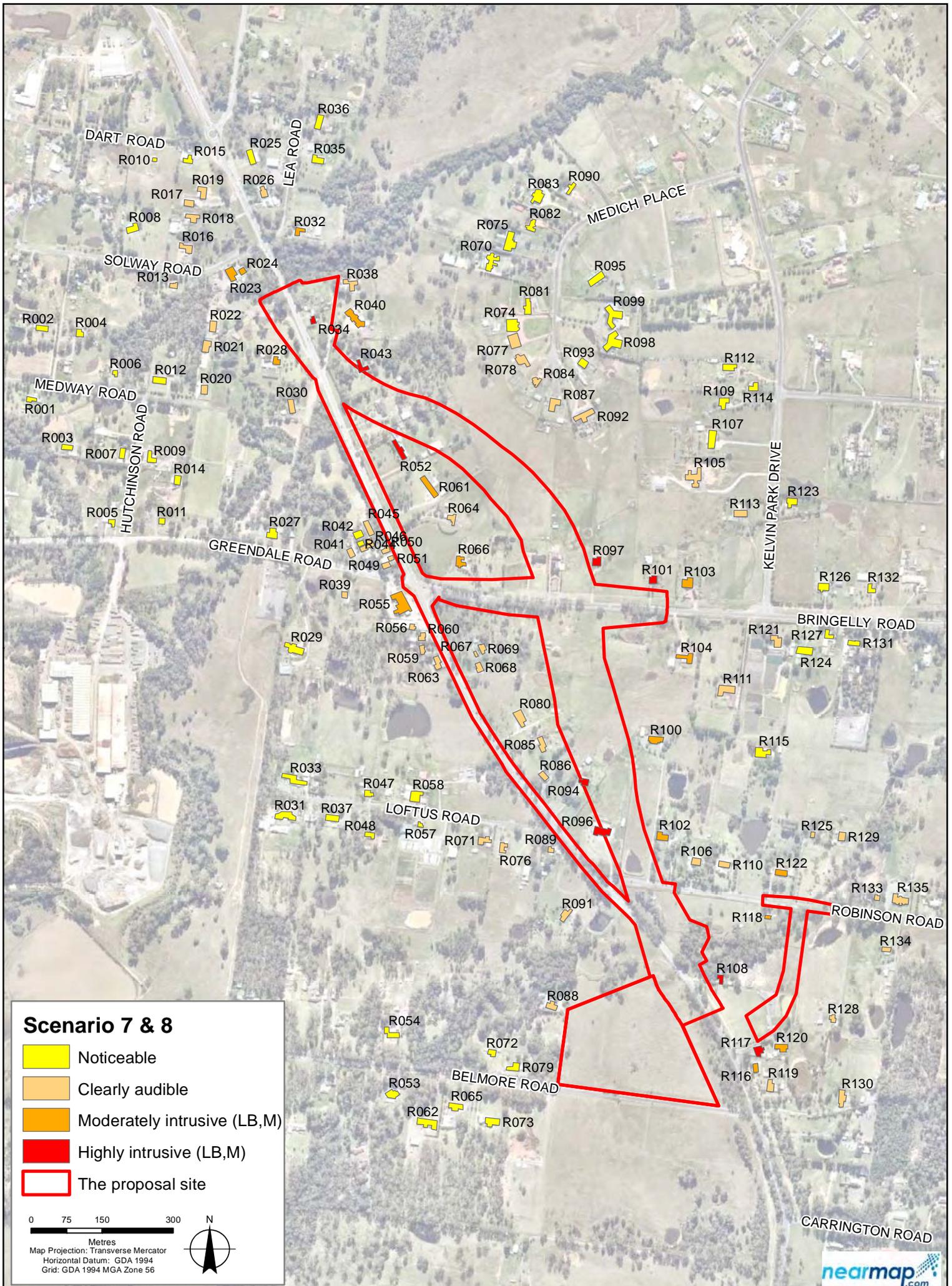


Figure 6.13  
 Predicted day-time noise exceedances - construction scenario 7 and 8

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by jrjrichardson

### **Sleep disturbance**

During out of hours work there is the potential that residential receivers would experience noise that exceeds the construction noise management levels and sleep disturbance criteria.

Mitigation measures and safeguards detailed in section 6.2.6 would be implemented where feasible and reasonable to reduce noise impacts.

### **Construction compound**

The potential for noise impacts has been assessed at one compound location which is 1089 The Northern Road and is further discussed in section 3.5.

Noisy activities at the construction compound would include establishing the compound (including any demolition of existing buildings) and construction vehicle movements entering and leaving the compound. Deliveries and stockpiling may also generate noise; however these activities are likely to be intermittent.

Predicted noise levels during the operation of the construction compound are expected to exceed the daytime noise management levels at 20 properties and are shown on Figure 6.7.

### **Construction traffic noise**

During construction, if road traffic noise increases are within two dB(A) of current levels then the objectives on the *Road Noise Policy* are achieved. It is noted that a large increase in traffic volumes is needed to increase road traffic noise by two dB(A), as a doubling in traffic corresponds to about a three dB(A) increase in noise.

The increase in traffic volumes along Jersey Road and Robinson Road as a result of the construction diversion triggers new road criteria due to the changes in the functional class under the *Noise Criteria Guideline*. As a result, there are 22 receivers that would qualify for consideration of noise mitigation under the *Noise Mitigation Guideline* as they are predicted to experience an increase of 2 dBA. These receivers are shown in Table 4.13 and Figure 4.1 of Appendix D. Mitigation measures and safeguards detailed in section 6.2.6 would be implemented where feasible and reasonable to reduce noise impacts for residents along the diversion.

### **Construction vibration**

The predicted ground vibrations at various distances for typical construction equipment are shown in Table 6.18.

Table 6.18 Typical vibration levels at distances (mm/s Peak)

Plant items	Distance from source			
	10 m	20 m	50 m	100 m
Roller (15 tonne)	7 to 8	4.0	1.6	0.8
Compactor (7 tonne)	5 to 7	3.5	1.4	0.7
Dozer	2.5 to 4	2.0	0.8	0.4
Backhoe	1.0	0.5	0.2	0.1
Pavement breaker	4.5 to 6	3.0	1.2	0.6

### **Predicted vibration levels for receivers**

Predicted vibration levels presented in Table 6.18, indicate that any buildings located within about 20 m of construction activities would experience vibration levels approaching the five mm/s peak particle velocity recommended limit.

The residence likely to be closest to vibratory construction activities is the dwelling at 11 Robinson Road (R029), which is located about 25 m from the proposal site at the closest point. Vibration levels that are likely to cause complaint may be experienced at this receiver when activities are located close to the receiver, however no structural damage is likely to occur. A dilapidation survey at this property is recommended.

Residences at 1110 The Northern Road (R025), 1200 Bringelly Road (R042) and 1250 Bringelly Road (R043) are located about 50 m from the proposal site, are could perceive vibrations within their dwelling with the possibility of loose items falling. No structural damage is likely to occur at this distance.

There are seven residential receivers and two commercial premises located about 75 to 90 m from the nearest vibratory construction activities. These include 1212, 1251, 1186, 1197, 1193, 1160 and 1152 The Northern Road (R002, R007, R010, R011, R012, R018, and R019 respectively), 4 Solway Road (R005), and 17 Robinson Road (R030). These receivers are likely to just perceive vibrations within their dwelling yet no structural damage is likely to occur.

Mitigation measures and safeguards detailed in section 6.2.6 would be implemented where feasible and reasonable to reduce vibration impacts. There are not expected to be any vibration impacts as a result of the traffic diversion during construction.

#### ***Predicted vibration levels for heritage buildings***

There are no identified heritage buildings located within 35 m of proposed construction activities, and no vibration impacts on heritage buildings are predicted.

### **Operation noise**

#### ***Predicted road noise levels without mitigation***

The predicted day and night-time period noise levels at receivers for 2019 (proposal opening) and 2029 (10 years after opening), both with and without the proposal, are detailed in Appendix D and Appendix E of Appendix E.

Figure 6.14 and Figure 6.15 show the predicted noise levels during the day-time and night-time periods in 2029 with the proposal operational.

The controlling criterion from the NCG is predicted to be exceeded at 28 sensitive receivers and Bringelly Public School during the day time period, while exceedances would occur at 27 receivers during the night-time period. A number of receivers would benefit from the proposal with a decrease in noise levels between the 'build' and 'no build' scenarios where the proposal increases the setback distance.

The cumulative criterion from the NMG (i.e. five dB(A) above the controlling criterion) is predicted to be exceeded at 10 sensitive receivers during the night-time period. This criterion is also predicted to be exceeded at the Bringelly Public School. However, this exceedance is pre-existing, and the proposal would decrease the level of the exceedance by moving the main roadway further from the school. The recreational outdoor areas of the Bringelly Public School comply with the criteria.

Noise level exceedances at the above properties are a result of the following:

- Change in proximity to the roadway with some receivers now located in close proximity to the operational road, which would result in exceedances of up to about 10 dB(A)
- Change in traffic volumes, distribution and speeds along the new roadway
- Change in road design elevations.

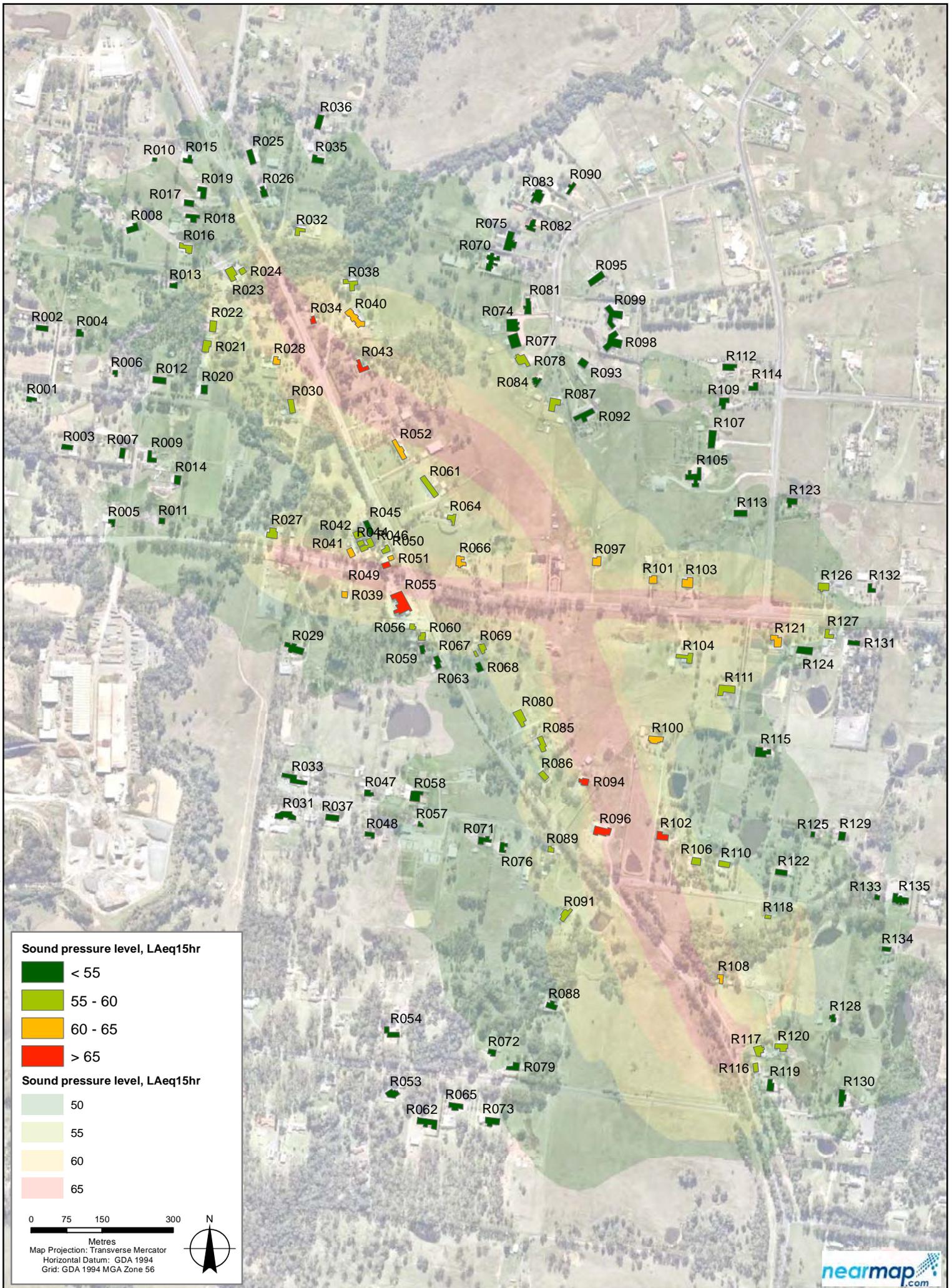


Figure 6.14  
 Predicted road traffic noise levels, 2029 day-time period with proposal

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by: MWeerakoon

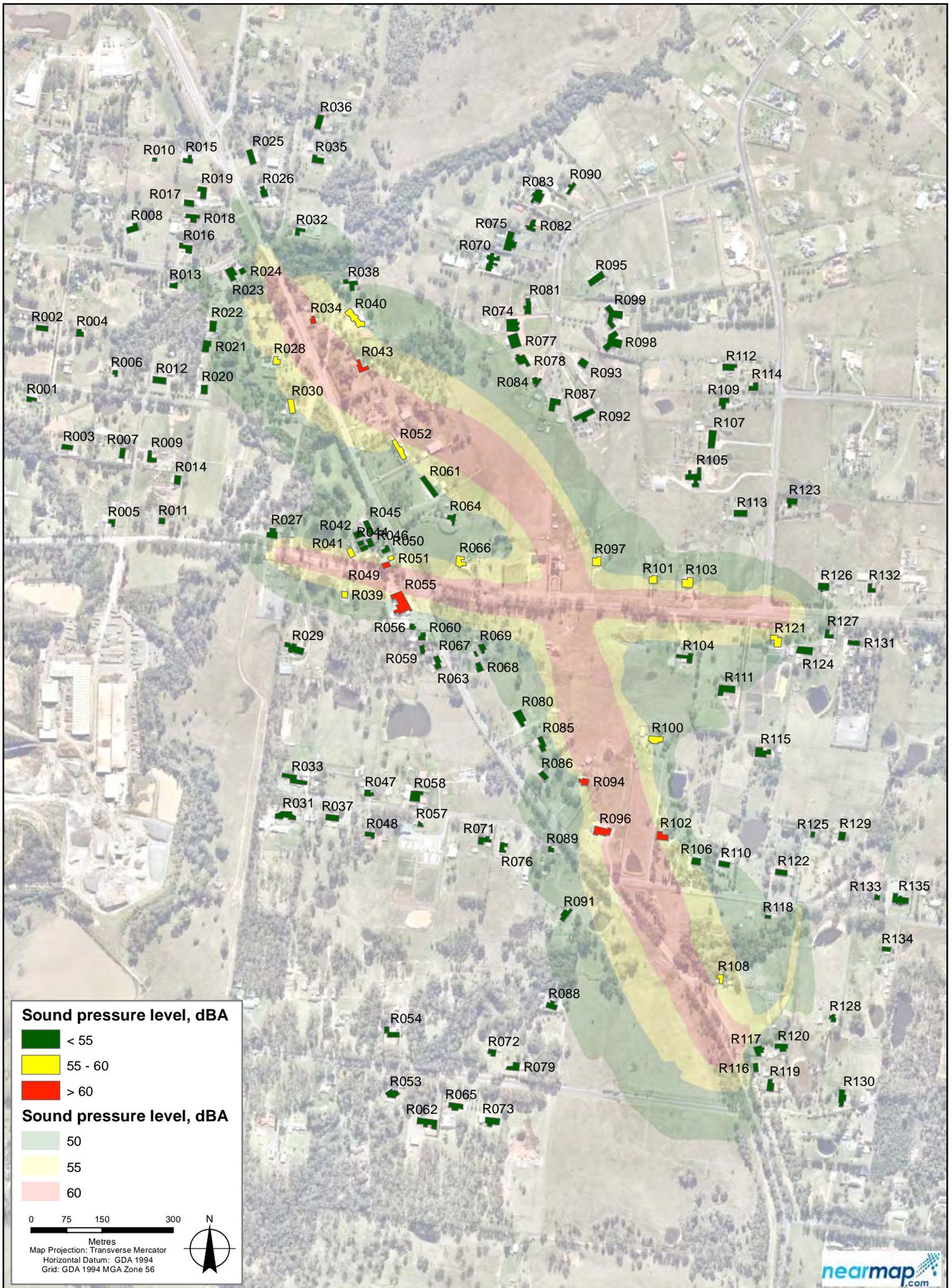


Figure 6.15  
 Predicted road traffic noise levels, 2029 night-time period with proposal

### Receivers eligible for consideration for operational noise mitigation

Figure 6.16 outlines the process used to determine which receivers would be eligible for consideration of the additional noise mitigation recommended by the NMG. Additional noise mitigation as is as follows in order of preference:

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

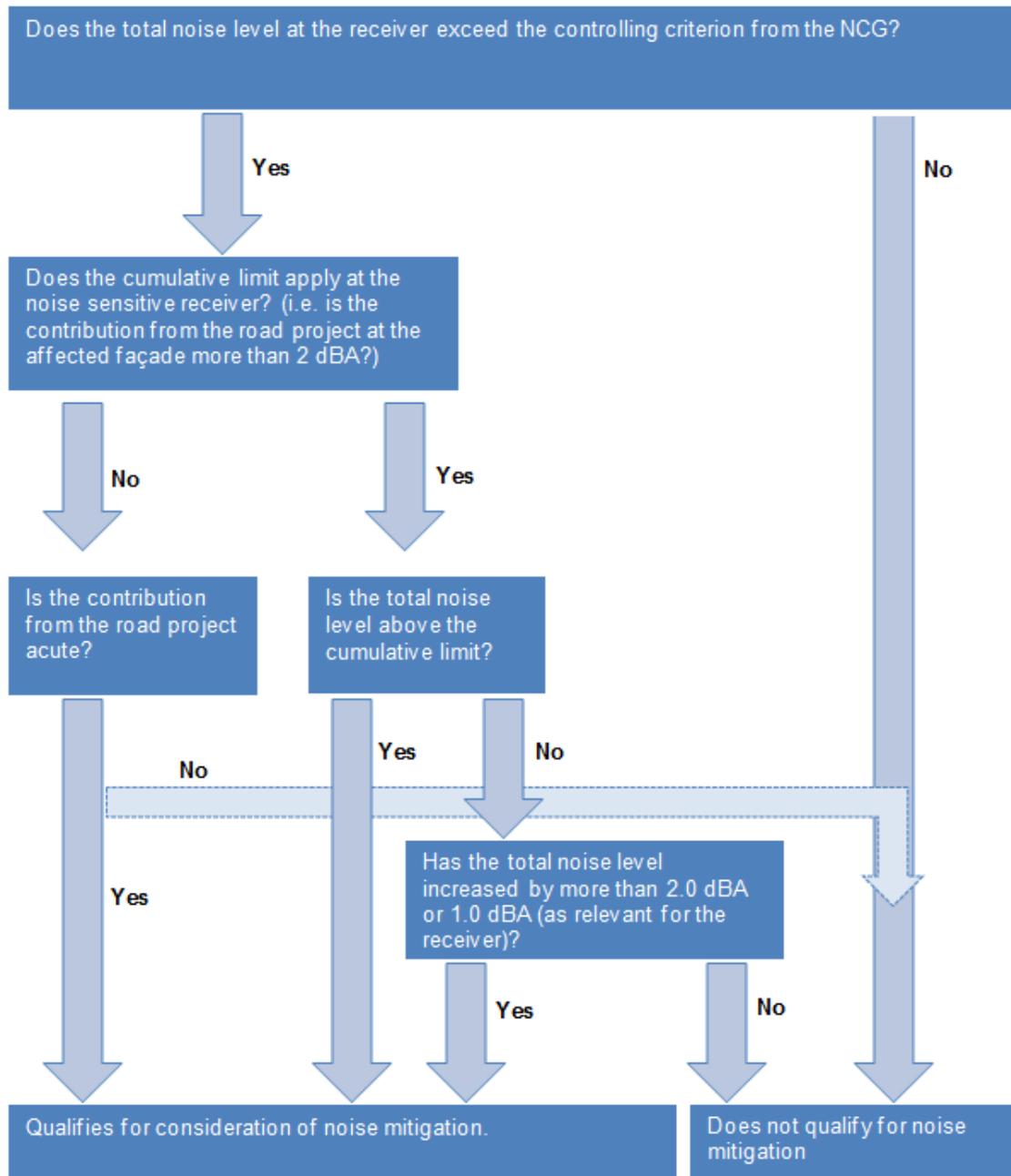


Figure 6.16 Noise mitigation flowchart

The proposal is expected to result in 21 properties which are eligible for further consideration for additional mitigation. Bringelly Public School is also eligible for consideration for additional mitigation. Additional detailed noise assessment is recommended to be undertaken at the Bringelly Public School to identify which buildings are classrooms and to determine the transmission loss through the building facades.

Table 5.9 of Appendix E outlines the 21 properties which are eligible for consideration for mitigation, and Appendix E of Appendix E includes details of which property facades would be subject to exceedances and therefore where mitigation would be required.

Predicted noise levels and exceedances resulting from the proposal show that to reduce noise levels a combination of mitigation would be required. The use of low noise pavements as detailed in the ENMM would reduce noise by three dB(A). Such a reduction would result in compliance with the criteria for 11 of the 21 properties eligible for mitigation.

Following the implementation of low noise pavements, 10 receivers would still require noise mitigation. The use of noise walls is only considered where groups of more than four receivers would benefit from the installation of the wall. The majority of receivers are spread out across the proposal site, which means that the use of a noise wall is not viable to reduce noise levels. The exception to this is receivers 52, 61 and 64 and receivers 80, 85 and 86 which are located somewhat close together. However, due to their distance from the proposal site, the size and length of the wall which would be required to minimise impacts is likely to be cost prohibitive. The use of low noise pavements is likely to achieve compliance of the criteria at these receivers.

The remaining 10 receivers would be considered further during detailed design for at-property treatment.

#### **Maximum noise level/sleep disturbance assessment**

The  $L_{Amax}$  and  $L_{Aeq(9hr)}$  noise levels during the night-time period (10 pm to 7am) at the three road traffic noise monitoring locations are summarised in Table 6.19.

Table 6.19 Summary of maximum noise levels - dB(A)

Noise monitoring location	$L_{Amax}$ range	$L_{Aeq(9hr)}$	Highest $L_{Amax} - L_{Aeq(9hr)}$	$L_{Amax} - L_{Aeq(9hr)}$ average	Number of $L_{Amax}$ events > 65 dB(A) and 15 dB(A) above $L_{Aeq(9hr)}$
<b>Location 1</b> 1262 The Northern Road	63-94	49-66	32.2	20.5	30
<b>Location 2</b> 1178 The Northern Road	56-84	45-61	31.4	20.1	22
<b>Location 3</b> 1202 Bringelly Road	50-77	40-56	28.2	19.5	9

The current maximum noise levels exceed the  $L_{Aeq(9hr)}$  noise levels by more than 15 dB(A) and are above 65 dB(A) on several occasions per night.

However, in general, the road design is likely to reduce the maximum noise levels as a result of the following:

- Improved intersection performance, reducing braking and accelerating

- An improved road surface which is likely to reduce road irregularities and associated maximum noise level events
- Recommended operational mitigation treatments described above
- Proposed acquisitions of residences in close proximity to the design alignment.

The road design, incorporating the new and redeveloped sections, is likely to reduce the maximum noise levels for some residential receivers. However due to the alignment moving closer to some receivers, the maximum noise levels would increase at these locations and noise mitigation needs to be considered.

#### 6.2.6 Safeguards and management measures

Mitigation measures provided below would be implemented to minimise potential noise and vibration impacts.

Impact	Environmental safeguards	Responsibility	Timing
Detailed design			
Noise assessment	Additional detailed noise assessment would be undertaken at Bringelly Public School to identify which buildings are classrooms and to determine the transmission loss through the building facades.	Roads and Maritime	Detailed design
Operational noise mitigation	Further investigation of mitigation options would be undertaken to determine suitability of low noise pavement, noise barriers and required at-property treatments.	Roads and Maritime	Detailed design
Vibration	Undertake a dilapidation survey at 11 Robinson Road prior to construction commencing.	Roads and Maritime	Detailed design
Construction			
Construction noise and vibration	<p>A construction noise and vibration management plan would be prepared as part of the construction environmental management plan. This plan would include, but not be limited to:</p> <ul style="list-style-type: none"> <li>• A map indicating the locations of sensitive receivers including residential properties</li> <li>• Management measures to minimise the potential noise impacts from the quantitative noise assessment and for potential works outside of standard working hours (including implementation of <i>Interim Construction Noise Guidelines</i> (DECC, 2009)</li> <li>• A risk assessment to determine potential risk for activities likely to affect receivers (for activities undertaken during and outside of standard working hours)</li> <li>• Mitigation measures to avoid noise and vibration impacts during construction activities including those associated with truck movements</li> <li>• A process for assessing the performance of the implemented mitigation measures</li> <li>• A process for documenting and resolving issues and complaints</li> <li>• A process for updating the plan when activities affecting construction noise and vibration change</li> </ul>	Construction contractor	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
	<ul style="list-style-type: none"> <li>• A process for consideration of cumulative impacts from adjacent projects</li> <li>• Identify in toolbox talks where noise and vibration management is required</li> <li>• An out of hours works procedure in accordance with the requirements of the <i>Interim Construction Noise Guideline</i> (DECC, 2009) and the <i>Environmental Noise Management Manual Practice</i> (RTA, 2001a)</li> <li>• Restrictions on construction delivery times to minimise noise impacts to receivers near the compound site</li> <li>• Scheduling works to complete noisiest activities during the day wherever possible (i.e. concrete saw cutting).</li> </ul>		
	<p>The out of hours procedure would as a minimum include:</p> <ul style="list-style-type: none"> <li>• Background levels for noise criteria in accordance with the NCG</li> <li>• Locations of the works</li> <li>• Locations of sensitive receivers</li> <li>• Predicted noise levels</li> <li>• Communications plan</li> <li>• Triggers for the provision of respite and a respite schedule.</li> <li>• Management measures where works are unable to comply with the criteria</li> </ul>	Construction contractor	Pre-construction and construction
Construction noise	Noise impacts would be minimised in accordance with Practice Note 7 in Roads and Maritime Services' <i>Environmental Noise Management Manual</i> and <i>Environmental fact sheet No. 2- Noise management and Night Works</i> .	Construction contractor	Construction
Construction noise from machinery and equipment	Construction compounds will be laid-out in such a way that the primary noise sources are at a maximum distance from residences, with solid structures (sheds, containers etc) placed between residences and noise sources (and as close to the noise sources as is practical).	Construction contractor	Construction
	All equipment will be selected to minimise noise emissions. Equipment should be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made	Construction contractor	Construction
	Noise-emitting plant would be directed away from sensitive receivers where possible.	Construction contractor	Construction
	Reversing alarms that have a tonal noise character are to be avoided during out of hours activities. Quacker style or 'smart' reversing alarms are to be used during night time activities (pending safety approvals).	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	To minimise the potential for sleep disturbance impacts, construction activities likely to generate the highest levels of noise would be scheduled to occur at the beginning of the shift (before 11 pm).	Construction contractor	Construction
Construction noise from inappropriate practices	<p>Site inductions would be provided to train staff on ways to minimise construction noise impacts on-site. Responsible working practices include:</p> <ul style="list-style-type: none"> <li>• Avoid the use of outdoor radios during the night-time period</li> <li>• Avoid shouting and slamming of doors</li> <li>• Where practical, operate machines at low speed or power and switched off when not being used rather than left idling for prolonged periods</li> <li>• Minimise reversing</li> <li>• Avoid dropping materials from height and avoid metal to metal contact on material</li> <li>• All engine covers should be kept closed while equipment is operating.</li> </ul> <p>Site inductions must include:</p> <ul style="list-style-type: none"> <li>• All relevant project specific and standard noise and vibration mitigation measures</li> <li>• Relevant licence and approval conditions</li> <li>• Permissible hours of work</li> <li>• Any limitations on high noise generating activities</li> <li>• Location of nearest sensitive receivers</li> <li>• Construction employee parking areas</li> <li>• Designated loading/ unloading areas and procedures</li> <li>• Construction traffic routes</li> <li>• Site opening/closing times (including deliveries)</li> <li>• Environmental incident procedures</li> </ul>	Construction contractor	Construction
Construction traffic noise	Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.	Construction contractor	Construction
Construction vibration	Confining vibration-generating operations to the least vibration-sensitive part of the shift – which could be when the background disturbance is highest.	Construction contractor	Construction
	Quieter and less noise/vibration emitting construction methods would be used where feasible and reasonable.	Construction contractor	Construction
	Compliance vibration monitoring would be undertaken in response to complaints or when vibration generating activities occur within the structural damage buffer distances. The results of the vibration monitoring would be compared to the structural damage criteria presented in Table 6.15 considering frequency content.	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Building condition surveys would be undertaken when vibration generating activities occur within the structural damage buffer distances.	Construction contractor	Construction
Noise and vibration impacts and appropriate complaints handling	The local community would be contacted and informed of the proposed work, location, duration of work, and hours involved. The contact would be made a minimum five days before work starts as per RMS ENMM Practice Note 7 requirements.	Construction contractor and Roads and Maritime	Pre-construction and construction
	A suitable advertisement will be placed in local papers including a reference to night-time noise impacts	Construction contractor	Construction
	Communications material such as the project website and community notification would include a contact person and phone number to enable complaints to be received and responded to.	Construction contractor	Construction
Monitoring	<p>Attended compliance noise or vibration monitoring should be undertaken to confirm the predicted noise or vibration levels upon receipt of a complaint. The ICNG state that complaint monitoring measurements should be taken at the complainant's location and the monitoring should cover the time of day when the impacts were reported to occur.</p> <p>In the case that exceedances of the relevant annoyance criteria levels listed in this report are detected in relation to the complaint, the situation should be reviewed in order to identify means to minimise the impacts to residences.</p>	Construction contractor	Construction
<b>Operation</b>			
Monitoring	A post construction noise monitoring program will be undertaken to confirm the noise levels predicted as part of the Noise and Vibration assessment. Monitoring locations will be selected along the route at locations monitored as part of the assessment and also at any locations where noise complaints have been made. Where exceedances are identified, further consideration of feasible and reasonable measures would occur.	Construction contractor	Operation (within 12 months of commencement of operation)
Road noise	At locations where residual impacts remain after all feasible and reasonable approaches have been exhausted, noise mitigation in the form of acoustic treatment of existing individual dwellings will be considered.	Roads and Maritime	Operation

## 6.3 Soils, topography and geology

### 6.3.1 Existing environment

#### Topography, geology and soils

The topography of the study area is gently undulating with low rising crests and elevations ranging between 70 and 90 m above sea level.

A review of the *Soils Landscapes of Penrith 1:100,000 Sheet* and *Soil Landscapes of Wollongong-Port Hacking 1:100,000 Sheet* indicates that the proposal site is underlain by the Blacktown residual soil unit. The Blacktown residual soil landscape typically comprises of clayey soils over gently undulating crests. The soil unit can have moderately reactive, highly plastic subsoils and poor drainage. The geology of the Blacktown Soil Landscape is characterised by undulating to rolling low hills on Wianamatta Group shales.

A description of existing catchments within the study area is provided in section 6.4.1.

#### Salinity

Salinity potential mapping for the study area (DIPNR, 2002) indicates that there is a moderate potential for salinity to occur within the proposal site, with some areas of high potential and known salinity located at the southern and northern ends of the proposal site (as shown on Figure 6.17).

#### Acid sulphate soils

The Australian Soil Resource Information System was searched on 21 July 2015. The results of the search indicate that the proposal site has an extremely low probability of containing acid sulphate soils. No acid sulphate soils were identified during the geotechnical investigations undertaken in August 2015.

#### Contamination

The NSW Environment Protection Authority's (EPA) Contaminated Lands Register was searched on 21 July 2015 (for the suburb of Bringelly). No listed contaminated sites were identified within or in the vicinity of the proposal site. No contamination was identified during the geotechnical investigations undertaken in August 2015.

Based on the review of land uses and field observations, there is considered to be minimal potential for widespread contamination to occur in the proposal site. The Northern Road Upgrade REF (SKM, 2012) noted that, if present, the contamination risk was more likely to be associated with regional agricultural land usage (current and/or historical) including:

- Shallow soil contamination associated with the historical (and current) spraying of pesticides and insecticides either directly within the proposal or present through run-off from neighbouring crops
- Minor hydrocarbon contamination associated with vehicle access tracks
- Asbestos containing material associated with former farm infrastructure e.g. sheds
- Cattle tick dips which can be associated with arsenic, DDT and other pesticides
- Buried fill material (including asbestos containing material).

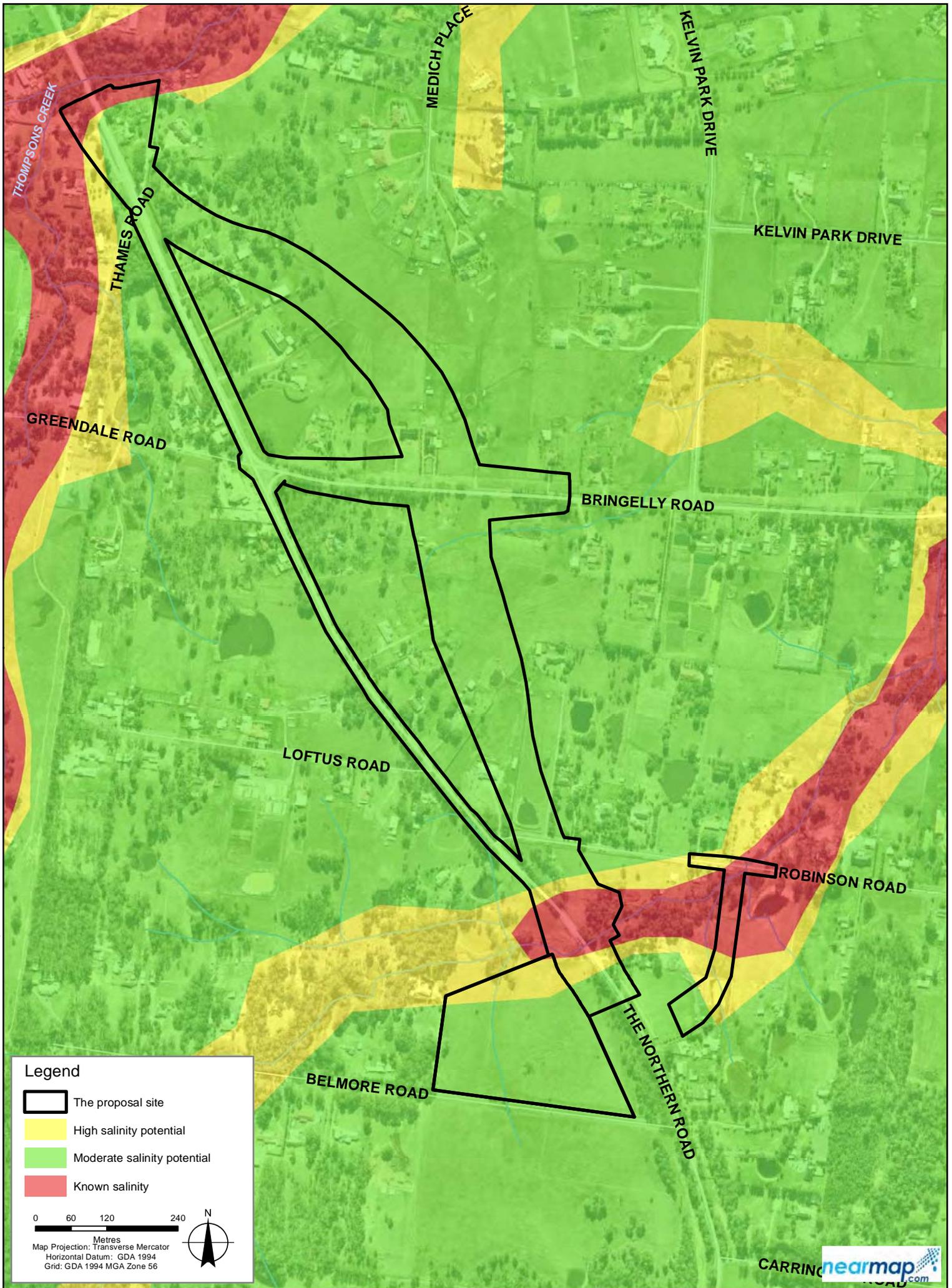


Figure 6.17  
Salinity potential

## 6.3.2 Potential impacts

### Construction

#### ***Topography, geology and soils***

As discussed in section 3.4.6, about 100,000 cubic metres of cut material would be excavated for the interchange construction and 22,000 cubic metres of certified fill material would be imported for the pavement works. Fill material imported from off-site would be sourced from certified suppliers to avoid the potential for importing contaminated material. The majority of cut material would be reused as fill on-site with about 7,000 cubic metres of spoil expected.

The cut and fill requirements are not considered to be major alterations to the existing topography from a regional perspective and would only be noticeable in the direct vicinity of the proposal.

Overall, the proposal would not result in any substantial changes to local topography. The vertical alignment of The Northern Road near the interchange would be eight metres below current ground level but the vertical alignment would generally match the existing nature of the terrain at the tie-ins with The Northern Road.

#### ***Erosion and sedimentation***

During construction, work activities have the potential to expose large areas of soil that may be eroded through wind and water. If inadequately managed, this could lead to sedimentation of surrounding land and drainage lines. Along the length of the proposal, major earthworks are required to provide an adequate vertical alignment. These earthworks would result in large quantities of material being excavated and transported within the study area for the purposes of reuse or stockpiling.

Additional work elements which have the potential to expose soils include:

- Interchange construction
- Vehicle movements
- Stockpiling
- Landscaping.

The mitigation measures provided in section 6.3.3 would be implemented to manage the potential for erosion and sedimentation impacts during construction.

#### ***Contamination***

Any soil contaminants present may pose a risk to human health including excavation workers and construction workers in the vicinity of the site during excavation works. If not managed appropriately, contaminants also have the potential to be spread into nearby lands or watercourses. Although there is considered to be minimal potential for widespread contamination to occur in the proposal site, there is always the potential to encounter previously unknown contamination during construction. An approach to managing any unexpected contaminated material that may be uncovered would be specified in the construction environmental management plan.

There is potential for chemical and fuel spills to occur during construction which may result in localised contamination of soils.

These impacts are considered to be minimal with the implementation of safeguards and management measures outlined in section 6.3.3.

## Operation

Operation of the proposal is not likely to result in any significant impacts on soils, landscape, topography or geology. The risk of soil erosion during operation would be minimal as all areas impacted during construction would be sealed or rehabilitated and landscaped to prevent soil erosion from occurring.

Saline soils can have a detrimental effect on vegetation growth and impact on infrastructure such as roads, pipes and cables. Salinity also has the potential to make soils unsuitable for reuse and may have implications on the suitability of plants for landscaping. The potential for salinity to damage infrastructure and the suitability of excavated material for reuse as fill would be considered during detailed design.

### 6.3.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Pre-construction</b>			
Erosion and sedimentation	<p>A soil and water management plan (SWMP) would be prepared as part of the construction environmental management plan in accordance with the requirements of Roads and Maritime contract specification G38. The SWMP would address the following:</p> <ul style="list-style-type: none"> <li>Roads and Maritime Code of Practice for Water Management, the Roads and Maritime Services' <i>Erosion and Sedimentation Procedure</i></li> <li>The NSW <i>Soils and Construction – Managing Urban Stormwater Volume 1 'the Blue Book'</i> (Landcom, 2004) and Volume 2 (DECC, 2008)</li> <li>Roads and Maritime Technical Guideline: <i>Temporary Stormwater Drainage for Road Construction, 2011</i></li> <li>Roads and Maritime <i>Technical Guideline: Environmental Management of Construction Site Dewatering, 2011</i></li> </ul>	Construction contractor	Pre-construction
	<p>The SWMP would detail the following as a minimum:</p> <ul style="list-style-type: none"> <li>Identification of catchment and sub-catchment areas, high risk areas and sensitive areas</li> <li>Sizing of each of the above areas and catchment</li> <li>The likely volume of run-off from each road sub-catchment</li> <li>Direction of flow of on-site and off-site water</li> <li>Separation of on-site and off-site water</li> <li>The direction of run-off and drainage points during each stage of construction</li> <li>The locations and sizing of sediment traps such as sump or basin as well as associated drainage</li> <li>Dewatering plan which includes process for monitoring, flocculating and dewatering water from site (ie sediment basin and sumps)</li> </ul>	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	<ul style="list-style-type: none"> <li>• A mapped plan identifying the above</li> <li>• Include progressive site specific Erosion and Sedimentation Control Plans (ESCPs). The ESCP is to be updated at least fortnightly</li> <li>• Identify high risk activities and the details required for work method statements to be developed and signed by Roads and Maritime prior to construction</li> <li>• A process to routinely monitor the BOM weather forecast</li> <li>• Preparation of a wet weather (rain event) plan which includes a process for monitoring potential wet weather and identification of controls to be implemented in the event of wet weather. These controls are to be shown on the ESCPs</li> <li>• Provision of an inspection and maintenance schedule for ongoing maintenance of temporary and permanent erosion and sedimentation controls.</li> </ul>		
Site stabilisation plan	<p>A site stabilisation plan would be prepared as part of the CEMP. The plan would include but not be limited to the following:</p> <ul style="list-style-type: none"> <li>• Identification and mapping of areas along the length of the proposal requiring stabilisation</li> <li>• A risk assessment for disturbed areas and stockpiles</li> <li>• Detailed methods for stabilisation</li> <li>• A monitoring program for the stabilised areas</li> <li>• A process for determining the success of stabilised areas or methods</li> <li>• A process for identifying additional stabilisation methods in: <ul style="list-style-type: none"> <li>○ All high risk areas would be stabilised within two weeks</li> <li>○ All medium risk areas would be stabilised within one month</li> <li>○ In anticipation of rain events.</li> </ul> </li> </ul>	Construction contractor	Pre-construction
Contamination	<p>An incident emergency spill plan would be developed and incorporated into the construction environmental management plan. The plan would include measures to avoid and manage spillages of fuels, chemicals, and fluids onto any surfaces or into stormwater inlets and an emergency response procedure.</p>	Construction contractor	Pre-construction
<b>Construction</b>			

Impact	Environmental safeguards	Responsibility	Timing
Erosion and sedimentation	Erosion and sediment control measures would be implemented and maintained to: <ul style="list-style-type: none"> <li>Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets</li> <li>Reduce water velocity and capture sediment on site</li> <li>Minimise the amount of material transported from site to surrounding pavement surfaces</li> <li>Divert clean water around the site.</li> </ul>	Construction contractor	Construction
	Erosion and sediment controls would be implemented before any construction starts and inspected regularly, particularly prior after a rainfall event. Maintenance work would be undertaken as needed.	Construction contractor	Construction
	Site stabilisation of disturbed areas would be undertaken progressively as stages are completed.	Construction contractor	Construction
	All stockpiles would be designed, established, operated and decommissioned in accordance with Roads and Maritime <i>Stockpile Management Guidelines</i> (RMS, 2015).	Construction contractor	Construction
	Controls would be implemented at exit points to minimise the tracking of soil and particulates onto pavement surfaces.	Construction contractor	Construction
	Any material transported onto pavement surfaces would be swept and removed at the end of each working shift.	Construction contractor	Construction
Excess spoil	Excess spoil not required or able to be used for backfilling would be stockpiled in a suitable location before being reused on adjacent Roads and Maritime projects or removed from the site, and disposed of at an appropriately licensed facility.	Construction contractor	Construction
Contamination of soil	A fully equipped emergency spill kit would be kept on-site at all times.	Construction contractor	Construction
	If an incident (e.g. spill) occurs, the RMS's Environmental Incident Classification and Management Procedure is to be followed and the Roads and Maritime Contract Manager notified as soon as practicable.	Construction contractor	Construction
	All staff would be inducted about incident and emergency procedures and made aware of the location of emergency spill kits.	Construction contractor	Construction
	Machinery would be checked daily to ensure there is no oil, fuel or other liquid leaking from the machinery.	Construction contractor	Construction
	Final waste classification is required once the volumes of waste requiring offsite disposal during construction are confirmed. Waste soils should be classified in accordance with the NSW EPA (2014) Waste Classification Guidelines	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	In the event that indication of contamination is encountered (such as odorous or visually contaminated materials), work in the area would cease until an environmental consultant can advise on the need for remediation or other action, as deemed appropriate.	Construction contractor	Construction

## 6.4 Hydrology, water quality, flooding and drainage

### 6.4.1 Existing environment

#### Hydrology, drainage and flooding

The closest watercourses to the proposal site are the South Creek tributary (located within the proposal site) and Thompsons Creek (located about 50 metres north of the proposal site). Thompsons Creek flows into South Creek about two kilometres north-east of the proposal site, and drains a catchment of about 4.5 km of rural land upstream of the existing road. The class 3 South Creek tributary is located near the southern end of the proposal site about 180 m south of Robinson Road (refer to Figure 1.1 for locations of watercourses).

The proposal site is located within the South Creek sub-catchment of the greater Hawkesbury-Nepean catchment. Hydrological and sediment regimes for this catchment have been dramatically altered due to vegetation clearance from agricultural practices and increasing urbanisation. Figure 6.18 illustrates the existing catchments associated with Thompsons Creek and the South Creek tributary. The catchments of Thompsons Creek and the South Creek tributary have areas of about 510 hectares and 171 hectares respectively.

The majority of water to the east of the proposal site boundary drains to the east.

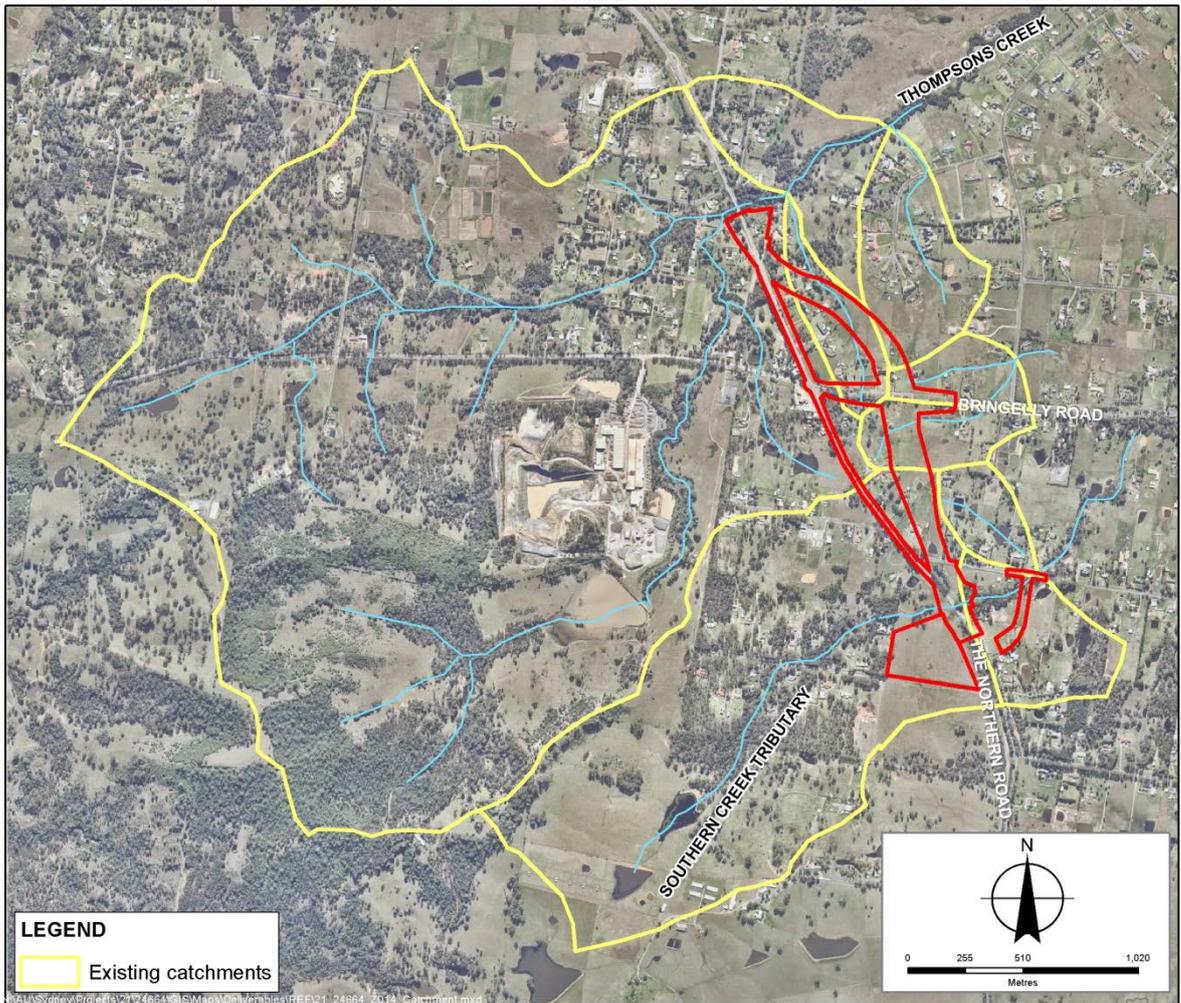


Figure 6.18 Existing catchments

Thompsons Creek is identified as flood prone land in the Liverpool Local Environmental Plan 2008. Flood modelling undertaken as part of the concept design identified the existing 1 in 100 year flood level, for both Thompsons Creek and the South Creek tributary at the upstream and downstream locations, at about 70 m. The existing 1 in 100 year flood levels for Thompsons Creek and the South Creek tributary are shown in Figure 6.19 and Figure 6.20.

Concentrated stormwater currently discharges onto the road corridor via uncontrolled drainage paths.

There are also a number of farm dams located within and surrounding the proposal site.

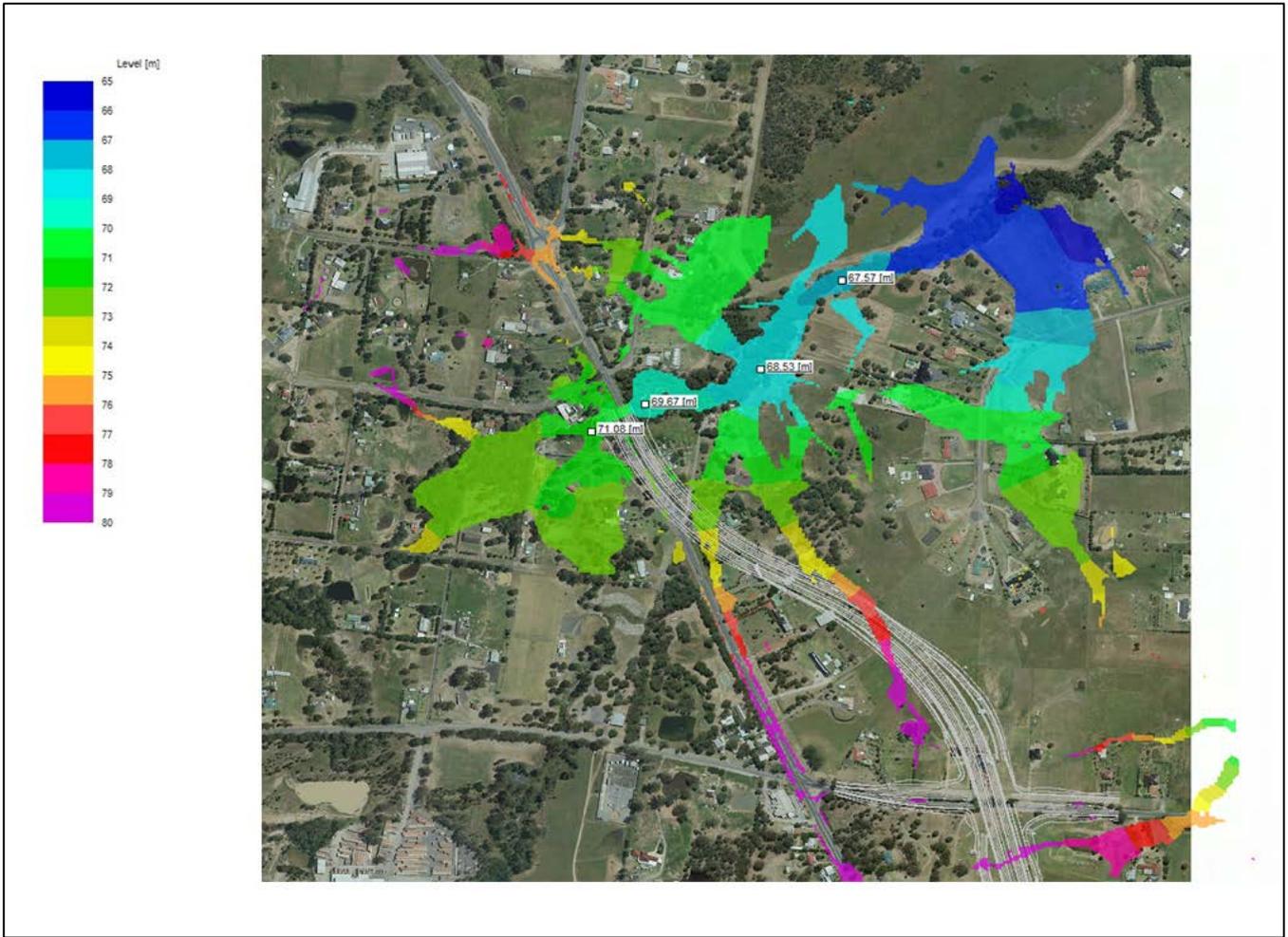


Figure 6.19 Existing 1 in 100 year flood levels for Thompsons Creek

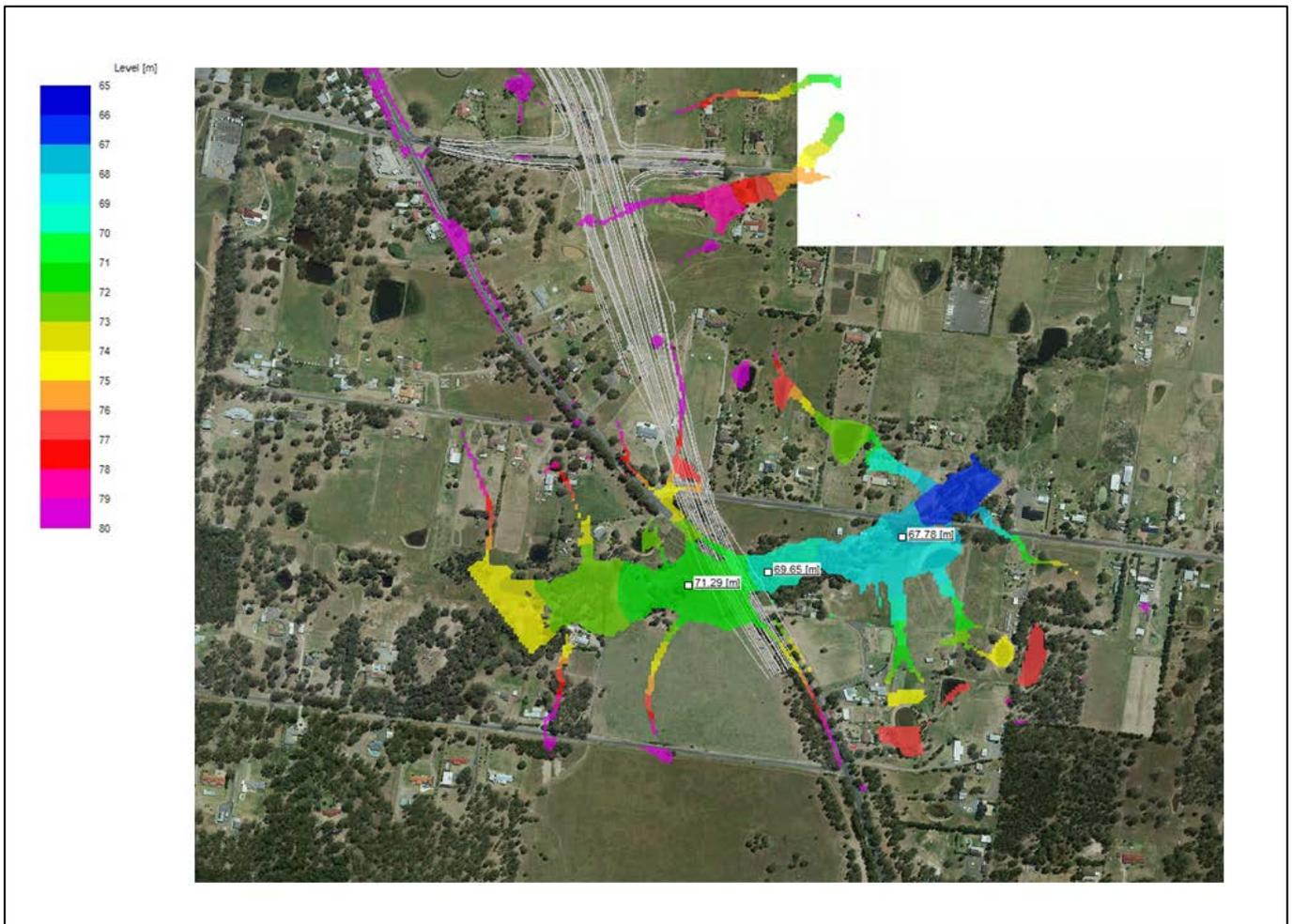


Figure 6.20 Existing 1 in 100 year flood levels for the South Creek tributary

### Water quality

Water quality of the South Creek sub-catchment is affected by both point and diffuse sources of pollution, including emissions from agricultural land uses such as intensive market gardens, dairy farms, grazing lands and urban stormwater runoff. The water quality of Thompsons Creek is currently impacted by runoff from the existing The Northern Road as well as runoff from nearby agricultural land (such as pesticides and herbicides) via stormwater drainage lines.

A technical report prepared for the Hawkesbury-Nepean region riverine ecosystems, identifies poor water quality in South Creek at St Marys, located about 16 km north of the proposal site (DECCW, 2010). Results indicate that 54 per cent of samples exceeded the Australian New Zealand ANZECC guidelines for total phosphorus, and 13 per cent of samples exceeded the guidelines for turbidity. A trend of increasing turbidity and slightly decreasing water temperature and electrical conductivity was also identified.

### Groundwater

The direction of groundwater flow is likely to be controlled by the proximity to local surface water bodies and areas of higher permeability alluvium. Regional groundwater flow direction is expected to be consistent with the topography; flowing generally west to east.

Existing groundwater borehole records were reviewed on 22 July 2015 using the Office of Water groundwater monitoring mapping (Office of Water, 2015). The results of the review identified that two groundwater bores are located within 500 metres of the proposal site. Only one of the boreholes identifies the standing groundwater level, which is about 45 m below ground level.

## 6.4.2 Potential impacts

### Construction

#### ***Hydrology and flooding***

During construction, local flooding patterns may be impacted by the reduction in the amount of infiltration and the disruption of flood flow paths. The risk of flooding would be higher where watercourses cross the proposal site, as they are generally associated with low points in the topography (refer to Figure 1.1). To minimise the potential for localised flooding and erosion during construction, it would be necessary to carefully plan, implement and maintain measures aimed at intercepting any concentrated flow and either diverting it toward the existing stormwater drainage system on The Northern Road or Bringelly Road, or directing stormwater away from the proposal site as overland flow.

To avoid the potential for inundation of stockpiles and materials/liquids storage areas, the compound site and stockpiles would be located above the 1 in 100 year flood level

Temporary sediment basins to manage stormwater during periods of high rain may be required as discussed in section 3.2.7. The size and location of these temporary sediment basins during construction would be considered further during detailed design.

The implementation of the mitigation measures provided in section 6.4.3 would minimise the potential for flooding impacts.

#### ***Water quality***

Construction activities have the potential to impact on water quality within local receiving waters, including Thompsons Creek. The main potential impacts relate to soil disturbance, which represents a risk to surface water quality, and run-off during construction. Pollutants such as sediment, soil nutrients and construction waste have the potential to mobilise and enter drainage lines, particularly during high rainfall events.

Water quality impacts could also potentially occur during construction as a result of contamination by fuel or chemical spills from construction vehicles.

As discussed in section 3.2.7, temporary construction basins were included in the proposal described by the REF for the upgrading of The Northern Road REF (SKM, 2012) at the northern and southern tie-ins - to the north-east of the proposal site near Thompsons Creek, and at the South Creek tributary, respectively. These basins were sized for a five day design event during construction in accordance with the 'Bluebook' (Landcom 2004). The temporary construction basins would be reduced in size (for a spill capacity of 20 cubic metres) and retained during operation of the proposal once construction is complete. The basins were designed to contain spills in dry weather or during small storm events. Following containment, the pollutant would be pumped out and the spill disposed of in an appropriate manner.

The final location and size of the temporary sediment basins and operational spill basins would be confirmed during the development of the detailed design.

The impact of construction activities on the quality of runoff discharging to the receiving drainage lines would be minimised by implementing the soil and water management plan. The likelihood of adverse impacts on water quality would be further reduced by the implementation of mitigation measures in sections 6.3.3 and 6.4.3.

As noted in section 6.3.3, a soil and water management plan would be prepared as part of the construction environmental management plan.

## Groundwater

Excavations and cuttings for the proposal would be relatively shallow compared to the potential depth of the groundwater table. As a result, groundwater is not likely to be encountered during excavation and substantial dewatering is not expected to be required. Any dewatering that may be required is likely to be superficial and associated with managing local and recent rainfall at the proposal site. If groundwater is encountered during construction, it would be pumped out into a contained area, tested, and if necessary treated, before re-use, discharge or disposal.

## Operation

### Hydrology and flooding

The catchment size for both Thompsons Creek and the South Creek tributary would increase by about 2.2 ha and four hectares respectively, as a result of the road cutting intercepting the catchments (which currently flow east). The potential new catchment boundaries are shown in Figure 6.21 below.

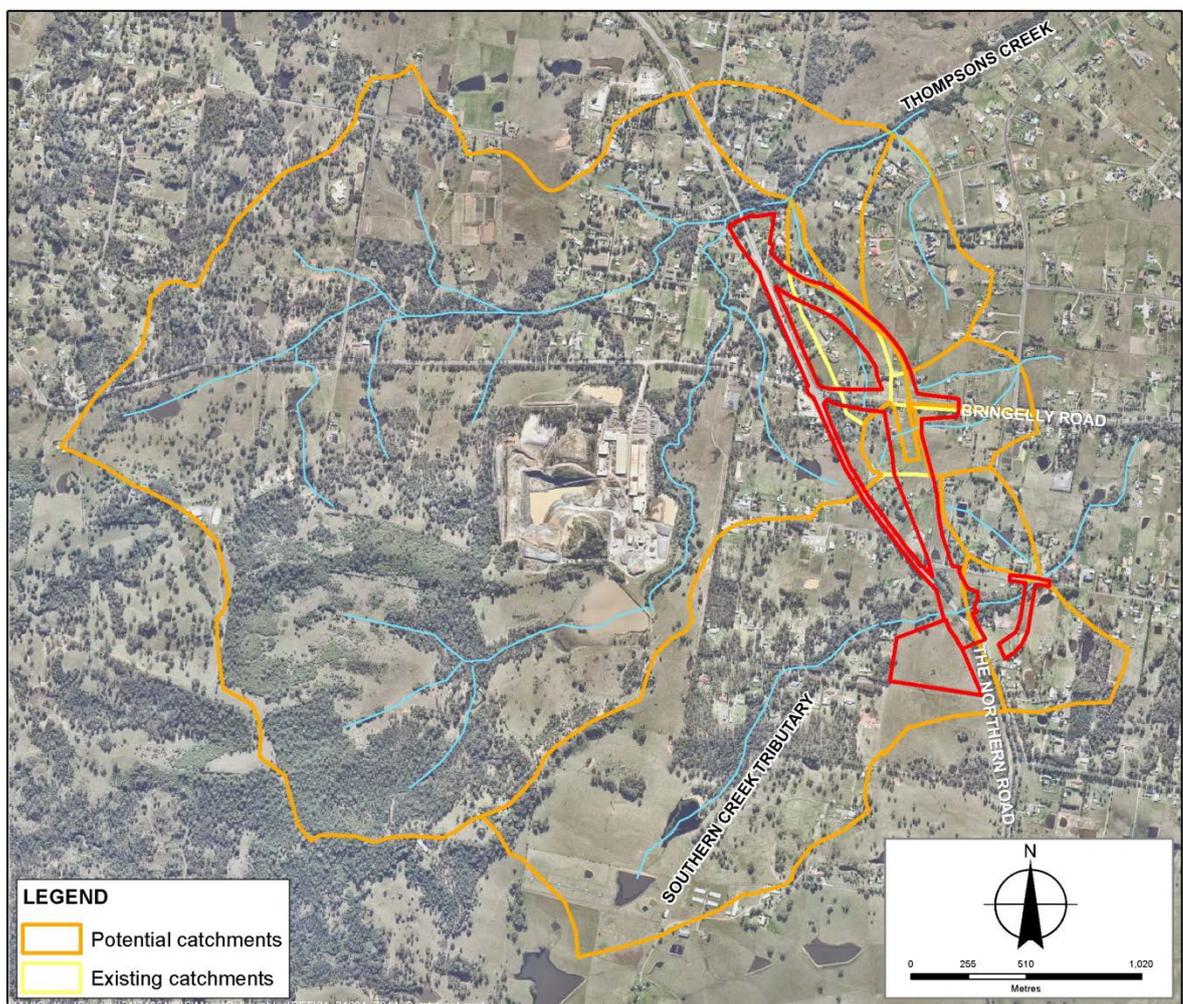


Figure 6.21 Potential new catchment boundaries as a result of the proposal

The bridge over Thompsons Creek is proposed to be upgraded as part of The Northern Road Upgrade Stage 2A and a new reinforced box culvert (5 cell 2400 mm wide by 2100 mm high) is proposed to be installed at the South Creek tributary.

Preliminary modelling results suggest that the realignment of The Northern Road would result in changed flow distributions on the floodplains downstream of the proposal. The proposed cutting would potentially increase flows to both Thompsons Creek and the South Creek tributary, with the potential to alter peak discharges in these creeks. At this stage of the design process, the results of the modelling indicate that the proposal would result in small increases in the 1 in 100 year flood afflux levels in Thompsons Creek and the lower reaches of Bardwell Gully upstream of The Northern Road, as well as the South Creek tributary. These increases in flood levels would be confined to rural land adjacent to these watercourses and within about 100-150 m of The Northern Road. The increases would reach a maximum impact of 0.26 m in land immediately to the west of The Northern Road. The majority of this flood level increase would impact land that is currently flood prone. Although, the majority of the impacted rural land is agricultural or open paddocks, it is expected that the impacts would be able to be minimised through the development of detailed design. Increases in the 1 in 100 year flood afflux levels are shown in Figure 6.22 and Figure 6.23 for Thompsons Creek and the South Creek tributary respectively.

The sealed road surface would reduce water infiltration and increase the amount and velocity of stormwater run-off. This run-off would be channelled into a formal road drainage system that includes kerb and guttering, a buried pipe network, table drains and catch drains. Scour protection would be provided at the outlets of all cross drainage and longitudinal drainage systems. This would reduce the likelihood of scour and sedimentation.

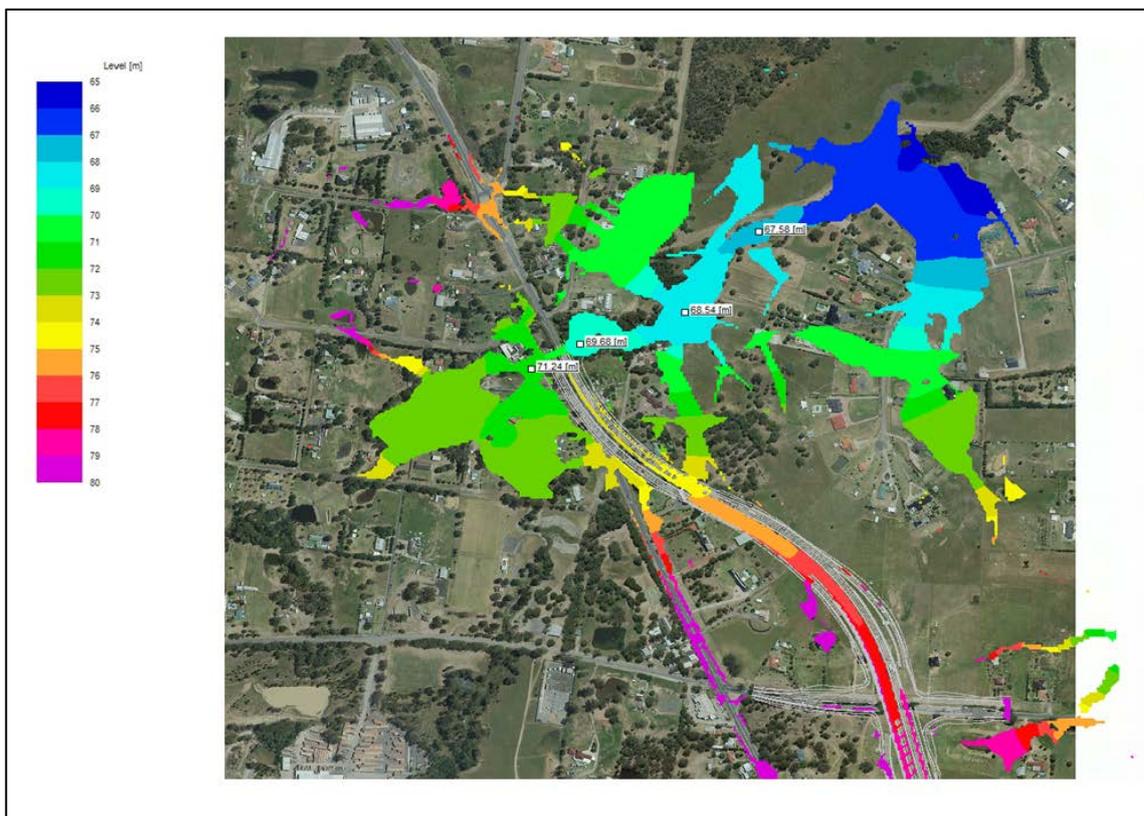


Figure 6.22 Proposed 1 in 100 year flood levels for Thompsons Creek

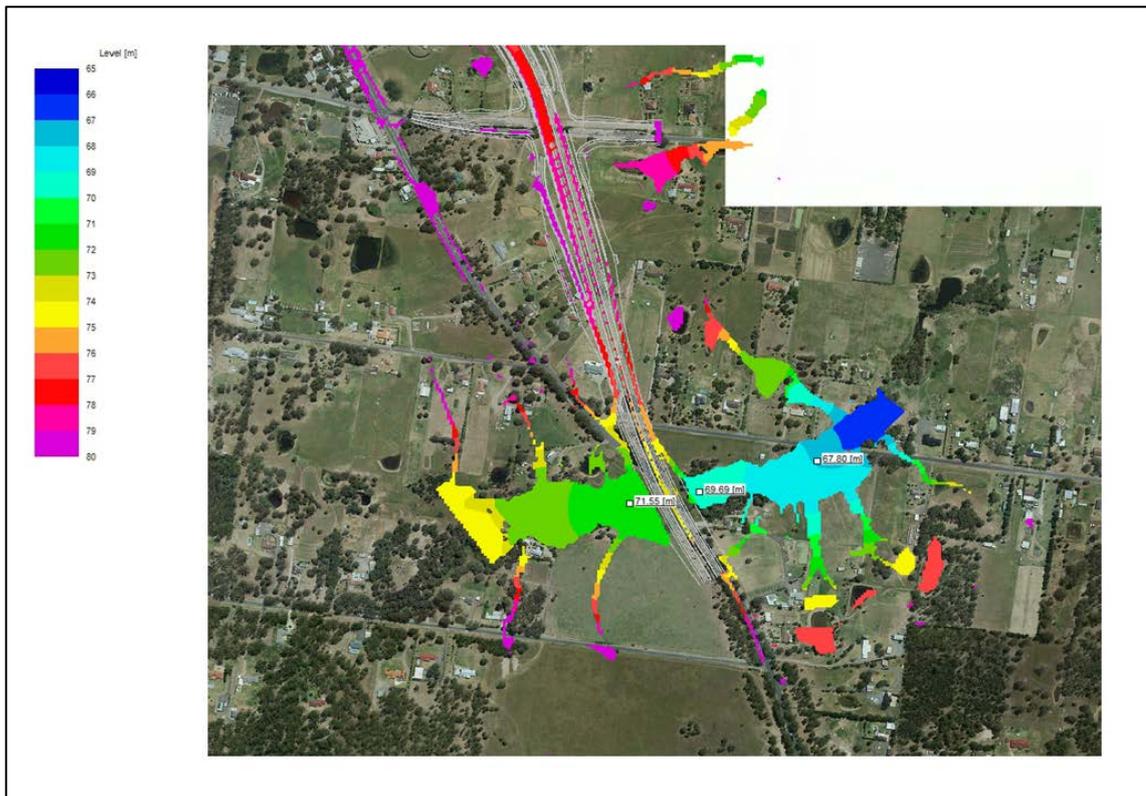


Figure 6.23 Proposed 1 in 100 year flood levels for the South Creek tributary

### **Water quality**

Stormwater run-off from impervious road surfaces can impact the water quality of receiving watercourses as a result of the transport of pollutants, including:

- Sediment from paved surfaces
- Heavy metals attached to particles washed off paved surfaces
- Oil, grease and other hydrocarbon products
- Litter
- Nutrients such as nitrogen and phosphorus from atmospheric deposition of particles.

The concept design incorporates features to reduce risks to soils and water quality during operation including rehabilitation, permanent spill basins, grassed swales and grassed channels. Given the implementation of these features, the operation of the proposal would not be expected to substantially impact on downstream water quality.

### **Farm dams**

The proposal has the potential to directly or indirectly impact up to 11 farm dams. Some of these dams are located on properties that would be subject to full acquisition. During detailed design, consultation will be undertaken with the owners of these properties regarding the potential impacts on the dams and the preferred options to mitigate these impacts (such as modification or relocation of the dam).

### 6.4.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Detailed design</b>			
Flooding impacts	Further flood modelling would be undertaken during detailed design to minimise impacts where possible	Roads and Maritime	Detailed design
	Surveys of identified properties would be undertaken to confirm floor levels	Roads and Maritime	Detailed design
<b>Construction</b>			
General construction impacts	Construct temporary drainage structures in accordance with the <i>Technical Guideline – Temporary Stormwater Drainage for Road Construction</i> (Roads and Maritime, 2011).	Construction contractor	Construction
Contamination of surface water	All fuels, chemicals, and liquids would be stored at least 50 m away from the existing stormwater drainage system and would be stored in an impervious bunded area within the compound site.	Construction contractor	Construction
	The refuelling of plant and maintenance of machinery would be undertaken in impervious bunded areas in the compound site.	Construction contractor	Construction
	Vehicle wash downs and/or concrete truck washouts would be undertaken within a designated bunded area of an impervious surface or undertaken off-site.	Construction contractor	Construction
Dewatering	Low lying areas of construction formations and excavations that collect stormwater would be dewatered in accordance with the <i>Technical Guideline - Environmental Management of Construction Site Dewatering EMS-TG-011</i> (RTA, 2011)	Construction contractor	Construction

## 6.5 Biodiversity

### 6.5.1 Overview

This section summarises the results of the biodiversity assessment undertaken by GHD provided in Appendix F.

The biodiversity assessment involved:

- A desktop review of relevant database records and previous studies for the study area
- A terrestrial flora and fauna field survey conducted on 1 and 2 July 2015 with reference to the *Threatened Species Survey Guidelines for Developments and Activities 2004* (DEC, 2004)
- Impact assessment and reporting.

## Certified lands

As noted by section 4.4.2 of Appendix F, the proposal site is located within the biodiversity certified land of the South West Growth Centre. Biodiversity certification removes the need to consider the potential effects on biodiversity values of an activity, and activities within this land are taken to not significantly affect any threatened species, population or ecological community listed under the NSW *Threatened Species Conservation Act 1995*. The Australian Minister for the Environment approved all actions associated with development of the Sydney Growth Centres as described in the Sydney Growth Centres Strategic Assessment Program Report (NSW Department of Planning, 2010b), and activities in certified land are taken to not significantly affect any Matters of National Environmental Significance listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Note, however, that biodiversity certification does not apply to threatened biota listed under the NSW *Fisheries Management Act 1994*.

The proposal site adjoins a small area of land that is not subject to biodiversity certification. This area, which is shown in Figure 6.24, is associated with Thompsons Creek and is located to the east of The Northern Road. There is potential for indirect construction impacts on biodiversity in this area.

Although biodiversity certification removes the need to consider the potential biodiversity impacts of the proposal, the following sections provide, for information purposes, a general description of the findings of the biodiversity assessment as they relate to the certified land in the study area. A summary of the findings of the assessment in relation to the potential for indirect impacts on the small area of non-certified land is also provided.

### 6.5.2 Existing environment

#### Flora species and vegetation communities

Rural and agricultural use of land in Western Sydney, including the land within the study area, has resulted in the large scale clearing of native vegetation. The remaining areas of native vegetation in the study area are fragmented and isolated, mainly in isolated patches of remnant or regenerating vegetation within the road reserve or along watercourses. There are no large continuous tracts of vegetation.

A total of 225 species of flora were recorded within the study area, comprising 124 species that are native to the Liverpool and Camden LGAs and 101 species that are either exotic or are native species but not endemic to the LGAs (ie planted natives).

All native vegetation communities in the study area are commensurate with threatened ecological communities listed under the TSC Act. These comprise the critically endangered ecological community *Cumberland Plain Woodland in the Sydney Basin Bioregion* (Cumberland Plain Woodland) and the endangered ecological community *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (River-Flat Eucalypt Forest). No patches of Cumberland Plain Woodland in the study area meet the condition criteria for the form of the critically endangered ecological community listed under the EPBC Act (Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest). The native vegetation communities, conservation status and location with respect to the certified areas are summarised in Table 6.21. Further information is provided in Appendix F.

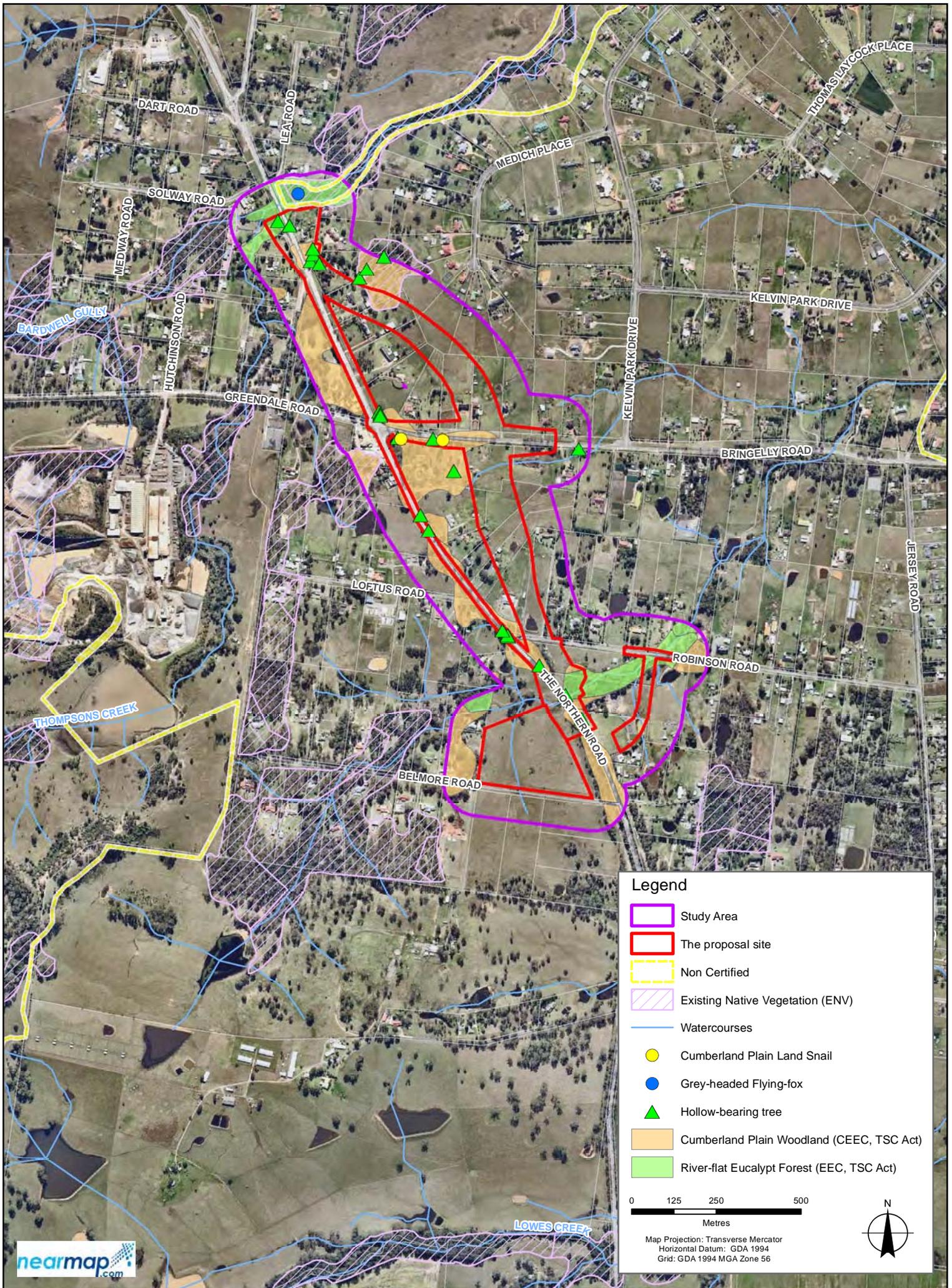


Figure 6.24  
Vegetation, threatened species and hollow-bearing trees

Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by: MWeerakoon

Non native vegetation communities comprise:

- Exotic grassland and gardens
- Aquatic plants in dams.

Table 6.20 Native vegetation communities in the proposal site

Native vegetation community	Conservation status/classification	Area within proposal site (ha)
<b>Within certified land</b>		
Cumberland Plain Woodland (Shale Plains Woodland)	Listed under the TSC Act as the critically endangered ecological community <i>Cumberland Plain Woodland in the Sydney Basin Bioregion</i>  No patches in the study area meet the condition criteria for the form of the critically endangered ecological community listed under the EPBC Act	3.30
River-flat Eucalypt Forest	Listed under the TSC Act as the critically endangered ecological community <i>River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions</i>	0.96
<b>Total area of native vegetation</b>		<b>4.26</b>
<b>Within non-certified land</b>		
River-flat Eucalypt Forest	As above	This area adjoins the proposal site

A small patch of Cumberland Plain Woodland (within certified land) and a small area of the River-flat Eucalypt Forest on Thompsons Creek (within non-certified land) meet the definition of existing native vegetation provided by the Order conferring biodiversity certification on the Growth Centres SEPP.

### **Threatened flora species**

Of the 22 threatened flora species previously recorded in the search area for the biodiversity assessment, most are considered unlikely to occur within or in the vicinity of the proposal site based on known geographic range, associated vegetation types, specific habitat requirements, previous records, and the lack of evidence during field surveys. There is broadly suitable habitat in the study area for a number of threatened plant species including Downy Wattle, Juniper-leaved Grevillea, Small-flower Grevillea and Austral Toadflax. These species are easily identifiable, yet were not located during field surveys and are, therefore, not likely to occur in the study area.

One species that could occur in the study area is the endangered Spiked Rice-flower which flowers sporadically and is difficult to detect when not flowering.

No threatened flora species or populations native to the Liverpool and Camden LGAs were recorded during the field surveys.

One endangered flora population listed under the TSC Act has been recorded close to the study area: *Marsdenia viridiflora* R. Br. subsp. *Viridiflora*; however no individuals were found during the field surveys despite targeted searches in potential habitat.

### **Noxious weeds**

Twelve weed species declared as noxious in the Liverpool and Camden LGAs were recorded in the proposal site and surrounds. Two of these species, Green Cestrum and Honey Locust, are listed as class three noxious weeds, with the requirement that 'the plant must be fully and continuously

suppressed and destroyed'. Others are listed as class four, with the requirements including that 'the plant must not be sold, propagated or knowingly distributed' and/or 'the growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread'. Further information is provided in section 4.2.3 of Appendix F.

## Fauna

### **Fauna habitat and species**

Fauna habitat is patchy throughout the study area. Many of the remaining patches are of poor quality. The more intact remnants provide potential habitat for a variety of fauna and the creeklines provide potential habitat for birds, microbats and amphibians. Native woodland and forest vegetation within the study area includes a range of habitat features for native biota, including fallen timber, sparse hollow-bearing trees, occasional accumulations of leaf litter, and patches of dense shrubs.

The River-flat Eucalypt Forest in the non-certified lands occurs as a narrow strip of vegetation along Thompsons Creek, with Swamp Oak (*Casuarina glauca*) present along the margins. A range of paperbarks (*Melaleuca* spp.) are also present. Understorey vegetation includes rushes and sedges. This vegetation occurs within thin and fragmented riparian corridors, and thus provides habitat for species that are mobile and able to utilise smaller, isolated fragments. Species that require larger, more intact stands of woodland/forest vegetation are unlikely to occur. Riparian corridors provide potential movement corridors and the denser vegetation present provides refuge for smaller woodland birds, although not those which require more extensive tracts of habitat.

A total of 35 species of native fauna were recorded during the field survey for the biodiversity assessment. The recordings comprise 26 bird species, four mammal species, one reptile species, two frog species, and two snail species.

### **Threatened and migratory fauna species**

Two threatened fauna species were recorded during the field survey:

- the Cumberland Plain Land Snail (*Meridolum corneovirens*) listed as an endangered species under the TSC Act – recorded in Cumberland Plain Woodland at the western end of Bringelly Road (within certified land)
- Grey-headed Flying-fox (*Pteropus poliocephalus*) listed as a vulnerable species under the TSC Act and EPBC Act – heard near Thompsons Creek (within non-certified land).

Seven threatened fauna species listed as vulnerable species under the TSC Act are likely to occur within the study area (within both certified and non-certified lands) given the presence of suitable habitat and previous records. These are:

- Varied Sittella (*Daphoenositta chrysoptera*)
- Little Eagle (*Hieraaetus morphnoides*)
- Hollow-roosting microbats:
  - Eastern Freetail Bat (*Mormopterus norfolkensis*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
  - Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*)
- Cave-breeding microbats:
  - Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
  - Large-footed Myotis (*Myotis macropus*).

None of these species are likely to rely on habitats present in the study area for their survival in the locality.

No threatened terrestrial or arboreal mammals listed under the TSC Act and/or the EPBC Act are likely to occur given the patchy nature of the vegetation and lack of connectivity. No habitat for threatened frogs, reptiles or fish listed under the TSC Act, EPBC Act or FM Act is present.

One migratory species listed under the EPBC Act, the Cattle Egret (*Ardea ibis*), was recorded foraging in pasture areas in the study area. This is a highly mobile species and is highly unlikely to rely on habitats within the study area for any part of its lifecycle.

The Great Egret (*Ardea alba*), a migratory species listed under the EPBC Act, is also likely to forage at farm dams on occasion. A number of additional migratory species may occur on occasion in the study area during their winter migration. The proposal site is not considered important habitat for any of these species, according to the significant impact criteria for migratory species (DEWHA, 2009).

### 6.5.3 Potential impacts on certified lands

#### Construction

Potential impacts on biodiversity during construction include:

- direct impacts – as a result of the clearing or temporary disturbance of vegetation within the proposal site
- indirect impacts – disturbance of flora and fauna located outside the proposal site.

#### **Direct impacts**

The majority of land that would be disturbed during construction is subject to pre-existing disturbance and has been cleared for rural and/or residential purposes. Construction of the proposal would result in the removal of about 4.26 hectares of native vegetation as listed in Table 6.20, including removal of up to 17 hollow-bearing trees (note that the removal of about five trees along the existing The Northern Road is unlikely as works would be on the opposite side of the road to these trees).

A number of farm dams (up to about 11 dams) would be removed and/or impacted by construction. This would remove shelter, breeding and foraging habitat for common fauna species such as waterbirds, turtles and frogs, and foraging habitat for microchiropteran bats and birds such as the Welcome Swallow (*Hirundo neoxena*) that forage above waterbodies.

All of the above direct impacts would occur within certified land. As outlined in section 4.2.2, no further assessment is required.

#### **Indirect impacts**

The main potential for indirect impacts on flora and fauna during construction would include:

- injury or mortality to fauna species
- sedimentation, soil and/or water pollution impacting adjoining areas of habitat
- weed invasion and edge effects
- increase in noise and dust
- introduction of pests or pathogens.

The indirect impacts listed above can be readily managed by implementing standard construction soil and water management measures; implementing hygiene protocols (to prevent the potential spread of disease and plant pathogens); and the mitigation measures listed in section 6.5.5. By implementing these measures, indirect impacts on locally occurring flora and fauna are not likely to be significant.

## Operation impacts

Operation of the proposal has the potential to result in the following flora and fauna impacts:

- Injury to fauna as a result of vehicle strike
- Disruption to the movement of fauna
- Disturbance as a result of noise and lights
- Contamination of downstream habitats as a result of spills from the road.

There would also be an increased risk of introduction of weeds and chemical spills, potentially having a greater risk of impact on native vegetation and aquatic habitats. However, future development of the Western Sydney Priority Growth Area and South West Priority Land Release Area would further reduce flora and fauna habitats in the study area, thus reducing the flora and fauna populations that may be indirectly impacted during operation.

Mitigation measures are provided in section 6.5.5 to manage weeds.

### 6.5.4 Potential impacts on non-certified lands

#### Construction

Construction of the proposal would not directly impact on the River-flat Eucalypt Forest within non-certified lands around Thompsons Creek. As outlined above, the proposal may contribute to indirect impacts on this vegetation through the further spread of weeds, sedimentation and/or introduction of pollutants.

While no substantial impacts are anticipated on River-flat Eucalypt Forest within non-certified lands, an assessment of the likely significance of the potential indirect impacts on the EEC has been prepared on a precautionary basis (see Appendix F). The assessment concluded that the proposal would not have a significant impact on this community. Mitigation measures are provided in section 6.5.5 to minimise the potential for indirect impacts on non-certified lands.

#### Operation

Potential impacts during operation would be as described for non-certified land in section 6.5.4.

### 6.5.5 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Detailed design</b>			
Direct impacts to native vegetation	The detailed design would minimise the removal of vegetation in certified land and avoid the removal of vegetation in non-certified land.	Roads and Maritime	Detailed design
<b>Pre-construction</b>			
Biodiversity impacts	<p>A biodiversity management plan would be prepared and included within the CEMP in accordance with Roads and Maritime's <i>Biodiversity Guidelines</i> (RTA, 2011). It would include:</p> <ul style="list-style-type: none"> <li>• A site walk with qualified site personnel including Roads and Maritime representatives prior to commencement of works to confirm clearing boundaries and sensitive location</li> <li>• A map which clearly shows vegetation</li> </ul>	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>clearing boundaries and sensitive areas/no go zones</p> <ul style="list-style-type: none"> <li>• On site identification (marking) of the clearing boundary and habitat features (including hollow-bearing trees) to be protected</li> <li>• Pre-clearing survey plan and management measures describing the survey methodology and targeted species, including the Cumberland Plain Land Snail</li> <li>• Incorporation of management measures identified as a result of the pre-clearing survey report and nomination of actions to respond to the recommendations made. This would include details of measures to be implemented to protect clearing limits and no go areas</li> <li>• A detailed clearing process in accordance with Roads and Maritime's <i>Biodiversity Guidelines 2011</i>, including the requirements of Guide 1,2, 4 &amp; 9</li> <li>• Identify in toolbox talks where biodiversity would be included such as vegetation clearing or works in or adjacent to sensitive locations</li> <li>• Identify control/mitigations measures to prevent impacts on sensitive locations or no go zones</li> <li>• A stop works procedure in the event of identification of unidentified species, habitats or populations</li> <li>• A procedure for clearing hollow bearing trees in line with Guide 4 of the RMS Biodiversity Guidelines 2011</li> <li>• Hygiene protocols to prevent the introduction and spread of pathogens</li> <li>• A protocol for the management of dewatering of farm dams to prevent introduction of Mosquito Fish into surrounding waterways should be implemented.</li> </ul>		
	<p>A suitably qualified ecologist would be engaged to clearly demarcate vegetation protection areas (including habitat trees) and complete the pre-clearing survey report.</p>	<p>Construction contractor</p>	<p>Pre-construction</p>
<b>Construction</b>			
<p>Biodiversity impacts</p>	<p>Construction would be undertaken in accordance with the biodiversity management plan.</p>	<p>Construction contractor</p>	<p>Construction</p>
	<p>An ecologist would be present during the clearing of habitat trees to handle and relocate any injured fauna. WIRES would be consulted if any injured fauna are encountered.</p>	<p>Construction contractor</p>	<p>Construction</p>

Impact	Environmental safeguards	Responsibility	Timing
	Declared noxious weeds would be managed in accordance with the requirements of the <i>Noxious Weeds Act 1993</i> and Guide 6 (Weed Management) of the Roads and Maritime Biodiversity Guidelines 2011.	Construction constructor	Construction
	Dams would be progressively emptied over a number of days to allow native fauna to relocate. An experienced, licenced wildlife carer or ecologist would be required to assist with relocation of fauna such as turtles, or with humane disposal of noxious fish	Construction constructor	Construction
	Any large woody debris would be relocated rather than removed	Construction constructor	Construction
<b>Operation</b>			
Weed management	Ongoing weed management and control would be undertaken in accordance with the Biodiversity Guidelines 2011.	Roads and Maritime	Operation

## 6.6 Aboriginal cultural heritage

### 6.6.1 Overview

A preliminary Aboriginal cultural heritage assessment was undertaken by Artefact Heritage. The assessment is provided in Appendix G.

The assessment was based on Stage 1 and 2 of the Roads and Maritime *Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI)* and included a desktop search for known items in the study area, followed by a site inspection. The results of this assessment are summarised in the following sections. A description of the historical context for the study area is provided in Appendix G.

### 6.6.2 Existing environment

#### Database and survey results

An extensive search of the Aboriginal Heritage Information System (AHIMS) database was undertaken on 26 June 2015 for the proposal site. There are 23 registered sites located within the search area (defined according to the coordinates provided in Appendix G). Of the 23 previously recorded sites, artefacts are the predominant site feature. There is one scarred tree recorded to the south of the proposal site.

The majority of existing sites are located in the vicinity of The Northern Road and Bringelly Road, which is likely to reflect the focus of previous investigations for adjoining projects.

Of the identified sites, five sites are located within the proposal site boundary (refer to Table 6.21). Note that sites 45-5-3886 and 45-5-4150 overlap. During the Aboriginal heritage investigations undertaken in 2012 for The Northern Road upgrade REF (SKM, 2012), Artefact Heritage also identified a potential archaeological deposit (PAD) associated with sites BRP-IF-16 and TNRU14 AHIMS sites.

Table 6.21 Registered sites located within the proposal site

AHIMS site number	Site name	Site feature
45-5-3886 and 45-5-4150	BRP-IF-16 / TNRU14	Artefact
45-5-3894	BRP-S-07	Artefact
45-5-4142	TNRU6	Artefact scatter
45-5-4143	TNRU7	Artefact scatter

An archaeological field survey of the proposal site was undertaken on 15 and 24 July 2015 and 30 September 2015 with members from Tharawal Local Aboriginal Land Council and Gandangara Local Aboriginal Land Council. The survey confirmed the location of the previously recorded AHIMS sites. During the survey two new PADs were identified, located about 150 m north of Bringelly Road (TNRB PAD01) and south of Robinson Road about 300 m east of The Northern Road, within the proposal site (TNRB PAD02). As artefacts have been previously found in areas of exposure along Bringelly Road to the south and south-east of PAD01, this site has the potential to contain intact archaeological deposits and Aboriginal objects. It is likely that PAD02 would extend into neighbouring properties and due to the proximity to other artefact scatters, this site has the potential to contain intact archaeological deposits and Aboriginal objects.

The significance of each site is described in Table 6.22.

Table 6.22 Summary of archaeological significance

AHIMS number	Name	Significance
45-5-3886 and 45-5-4150	BRP-IF-16 / TNRU14	Moderate
45-5-3894	BRP-S-07	Low
45-5-4142	TNRU6	Moderate
45-5-4143	TNRU7	Low
N/A (new site discovered during survey)	TNRB PAD01	Likely moderate to low potential
N/A (new site discovered during survey)	TNRB PAD01	Likely moderate to low potential

AHIMS site BRP-IF-16 / TNRU14 and TNRU6 have a moderate archaeological significance, based on the moderate potential for subsurface potential, the generally undisturbed nature of the site, and the site's potential to contribute to the archaeological knowledge of the study area. BRP-S-07 and TNRU7 have low archaeological significance, based on the existing levels of disturbance, low archaeological potential, and relative frequency of the site type in the local area. The newly identified PADs are of likely moderate to low potential for archaeological significance. TNRB PAD01 is within a similar crest landform to other previously identified sites such as BRP-IF-16 which has been assessed as having moderate archaeological significance. TNRB PAD2 is within a similar landform (raised terrace next to a waterway) to identified sites such as TNRU 6 and TNRU 7 which have been assessed as having a moderate and low archaeological significance respectively. Further archaeological investigations would be required to determine the significance of these sites.

Ten properties were not accessible at the time of survey. The likely archaeological potential of those properties based on the observations and findings throughout the remainder of the study area are discussed further in section 8 of Appendix G. In summary, two properties were identified as having a low archaeological potential. The remaining eight properties were assessed as having some potential to contain surface sites or PADs which would be confirmed by a site survey once access is available. It is likely that any artefact sites or PADs identified during a survey would be consistent in terms of archaeological potential and significance with others in the locality, and are

therefore unlikely to have a high archaeological significance. The possibility of scarred trees remaining within areas of remnant vegetation is a possibility but the risk is considered to be minor.

### 6.6.3 Potential impacts

#### Construction

Construction of the proposal would impact on the sites identified above. A summary of the potential impacts of the proposal on these sites is provided in Table 6.23.

Table 6.23 Potential impacts on non-Aboriginal heritage items

Site name	Nature of impact	Consequence of impact in terms of the site's significance
BRP-IF-16 /TNRU14	Site would be partially removed	Partial loss of value
BRP-S-07	Site would be completely removed	Total loss of value
TNRU6	Site would be partially removed	Partial loss of value
TNRU7	No impact	No loss of value
TNRB PAD01	Site would be completely removed	Total loss of value
TNRB PAD02	Site would be completely removed	Total loss of value

Impacts to sites BRP-IF-16/TNRU14 and BRP-S-07 were identified by the Bringelly Road upgrade REF (ngh environmental, 2011). An AHIP to permit impacts to these sites was sought by Roads and Maritime in May 2014. These sites are subject to Bringelly Road upgrade AHIP number C0000436. The conditions of the AHIP require salvage excavation of BRP-IF-16/TNRU14, and surface collection at BRP-S-07, prior to impacts at these sites.

Site TNRU6 was identified by The Northern Road upgrade REF. An AHIP application to salvage this site is currently being processed by the NSW Office of Environment and Heritage (OEH). TNRU7 is unlikely to be impacted by the proposal. It is located within the proposal site but it is not within the footprint of the works and can be avoided.

The proposal would also impact site TNRB PAD01 and TNRB PAD02. Test excavation in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010) would be undertaken to determine whether any sub-surface intact archaeological deposits and Aboriginal objects are present. It is unlikely that TNRB PAD01 and TNRB PAD02 would be found to have high archaeological significance. As such, impacts to TNRB PAD01 and TNRB PAD02 could be effectively mitigated through test excavation.

Due to the overlapping nature of the existing AHIPs, Roads and Maritime would either need to apply for a whole of site AHIP or undertake salvage or surface collection under the existing AHIPs prior to commencement of works.

#### Operation

No impacts to Aboriginal heritage during operation have been identified.

#### 6.6.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Detailed design</b>			
Avoiding impacts on Aboriginal heritage items	Properties not accessible at the time of writing this REF are to be surveyed and assessed prior to works commencing,	Roads and Maritime	Detailed design
<b>Preconstruction</b>			
Aboriginal heritage impacts	In accordance with the Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation, Stage 3 is to be implemented, including the preparation of a Cultural Heritage Assessment Report and comprehensive consultation with key stakeholders.	Roads and Maritime	Pre-construction
	Test excavation would be undertaken for TNRB PAD01 and TNRB PAD02 to inform an assessment of archaeological significance in accordance with the Code of Practice.	Roads and Maritime	Pre-construction
	A program of archaeological salvage or surface collection would be undertaken in accordance with the requirements of the existing AHIPs relating to sites BRP-IF-16 / TNRU14, BRP-S-07 and TNRU6.	Roads and Maritime	Pre-construction
	An Aboriginal heritage management plan would be prepared and incorporated into the CEMP. The plan would include (but not be limited to) the following: <ul style="list-style-type: none"> <li>• A sensitive areas map which clearly identifies the exclusion zones</li> <li>• Fencing to control access during construction to the exclusion zones</li> <li>• An environmental risk assessment to determine potential risks for discrete work elements or activities likely to affect significant heritage elements</li> <li>• Specific mitigation measures to avoid risk of harm</li> <li>• A process to communicate risk and responsibilities through environmental awareness training</li> <li>• A stop works procedure in the event of actual or suspected potential harm to a heritage feature/place</li> <li>• All measures recommended in the CHAR and AHIP, including notification requirements</li> <li>• Site training and induction.</li> </ul>	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
<b>Construction</b>			
Consultation	Stakeholders would continue to be consulted in accordance with Roads and Maritime's PACHCI procedure.	Construction contractor	Construction
Aboriginal cultural heritage item encountered during work	In the event of an unexpected find of Aboriginal cultural heritage, work would cease in the affected area and the <i>Standard Management Procedure - Unexpected heritage items</i> (Roads and Maritime 2015) will be implemented. This would include stopping all work in the vicinity of the find and contacting Roads and Maritime's Aboriginal cultural heritage advisor or the relevant Roads and Maritime environmental officer immediately to identify the appropriate course of action. Work would not recommence until receipt of written approval from Roads and Maritime.	Construction contractor	Construction

## 6.7 Non-Aboriginal heritage

This section summarises the results of the non-Aboriginal heritage assessment and statement of heritage impacts prepared by Artefact Heritage as an input to the REF. The full report is provided in Appendix H.

The heritage assessment included:

- A desktop search of relevant statutory and non-statutory registers and schedules to identify any items of non-Aboriginal heritage significance in the proposal site
- An inspection of the proposal site on 15 July 2015 and 24 July 2015 and 30 September 2015 to verify identified heritage items and any other potential items located within 50 m of the proposal site. The survey involved physical inspections of the carriageway, footpaths, grassed verges and all heritage listed items located within the study area. A photographic record was kept, with photographs taken of all heritage items (refer to Appendix H).

A description of the historical context for the study area is provided in Appendix H.

### 6.7.1 Existing environment

#### Database and survey results

Two locally listed heritage items, an item of potential heritage significance, and two potential archaeological sites are located in the vicinity of the proposal site. A summary of these items/sites is provided in Table 6.24 and the locations of these items/sites are shown on Figure 6.25.

Table 6.24 Non-Aboriginal heritage items and potential archaeological sites in the vicinity of the proposal site

Item no.	Name	Description	Location with respect to the proposal site	Heritage listings	Heritage significance
<b>Heritage listed items</b>					
1	<b>Bringelly Public School Group</b> Lot 50 in DP 746911 	<p>Both the teacher's residence and the school building, which were constructed in 1897, are still present at the site.</p> <p>The teacher's residence is a single storey building, oriented to the east, with a veranda on the eastern side. Most recently, it was subject to use as the administration office for the school.</p> <p>The schoolroom is also a single storey building, oriented to the east. Some of the building is used as a classroom.</p> <p>Both buildings front The Northern Road, and are located about 350 m south of the proposal site boundary.</p>	Located on the north-western corner of the existing intersection of The Northern Road, Bringelly Road and Greendale Road, about 350 m south of the proposal site .	<i>Liverpool LEP 2008</i>  <i>Section 170 register of the Department of Education and Communities</i>	Local
2	<b>Cottage</b> 1186 The Northern Road 	<p>The cottage is Edwardian in style and is set back about 40 m from The Northern Road and 100 m from Bringelly Road. The space around it is vegetated with scrubby regrowth.</p> <p>The cottage is intact and in excellent condition.</p>	Located near the south-eastern corner of the existing intersection of The Northern Road, Bringelly Road and Greendale Road, about 40 m south-west of the proposal site at the nearest point.	<i>Camden LEP 2010</i>	Local
<b>Item of potential heritage significance</b>					
3	<b>Bringelly Road / Greendale Road corridor</b> With its associated rural cultural landscape 	<p>The rural nature that was established with the first land grants is still visible across the study area. This includes ongoing use of the land for pastoral and market gardening activities, and wide sweeping visual references to the rural nature of the area.</p> <p>Existing farm structures, including sheds, and evidence of former structures, such as concrete pads, support the visual reference to the rural landscape. The rolling terrain and local highpoints through the study area add to visual amenity.</p>	Located within the proposal site along Bringelly Road	<i>Camden Development Control Plan 2011</i>	Local historical and aesthetic significance

Item no.	Name	Description	Location with respect to the proposal site	Heritage listings	Heritage significance
<b>Potential archaeological sites</b>					
4	<b>Bringelly Church site</b> 991 Bringelly Road 	<p>The first church in the study area was built in the early 1900s. It is understood that the church was destroyed by fire in 1963. The site has remained undeveloped and undisturbed since the church building was destroyed. It is likely that archaeological remains associated with the building have survived.</p> <p>A rectangular outline of ridged land delineates the site of the church (shown in the photo) and brick fragments are visible at the southern and northern ends.</p>	Located about 20 m to the west of the proposal site at the nearest point	n/a	Likely that archaeological remains associated with the building have survived
5	<b>The Northern Road and Bringelly Road</b>	<p>Roads have existed at the current location of Bringelly Road, and the section of The Northern Road between Cobbitty Road and Bringelly Road, since at least 1826.</p> <p>There is the potential for early road surfaces to survive beneath the current surface. However, before the mid-twentieth century, these roads were unsealed or insubstantial and remains related to former surfaces would be limited. The current road surfaces of The Northern Road and Bringelly Road are bitumen. No further road surfaces were identified.</p>	Located within the proposal site along Bringelly Road and at the northern and southern tie-ins to The Northern Road	n/a	Local

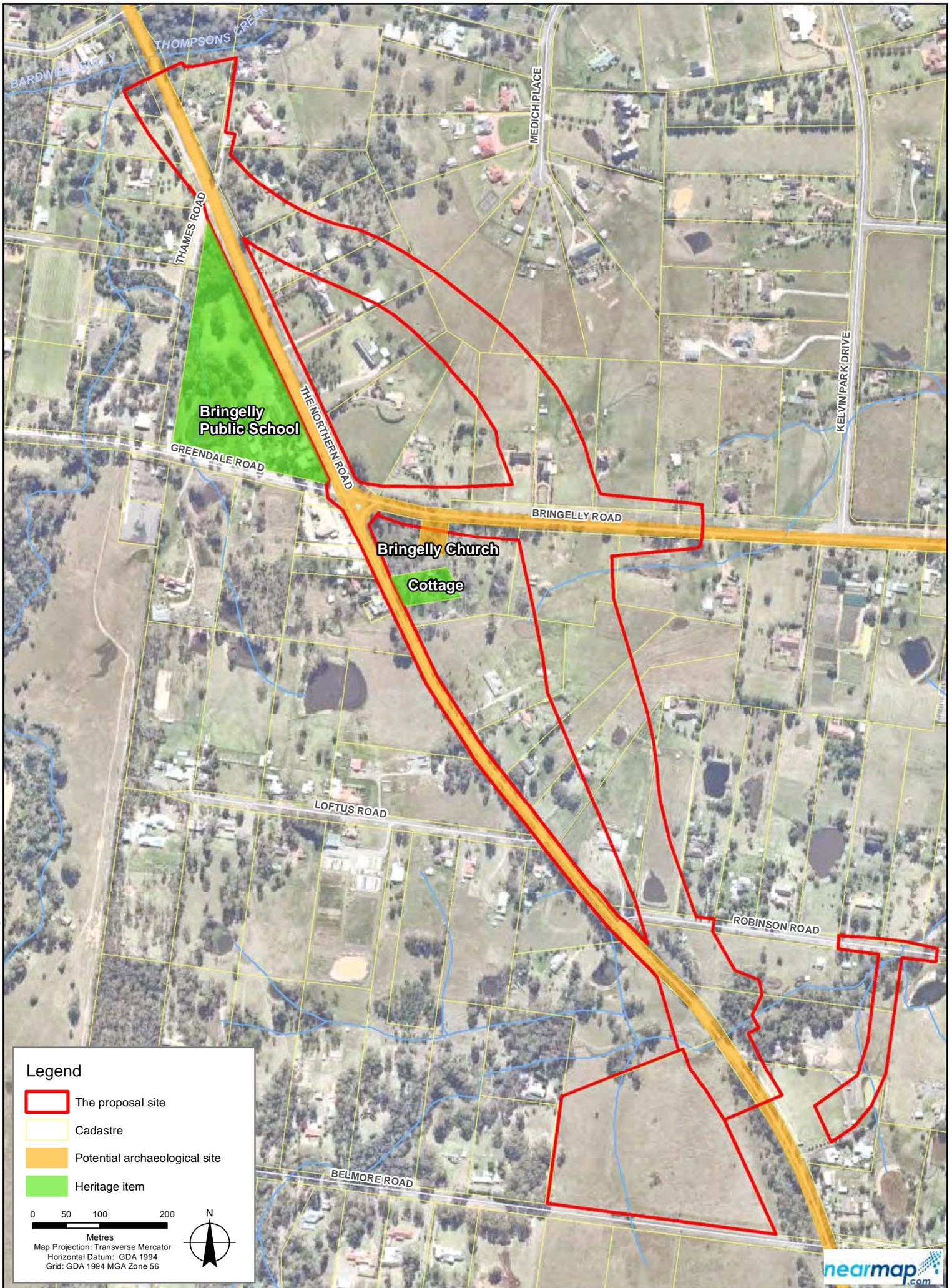


Figure 6.25  
Non-Aboriginal heritage items and potential archaeological sites

## Operation

No impacts to non-Aboriginal heritage during operation have been identified.

### 6.7.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Detailed design</b>			
Avoiding impacts on heritage items	During design development, impacts on heritage items are to be avoided where practicable.	Roads and Maritime	Detailed design
	If the final design of the proposal changes considerably from that currently proposed, additional assessment may be required.	Roads and Maritime	Detailed design
	Properties not accessible at the time of writing this REF are to be surveyed and assessed prior to works commencing,	Roads and Maritime	Detailed design
	Implement measures outlined in section 6.8.4.	Construction contractor	Detailed design
<b>Pre-construction</b>			
Avoiding impacts on heritage items	<p>A non-Aboriginal Heritage Management plan would be prepared and included in the CEMP. This plan would include:</p> <ul style="list-style-type: none"> <li>• A map identifying locations of items/sites in the vicinity of the proposal site</li> <li>• Identification of potential environmental risks/ impacts due to the work/activities</li> <li>• Mitigation measures for the identified risks</li> <li>• A procedure to report any damage to heritage items compliant with the Roads and Maritime Incident Classification and Reporting Procedure</li> <li>• Identify in toolbox talks where management of non-Aboriginal heritage is required such as identification of no go zones and responsibilities under the <i>Heritage Act 1977</i></li> <li>• Requirement to comply with the Roads and Maritime <i>Standard Management Procedure: Unexpected Heritage items</i> (2015).</li> </ul>	Construction contractor	Pre-construction
	Retain the vegetation buffer between the proposal and the cottage, where possible		

Impact	Environmental safeguards	Responsibility	Timing
<b>Construction</b>			
Inadvertent impacts on heritage items	Environmental awareness training would include responsibilities under heritage legislation. Workers would be informed regarding the location of known heritage items, and the unanticipated finds procedure.	Construction Contractor	Construction
Unanticipated archaeological finds	If unexpected archaeological remains are uncovered during the work, all work must cease in the vicinity of the material/find and the steps in the Roads and Maritime <i>Standard Management Procedure: Unexpected Heritage items</i> (2015) procedure must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.	Construction Contractor	Construction

## 6.8 Landscape character and visual impacts

### 6.8.1 Overview

This section summarises the results of the landscape character and visual impact assessment of the proposal undertaken by SMM. The results of the assessment are summarised in the following sections. A full copy of the report is provided in Appendix I.

The assessment was undertaken in accordance with the *Environmental Impact Assessment Guidance Note – Guidelines for landscape character and visual impact assessment* (EIA-N04) (Roads and Maritime, 2013a).

The assessment involved:

- Contextual analysis providing a discussion of the key urban, environmental and cultural factors that would affect the design and potential impacts of the proposal
- Review of relevant urban design considerations and the urban design
- Landscape character assessment
- Visual impact assessment
- Provision of mitigation measures to minimise the potential for negative impacts and enhance the potential for positive impacts of the proposal.

The contextual analysis involved a desktop review of aerial photography and existing mapping information, including GIS and topographic maps, was undertaken to identify representative publicly accessible viewpoints, potentially affected receptors and potential local landscape character and visual context areas for site assessment purposes.

A site evaluation was then undertaken to verify the results of the desktop study and provide more information about the study area, the location of the main infrastructure proposed, and the potential impacts. The area from where the proposal would be visible (the 'visual envelope map' was determined). Publicly accessible and representative viewpoints (visual receptors) were confirmed and recorded.

A qualitative assessment of the landscape and visual impacts of the proposal was undertaken. The potential sensitivity of the visual receptors to change was determined and rated (from negligible to high). Sensitivity is dependent upon the location of receptors, the importance of their view, activity at this location, and the extent of existing screening.

Impact	Environmental safeguards	Responsibility	Timing
Inadvertent impacts on heritage items	Environmental awareness training would include responsibilities under heritage legislation. Workers would be informed regarding the location of known heritage items, and the unanticipated finds procedure.	Construction Contractor	Construction
Unanticipated archaeological finds	If unexpected archaeological remains are uncovered during the work, all work must cease in the vicinity of the material/find and the steps in the Roads and Maritime <i>Standard Management Procedure: Unexpected Heritage items</i> (2015) procedure must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.	Construction Contractor	Construction

## 6.8 Landscape character and visual impacts

### 6.8.1 Overview

This section summarises the results of the landscape character and visual impact assessment of the proposal undertaken by SMM. The results of the assessment are summarised in the following sections. A full copy of the report is provided in Appendix I.

The assessment was undertaken in accordance with the *Environmental Impact Assessment Guidance Note – Guidelines for landscape character and visual impact assessment* (EIA-N04) (Roads and Maritime, 2013a).

The assessment involved:

- Contextual analysis providing a discussion of the key urban, environmental and cultural factors that would affect the design and potential impacts of the proposal
- Review of relevant urban design considerations and the urban design
- Landscape character assessment
- Visual impact assessment
- Provision of mitigation measures to minimise the potential for negative impacts and enhance the potential for positive impacts of the proposal.

The contextual analysis involved a desktop review of aerial photography and existing mapping information, including GIS and topographic maps, was undertaken to identify representative publicly accessible viewpoints, potentially affected receptors and potential local landscape character and visual context areas for site assessment purposes.

A site evaluation was then undertaken to verify the results of the desktop study and provide more information about the study area, the location of the main infrastructure proposed, and the potential impacts. The area from where the proposal would be visible (the 'visual envelope map' was determined). Publicly accessible and representative viewpoints (visual receptors) were confirmed and recorded.

A qualitative assessment of the landscape and visual impacts of the proposal was undertaken. The potential sensitivity of the visual receptors to change was determined and rated (from negligible to high). Sensitivity is dependent upon the location of receptors, the importance of their view, activity at this location, and the extent of existing screening.

Landscape character impacts refer to the relative capacity of the landscape to accommodate changes to the physical landscape through the introduction of new features or loss/modification of existing features. Impacts were assessed from representative viewpoints and rated (from negligible to high)

The significance of potential visual impacts was determined by assessing the magnitude of change to the landscape (views) in combination with the sensitivity of the receptor. Potential impacts were qualified (rated) according to their significance (severity), as shown in Figure 6.26. Significant impacts are considered to be those with a rating of moderate to high or above.

Appendix I provides further information on how the impact, sensitivity and level of significance were assigned.

		Magnitude of impacts			
		High	Moderate	Low	Negligible
Sensitivity of feature	High	High	Moderate to high	Moderate	Negligible
	Moderate	Moderate to high	Moderate	Moderate to low	Negligible
	Low	Moderate	Moderate to low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 6.26 Impact significance rating matrix

### 6.8.2 Existing environment

The landscape and visual environment of the proposal site is characterised by its generally rural/rural residential nature. Features contributing to the visual appearance include open rural land interspersed with scattered development, dwellings, buildings and sheds; small stands of existing native vegetation and scattered trees; and road infrastructure.

#### Landscape character zones

Based on the outcomes of the contextual analysis, three landscape character zones were identified. These are areas with similar landscape and physical qualities. The landscape character zones are shown in Figure 6.27 and the key elements of each are summarised in Table 6.26.

Table 6.26 Landscape character zones

Character zone	Description	Sensitivity
Bringelly Acreage (north and south)	<p>The majority of the study area falls into this character zone. This zone is characterised by rural lots with low density/large lot residential development scattered across gently undulating land. There is a mix of built form and vegetation types. There are occasional lots with established gardens as well as those used for grazing and rural/agricultural uses.</p> <p>This zone includes the Bringelly Recreation Reserve, to the west of the Bringelly Village zone (below).</p> <p>This zone is defined by mid-distance views of gently undulating rural/rural residential land. Views are interrupted in some locations by established roadside trees and shrubs.</p>	<b>High</b> – due to the scenic nature of the rolling pastures, scattered trees and proximity of local residents
Bringelly Village	<p>This character zone includes the Bringelly Village shops and Bringelly Public School, which are located on the edge of the north-western slopes of a low broad hill at the junction of The Northern Road, Bringelly Road and Greendale Road. Bringelly Village is a small low-key village centre which fronts a main road.</p> <p>This character zone is reasonably open in appearance due to the single storey buildings, low shrub and tree plantings, and the wide grassed road verge to the north of Bringelly Road.</p>	<b>Moderate</b> – due to the low key village character and the location at the existing intersection
Thompsons Creek	<p>This character zone is located at the northern end of the proposal site around Thompsons Creek. The creek meanders through Bringelly Reserve towards a waterbody located to the south of the Bringelly Brickworks. There is limited public access to the creek and remnant vegetation visually encloses the creek.</p> <p>Generally the creek it is quite degraded and has been affected by domestic livestock, urban expansion and farming.</p> <p>Mid distance views of gently undulating rural residential lands can be seen from the creek and are filtered or blocked by creek vegetation.</p>	<b>Low</b> – due to the generally degraded and modified nature of the creek corridor and its limited public access

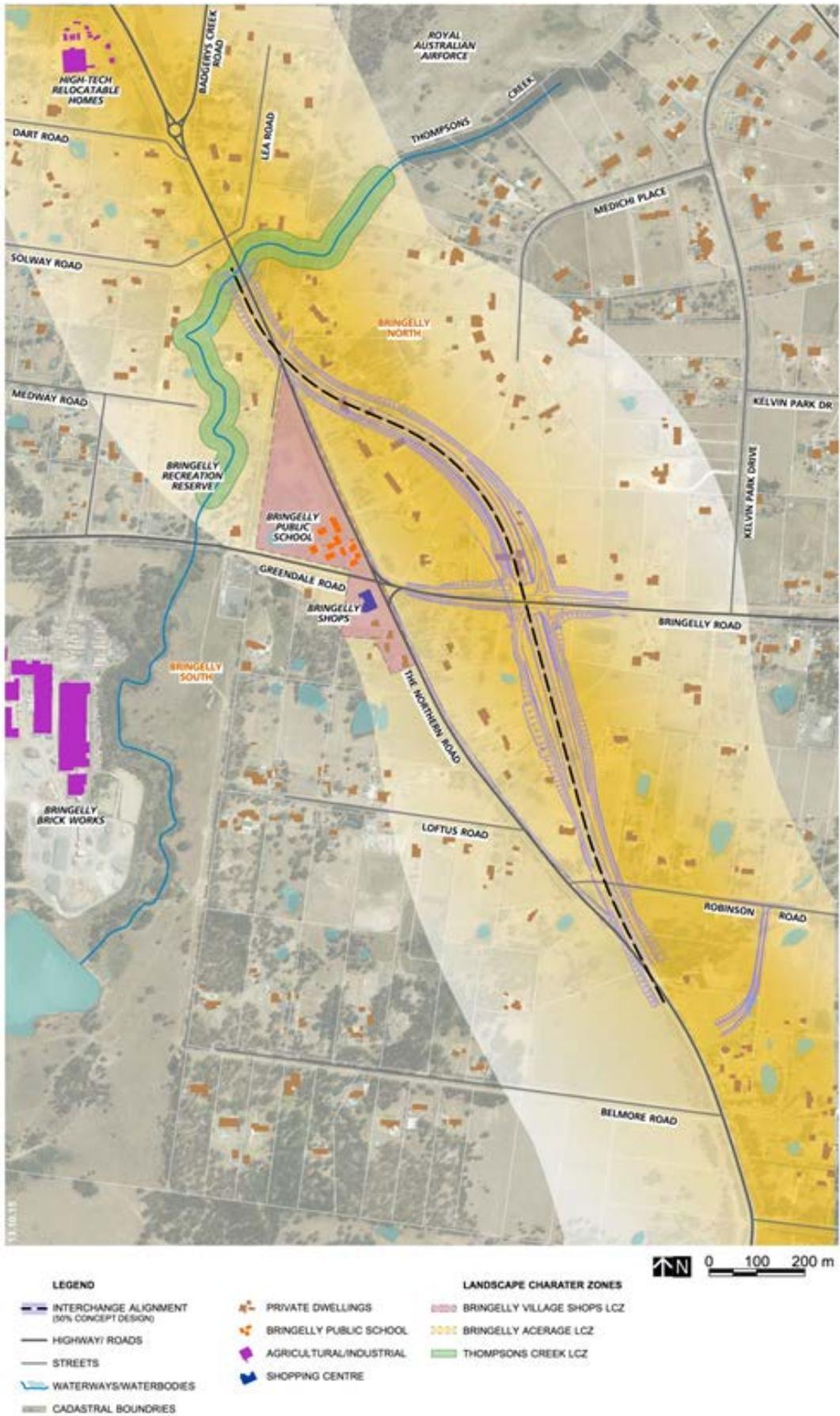


Figure 6.27 Key landscape features and character zones

## Key viewpoints

The extent from which the proposal would be visible from adjoining areas varies along the length of the proposal site. It is influenced by topography, vegetation, land uses (rural, residential, commercial) and associated buildings.

Within the identified visual envelope map, key viewpoints were identified along the proposal site and at public domain areas. This involved the analysis of views, from the road, to identify the extent to which houses and other buildings were visible. This provided an indication of the likely level of visibility from these buildings, as it was not feasible to inspect private residences to check potential views from these properties. Locations and directions of chosen viewpoints are representative of the range of viewpoints both within and beyond the proposal site.

A total of 12 viewpoints were identified. These are shown in Figure 6.28 and listed in Table 6.27. Photographs of each viewpoint are provided in Appendix I. The sensitivity of each viewpoint was identified based on

- Distance from the proposal site
- The category of viewer, for example, resident, worker, shopper, open space user
- The elements of the proposal that are visible
- Importance of the view.

Generally, viewers with the highest sensitivity include:

- Residents who have existing attractive views that would be affected by the proposal
- Users of public open space where their attention is focused on the visual landscape, for example, lookouts or other scenic natural areas
- Communities that place high cultural and historical significance on the visual landscape.

Viewers with the lowest sensitivity are most likely to be:

- Employees focused on their work
- Motorists whose attention is focused on driving.

Table 6.27 Key viewpoints

Viewpoint	Location	Distance from proposal site	Visual receptors	View type	Sensitivity
1	Kelvin Park Drive intersection	500 m	Residents and motorists	Long distance view	<b>Moderate</b> – The sensitivity of the residents would be considered high, however, their distance from the proposal site (over 500 m), and the limited extent of the proposal elements that would be visible (as a result of existing houses) reduces the rating to moderate.
2	Medich Place (southern end of the cul-de-sac)	220 m	Residents	Mid distance view	<b>High</b> – Residents within the area would have high sensitivity to changes, due to the proximity of their private spaces and orientation to the interchange works.
3	Robinson Road (adjacent to Lot 17)	150 m	Residents and motorists	Foreground view	<b>Moderate</b> – Motorists would have a low sensitivity to change, while residents within the area would have moderate sensitivity to the changes. The majority of properties are set back from the road and are densely vegetated to their perimeter boundary, limiting distant views.
4	Belmore Road	320 m	Residents and motorists	Long distance view	<b>Moderate</b> - The sensitivity of the residents would be considered high, however, their distance from the proposal site (320 m), and the limited extent of the elements that would be visible, reduces the rating to moderate.
5	The Northern Road (Lot 1110)	140 m	Motorists	Foreground view	<b>Low</b> - Motorists would have low sensitivity to change in this existing road environment.
6	Loftus Road (Lot 16)	370 m	Residents and motorists	Mid to long distance view	<b>Moderate</b> – The sensitivity of residents would be considered high, however, their distance from the proposal site and the screening provided by existing vegetation reduces the rating to moderate. Motorists on The Northern Road would have low sensitivity to change.
7	Bringelly Village shops	90 m	Visitors to the Bringelly Village shops and motorists	Foreground view	<b>Low</b> – The sensitivity would be low as the viewers would be patrons using local shops who would have their attention focussed on parking their car and shopping. Motorists on Bringelly Road and The Northern Road would have low sensitivity to change.

Viewpoint	Location	Distance from proposal site	Visual receptors	View type	Sensitivity
8	Greendale Road (near the south-western boundary of Bringelly Public School)	480 m	School children and motorists	Long distance view	<b>Low</b> – The sensitivity of school children would be low as their attention would be focussed internally on sports and other activities. Motorists on Greendale Road would have low sensitivity to change.
9	Thames Road	85 m	Residents and motorists	Mid distance view	<b>High</b> – Residents within the area would have high sensitivity to changes, due to the proximity of their private spaces to the proposal site. Motorists on The Northern Road would have low sensitivity to change.
10	The Northern Road at the intersection of Badgerys Creek Road	155 m	Motorists	Mid distance view	<b>Low</b> – Motorists would have low sensitivity to change in this road environment.
11	Bringelly Road (east of the existing intersection with The Northern Road)	0 m	Motorists	Foreground view	<b>Low</b> – Motorists would have low sensitivity to change in this road environment.
12	Bringelly Road at the intersection of Kelvin Park Drive	200 m	Motorists	Mid distance view	<b>Low</b> - Motorists would have low sensitivity to change in this existing road environment.

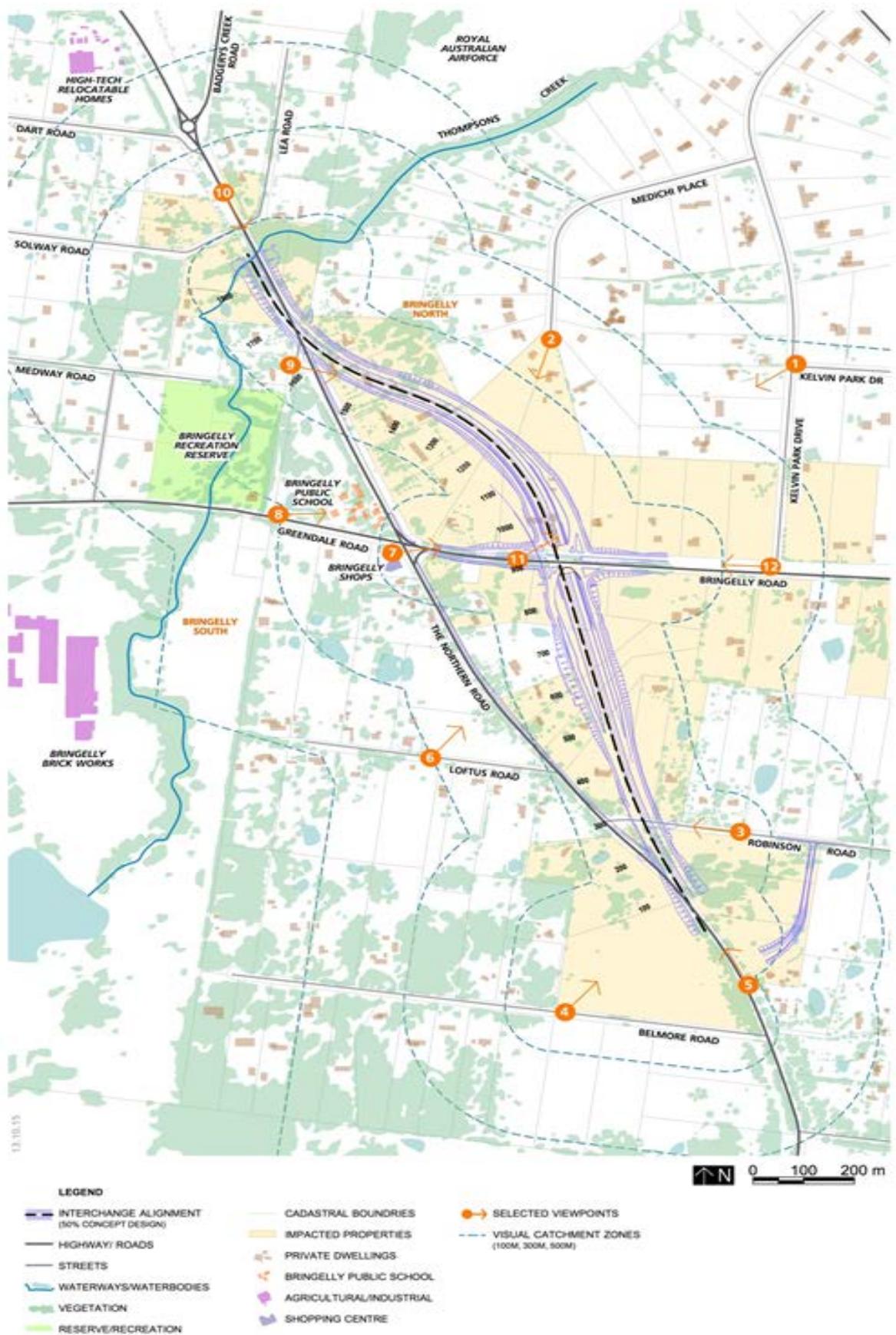


Figure 6.28 Viewpoint location plan

### 6.8.3 Potential impacts

#### Construction

During construction, positioning of plant and equipment within the view of neighbouring properties and existing road users would result in temporary visual impacts. Earthworks would also expose subsoil. The exposed soil would form a visible element in the landscape for a limited period. The use of lighting towers during any night work may result in light spill impacting adjoining properties and residents.

The proposal would require removal of some vegetation within the boundaries of the proposal site. This would include trimming and/or clearing of vegetation within certified land (as described in section 6.5.5) and landscaping within private property. Some of this vegetation contributes to the amenity and character of the local area, and/or screens views from properties adjoining the road. The removal of this vegetation would have the potential to reduce some screening between residential dwellings and the road. This would lead to temporary visual impacts during construction until the works are complete and disturbed areas rehabilitated.

Potential visual impacts during construction would be minimised through implementation of the safeguards and management measures outlined in section 6.8.4.

#### Operation Impacts

In general, the impact of the proposal on the landscape and visual environment would vary along the length of the proposal. As The Northern Road will travel under Bringelly Road, views to the proposal will be limited to the interchange structure.

Change resulting from the proposal would mainly affect residents, pedestrians, shoppers and motorists.

#### ***Landscape character impact***

The potential impacts on each landscape character zone are summarised in Table 6.28.

The greatest impacts on landscape character generally occur where the sensitivity to change is greatest. For the proposal, this occurs in the areas where the interchange works are located within or close to rural 'Bringelly acreage' landscape character zone. For other areas, the magnitude of the impacts are lower, as the visibility of the proposal is reduced by having The Northern Road passing under Bringelly Road.

Table 6.28 Summary of landscape character impact ratings

Zone	Key works in zone	Impact summary	Magnitude of impacts	Impact rating
Bringelly Acreage (north and south)	New section of The Northern Road Works to Bringelly Road Interchange works	The proposal will have the greatest impact within this zone as the majority of the proposal would be undertaken within this zone. The presence of the proposal would change the existing character of the zone.	High	High
Bringelly Village	<ul style="list-style-type: none"> <li>Shared path</li> <li>Converting the existing section of The Northern Road to a no through road</li> </ul>	<p>Due to the existing character of this zone being a two lane road, this change is not likely to result in a major impact.</p> <p>The new shared path, which would be located inside the existing road corridor adjacent the southbound road shoulder, is unlikely to impact on the existing roadside vegetation.</p>	Low	Moderate to low
Thompsons Creek	tie-in works with The Northern Road Upgrade Stage 2C	Minor clearing would be required of roadside vegetation. As the proposal transitions to the existing road corridor in this location, the magnitude of change is considered to be low.	Low	Low

### ***Visual impacts***

Views to the proposal are generally constrained, as the upgraded section of Bringelly Road would remain at grade, and the new section of The Northern Road would pass under Bringelly Road. The proposal uses the existing ridge line to ensure that interchange does not sit higher in the landscape than the existing Bringelly Road alignment. A summary of the results of the visual impact assessment in relation to the potential impacts on visual receptors is provided in Table 6.29. The impact rating is based on a combination of the sensitivity of the receptor and the magnitude of the potential impacts (as shown in Figure 6.26).

In summary:

- No viewpoints would have high visual impact
- Two viewpoints would have high to moderate visual impact
- One viewpoint would have moderate visual impact
- Six viewpoints would have moderate to low visual impact
- One viewpoint would have low visual impact
- Two viewpoints would have negligible visual impact.

An impact rating of high to moderate occurs at viewpoints where residents are closest to the proposal site (at Medich Place and Thames Road) potentially exposing residential viewers to views of the proposal. The moderate, moderate to low, low and negligible ratings are the most common, reflecting the generally low visibility of the proposal to those outside of the road corridor. It also indicates that the scale of the proposal would be consistent with the surrounding (upgraded) road environment.

With the implementation of mitigation measures provided in section 6.8.4, the potential impacts on landscape character and visual receptors would be minimised.

Table 6.29 Summary of visual impacts

Viewpoints	Key visual features of the proposal at the viewpoint	Impact discussion	Magnitude of potential impacts	Impact rating
1 – Kelvin Park Drive intersection	Unlikely to be views of the proposal, but at least two dwellings and some vegetation would be removed	Although the residential dwellings and gardens in the mid distance partially obscure the view, a small amount of vegetation would be removed. Planting of similar native species would mitigate the impacts as they mature over time.	Negligible	Negligible
2 – Medich Place	<ul style="list-style-type: none"> <li>Retaining walls</li> <li>Batters</li> <li>Central median</li> <li>Moving traffic along Bringelly Road and The Northern Road.</li> </ul>	Although the foreground residential dwellings and gardens partially obscure the view, some elements of the proposal may be visible from this viewpoint. Planting of similar native species would mitigate the impacts as they mature over time.	Moderate	High to moderate
3 – Robinson Road	<ul style="list-style-type: none"> <li>Southern tie-in</li> <li>Robinson Road cul-de-sac and new connection with Belmore Road</li> <li>Removal of roadside vegetation</li> <li>Batters</li> <li>Moving traffic along The Northern Road</li> <li>Central median.</li> </ul>	<p>The majority of properties close to the proposal site are set back from the road and are densely vegetated. Although the foreground trees partially obscure the view, elements of the proposal are likely to be partially visible.</p> <p>It is likely that some vegetation close to The Northern Road carriageway would be removed, however, replacement planting with similar native species would mitigate the impacts as they mature over time.</p>	Moderate	Moderate
4 – Belmore Road	<ul style="list-style-type: none"> <li>Southern tie-in</li> <li>Batters</li> <li>Potential compound location</li> </ul>	The elements of the proposal may be partially visible as some vegetation close to The Northern Road carriageway would be removed. However, replacement planting with similar native species would mitigate the impacts as they mature over time.	Low	Moderate to low
5 – The Northern Road	<ul style="list-style-type: none"> <li>Southern tie-in</li> <li>Travel lanes</li> <li>Batters</li> </ul>	<p>From this viewpoint the existing two way road would be replaced by four travel lanes, and more vehicular traffic on the widened road carriageway would be visible.</p> <p>New planting with similar native species would mitigate the impacts by screening views of the southern 'no through road' cul-de-sac from The Northern Road motorists.</p>	Moderate	Moderate to low
6 – Loftus Road	<ul style="list-style-type: none"> <li>Road alignment located 175 m to the east</li> <li>Shared path</li> </ul>	Foreground trees associated with the existing alignment of The Northern Road would almost fully obscure the view of the shared path and the new alignment of The Northern Road.	Low	Moderate to low
7 – Bringelly Village shops	<ul style="list-style-type: none"> <li>Existing The Northern Road</li> <li>Interchange</li> <li>Shared path</li> </ul>	Close to the existing intersection, areas of vegetation adjacent Bringelly Road would be removed. However, replacement planting with similar native species would mitigate the impacts as they mature over time	Moderate.	Moderate to low

Viewpoints	Key visual features of the proposal at the viewpoint	Impact discussion	Magnitude of potential impacts	Impact rating
8 – Greendale Road	<ul style="list-style-type: none"> <li>Road alignment located 430 m to the east</li> <li>Possible batters</li> </ul>	Vegetation close to The Northern Road would screen the majority if not all of the interchange works from this viewpoint. There is the potential for small and intermittent views of the new alignment through the vegetation, but these glimpses would be over 400 m away.	Negligible	Negligible
9 – Thames Road	<ul style="list-style-type: none"> <li>Cul-de-sac</li> <li>Shared path</li> <li>Batters</li> <li>Travel lanes</li> <li>Central median</li> </ul>	The proposal would nearly triple the width of the road pavement and require the removal of existing vegetation. New planting with similar native species would help to mitigate the impacts by screening views, which reduces the rating to moderate.	Moderate	High to moderate
10 – The Northern Road at the intersection of Badgerys Creek Road	Northern tie-in	From this viewpoint the existing two way road would be replaced by four travel lanes and more vehicular traffic on the widened road carriageway would be visible.	Moderate	Moderate to low
11 – Bringelly Road (east of the existing intersection with The Northern Road)	<ul style="list-style-type: none"> <li>Anti-throw screen</li> <li>Travel lanes</li> <li>Central medians</li> <li>Signalised intersection</li> </ul>	The works would almost double the extent of visible road pavement and would require the removal of some existing vegetation. New planting with similar native species would help to mitigate the impacts by screening views, reducing the rating to moderate.	Moderate	Moderate to low
12 – Bringelly Road at the intersection of Kelvin Park Drive	<ul style="list-style-type: none"> <li>Travel lanes</li> <li>Central median</li> </ul>	Foreground trees would partially obscure the view of the widened road. New planting with similar native species would help to mitigate the impacts by screening views, reducing reduces the rating to low.	Low	Low

#### 6.8.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Detailed design</b>			
Landscape character and visual impacts	Detailed design would be undertaken according to the urban design vision, objectives and principles which underpin the concept design.	Roads and Maritime	Detailed design
	A landscaping plan would be developed detailing options for planting designs and landscape treatments.	Roads and Maritime	Detailed design
	The quality of finishes and treatments that can be viably maintained over time would be considered during detailed design.	Roads and Maritime	Detailed design
	Materials and finishes for new road elements such as retaining walls are to be site appropriate.	Roads and Maritime	Detailed design
Light spill	Lighting would be designed to minimise light spill into residential properties and sensitive receptors.	Roads and Maritime	Detailed design
Cyclist safety	Where shared paths cross driveways, consideration would be given to use treatment (materials or colours) to provide a visual cue to remind cyclists to look out for cars.	Roads and Maritime	Detailed design
<b>Construction</b>			
Landscape character and visual impacts	Construction equipment, stockpiles, and other visible elements would be located away from key views to and from the identified visual receptors where feasible.  Where this is not feasible, screening measures and practices to keep sites tidy would be implemented.	Construction contractor	Construction
	Existing trees would be retained where feasible by identifying 'no go areas' to restrict access around trees not affected by the proposal.	Construction contractor	Construction
Compound	Revegetate compound sites and stockpile locations with grasses, ground covers and shrubs consistent with the pre-construction state of the location.	Construction contractor	Construction
Light spill	Temporary lighting would be sited and designed to avoid light spill into residential properties and identified sensitive receptors.	Construction contractor	Construction
<b>Operation</b>			
Visual impacts	New plantings would incorporate locally occurring species which reflect the landscape character zone	Construction contractor	Operation
Safety	New plantings along the shared path/ footpath would be selected and positioned such that they do not present safety hazards	Construction contractor	Operation

## 6.9 Air quality

### 6.9.1 Existing environment

The National Pollutant Inventory was searched on 27 July 2015. The results of the search for the Liverpool local government area identified 35 air pollutant substances from 17 sources during the 2013 to 2014 reporting period. The results of the search for the Camden local government area identified 27 air pollutant substances from seven sources during the 2013 to 2014 reporting period. The closest identified source of air pollution is the Bringelly Brickworks. Inghams Poultry Farm at Badgerys Creek was another identified source, located about four kilometres to the north of the proposal site.

The air quality of the study area is considered to be typical of a semi-rural area within the Sydney region. The main contributors to air quality are emissions would be from motor vehicles on the surrounding road network, as well rural activities, backyard burning, domestic wood-fire heaters and industry activities.

Climate data for the study area was obtained from the Bureau of Meteorology station located at Badgerys Creek (station number 067108) about four kilometres north of the proposal site (BoM, 2015). Climate data for Badgerys Creek is summarised as follows:

- The annual average rainfall is 696.4 millimetres, with February receiving the highest average monthly rainfall of about 104.3 millimetres
- The annual mean maximum temperature is 23.8 degrees. The warmest months are December to February, with mean maximum temperatures during these months ranging from 28.1 to 29.8 degrees. The coolest month is July, with a mean minimum and maximum temperature of 4.2 degrees and 17.3 degrees, respectively
- The area experiences winds predominantly from the south-west in the morning and the east and north-east in the afternoon. Average wind speeds are typically in the zero to 12 km/h range in the morning and 12 to 20 km/h range in the afternoon.

### 6.9.2 Potential impacts

#### Construction

Construction of the proposal may have short-term localised impacts on air quality as a result of:

- Clearing of vegetation
- Stripping, stockpiling and managing of topsoil
- Earthworks and excavation leading to the creation of airborne dust, especially in dry and windy conditions
- Road sub-grade preparation and road pavement work
- Transport and handling of soil and materials to and from the proposal site
- Use of construction vehicles leading to the creation of exhaust fumes
- Spray painting of the road for line marking.

Potential air quality impacts during construction would be predominantly associated with the generation of dust. Dust settlement may impact upon adjacent properties. Substantial dust generation could result in health impacts to nearby receivers. Air quality impacts as a result of dust generation are considered to be minor as they would be limited to the construction phase only, and would be minimised through the implementation of the safeguards and management measures outlined in section 6.9.3.

Machinery and other construction vehicles would emit exhaust fumes. The impact of these emissions would be limited to the duration of the construction phase. Odours may be generated during the application of asphalt and line marking. However, the construction period would be temporary and there would be no long term odour impacts for nearby receivers.

Overall, potential air quality impacts during construction would be short-term in nature and appropriate mitigation measures outlined in section 6.9.3 would be implemented.

### Operation

Together with the upgrades of The Northern Road and Bringelly Road, the proposal would increase the carrying capacity of The Northern Road and Bringelly Road to accommodate forecast traffic growth. This increase in traffic would have the potential to impact on local air quality through vehicle emissions. The potential air quality impacts of this increase in traffic were assessed by the REFs for the upgrading of The Northern Road and Bringelly Road.

The proposal incorporates public transport facilities, such as bus stops, which support the use of public transport. The proposal also incorporates a shared pedestrian and cycle pathway which would provide a healthy and non-polluting means of transport for users of The Northern Road and Bringelly Road.

### 6.9.3 Safeguards and management measures

Mitigation measures provided below would be implemented to minimise potential air quality impacts.

Impact	Environmental safeguards	Responsibility	Timing
<b>Pre-construction</b>			
General air quality impacts	An air quality management plan would be prepared as part of the construction environmental management plan. The plan would include but not be limited to: <ul style="list-style-type: none"> <li>A map identifying locations of sensitive receivers</li> <li>Identification of potential risks/impacts due to the work/activities as dust generation activities</li> <li>Management measures to minimise risk including a progressive stabilisation plan</li> <li>A process for monitoring dust on-site and weather conditions</li> <li>A process for altering management measures as required.</li> </ul>	Construction contractor	Pre-construction
<b>Construction</b>			
Dust emissions	Dust suppression measures would be implemented as per the air quality management plan.	Construction contractor	Construction
	Stockpiled materials would be covered, stabilised or stored in areas not subject to high wind.	Construction contractor	Construction
	All trucks would be covered when transporting material to and from the site.	Construction contractor	Construction
	Work activities would be reprogrammed if the mitigation measures are not adequately restricting dust generation.	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Exhaust emissions	Construction plant and equipment would be maintained in a good working condition in order to limit impacts on air quality.	Construction contractor	Construction
	Plant and machinery would be turned off when not in use.	Construction contractor	Construction
Impacts on sensitive receivers	Local residents would be advised of hours of operation and duration of work and supplied with a contact name and number for queries regarding air quality.	Construction contractor	Construction

## 6.10 Land use and property

### 6.10.1 Existing environment

The proposal site is located within a semi-rural area which is dominated by rural and rural residential land uses. Existing land use zones and key land uses in the area surrounding the proposal site are shown in Figure 6.29. The broader land use context for the proposal is shown in Figure 2.1.

Land uses within and immediately surrounding the proposal site include rural, rural residential and infrastructure (roads).

Other land uses, located to the west of the proposal site near the intersection of The Northern Road, Bringelly Road and Greendale Road, include the following (approximate distances to the proposal site are shown in brackets):

- Commercial - Bringelly Village shops (220 m)
- Education - Bringelly Public School (185 m)
- Recreation/community - Bringelly Park, Bringelly Community Centre and Bringelly Rural Fire Brigade (300 m)
- Bringelly Zone Substation (300 m)
- Industrial - Bringelly Brickworks/Boral Bricks and Pavers/ (550 m)

Bringelly Vineyard Church is located about 250 m to the east of the proposal site

Other land uses in the broader area include:

- Commonwealth land – occupied by the (former) Royal Australian Air Force Telecommunications Unit site and the Bringelly Radio Receiving Station – located about 400 m to the north-east of the proposal site at the nearest point
- The University of Sydney Farm (Wolverton, J B Pye, and Coates Park Farms) – located about three kilometres to the west of the proposal site at the nearest point.

### 6.10.2 Future land uses

As noted in section 2.1, the proposal site is located on the boundary of the Western Sydney Priority Growth Area and the South West Priority Land Release Area. As an indication of potential future land uses in the study area, the original structure plan for the South West Growth Centre notes that when the Bringelly precinct is fully developed, it will accommodate about 5,000 new dwellings for 14,000 people. It also indicates that there will be a ‘town and village centre’ at the existing intersection of The Northern Road and Bringelly Road.

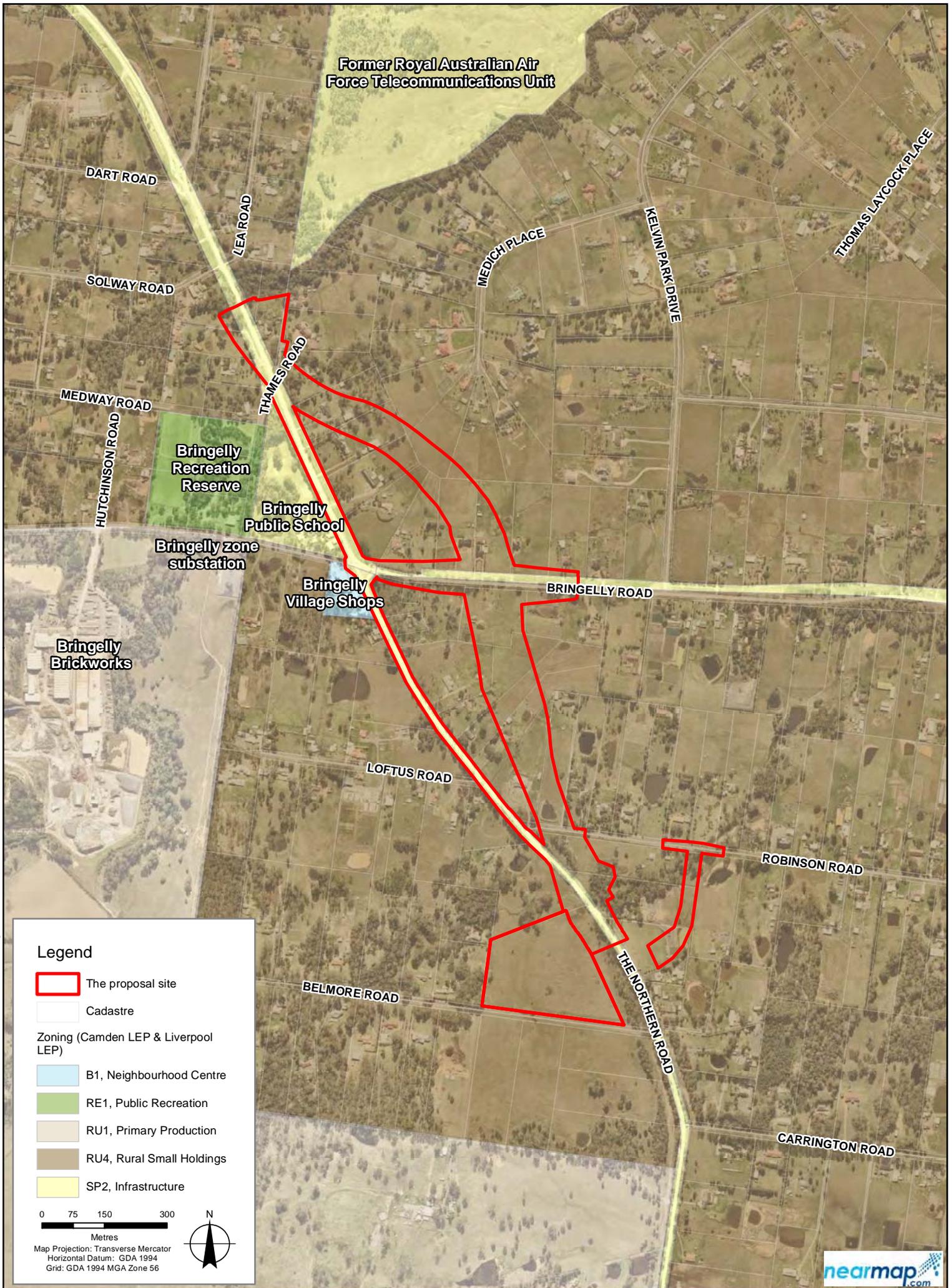


Figure 6.29  
Zoning and land use

*A Plan for Growing Sydney* proposes two 'enterprise corridors' in Western Sydney. Enterprise corridors are defined as 'An area designed to attract investment and stimulate employment-generating development that is aligned with specific sections of rail or road transport infrastructure'. The proposal site is located within/adjointing the Bringelly Road Enterprise Corridor, which is proposed to be located along Bringelly Road and The Northern Road, between Leppington and the proposed western Sydney airport.

The indicative location for the South West Rail Link Extension - Public transport preservation corridor is about 380 m to the east of the proposal site.

The Bringelly Brickworks (owned and operated by Boral) is located about 615 m to the west of the existing intersection of The Northern Road, Bringelly Road and Greendale Road. Most vehicles associated with the operation of the Brickworks travel through the intersection. In March 2015, Boral Bricks Pty Ltd's application to extend its operations at the Bringelly Brickworks on Greendale Road was approved by the Minister for Planning. As per consent condition number seven, this included approval to:

- Transport no more than 263,500 tonnes of bricks from the site in a calendar year
- Receive no more than 90 trucks to the site per day or more than 18 trucks per hour
- Dispatch no more than 90 trucks from the site per day or more than 18 trucks per hour.

This is an increase from its current approval/operations, which involves:

- Processing and transporting up to 160,000 tonnes of bricks a year
- Up to 78 heavy vehicle movements and 55 light vehicle movements a day (into and out of the site).

### 6.10.3 Potential impacts

#### Pre-construction

As noted in section 3.7, the proposal would require the total and partial acquisition of a number of properties. Impacts associated with partial property acquisition/adjustment include the need to relocate property boundary fencing, driveway adjustments, impacts to dams, roadside trees and landscaped areas. Property adjustment plans would be developed in consultation with the affected property owners.

All land acquisitions would be conducted in accordance with the Roads and Maritime Land Acquisition Policy and compensation would be based on the requirements of the *Land Acquisition (Just Terms) Compensation Act 1991*.

On properties not subject to full acquisition, the proposal has the potential to directly or indirectly impact up to 12 farm dams. During detailed design, consultation will be undertaken with the owners of these properties regarding the potential impacts on the dams and the preferred options to mitigate these impacts (such as modification or relocation of the dam).

The potential socio-economic impacts of property acquisition are considered in section 6.11.

#### Construction

Direct impacts on land use during construction would mainly relate to the short-term presence of construction work within the proposal site, and use of the compound site. Potential traffic and access impacts are considered in section 6.1. As discussed in section 3.5, a possible compound site has been identified on the corner of The Northern Road and Belmore Road. However this may not be available at the time of construction. As such alternative locations would be investigated during detailed design. This is likely to be properties subject to full acquisition. The selection of the preferred site would be subject to key criteria as outlined in section 3.5. Following construction, the

site would either continue to be used as a compound by Roads and Maritime, or it would be rehabilitated for re-use in accordance with Council's land use and development controls.

Construction activities have the potential to impact on existing utilities and services, in particular underground services such as electricity, gas, and telecommunications. The proposed strategies for adjustment and/or protection of each utility (based on initial consultation with utility providers) are provided in section 3.5. Roads and Maritime would consult with other relevant service providers before construction starts to identify possible interactions and develop procedures to be implemented to minimise the potential for service interruptions which have the potential to impact on existing land use.

## Operation

### **Short-term**

The use of land acquired for and occupied by infrastructure associated with the proposal would change from rural/rural residential to infrastructure (road). Following the completion of construction, for properties subject to full acquisition, land not required for the proposal may be available for redevelopment subject to Council's land use and development controls.

### **Long-term**

The existing land uses in the vicinity of the proposal site would remain consistent with the current zoning, until such time as the Bringelly precinct is released for planning and the areas surrounding the proposal site are rezoned.

The proposal would result in the creation of a residual area of land that would be surrounded by the existing alignment of The Northern Road, and the proposed new section of The Northern Road. This land would have an area of about 23 hectares, and would be up to 300 m wide at the widest point. The future use of this land would be taken into consideration during the Bringelly precinct planning process and suitable future land uses would be identified.

As noted in section 2.1.3, *A Plan for Growing Sydney*, proposes that an 'enterprise corridor' (the Bringelly Road Enterprise Corridor) be located along Bringelly Road and The Northern Road, between Leppington and the proposed western Sydney airport. The B6 Enterprise Corridor zone used by local environmental plans is generally intended to be applied to land where commercial or industrial development is to be encouraged along main roads such as those identified by the metropolitan, regional and subregional strategies. Opportunities for urban consolidation along busy roads may be pursued and some residential accommodation uses may be included in this zone, if considered appropriate (Department of Planning, 2011).

*A Plan for Growing Sydney* notes that, in relation to the proposed Bringelly Road Enterprise Corridor, the NSW Government will (under action 1.4.2) develop a 'flexible and innovative regulatory environment' to 'enable a wide range of commercial activities to take advantage of transport access to this precinct and its proximity to the airport, Leppington and the population growth of the South West Growth Centre'.

Employment generating development may be attracted to land in the vicinity of the proposal site, including the residual area of land noted above, as it will have good access to what will be a significant movement/freight corridor, and will also potentially have access to the South West Rail Link extension, assuming that the final preservation corridor remains in the study area.

In addition, as noted in section 2.1, the *Structure Plan for the South West Growth Centre* states that, when the Bringelly precinct is fully developed, it will accommodate about 5,000 new dwellings for 14,000 people. It also states that there will be a 'town and village centre' at the existing intersection of The Northern Road and Bringelly Road. The proposal would benefit the development of a centre at this location, as it would remove regional through traffic from the

intersection, providing an environment (in terms of road safety and amenity) more conducive to the location of a town and village centre.

#### 6.10.4 Safeguards and management measures

Mitigation measures provided below would be implemented to minimise potential land use and property impacts.

Impact	Environmental safeguards	Responsibility	Timing
<b>Pre-construction</b>			
Property acquisition	All land acquisitions would be conducted in accordance with the Roads and Maritime Land Acquisition Policy and the requirements of the <i>Land Acquisition (Just Terms) Compensation Act 1991</i> .	Roads and Maritime	Pre-construction
Impacts on dams	Consultation would be undertaken with the owners of properties containing dams that would be impacted by the proposal regarding options to mitigate the impacts.	Roads and Maritime	Pre-construction

## 6.11 Socio-economic

### 6.11.1 Overview

This section provides a summary of the results of the socio-economic assessment of the proposal undertaken by GHD. The full report is provided in Appendix J. The assessment was prepared in accordance with the *Environmental Impact Assessment Practice Note: Socio-economic assessment* (Roads and Maritime, 2013b). It involved the following tasks:

- Site visit
- Preparing and analysing a community profile based on data from the Australian Bureau of Statistics (ABS) *2011 Census of Population and Housing*
- Reviewing the outcomes of community consultation undertaken to date
- Reviewing the outcomes of other specialist environmental assessments and the previous REFs for the upgrading of The Northern Road and Bringelly Road
- Identifying and assessing the potential socio-economic impacts and benefits of the proposal
- Developing appropriate mitigation measures.

### 6.11.2 Existing environment

#### Population and demographics

The study area for the socio-economic assessment consists of the four statistical data units surrounding the proposal site. In 2011, the population of the study area was 1893 people. Key community indicators for study area, compared to similar indicators for Greater Sydney as a whole, are summarised below:

- People in the study area have a comparatively longer tenure of home ownership and/or occupancy
- The study area is generally characterised by family households and couples with children
- There is a higher proportion of older people aged between 50 and 70 years, and a higher proportion of teenagers

- There is a higher reliance on travel using private motor vehicles
- More residents work in home-based employment
- A higher proportion of residents are engaged in construction, agriculture and trades
- The average household income in the study area is more than the average household income for Greater Sydney as a whole.

### Social infrastructure

Social infrastructure includes the facilities and services that are used for the physical, social, cultural or intellectual development or welfare of the community. Social infrastructure in the vicinity of the proposal site is listed and shown on Figure 6.30 and are listed in Table 6.30.

### Local businesses

The Bringelly Village shops include a number of local businesses. These businesses service the local area and passing trade. Businesses in the vicinity of the proposal site (considered to be those located within about 500 m of the proposal site) are shown on Figure 6.30 and are listed in Table 6.30.

Table 6.30 Social infrastructure and businesses in the study area

Premises	Street address
<b>Social infrastructure</b>	
Bringelly Public School	1205 The Northern Road
Bringelly Park/Recreation Reserve	5-7 Greendale Road
Bringelly Community Centre	5 Greendale Road
Bringelly Rural Fire Brigade	5-7 Greendale Road
Local bus stops	Refer section 2.2.5 for locations and bus routes
Bringelly Vineyard Church	915 Bringelly Road
<b>Local businesses</b>	
Bringelly Village (business include Australia Post, SPAR supermarket, Ray White Real Estate, Bringelly Cellars, Bringelly Take Away, Bringelly Pharmacy, Redback Pet and Stockfeeds, and a mechanics/petrol station)	1197 Bringelly Road
United Realty	1193 Bringelly Road
Boral Bricks and Pavers/Bringelly Brickworks	2 Greendale Road
Bringelly Nursery and Watergardens	900 Bringelly Road

### Community values

Community values relate to the quality of life and wellbeing for local residents. Community consultation completed by Camden and Liverpool City councils for their community strategic plans indicate that the rural elements of both LGAs are valued. The existing amenity and character of the study area relates to its semi-rural setting. Native vegetation, which is retained in scattered pockets and along watercourses, contributes to the scenic rural character. Consultation with Liverpool City Council (telephone discussion with the Community Development Manager undertaken in June 2015) indicated that residents in the study area value its rural residential amenity and lifestyle. Also valued are privacy, the ability to undertake rural/agricultural pursuits, and separation from urban areas.

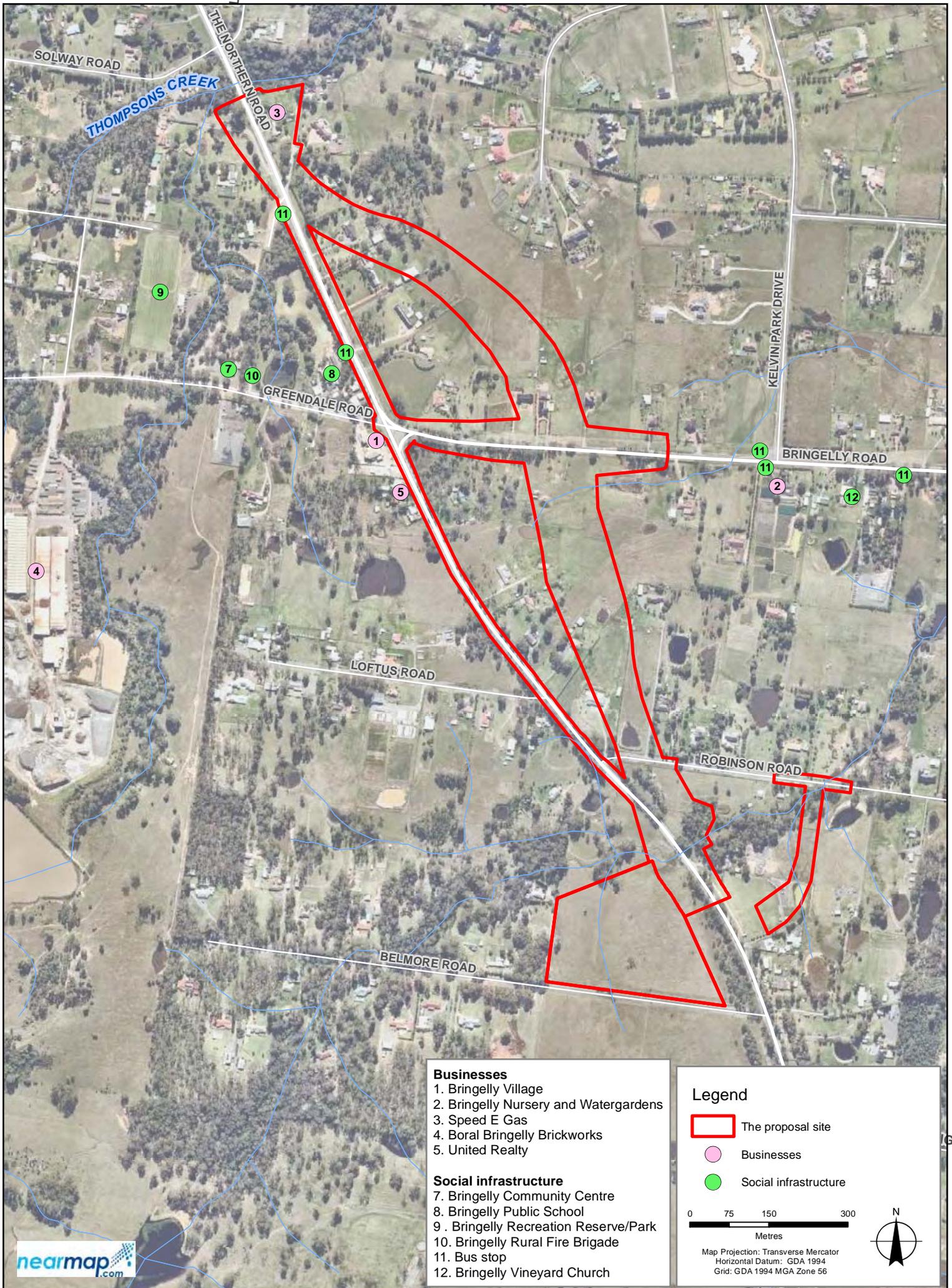


Figure 6.30  
Social infrastructure and businesses in the vicinity of the proposal site

### 6.11.3 Potential impacts

#### Pre-construction

As noted in sections 3.7 and 6.10.3, the proposal would require the partial or total acquisition of a number of properties.

Property adjustment plans would be developed during detailed design in consultation with the property owners. It is not anticipated that residents would need to relocate as a result of the partial property acquisition. Details of property acquisition would be confirmed during detailed design of the proposal.

As noted by the socio-economic assessment, the potential social and community impacts of property acquisition include:

- Potential stress and uncertainty for affected residents and property owners
- Disruption for residents needing to relocate
- Change in the structure of the local community
- Difficulty finding comparative properties in the local area if a number of people need to relocate at the one time
- Loss of established community connections if residents are not able to relocate locally.

Roads and Maritime has been consulting with property owners, business owners and local residents since 2012. This has included consultation with directly affected residents and property owners about potential impacts and the property acquisition process and opportunities

Roads and Maritime would continue to consult with affected property owners, as noted in section 0.

#### Construction

##### Access

During construction the proposal would result in some temporary changes to property access. Construction may temporarily impact on vehicular and pedestrian access in the immediate vicinity of work sites. Impacts could include:

- changes to some property's access arrangements
- changes to the movement of traffic around the local area, including the route that some residents use to access the local shops, school, Bringelly Road and The Northern Road
- increases to traffic using roads associated with the proposed traffic diversion.

These changes, which are described in 3.4.7, could result in an increase in the distance travelled and delays for some residents. Potential access impacts are assessed in section 6.1. Any temporary access changes to properties would be managed in consultation with the property owner/occupant.

The proposal would not directly impact on access to local businesses and social infrastructure. However, it would change the route travelled for some local residents.

Access would be maintained for emergency vehicles in the vicinity of construction works and ongoing consultation would be undertaken with emergency service personnel during construction to ensure that potential impacts are identified and appropriately managed. Ongoing consultation with Bringelly Public School would be undertaken to maintain access and safety for students.

### ***Amenity***

Construction of the proposal may result in amenity impacts on the local community due to the following:

- Potential increase in traffic due to the delivery of plant, materials and construction personnel
- Increase in noise and traffic for residents along the route of the proposed traffic diversion
- Increase in noise due to the operation of plant and equipment, and increased traffic
- Visual impacts
- Potential dust disturbance during minor excavation works.

These issues have been addressed in other sections of this REF, as follows:

- Traffic and access (refer to section 6.1)
- Noise and vibration (refer to section 6.2)
- Visual impacts (refer to section 6.8)
- Air quality (refer to section 6.9).

Amenity impacts would be temporary and appropriately managed with the safeguards provided in sections 6.1.4, 6.2.6, 6.8.4 and 6.9.3.

### ***Economic and business impacts***

Construction of the proposal would generate employment. It is anticipated that a workforce of about 60 personnel would be required during peak construction. On either side of this peak period, daily workforce numbers would fluctuate between about 20 and 40 personnel. The source of the workforce is unknown; however, it is assumed that at least some of the workforce would come from western Sydney.

The construction workforce would have the potential to result in increased trade at the Bringelly Village shops. Potential benefits and impacts on local businesses include:

- Increase in customers for local businesses generated by the construction workforce – mainly in relation to meals and convenience shopping requirements
- Loss of business if people avoid the area due to delays and inconvenience caused by construction
- Amenity impacts.

Potential impacts on businesses within the proposal site would be temporary and managed by the implementation of mitigation measures provided in section 6.11.4.

### ***Other impacts***

Construction activities have the potential to result in temporary disruptions to services (power, water, gas and telecommunications) for some properties during the relocation of utility services (refer section 6.10). These impacts are considered to be minimal as the disruptions would be short-term, and affected residents and/or business owners would be notified of the disruptions by letter in accordance with Roads and Maritime utility relocation requirements.

## Operation

### **Access**

The presence and operation of the proposal would result in changes to access arrangements for some properties and local residents. This would include changes in the location of some driveways; permissible turning movements to and from properties; and the route that some residents use to access the local shops, school, Bringelly Road and The Northern Road. These changes, which are described in 3.4.7 and 6.1.3, would result in an increase in the distance travelled for some residents.

For other residents, existing and future businesses, the proposal would have the potential to facilitate access to regional freight routes and to areas within the Western Sydney Priority Growth Area and South West Priority Land Release Area, the Western Sydney Employment Area and the proposed western Sydney airport. During operation, together with the upgrades of The Northern Road and Bringelly Road as a whole, the proposal would improve access and connectivity for local and regional communities by reducing traffic congestion and improving safety for all road users.

Further information on potential access impacts during operation is provided in section 6.1.

The proposal would result in an upgrade to pedestrian and cycle facilities through the study area by providing an off-road shared pedestrian and cyclist path as part of the proposal. Improvements to pedestrian and cycle facilities would benefit the wider community. The new pathway would improve safety for pedestrians and cyclists as it would be separated from the vehicle lanes.

The proposal would improve the flow of traffic to and through the study area. This would facilitate bus operations, which would have a positive impact on bus services and the local community.

During operation of the proposal there would be no direct impacts on social infrastructure. Indirect impacts include changed access arrangements in terms of the route travelled for some residents.

### ***Community values and amenity***

The proposal would result in the introduction of a substantial and visible piece of transport infrastructure in what is currently a semi-rural area. This would result in a change in the character of those properties that are directly impacted by the proposal, and a change in views from those viewpoints and properties with views to the proposal. Potential landscape character and visual impacts are discussed in section 6.8.

These impacts would be greater in the short to medium term. In the longer term, local land uses and the nature and character of the study area is likely to change as development increases (as described in sections 2.1 and 6.10.3). As the Bringelly precinct is developed, urban densities increase, and additional roads and transport infrastructure (including the proposed extension of the South West Rail Line) are developed, the difference between the character of the proposal and the study area would be less.

The operation of the proposal would result in a change in the noise environment in the study area. Some residences would experience lower levels of noise as the main route for traffic to, from and along The Northern Road would be located further to the east. Those residents located in close proximity to the proposal site have the potential to experience higher levels of noise. Potential noise impacts are discussed in section 6.2.

Changes to traffic volumes, traffic noise levels, increased air pollution and visual changes from the presence of the proposal may impact on the amenity for existing residents. These impacts and mitigation measures are addressed in other sections of the REF, as noted above.

The removal of through traffic from the remaining section of The Northern Road would improve amenity along this section and benefit the local shopping environment and the ability of people to access the Bringelly Village shops. In particular, heavy vehicles associated with the operation of the expanded Bringelly Brickworks (refer to section 2.1) would no longer turn north or south onto The Northern Road from Greendale Road, passing The Northern Road frontage of the Bringelly School and the village shops. Vehicles travelling to and from the brickworks would now travel further and then travel north and south via the new interchange and the new section of The Northern Road. This would provide amenity and safety benefits for the school, village shops, and residents along the remaining section of The Northern Road.

### ***Economic and business impacts***

The proposal would not result in any direct impacts to local businesses. However, there may be the potential for some reduction in passing trade as through traffic along The Northern Road would no longer pass Bringelly Village. It is considered that the proposal would improve the environment surrounding the village with the potential to enhance the shopping experience for local residents. Road signage would help to reduce the impacts of passing trade by promoting the Bringelly Village. Potential indirect impacts, including to amenity and access, are described above.

Together with the upgrade of The Northern Road and Bringelly Road, the proposal has the potential for wider economic benefits. As noted in section 2.1 a number of large scale developments within and surrounding the study area for the proposal are likely to increase traffic demand over the next thirty years. The proposal would improve access, for the local and regional community and businesses, to and through the Western Sydney Priority Growth Area and South West Priority Land Release Area, the Western Sydney Employment Area, and the proposed western Sydney airport. This would benefit the local and regional economy.

#### 6.11.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing		
<b>Detailed design</b>					
Road signage	Signage at key locations along The Northern Road and Bringelly Road would be investigated during detailed design to promote the town of Bringelly	Roads and Maritime	Detailed design		
Business impacts	A business survey would be undertaken prior to works commencing	Roads and Maritime	Detailed design		
<b>Pre-construction</b>					
Construction impacts on the community	<p>A communication plan would be prepared and included in the construction environmental management plan. The communication plan would include (as a minimum):</p> <ul style="list-style-type: none"> <li>• Requirements to provide details and timing of proposed activities to affected residents, the local community and businesses, and local bus operators</li> <li>• Consultation actions in relation to access arrangements and servicing requirements, including for local businesses, the bus operator and Bringelly Public School</li> <li>• Complaints handling procedure</li> <li>• Contact name and number for complaints</li> <li>• Procedure to notify adjacent land users for changed conditions during the construction period such as traffic, pedestrian or driveway access.</li> </ul> <p>The communications plan would be prepared in accordance with G36 requirements and Roads and Maritime <i>Community Engagement and Communications Manual 2012c</i>.</p>	Construction contractor	Pre-construction		
	Local residents, businesses and other stakeholders would be notified before work starts in accordance with the communications plan.			Construction contractor	Pre-construction
	Local residents, businesses and other stakeholders would be kept regularly informed of construction activities during the construction process through the implementation of the communication plan. The complaints handling procedure would be maintained for the duration of construction.			Construction contractor	Construction
Acquisition	<p>Acquisition arrangements and associated consultation would consider:</p> <ul style="list-style-type: none"> <li>• The ability of property owners/occupants to relocate, within the timeframe required, to comparable accommodation that meets the owners/occupants needs</li> <li>• The need to liaise and consult on an ongoing basis with affected owners/occupants</li> <li>• Providing assistance to households as a required, with a focus on any vulnerable groups identified (older people, people with a disability, people from culturally and linguistically diverse backgrounds),</li> </ul>	Roads and Maritime	Detailed design		
Bus stops	Crime prevention through environmental design principles would be considered as part of the design of the bus stops.	Roads and Maritime	Design		

Impact	Environmental safeguards	Responsibility	Timing
<b>Construction</b>			
Construction impacts on the community	Local residents, businesses and other stakeholders would be kept regularly informed of construction activities during the construction process through the implementation of the communication plan. The complaints handling procedure would be maintained for the duration of construction.	Construction contractor	Construction
Access and connectivity	During construction, road users, pedestrians and cyclists would be informed of any changed conditions.	Construction contractor	Construction
	Signage would be provided during construction to communicate changes, and ensure safety for pedestrians near to construction work.		
	Access to bus stops would be maintained.		
	The traffic management plan would include measures to minimise heavy vehicle usage and parking on local roads.		
	Property access would be maintained wherever practicable. Prior to any unavoidable disruption to access, consultation would be undertaken with the affected property owner.		
	Access would be maintained for emergency vehicles in the vicinity of construction works. Ongoing consultation would be undertaken with emergency services during construction to ensure that potential impacts are identified and appropriately managed.		
Construction impacts on utilities and services	Residents and businesses would be informed before any interruptions to utility services that may be experienced as a result of utilities relocation.	Construction contractor	Construction

## 6.12 Resource use and waste management

Roads and Maritime is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act 2000*. These resource management hierarchy principles, in order of priority are:

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

By adopting the above principles, Roads and Maritime aims to efficiently reduce resource use, reduce costs, and reduce environmental harm in accordance with the principles of ecologically sustainable development, as outlined in section 8.2 of this REF.

### 6.12.1 Potential impacts

#### Resource use

Construction of the proposal would require the use of a number of resources, including:

- Resources associated with the operation of construction machinery and motor vehicles (this includes the use of diesel and petrol)
- Material required for road surface and pavements (road base, asphalt, spray seal, sand, concrete, aggregate etc.)
- Material required for the interchange construction (concrete, steel etc.)
- Fill required to meet design levels
- Materials required for road signage, street lighting and traffic signals
- Construction water (for concrete mixing and dust suppression).

The estimated quantities of these materials required for the proposal are provided in section 3.4.6.

The materials required for construction of the proposal are not currently limited in availability. However, materials such as metal and fuel are non-renewable and would be used conservatively. Excess spoil, not suitable for reuse, would be disposed of in accordance with safeguards and mitigation measures outlined in section 6.12.2.

The amount of water required for construction is currently unknown, but would be sourced from Sydney Water supply.

The management measures outlined in section 6.12.2 to reuse waste on-site would assist in minimising the amount of resources required for construction.

#### Waste generation

The proposal has the potential to generate waste from the following activities:

- Vegetation (native, exotic and noxious) to be removed as part of the proposal
- Earthworks for constructing the retaining wall, road widening and new footpath
- Utility adjustments.

Waste streams likely to be generated during construction of the proposal include:

- Excess spoil – about 7000 cubic metres of spoil would be removed from the site
- Green waste as a result of vegetation clearing. Noxious weed material would be separated from native green waste
- Roadside materials (fencing, guide posts, guard rails etc.)
- Packaging and general waste from staff (lunch packaging, portable toilets etc.)
- Chemicals and oils
- Waste water from wash-down and bunded areas
- Redundant erosion and sediment controls.

Unsuitable material and excess materials is proposed to be reused on adjoining projects where possible. The potential to reuse materials would be investigated during detailed design. Unsuitable fill material and excess cut material that cannot be used on-site would be classified in accordance with the NSW EPA *Waste Classification Guidelines* (2014) and disposed of at an approved materials recycling or waste disposal facility. Final waste classification is required once the volumes of waste requiring offsite disposal during construction are confirmed.

## 6.12.2 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
<b>Pre-construction</b>			
Demand on resources	Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Construction contractor	Pre-construction
Waste management	<p>A resource and waste management plan would be prepared and included in the construction environmental management plan. The plan would include the following (as a minimum):</p> <ul style="list-style-type: none"> <li>• The type, classification and volume of all materials to be generated and used on-site including identification of recyclable and non-recyclable waste in accordance with NSW EPA <i>Waste Classification Guidelines (2014)</i></li> <li>• Quantity and classification of excavated material generated as a result of the proposal (refer Roads and Maritime Service's <i>Waste Management Fact sheets 1-6, 2012</i>)</li> <li>• Interface strategies for cut and fill on-site to ensure re-use where possible</li> <li>• Strategies to 'avoid', 'reduce', 'reuse' and 'recycle' materials</li> <li>• Classification and disposal strategies for each type of material</li> <li>• Destinations for each resource/waste type either for on-site reuse or recycling, offsite reuse or recycling, or disposal at a licensed waste facility</li> <li>• Details of how material would be stored and treated on-site</li> <li>• Identification of available recycling facilities on and off-site</li> <li>• Identification of suitable methods and routes to transport waste</li> <li>• Procedures and disposal arrangements for unsuitable excavated material or contaminated material including asbestos waste</li> <li>• The types of waste collected, amounts, date/time and details of disposal are to be recorded in a waste register</li> <li>• Site clean-up for each construction stage.</li> </ul>	Construction contractor	Pre-construction
<b>Construction</b>			
Demand on resources	Excavated material would be reused on-site for fill where feasible to reduce demand on resources.	Construction contractor	Construction
	Any additional fill material required would be sourced from appropriately licensed facilities and/or other Roads and Maritime projects wherever possible.	Construction contractor and Roads and Maritime	Construction

Impact	Environmental safeguards	Responsibility	Timing
Waste minimisation	<p>The following resource management hierarchy principles would be followed:</p> <ul style="list-style-type: none"> <li>• Avoid unnecessary resource consumption as a priority</li> <li>• Avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery)</li> <li>• Disposal would be undertaken as a last resort (in accordance with the <i>Waste Avoidance and Resource Recovery Act 2001</i>).</li> </ul>	Construction contractor	Construction
Management of green waste	Clearing and grubbing, including mulching, will be undertaken in accordance with RMS QA specification G40 Clearing and Grubbing Rev1. Where possible, mulch will be used on-site.	Construction contractor	Construction
Spoil management	Excavated material would be reused on adjoining projects where feasible to reduce waste.	Construction contractor	Construction
	Excess excavated material would be disposed of at an appropriate facility or reused appropriately for fill on the proposal site.	Construction contractor	Construction
	Excess soil requiring waste disposal would first be assessed against the <i>Waste Classification Guidelines- Part 1: Classifying Waste</i> (EPA 2014). Soil samples would be taken from stockpiled material and analysed. Transportation would be undertaken by a licensed contractor capable of transporting the waste and waste would be disposed of to an appropriately licensed waste facility with supporting waste classification documentation.	Construction contractor	Construction
Waste management	Garbage receptacles would be provided and recycling of materials encouraged. Rubbish would be transported to an appropriate waste disposal facility.	Construction contractor	Construction
	All wastes would be managed in accordance with the POEO Act.	Construction contractor	Construction
	Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage.	Construction contractor	Construction
	Noxious weeds removed during work would be managed in accordance with the Department of Primary Industries' requirements that relate to its classification status.	Construction contractor	Construction
	Site inductions would occur and be recorded by a Site Supervisor to ensure staff are aware of waste disposal protocols.	Construction contractor	Construction
Wastewater contamination of soils and water	A dedicated concrete washout facility would be provided during construction so that run-off from the washing of concrete machinery and equipment can be collected and disposed of at an appropriate waste facility.	Construction contractor	Construction

## 6.13 Hazards and risks

Existing hazards and risks in the vicinity of the proposal site are generally associated with the operation of the existing road network. The proposal is located within flood prone land near Thompsons Creek and the South Creek tributary, and therefore flooding is considered a risk.

### 6.13.1 Potential impacts

#### Construction

Hazards and risks associated with construction include:

- Environmental hazards and risks, including:
  - Spills or leakage of contaminants such as fuels, chemicals and hazardous substances entering surface and groundwater or contaminating soils
  - Discharge of turbid run-off, resulting in pollution of waterways
  - Encountering utilities or contaminated material during earthworks
  - Spread of noxious weed material
  - Flooding of the area during extreme rain events
  - Changed traffic conditions leading to incidents.
- Health and safety hazards and risks – including any activity or outcome that may affect the health and/or safety of construction personnel or the community.

An emergency response plan for hazards and risk during construction would be incorporated into the construction environmental management plan.

The presence of construction activities can create a risk for people moving in the vicinity of construction sites and vehicles.

NSW workplace safety laws require construction sites to have adequate site security, which includes appropriate fencing. All construction work would be isolated from the general public. The construction contractor would ensure that construction sites are secure at all times, and would take all possible actions to prevent entry by unauthorised persons.

Health and safety risks during construction would be managed by the implementation of standard workplace health and safety requirements. Construction sites would be managed in accordance with the requirements of the WorkCover Authority of NSW and the *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2011*.

#### Operation

Operational hazards and risks relating to the proposal could include:

- Salinity impacts on infrastructure
- Fuel and oil spills during maintenance activities polluting the natural environment
- Flooding at Thompsons Creek and the South Creek tributary as a result of the increased paved surfaces
- Vehicle/pedestrian incidents.

The majority of these potential impacts would be considered as part of design development and are also addressed in sections 6.1.4, 6.3.2, 6.4.2 and 6.12.2.

Vehicle crashes are an inherent aspect of the operation of any road. During design of the proposal, Roads and Maritime has applied the requirements of the Road Design Guide (RTA, undated) to meet appropriate safety standards.

### 6.13.2 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Risk Management	Emergency response plans would be incorporated into the construction environmental management plan including a flood evacuation plan.	Construction contractor	Pre-construction and construction
	A pollution incident response management plan would be developed and implemented in accordance with the POEO Act requirements. The plan would form a sub-plan within the construction environmental management plan.	Construction contractor	Pre-construction and construction
	Hazards and risks associated with construction activities would be identified prior to construction. Management measures for each identified hazard/risk would also be developed. A process for regularly reviewing work practices/procedures would be implemented throughout construction to identify, report and respond to any new environmental hazards/risks.	Construction contractor	Pre-construction
	Site-specific safety management plans and safe work method statements would be developed and implemented in accordance with work health and safety requirements.	Construction contractor	Pre-construction
Flood management	A flood evacuation plan would be prepared prior to works commencing on site and incorporated into the construction environmental management plan.	Construction contractor	Pre-construction

### 6.14 Climate change and greenhouse gases

Climate change refers to the warming temperatures and altered climate conditions associated with the concentration of greenhouse gases in the atmosphere. These changes to future climatic conditions have the potential to impact existing and new road infrastructure.

In 2010 the NSW Government published climate change projections for NSW. The study focused on projections to the year 2050 for rainfall, evaporation and maximum and minimum temperatures as these are the four climate variables considered to most directly affect biophysical systems across the State.

The projected climatic changes by 2050 for the Sydney region of NSW show that rainfall is likely to increase in all seasons except for winter; sea levels are predicted to rise, changing flood frequency; and average daily maximum and minimum temperatures are likely to increase in all seasons by 1.5 to 3.0 °C (DECCW, 2010). Table 6.31 shows the projected climate change in the Sydney region.

Table 6.31 Current and projected climate change in the Sydney region

Season	Minimum temperatures	Maximum temperatures	Precipitation	Evaporation
Spring	2-3°C warmer	2-3°C warmer	10-20% increase	10-20% increase
Summer	1.5-3°C warmer	1.5-2°C warmer	20-50% increase	10-20% increase
Autumn	1.5-3°C warmer	1.5-3°C warmer	No substantial change	No clear pattern
Winter	1.5-3°C warmer	2-3°C warmer	10-20% decrease	No clear pattern

## Roads and Maritime Climate Change Plan

To address the challenge of climate change, Roads and Maritime has developed a Climate Change Plan which includes actions to:

- Reduce Roads and Maritime's carbon footprint
- Help reduce the carbon footprint of NSW road transport
- Adapt the Road and Maritime road transport system to the impacts of climate change
- Manage Road and Maritime's transition to a low carbon economy.

Roads and Maritime also reports its greenhouse gas emissions and direct energy consumption annually to the Office of Environment and Heritage in accordance with the NSW Government Sustainability Policy. The annual report includes information on greenhouse gas emissions from energy usage associated with the operation of Roads and Maritime properties, street lighting, traffic signals, and vehicles.

### 6.14.1 Potential impacts

#### Potential climate change impacts on the proposal

Changes in rainfall patterns and severe weather events may influence the risk of erosion impacts on the proposal site and associated sediment loss. Severe weather events may also influence the construction schedule.

In the long-term, increases in temperature may affect the integrity of pavement and other construction elements, either directly or through evaporative changes and then changes to soil moisture content and soil instability which may eventually impact on foundations of structures, softening of pavements, and road rutting.

The proposal is not in a coastal location and would not be directly affected by sea level changes.

#### Potential impacts of the proposal on climate change

The effect of greenhouse emissions on the climate has been provided to be the main instrument driving increased temperatures and other associated indicators of climate change. Each gas that has been identified by the Intergovernmental Panel on Climate Change has been classified with a global warming potential, the units of which are 'carbon dioxide equivalents'. Greenhouse gas emissions are also categorised according to the source of emission. Scope one emissions are created directly by a person, for example fuel consumption. Scope two emissions are indirect emissions and include the generation of electricity. Scope three emissions are indirect emissions generated by the wider economy for example coal mining and export.

#### Construction

Construction of the proposal would result in greenhouse gas emissions being produced, including:

- Release of stored carbon dioxide from vegetation removal (decomposition of cleared vegetation)
- Carbon dioxide and nitrous oxide from liquid fuel use in plant and vehicles (diesel, petrol) during construction, disposal and transport of materials
- Use of materials such as concrete that have high embodied energy content
- Methane from landfilling any carbon based waste, and possible fugitive emissions from the use of natural gas
- On-site electricity usage.

It is anticipated that operation of construction equipment would be the main emissions source during construction.

Vegetation removal can result in an increase in carbon dioxide in the atmosphere as the carbon would no longer be stored in this vegetation through carbon sequestration. Only minimal vegetation would be lost as a result of the proposal, which would result in a negligible increase in carbon dioxide.

### Operation

During operation, the proposal may alleviate vehicle emissions through increased efficiency of the road network, reducing congestion and travel times. However, the developments proposed within and surrounding the study area are likely to significantly increase traffic demand over the coming decades (refer to section 2.1) and this will increase vehicle emissions in the future.

A minimal amount of emissions would be generated during maintenance activities (which would be frequency and intensity dependant) and through the use of electricity for new traffic signals.

#### 6.14.2 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Greenhouse gas emissions	The use of alternative fuels and power sources for construction plant and equipment would be investigated and implemented, where appropriate.	Construction contractor	Pre-construction
	The energy efficiency and related carbon emissions would be considered in the selection of vehicle and plant equipment.	Construction contractor	Pre-construction
	Materials would be delivered as full loads and local suppliers would be used where possible.	Construction contractor	Construction
	Construction equipment, plant and vehicles would be appropriately sized for the task.	Construction contractor	Construction
	Equipment would be serviced frequently to ensure they are operating efficiently.	Construction contractor	Construction
	Vehicles and machinery would not be left idling when not in use.	Construction contractor	Construction
	Clearing of vegetation would be minimised where possible.	Construction contractor	Construction

### 6.15 Cumulative impacts

Cumulative environmental impacts have the potential to arise from the interaction of individual elements within the proposal and the additive effects of other external projects. Roads and Maritime is required under clause 228(2)(o) of the Environmental Planning and Assessment Regulation 2000 to take into account potential cumulative impacts as a result of the proposal.

#### Adjoining road upgrades

As noted in section 2.2, The Northern Road is being upgraded from a generally two lane road to a four lane divided road, with a wide central median to allow for future widening. The proposal would tie into The Northern Road Upgrade Stage 2A (Peter Brock Drive to Belmore Road) to the south and The Northern Road Upgrade Stage 2C (Thames Road to Mersey Road) to the north with a similar construction timeframe to the proposal. The Northern Road Upgrade Stage 3 (Littlefields Road to Jamison Road) and The Northern Road Upgrade Stage 4 (Mersey Road to Littlefields

Road). Stages 3 and 4 are proposed to commence construction in late 2017 for a period of 24 months.

Bringelly Road is being upgraded from a two lane road to a six lane divided road in two stages. The proposal would tie into the Bringelly Road Upgrade Stage 2 upgrade project to the east (King Street to The Northern Road) with a similar construction timeframe to the proposal.

As part of the WSIP, the M12 Motorway is also proposed to be upgraded to a generally six lane divided motorway with grade separated interchanges at the M7 Motorway, the proposed western Sydney airport site and at The Northern Road. This upgrade is proposed between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham. However, construction is not proposed to commence until the year 2020.

The South West Rail Link extension corridor is proposed to connect Leppington Station to Bringelly, and then head in two directions: north to the Western Line near St Marys, and south to Narellan. A train station is proposed to be located in Bringelly to the north-east of the proposal site. The location of the proposed extension corridor is shown on Figure 2.1. Although the location of the corridor is indicative for consultation purposes only, the concept design for the proposal has taken the proposed extension corridor into account.

### Major projects

Major developments in the region are described in section 2.1. As noted in section 2.1, the Bringelly Brickworks extension project was approved in March 2015. There will be an increase in heavy vehicle and light vehicle movements as a result of the extension. The proposed western Sydney airport is also proposed to be located at Badgerys Creek, about 3.7 km north of the proposal site. Early works could commence as early as 2016.

Based on a search of the major projects register search maintained by the Department of Planning and Environment, numerous residential development planning agreements have been determined by the Department in the Camden and Liverpool local government areas.

### Local developments

A search of the development application tracking database for Camden and Liverpool councils was undertaken on 10 August 2015. Applications in the study area relate mainly to residential modifications.

#### 6.15.1 Potential impacts

Potential cumulative impacts may occur as a result of construction activities occurring simultaneously with the projects listed above. There would be potential for short-term negative cumulative impacts related to traffic delays, access, pollution, waste, noise, resource use and visual amenity as a result of concurrent adjoining road upgrades. However, the proposal and adjoining road upgrades would have a positive cumulative impact on travel times, road safety and will allow for the anticipated increase in traffic volumes as a result of future population growth in the area.

The potential for cumulative impacts would be managed by construction planning to ensure the integration of all regional Roads and Maritime projects. This is discussed in section 6.1.3.

The extension of the Bringelly Brickworks and the proposed western Sydney airport, are being considered as part of design development. The proposal allows for the upgrade of the interchange to support the predicted increase in traffic resulting from the Bringelly Brickworks extension and the proposed western Sydney airport. This is considered in sections 3 and 6.1.

Construction of a number of smaller scale projects may occur in the local area; however the cumulative impacts of the proposal and such small scale projects are expected to be relatively minor.

Cumulative impacts would be minimised and managed through the application of environmental safeguards and management measures as summarised in sections 6.15.2 and 7.2. Consultation with relevant stakeholders would be undertaken during construction planning to ensure that potential cumulative impacts are minimised. Any additional mitigation measures from consultation would be included in the traffic management plan and noise and vibration management plan.

The proposal would have a positive cumulative impact on travel times, road safety and efficiency, facilitating the anticipated increase in traffic volumes as a result of future traffic predictions and population growth. The proposal would result in an improved transport corridor in the area and better access and is further discussed in section 6.16.

#### 6.15.2 Safeguards and management measures

Mitigation measures provided below would be implemented to minimise potential cumulative impacts.

Impact	Environmental safeguards	Responsibility	Timing
Cumulative impacts	Ongoing coordination and consultation would be undertaken with Boral Pty Ltd to ensure cumulative noise and traffic impacts are appropriately assessed and managed.	Roads and Maritime and construction contractor	Detailed design and construction
	The construction environmental management plan would be revised to consider potential cumulative impacts from surrounding development activities as they become known.	Construction contractor	Pre-construction
Cumulative traffic and access impacts	The traffic management plan would be prepared in consultation with the Transport Management Centre, Liverpool Council and Camden Council.	Roads and Maritime and construction contractor	Pre-construction
Night work	An 'out of hours work procedure' would be prepared as part of the construction noise and vibration management plan for the proposal in accordance with the requirements of the <i>Interim Construction Noise Guideline</i> (DECC, 2009) and the <i>Environmental Noise Management Manual Practice</i> (RTA, 2001a) and would consider the cumulative impact from other construction activities occurring in the vicinity of the proposal.	Construction contractor	Construction

#### 6.16 Summary of beneficial effects

On completion, the proposal would support the upgrades of The Northern Road and Bringelly Road by providing safe and efficient traffic flow and turning arrangements between these roads, which would:

- Improve transport connections to the proposed western Sydney airport and the Western Sydney Employment Area
- Improve traffic and freight movements through and within the Western Sydney Priority Growth Area and South West Priority Land Release Area
- Improve access, connectivity and reliability for regional freight vehicle movements
- Provide adequate road capacity for projected regional population growth and development

- Reduce local and regional travel time
- Support the operation of the bus network
- Improve road safety for pedestrians, cyclists and motorists
- Benefit the regional economy.

Together with the upgrades of The Northern Road and Bringelly Road, the proposal would:

- Support the directions of the Sydney Metropolitan Strategy (*A Plan for Growing Sydney*) and the strategic plan for the South West Growth Centre by enabling these roads to fulfil their intended roles as key north–south and east–west routes through the South West Growth Centre
- Support the program objectives of the Western Sydney Infrastructure Plan.

The proposal would also have a number of local benefits:

- Improve access between the local area and the Western Sydney Priority Growth Area and South West Priority Land Release Area, the Western Sydney Employment Area and the proposed western Sydney airport
- Improve access, connectivity, safety and reliability for local freight vehicle movements – the proposal would provide safer access to and from The Northern Road for heavy vehicles associated with the operation of the expanded Bringelly Brickworks
- Amenity and safety benefits for the school, village shops, and residents along the remaining section of The Northern Road.

## 6.17 Summary of adverse effects

Adverse effects of the proposal include:

- Temporary construction impacts including changes to local access arrangements, and potential for noise, vibration, air and water quality impacts, and increase in traffic along the route for the proposed diversion
- Increased noise levels for properties close to the proposal site, with about 10 properties requiring additional noise mitigation
- Increase in traffic volumes along Robinson Road, Jersey Road and Carrington Road as a result of the operation of the proposed temporary diversion from Bringelly Road
- Property impacts, including:
  - Total acquisition of up to 10 properties
  - Partial acquisition of up to 25 properties
  - Direct/indirect impacts to 11 farm dams
  - Changes to access arrangements for some properties.
- Removal of about 4.26 hectares of native vegetation from certified lands and potential for indirect impacts on a small area of vegetation in non-certified lands
- Changes to the local landscape and visual environment as a result of the introduction of a large piece of transport infrastructure
- Impacts to six Aboriginal heritage sites (with four sites already assessed as part of adjoining upgrades)
- Reduction in passing trade for the shops located at Bringelly Village.

## 7. Environmental management

This section describes how the proposal would be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided with reference to environmental management plans and relevant Roads and Maritime QA specifications. A summary of site-specific environmental safeguards is provided as detailed in section 6 and the licence and approval requirements required before construction starts are also listed.

### 7.1 Environmental management plans

A number of safeguards and management measures have been identified in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A project environmental management plan (PEMP) and a construction environmental management plan (CEMP) would be prepared to describe safeguards and management measures identified. These plans would provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The plans would be prepared before construction of the proposal and must be reviewed and certified by Roads and Maritime's Environment Officer, Sydney Region, before the start of any on-site work. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP and PEMP would be developed in accordance with the specifications set out in the *RTA QA Specification G36 – Environmental Protection (Management System)*, *RTA QA Specification G38 – Soil and Water Management (Soil and Water Plan)* and *RTA QA Specification G40 – Clearing and Grubbing*.

### 7.2 Summary of safeguards and management measures

Environmental safeguards outlined in this document would be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards would minimise any potential adverse impacts arising from the proposed work on the surrounding environment. The safeguards and management measures are summarised in Table 7.1.

### 7.3 Licensing and approvals

Prior to commencement of construction works:

- Following further investigations, an AHIP may be required under section 90 of the *National Parks and Wildlife Act 1977* for impacts to the PAD sites not covered by the existing AHIP
- An EPL would be required under the *Protection of the Environment Operations Act 1997* for the construction of the proposal. If the proposal is constructed with adjacent projects (such as The Northern Road Upgrade Stage 2C or Bringelly Road Upgrade Stage 2) one EPL would be required to cover the construction works as a whole. This would be confirmed once the final staging methodology is confirmed.

Table 7.1 Summary of site specific environmental safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing
<b>Traffic and access</b>				
1	Construction traffic management	A detailed traffic management plan would be prepared in accordance with <i>Traffic Control at Work Sites</i> (RTA, 2010) and Specification G10 - <i>Control of Traffic</i> . The plan would be approved by Roads and Maritime before implementation to provide a comprehensive and objective approach to minimise any potential impacts on road and pedestrian operations during construction.	Construction contractor	Pre-construction
2		<p>The plan would be submitted in stages to reflect the progress of work and would:</p> <ul style="list-style-type: none"> <li>• Identify the traffic management requirements during construction, particularly for the traffic diversion</li> <li>• Describe the general approach and procedures to be adopted when producing specific traffic control plans</li> <li>• Ensure the continuous, safe and efficient movement of traffic for both the public and construction workers</li> <li>• Maintain the capacity of local roads</li> <li>• Determine temporary speed restrictions to ensure safe driving environments around work zones</li> <li>• Undertake a speed limit review of local roads associated with the traffic diversion</li> <li>• Minimise impacts on existing roads and local traffic</li> <li>• Provide access to local roads and properties, including the use of temporary turnaround bays</li> <li>• Provide temporary works and traffic signals</li> <li>• Determine the number and width of traffic lanes in operation</li> <li>• Identify traffic barrier requirements and placement</li> <li>• Include the need to consult with emergency services on access changes</li> <li>• Include methods for implementing the traffic management plan</li> <li>• Include methods for minimising road user delays</li> <li>• Provide appropriate warning and advisory signposting</li> <li>• Consider other developments that may also be under construction, to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic</li> <li>• Maintain designated pedestrian and cyclist access for safe movements in the study</li> </ul>	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		area.		
3		Consultation would be undertaken with Interline Bus Services before and during construction to confirm bus diversions and bus stop closures.	Roads and Maritime	Pre-construction and construction
4		A speed limit review of the traffic diversion through Robinson Road and Jersey Road would be undertaken to determine if a temporary speed reduction is required during the diversion	Roads and Maritime	Pre-construction and construction
5		Consultation with the Transport Management Centre would be undertaken to manage cumulative construction traffic impacts	Roads and Maritime	Pre-construction and construction
6		Consultation would be undertaken with Bringelly Public School to ensure safe walking to School can be maintained during construction	Roads and Maritime	Pre-construction and construction
7		The community would be kept informed about construction through advertisements in the local media and by prominently placed advisory notices or variable message signs.	Roads and Maritime	Pre-construction and construction
8	Congestion and safety	Traffic control would be provided to manage and regulate traffic movements during construction. For example, construction and delivery vehicles entering or leaving the site compound would use arterial roads. These movements would be restricted to non-peak traffic periods wherever possible.	Construction contractor	Construction
9		Disruption to all road users during the construction period would be kept to a minimum.	Construction contractor	Construction
10		Clear signage would be provided if traffic or footpath diversions are required.	Construction contractor	Construction
11	Access to properties	Property access would be maintained throughout the construction period with suitable alternative access arrangements provided.	Construction contractor and Roads and Maritime	Construction
12		Where changes to access arrangements are necessary, Roads and Maritime would advise owners and tenants and consult with them in advance regarding alternate access arrangements.	Construction contractor and Roads and Maritime	Construction
<b>Noise and vibration</b>				
13	Noise assessment	Additional detailed noise assessment would be undertaken at Bringelly Public School to identify which buildings are classrooms and to determine the transmission loss through the building facades.	Roads and Maritime	Detailed design
14	Operational noise mitigation	Further investigation of mitigation options would be undertaken to determine suitability of low noise pavement, noise barriers and required at-property treatments.	Roads and Maritime	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
15	Vibration	Undertake a dilapidation survey at 11 Robinson Road prior to construction commencing.	Roads and Maritime	Detailed design
16	Construction noise and vibration	<p>A construction noise and vibration management plan would be prepared as part of the construction environmental management plan. This plan would include, but not be limited to:</p> <ul style="list-style-type: none"> <li>• A map indicating the locations of sensitive receivers including residential properties</li> <li>• Management measures to minimise the potential noise impacts from the quantitative noise assessment and for potential works outside of standard working hours (including implementation of Interim Construction Noise Guidelines (DECC, 2009)</li> <li>• A risk assessment to determine potential risk for activities likely to affect receivers (for activities undertaken during and outside of standard working hours)</li> <li>• Mitigation measures to avoid noise and vibration impacts during construction activities including those associated with truck movements</li> <li>• A process for assessing the performance of the implemented mitigation measures</li> <li>• A process for documenting and resolving issues and complaints</li> <li>• A process for updating the plan when activities affecting construction noise and vibration change</li> <li>• A process for consideration of cumulative impacts from adjacent projects</li> <li>• Identify in toolbox talks where noise and vibration management is required</li> <li>• An out of hours works procedure in accordance with the requirements of the Interim Construction Noise Guideline (DECC, 2009) and the Environmental Noise Management Manual Practice (RTA, 2001a)</li> <li>• Restrictions on construction delivery times to minimise noise impacts to receivers near the compound site</li> <li>• Scheduling works to complete noisiest activities during the day wherever possible (i.e. concrete saw cutting).</li> </ul>	Construction contractor	Pre-construction and construction

No.	Impact	Environmental safeguards	Responsibility	Timing
17		<p>The out of hours procedure would as a minimum include:</p> <ul style="list-style-type: none"> <li>• Background levels for noise criteria in accordance with the NCG</li> <li>• Locations of the works</li> <li>• Locations of sensitive receivers</li> <li>• Predicted noise levels</li> <li>• Communications plan</li> <li>• Triggers for the provision of respite and a respite schedule.</li> <li>• Management measures where works are unable to comply with the criteria</li> </ul>	Construction contractor	Pre-construction and construction
18	Construction noise	Noise impacts would be minimised in accordance with Practice Note 7 in Roads and Maritime Services' <i>Environmental Noise Management Manual</i> and <i>Environmental fact sheet No. 2- Noise management and Night Works</i> .	Construction contractor	Construction
19	Construction noise from machinery and equipment	Construction compounds will be laid-out in such a way that the primary noise sources are at a maximum distance from residences, with solid structures (sheds, containers etc) placed between residences and noise sources (and as close to the noise sources as is practical).	Construction contractor	Construction
20		All equipment will be selected to minimise noise emissions. Equipment should be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made	Construction contractor	Construction
21		Noise-emitting plant would be directed away from sensitive receivers where possible.	Construction contractor	Construction
22		Reversing alarms that have a tonal noise character are to be avoided during out of hours activities. Quacker style or 'smart' reversing alarms are to be used during night time activities (pending safety approvals).	Construction contractor	Construction
23		To minimise the potential for sleep disturbance impacts, construction activities likely to generate the highest levels of noise would be scheduled to occur at the beginning of the shift (before 11 pm).	Construction contractor	Construction
24	Construction noise from inappropriate practices	<p>Site inductions would be provided to train staff on ways to minimise construction noise impacts on-site. Responsible working practices include:</p> <ul style="list-style-type: none"> <li>• Avoid the use of outdoor radios during the night-time period</li> <li>• Avoid shouting and slamming of doors</li> <li>• Where practical, operate machines at low speed or power and switched off when not being used rather than left idling for prolonged periods</li> <li>• Minimise reversing</li> </ul>	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>Avoid dropping materials from height and avoid metal to metal contact on material</li> <li>All engine covers should be kept closed while equipment is operating.</li> </ul> Site inductions must include: <ul style="list-style-type: none"> <li>All relevant project specific and standard noise and vibration mitigation measures</li> <li>Relevant licence and approval conditions</li> <li>Permissible hours of work</li> <li>Any limitations on high noise generating activities</li> <li>Location of nearest sensitive receivers</li> <li>Construction employee parking areas</li> <li>Designated loading/ unloading areas and procedures</li> <li>Construction traffic routes</li> <li>Site opening/closing times (including deliveries)</li> <li>Environmental incident procedures</li> </ul>		
25	Construction traffic noise	Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.	Construction contractor	Construction
26	Construction vibration	Confining vibration-generating operations to the least vibration-sensitive part of the shift – which could be when the background disturbance is highest.	Construction contractor	Construction
27		Quieter and less noise/vibration emitting construction methods would be used where feasible and reasonable.	Construction contractor	Construction
28		Compliance vibration monitoring would be undertaken in response to complaints or when vibration generating activities occur within the structural damage buffer distances. The results of the vibration monitoring would be compared to the structural damage criteria presented in Table 6.15 considering frequency content.	Construction contractor	Construction
29		Building condition surveys would be undertaken when vibration generating activities occur within the structural damage buffer distances.	Construction contractor	Construction
30	Noise and vibration impacts and appropriate complaints handling	The local community would be contacted and informed of the proposed work, location, duration of work, and hours involved. The contact would be made a minimum five days before work starts as per RMS ENMM Practice Note 7 requirements.	Construction contractor and Roads and Maritime	Pre-construction and construction
31		A suitable advertisement will be placed in local papers including a reference to night-time noise impacts	Construction contractor	Construction
32		Communications material such as the project website and community notification would include a contact person and phone number to enable complaints to be received and responded to.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
33	Monitoring	<p>Attended compliance noise or vibration monitoring should be undertaken to confirm the predicted noise or vibration levels upon receipt of a complaint. The ICNG state that complaint monitoring measurements should be taken at the complainant's location and the monitoring should cover the time of day when the impacts were reported to occur.</p> <p>In the case that exceedances of the relevant annoyance criteria levels listed in this report are detected in relation to the complaint, the situation should be reviewed in order to identify means to minimise the impacts to residences.</p>	Construction contractor	Construction
34	Monitoring	A post construction noise monitoring program will be undertaken to confirm the noise levels predicted as part of the Noise and Vibration assessment. Monitoring locations will be selected along the route at locations monitored as part of the assessment and also at any locations where noise complaints have been made. Where exceedances are identified, further consideration of feasible and reasonable measures would occur.	Construction contractor	Operation (within 12 months of commencement of operation)
35	Road noise	At locations where residual impacts remain after all feasible and reasonable approaches have been exhausted, noise mitigation in the form of acoustic treatment of existing individual dwellings will be considered.	Roads and Maritime	Operation
<b>Soils, topography and geology</b>				
36	Erosion and sedimentation	<p>A soil and water management plan (SWMP) would be prepared as part of the construction environmental management plan in accordance with the requirements of Roads and Maritime contract specification G38. The SWMP would address the following:</p> <ul style="list-style-type: none"> <li>• Roads and Maritime Code of Practice for Water Management, the Roads and Maritime Services' <i>Erosion and Sedimentation Procedure</i></li> <li>• The NSW <i>Soils and Construction – Managing Urban Stormwater Volume 1 'the Blue Book'</i> (Landcom, 2004) and Volume 2 (DECC, 2008)</li> <li>• Roads and Maritime Technical Guideline: <i>Temporary Stormwater Drainage for Road Construction, 2011</i></li> <li>• Roads and Maritime <i>Technical Guideline: Environmental Management of Construction Site Dewatering, 2011</i></li> </ul>	Construction contractor	Pre-construction
37		<p>The SWMP would detail the following as a minimum:</p> <ul style="list-style-type: none"> <li>• Identification of catchment and sub-catchment areas, high risk areas and sensitive areas</li> <li>• Sizing of each of the above areas and catchment</li> </ul>	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>• The likely volume of run-off from each road sub-catchment</li> <li>• Direction of flow of on-site and off-site water</li> <li>• Separation of on-site and off-site water</li> <li>• The direction of run-off and drainage points during each stage of construction</li> <li>• The locations and sizing of sediment traps such as sump or basin as well as associated drainage</li> <li>• Dewatering plan which includes process for monitoring, flocculating and dewatering water from site (ie sediment basin and sumps)</li> <li>• A mapped plan identifying the above</li> <li>• Include progressive site specific Erosion and Sedimentation Control Plans (ESCPs). The ESCP is to be updated at least fortnightly</li> <li>• Identify high risk activities and the details required for work method statements to be developed and signed by Roads and Maritime prior to construction</li> <li>• A process to routinely monitor the BOM weather forecast</li> <li>• Preparation of a wet weather (rain event) plan which includes a process for monitoring potential wet weather and identification of controls to be implemented in the event of wet weather. These controls are to be shown on the ESCPs</li> <li>• Provision of an inspection and maintenance schedule for ongoing maintenance of temporary and permanent erosion and sedimentation controls.</li> </ul>		
38	Site stabilisation plan	<p>A site stabilisation plan would be prepared as part of the CEMP. The plan would include but not be limited to the following:</p> <ul style="list-style-type: none"> <li>• Identification and mapping of areas along the length of the proposal requiring stabilisation</li> <li>• A risk assessment for disturbed areas and stockpiles</li> <li>• Detailed methods for stabilisation</li> <li>• A monitoring program for the stabilised areas</li> <li>• A process for determining the success of stabilised areas or methods</li> <li>• A process for identifying additional stabilisation methods in: <ul style="list-style-type: none"> <li>○ All high risk areas would be stabilised within two weeks</li> <li>○ All medium risk areas would be stabilised within one month</li> <li>○ In anticipation of rain events.</li> </ul> </li> </ul>		

No.	Impact	Environmental safeguards	Responsibility	Timing
39	Contamination	An incident emergency spill plan would be developed and incorporated into the construction environmental management plan. The plan would include measures to avoid and manage spillages of fuels, chemicals, and fluids onto any surfaces or into stormwater inlets and an emergency response procedure.	Construction contractor	Pre-construction
40	Erosion and sedimentation	Erosion and sediment control measures would be implemented and maintained to: <ul style="list-style-type: none"> <li>Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets</li> <li>Reduce water velocity and capture sediment on site</li> <li>Minimise the amount of material transported from site to surrounding pavement surfaces</li> <li>Divert clean water around the site.</li> </ul>	Construction contractor	Construction
41		Erosion and sediment controls would be implemented before any construction starts and inspected regularly, particularly prior after a rainfall event. Maintenance work would be undertaken as needed.	Construction contractor	Construction
42		Site stabilisation of disturbed areas would be undertaken progressively as stages are completed.	Construction contractor	Construction
43		All stockpiles would be designed, established, operated and decommissioned in accordance with Roads and Maritime <i>Stockpile Management Guidelines</i> (RMS, 2015).	Construction contractor	Construction
44		Controls would be implemented at exit points to minimise the tracking of soil and particulates onto pavement surfaces.	Construction contractor	Construction
45		Any material transported onto pavement surfaces would be swept and removed at the end of each working shift.	Construction contractor	Construction
46	Excess spoil	Excess spoil not required or able to be used for backfilling would be stockpiled in a suitable location before being reused on adjacent Roads and Maritime projects or removed from the site, and disposed of at an appropriately licensed facility.	Construction contractor	Construction
47	Contamination of soil	A fully equipped emergency spill kit would be kept on-site at all times.	Construction contractor	Construction
48		If an incident (e.g. spill) occurs, the RMS's Environmental Incident Classification and Management Procedure is to be followed and the Roads and Maritime Contract Manager notified as soon as practicable.	Construction contractor	Construction
49		All staff would be inducted about incident and emergency procedures and made aware of the location of emergency spill kits.	Construction contractor	Construction
50		Machinery would be checked daily to ensure there is no oil, fuel or other liquid leaking from the machinery.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
51		Final waste classification is required once the volumes of waste requiring offsite disposal during construction are confirmed. Waste soils should be classified in accordance with the NSW EPA (2014) Waste Classification Guidelines	Construction contractor	Construction
52		In the event that indication of contamination is encountered (such as odorous or visually contaminated materials), work in the area would cease until an environmental consultant can advise on the need for remediation or other action, as deemed appropriate.	Construction contractor	Construction
<b>Hydrology, water quality, flooding and drainage</b>				
53	Flooding impacts	Further flood modelling would be undertaken during detailed design to minimise impacts where possible	Roads and Maritime	Detailed design
54		Surveys of identified properties would be undertaken to confirm floor levels	Roads and Maritime	Detailed design
55	General construction impacts	Construct temporary drainage structures in accordance with the <i>Technical Guideline – Temporary Stormwater Drainage for Road Construction</i> (Roads and Maritime, 2011).	Construction contractor	Construction
56	Contamination of surface water	All fuels, chemicals, and liquids would be stored at least 50 m away from the existing stormwater drainage system and would be stored in an impervious bunded area within the compound site.	Construction contractor	Construction
57		The refuelling of plant and maintenance of machinery would be undertaken in impervious bunded areas in the compound site.	Construction contractor	Construction
58		Vehicle wash downs and/or concrete truck washouts would be undertaken within a designated bunded area of an impervious surface or undertaken off-site.	Construction contractor	Construction
59	Dewatering	Low lying areas of construction formations and excavations that collect stormwater would be dewatered in accordance with the <i>Technical Guideline - Environmental Management of Construction Site Dewatering EMS-TG-011</i> (RTA, 2011)	Construction contractor	Construction
<b>Biodiversity</b>				
60	Direct impacts to native vegetation	The detailed design would minimise the removal of vegetation in certified land and avoid the removal of vegetation in non-certified land.	Roads and Maritime	Detailed design
61	Biodiversity impacts	A biodiversity management plan would be prepared and included within the CEMP in accordance with Roads and Maritime's <i>Biodiversity Guidelines</i> (RTA, 2011). It would include: <ul style="list-style-type: none"> <li>A site walk with qualified site personnel including Roads and Maritime representatives prior to commencement of works to confirm clearing boundaries and sensitive location</li> </ul>	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>• A map which clearly shows vegetation clearing boundaries and sensitive areas/no go zones</li> <li>• On site identification (marking) of the clearing boundary and habitat features (including hollow-bearing trees) to be protected</li> <li>• Pre-clearing survey plan and management measures describing the survey methodology and targeted species, including the Cumberland Plain Land Snail</li> <li>• Incorporation of management measures identified as a result of the pre-clearing survey report and nomination of actions to respond to the recommendations made. This would include details of measures to be implemented to protect clearing limits and no go areas</li> <li>• A detailed clearing process in accordance with Roads and Maritime's <i>Biodiversity Guidelines 2011</i>, including the requirements of Guide 1,2, 4 &amp; 9</li> <li>• Identify in toolbox talks where biodiversity would be included such as vegetation clearing or works in or adjacent to sensitive locations</li> <li>• Identify control/mitigations measures to prevent impacts on sensitive locations or no go zones</li> <li>• A stop works procedure in the event of identification of unidentified species, habitats or populations</li> <li>• A procedure for clearing hollow bearing trees in line with Guide 4 of the RMS Biodiversity Guidelines 2011</li> <li>• Hygiene protocols to prevent the introduction and spread of pathogens</li> <li>• A protocol for the management of dewatering of farm dams to prevent introduction of Mosquito Fish into surrounding waterways should be implemented.</li> </ul>		
62		A suitably qualified ecologist would be engaged to clearly demarcate vegetation protection areas (including habitat trees) and complete the pre-clearing survey report.	Construction contractor	Pre-construction
63	Biodiversity impacts	Construction would be undertaken in accordance with the biodiversity management plan.	Construction contractor	Construction
64		An ecologist would be present during the clearing of habitat trees to handle and relocate any injured fauna. WIRES would be consulted if any injured fauna are encountered.	Construction contractor	Construction
65		Declared noxious weeds would be managed in accordance with the requirements of the <i>Noxious Weeds Act 1993</i> and Guide 6 (Weed	Construction constructor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		Management) of the Roads and Maritime Biodiversity Guidelines 2011.		
66		Dams would be progressively emptied over a number of days to allow native fauna to relocate. An experienced, licenced wildlife carer or ecologist would be required to assist with relocation of fauna such as turtles, or with humane disposal of noxious fish	Construction constructor	Construction
67		Any large woody debris would be relocated rather than removed	Construction constructor	Construction
68	Weed management	Ongoing weed management and control would be undertaken in accordance with the Biodiversity Guidelines 2011.	Roads and Maritime	Operation
<b>Aboriginal cultural heritage</b>				
69	Avoiding impacts on Aboriginal heritage items	Properties not accessible at the time of writing this REF are to be surveyed and assessed prior to works commencing,	Roads and Maritime	Detailed design
70	Aboriginal heritage impacts	In accordance with the Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation, Stage 3 is to be implemented, including the preparation of a Cultural Heritage Assessment Report and comprehensive consultation with key stakeholders.	Roads and Maritime	Pre-construction
71		Test excavation would be undertaken for TNRB PAD01 and TNRB PAD02 to inform an assessment of archaeological significance in accordance with the Code of Practice.	Roads and Maritime	Pre-construction
72		A program of archaeological salvage or surface collection would be undertaken in accordance with the requirements of the existing AHIPs relating to sites BRP-IF-16 / TNRU14, BRP-S-07 and TNRU6.	Roads and Maritime	Pre-construction
73		An Aboriginal heritage management plan would be prepared and incorporated into the CEMP. The plan would include (but not be limited to) the following: <ul style="list-style-type: none"> <li>• A sensitive areas map which clearly identifies the exclusion zones</li> <li>• Fencing to control access during construction to the exclusion zones</li> <li>• An environmental risk assessment to determine potential risks for discrete work elements or activities likely to affect significant heritage elements</li> <li>• Specific mitigation measures to avoid risk of harm</li> <li>• A process to communicate risk and responsibilities through environmental awareness training</li> <li>• A stop works procedure in the event of actual or suspected potential harm to a heritage feature/place</li> </ul>	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>All measures recommended in the CHAR and AHIP, including notification requirements</li> <li>Site training and induction.</li> </ul>		
74	Consultation	Stakeholders would continue to be consulted in accordance with Roads and Maritime's PACHCI procedure.	Construction contractor	Construction
75	Aboriginal cultural heritage item encountered during work	In the event of an unexpected find of Aboriginal cultural heritage, work would cease in the affected area and the <i>Standard Management Procedure - Unexpected heritage items</i> (Roads and Maritime 2015) will be implemented. This would include stopping all work in the vicinity of the find and contacting Roads and Maritime's Aboriginal cultural heritage advisor or the relevant Roads and Maritime environmental officer immediately to identify the appropriate course of action. Work would not recommence until receipt of written approval from Roads and Maritime.	Construction contractor	Construction
<b>Non-Aboriginal heritage</b>				
76	Avoiding impacts on heritage items	During design development, impacts on heritage items are to be avoided where practicable.	Roads and Maritime	Detailed design
77		If the final design of the proposal changes considerably from that currently proposed, additional assessment may be required.	Roads and Maritime	Detailed design
78		Properties not accessible at the time of writing this REF are to be surveyed and assessed prior to works commencing,	Roads and Maritime	Detailed design
79	Avoiding impacts on heritage items	<p>A non-Aboriginal Heritage Management plan would be prepared and included in the CEMP. This plan would include:</p> <ul style="list-style-type: none"> <li>A map identifying locations of items/sites in the vicinity of the proposal site</li> <li>Identification of potential environmental risks/ impacts due to the work/activities</li> <li>Mitigation measures for the identified risks</li> <li>A procedure to report any damage to heritage items compliant with the Roads and Maritime Incident Classification and Reporting Procedure</li> <li>Identify in toolbox talks where management of non-Aboriginal heritage is required such as identification of no go zones and responsibilities under the <i>Heritage Act 1977</i></li> <li>Requirement to comply with the Roads and Maritime <i>Standard Management Procedure: Unexpected Heritage items</i> (2015).</li> </ul>	Construction contractor	Pre-construction
80		Retain the vegetation buffer between the proposal and the cottage, where possible	Construction contractor	Pre-construction Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
81	Inadvertent impacts on heritage items	Environmental awareness training would include responsibilities under heritage legislation. Workers would be informed regarding the location of known heritage items, and the unanticipated finds procedure.	Construction Contractor	Construction
82	Unanticipated archaeological finds	If unexpected archaeological remains are uncovered during the work, all work must cease in the vicinity of the material/find and the steps in the Roads and Maritime <i>Standard Management Procedure: Unexpected Heritage items</i> (2015) procedure must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.	Construction Contractor	Construction
<b>Landscape character and visual</b>				
83	Landscape character and visual impacts	Detailed design would be undertaken according to the urban design vision, objectives and principles which underpin the concept design.	Roads and Maritime	Detailed design
84		A landscaping plan would be developed detailing options for planting designs and landscape treatments.	Roads and Maritime	Detailed design
85		The quality of finishes and treatments that can be viably maintained over time would be considered during detailed design.	Roads and Maritime	Detailed design
86		Materials and finishes for new road elements such as retaining walls are to be site appropriate.	Roads and Maritime	Detailed design
87	Light spill	Lighting would be designed to minimise light spill into residential properties and sensitive receptors.	Roads and Maritime	Detailed design
88	Cyclist safety	Where shared paths cross driveways, consideration would be given to use treatment (materials or colours) to provide a visual cue to remind cyclists to look out for cars.	Roads and Maritime	Detailed design
89	Landscape character and visual impacts	Construction equipment, stockpiles, and other visible elements would be located away from key views to and from the identified visual receptors where feasible. Where this is not feasible, screening measures and practices to keep sites tidy would be implemented.	Construction contractor	Construction
90		Existing trees would be retained where feasible by identifying 'no go areas' to restrict access around trees not affected by the proposal.	Construction contractor	Construction
91	Compound	Revegetate compound sites and stockpile locations with grasses, ground covers and shrubs consistent with the pre-construction state of the location.	Construction contractor	Construction
92	Light spill	Temporary lighting would be sited and designed to avoid light spill into residential properties and identified sensitive receptors.	Construction contractor	Construction
93	Visual impacts	New plantings would incorporate locally occurring species which reflect the landscape character	Construction contractor	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
		zone		
94	Safety	New plantings along the shared path/ footpath would be selected and positioned such that they do not present safety hazards	Construction contractor	Operation
<b>Air quality</b>				
95	General air quality impacts	An air quality management plan would be prepared as part of the construction environmental management plan. The plan would include but not be limited to: <ul style="list-style-type: none"> <li>• A map identifying locations of sensitive receivers</li> <li>• Identification of potential risks/impacts due to the work/activities as dust generation activities</li> <li>• Management measures to minimise risk including a progressive stabilisation plan</li> <li>• A process for monitoring dust on-site and weather conditions</li> <li>• A process for altering management measures as required.</li> </ul>	Construction contractor	Pre-construction
96	Dust emissions	Dust suppression measures would be implemented as per the air quality management plan.	Construction contractor	Construction
97		Stockpiled materials would be covered, stabilised or stored in areas not subject to high wind.	Construction contractor	Construction
98		All trucks would be covered when transporting material to and from the site.	Construction contractor	Construction
99		Work activities would be reprogrammed if the mitigation measures are not adequately restricting dust generation.	Construction contractor	Construction
100	Exhaust emissions	Construction plant and equipment would be maintained in a good working condition in order to limit impacts on air quality.	Construction contractor	Construction
101		Plant and machinery would be turned off when not in use.	Construction contractor	Construction
102	Impacts on sensitive receivers	Local residents would be advised of hours of operation and duration of work and supplied with a contact name and number for queries regarding air quality.	Construction contractor	Construction
<b>Land use and property</b>				
103	Property acquisition	All land acquisitions would be conducted in accordance with the Roads and Maritime Land Acquisition Policy and the requirements of the <i>Land Acquisition (Just Terms) Compensation Act 1991</i> .	Roads and Maritime	Pre-construction
104	Impacts on dams	Consultation would be undertaken with the owners of properties containing dams that would be impacted by the proposal regarding options to mitigate the impacts.	Roads and Maritime	Pre-construction
<b>Socio-economic</b>				
105	Road signage	Signage at key locations along The Northern Road and Bringelly Road would be investigated	Roads and	Detailed

No.	Impact	Environmental safeguards	Responsibility	Timing
		during detailed design to promote the town of Bringelly	Maritime	design
106	Business impacts	A business survey would be undertaken prior to works commencing	Roads and Maritime	Detailed design
107	Construction impacts on the community	<p>A communication plan would be prepared and included in the construction environmental management plan. The communication plan would include (as a minimum):</p> <ul style="list-style-type: none"> <li>• Requirements to provide details and timing of proposed activities to affected residents, the local community and businesses, and local bus operators</li> <li>• Consultation actions in relation to access arrangements and servicing requirements, including for local businesses, the bus operator and Bringelly Public School</li> <li>• Complaints handling procedure</li> <li>• Contact name and number for complaints</li> <li>• Procedure to notify adjacent land users for changed conditions during the construction period such as traffic, pedestrian or driveway access.</li> </ul> <p>The communications plan would be prepared in accordance with G36 requirements and Roads and Maritime <i>Community Engagement and Communications Manual 2012c</i>.</p>	Construction contractor	Pre-construction
108		Local residents, businesses and other stakeholders would be notified before work starts in accordance with the communications plan.	Construction contractor	Pre-construction
109		Local residents, businesses and other stakeholders would be kept regularly informed of construction activities during the construction process through the implementation of the communication plan. The complaints handling procedure would be maintained for the duration of construction.	Construction contractor	Construction
110	Acquisition	<p>Acquisition arrangements and associated consultation would consider:</p> <ul style="list-style-type: none"> <li>• The ability of property owners/occupants to relocate, within the timeframe required, to comparable accommodation that meets the owners/occupants needs</li> <li>• The need to liaise and consult on an ongoing basis with affected owners/occupants</li> <li>• Providing assistance to households as a required, with a focus on any vulnerable groups identified (older people, people with a disability, people from culturally and linguistically diverse backgrounds),</li> </ul>	Roads and Maritime	Detailed design
111	Bus stops	Crime prevention through environmental design principles would be considered as part of the design of the bus stops.	Roads and Maritime	Design
112	Construction impacts on the community	Local residents, businesses and other stakeholders would be kept regularly informed of construction activities during the construction process through the implementation of the communication plan. The complaints handling	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		procedure would be maintained for the duration of construction.		
113	Access and connectivity	During construction, road users, pedestrians and cyclists would be informed of any changed conditions.	Construction contractor	Construction
114		Signage would be provided during construction to communicate changes, and ensure safety for pedestrians near to construction work.		
115		Access to bus stops would be maintained.		
116		The traffic management plan would include measures to minimise heavy vehicle usage and parking on local roads.		
117		Property access would be maintained wherever practicable. Prior to any unavoidable disruption to access, consultation would be undertaken with the affected property owner.		
118		Access would be maintained for emergency vehicles in the vicinity of construction works. Ongoing consultation would be undertaken with emergency services during construction to ensure that potential impacts are identified and appropriately managed.		
119	Construction impacts on utilities and services	Residents and businesses would be informed before any interruptions to utility services that may be experienced as a result of utilities relocation.	Construction contractor	Construction
<b>Resource use and waste management</b>				
120	Demand on resources	Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Construction contractor	Pre-construction
121	Waste management	<p>A resource and waste management plan would be prepared and included in the construction environmental management plan. The plan would include the following (as a minimum):</p> <ul style="list-style-type: none"> <li>The type, classification and volume of all materials to be generated and used on-site including identification of recyclable and non-recyclable waste in accordance with NSW EPA <i>Waste Classification Guidelines (2014)</i></li> <li>Quantity and classification of excavated material generated as a result of the proposal (refer Roads and Maritime Service's <i>Waste Management Fact sheets 1-6, 2012</i>)</li> <li>Interface strategies for cut and fill on-site to ensure re-use where possible</li> <li>Strategies to 'avoid', 'reduce', 'reuse' and 'recycle' materials</li> <li>Classification and disposal strategies for each type of material</li> <li>Destinations for each resource/waste type either for on-site reuse or recycling, offsite reuse or recycling, or disposal at a licensed waste facility</li> <li>Details of how material would be stored and</li> </ul>	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>treated on-site</p> <ul style="list-style-type: none"> <li>• Identification of available recycling facilities on and off-site</li> <li>• Identification of suitable methods and routes to transport waste</li> <li>• Procedures and disposal arrangements for unsuitable excavated material or contaminated material including asbestos waste</li> <li>• The types of waste collected, amounts, date/time and details of disposal are to be recorded in a waste register</li> <li>• Site clean-up for each construction stage.</li> </ul>		
122	Demand on resources	Excavated material would be reused on-site for fill where feasible to reduce demand on resources.	Construction contractor	Construction
123		Any additional fill material required would be sourced from appropriately licensed facilities and/or other Roads and Maritime projects wherever possible.	Construction contractor and Roads and Maritime	Construction
124	Waste minimisation	<p>The following resource management hierarchy principles would be followed:</p> <ul style="list-style-type: none"> <li>• Avoid unnecessary resource consumption as a priority</li> <li>• Avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery)</li> <li>• Disposal would be undertaken as a last resort (in accordance with the <i>Waste Avoidance and Resource Recovery Act 2001</i>).</li> </ul>	Construction contractor	Construction
125	Management of green waste	Clearing and grubbing, including mulching, will be undertaken in accordance with RMS QA specification G40 Clearing and Grubbing Rev1. Where possible, mulch will be used on-site.	Construction contractor	Construction
126	Spoil management	Excavated material would be reused on adjoining projects where feasible to reduce waste.	Construction contractor	Construction
127		Excess excavated material would be disposed of at an appropriate facility or reused appropriately for fill on the proposal site.	Construction contractor	Construction
128		Excess soil requiring waste disposal would first be assessed against the <i>Waste Classification Guidelines- Part 1: Classifying Waste</i> (EPA 2014). Soil samples would be taken from stockpiled material and analysed. Transportation would be undertaken by a licensed contractor capable of transporting the waste and waste would be disposed of to an appropriately licensed waste facility with supporting waste classification documentation.	Construction contractor	Construction
129	Waste management	Garbage receptacles would be provided and recycling of materials encouraged. Rubbish would be transported to an appropriate waste disposal facility.	Construction contractor	Construction
130		All wastes would be managed in accordance with the POEO Act.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
131		Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage.	Construction contractor	Construction
132		Noxious weeds removed during work would be managed in accordance with the Department of Primary Industries' requirements that relate to its classification status.	Construction contractor	Construction
133		Site inductions would occur and be recorded by a Site Supervisor to ensure staff are aware of waste disposal protocols.	Construction contractor	Construction
134	Wastewater contamination of soils and water	A dedicated concrete washout facility would be provided during construction so that run-off from the washing of concrete machinery and equipment can be collected and disposed of at an appropriate waste facility.	Construction contractor	Construction
<b>Hazards and risks</b>				
135	Risk Management	Emergency response plans would be incorporated into the construction environmental management plan including a flood evacuation plan.	Construction contractor	Pre-construction and construction
136		A pollution incident response management plan would be developed and implemented in accordance with the POEO Act requirements. The plan would form a sub-plan within the construction environmental management plan.	Construction contractor	Pre-construction and construction
137		Hazards and risks associated with construction activities would be identified prior to construction. Management measures for each identified hazard/risk would also be developed. A process for regularly reviewing work practices/procedures would be implemented throughout construction to identify, report and respond to any new environmental hazards/risks.	Construction contractor	Pre-construction
138		Site-specific safety management plans and safe work method statements would be developed and implemented in accordance with work health and safety requirements.	Construction contractor	Pre-construction
139	Flood management	A flood evacuation plan would be prepared prior to works commencing on site and incorporated into the construction environmental management plan.	Construction contractor	Pre-construction
<b>Climate change and greenhouse gases</b>				
140	Greenhouse gas emissions	The use of alternative fuels and power sources for construction plant and equipment would be investigated and implemented, where appropriate.	Construction contractor	Pre-construction
141		The energy efficiency and related carbon emissions would be considered in the selection of vehicle and plant equipment.	Construction contractor	Pre-construction
142		Materials would be delivered as full loads and local suppliers would be used where possible.	Construction contractor	Construction
143		Construction equipment, plant and vehicles would be appropriately sized for the task.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
144		Equipment would be serviced frequently to ensure they are operating efficiently.	Construction contractor	Construction
145		Vehicles and machinery would not be left idling when not in use.	Construction contractor	Construction
146		Clearing of vegetation would be minimised where possible.	Construction contractor	Construction
<b>Cumulative impacts</b>				
147	Cumulative impacts	Ongoing coordination and consultation would be undertaken with Boral Pty Ltd to ensure cumulative noise and traffic impacts are appropriately assessed and managed.	Roads and Maritime and construction contractor	Detailed design and construction
148		The construction environmental management plan would be revised to consider potential cumulative impacts from surrounding development activities as they become known.	Construction contractor	Pre-construction
149	Cumulative traffic and access impacts	The traffic management plan would be prepared in consultation with the Transport Management Centre, Liverpool Council and Camden Council.	Roads and Maritime and construction contractor	Pre-construction
150	Night work	An 'out of hours work procedure' would be prepared as part of the construction noise and vibration management plan for the proposal in accordance with the requirements of the <i>Interim Construction Noise Guideline</i> (DECC, 2009) and the <i>Environmental Noise Management Manual Practice</i> (RTA, 2001a) and would consider the cumulative impact from other construction activities occurring in the vicinity of the proposal.	Construction contractor	Construction

## 8. Conclusion

This section provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

### 8.1 Justification

The Northern Road and Bringelly Road are principal arterial road corridors within the Western Sydney Priority Growth Area and South West Priority Land Release Area. Substantial traffic growth is predicted in the next thirty years as a result of the development of the Western Sydney Priority Growth Area and South West Priority Land Release Area; the Western Sydney Employment Area; the proposed western Sydney airport at Badgerys Creek and the Bringelly Brickworks expansion.

The proposal is one of the key projects being developed as part of the Western Sydney Infrastructure Plan. The Plan will deliver major road infrastructure upgrades to support an integrated transport solution for the region and capitalise on the economic benefits from developing the proposed western Sydney airport at Badgerys Creek.

The proposal is needed to cater for the anticipated increase in traffic that will use this intersection following the upgrading of The Northern Road and Bringelly Road.

A grade separated interchange will facilitate free flowing traffic on The Northern Road and it is also a safer option, separating traffic flows on The Northern Road and Bringelly Road. By building a grade separated interchange, road capacity would be improved, and the road network would provide for expected future traffic growth.

The proposal is consistent with relevant strategic planning, including:

- Strategic infrastructure and transport planning:
  - State Priorities
  - Rebuilding NSW - State Infrastructure Strategy
  - NSW Long Term Transport Master Plan
  - Sydney's Cycling Future
  - The Northern Road Corridor Strategy
  - South West Rail Link Extension - Public transport corridor preservation
- Strategic land use plans:
  - A Plan for Growing Sydney - the Sydney metropolitan strategy
  - Structure Plan for the South West Growth Centre
  - Broader Western Sydney Employment Area Draft Structure Plan

The proposal is considered to be justified as it would:

- Provide traffic capacity for future growth and development on The Northern Road and Bringelly Road corridors and surrounding areas
- Provide opportunities for improved public transport and an improved flow of traffic for road users
- Improve road safety for all road users by providing

- An interchange to separate traffic on The Northern Road and Bringelly Road
- Wide central medians on The Northern Road and Bringelly Road to separate opposing traffic flows
- Improve safety for pedestrians and cyclists by providing a shared path
- Increase connectivity for pedestrians by providing new footpaths
- Improve turning movements for heavy vehicles, in particular from Greendale Road onto The Northern Road.

The proposal has been developed as an outcome of an extensive option development and assessment process. The preferred alignment for the proposal was chosen because it reduces the impact on the Bringelly town centre and maintains access to businesses and properties.

While the proposal would result in some environmental impacts, they have been avoided or minimised wherever possible through the design and site-specific safeguards summarised in section 7. The beneficial effects listed in section 6.17 are considered to outweigh the adverse impacts and risks associated with the proposal (refer section 6.18).

## 8.2 Objects of the Environmental Planning and Assessment Act 1979

Table 8.1 provides a summary of the proposal against the objects of the EP&A Act.

Table 8.1 Objects of the EP&A Act

Object	Comment
5(a) (i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	<p>The proposal is needed to improve access to and within the Western Sydney Priority Growth Area and South West Priority Land Release Area, the Western Sydney Employment Area and the proposed western Sydney airport. The proposal, in conjunction with the upgrades of The Northern Road and Bringelly Road, supports the Northern Road Corridor Strategy (RTA, 2009b).</p> <p>The proposal would improve access, connectivity and safety and also provide amenity and safety benefits for the Bringelly Public School, Bringelly Village shops and residents along the remaining section of The Northern Road. This is further discussed in section 6.16.</p> <p>A number of mitigation measures would be implemented to minimise any environmental impacts associated with the proposal.</p>
5(a) (ii) To encourage the promotion and co-ordination of the orderly economic use and development of land.	<p>The proposal is required to cater for the safe and efficient movement of traffic associated with the development of land within the Western Sydney Priority Growth Area and South West Priority Land Release Area, the Western Sydney Employment Area and the proposed western Sydney airport.</p>
5(a) (iii) To encourage the protection, provision and co-ordination of communication and utility services.	<p>Some utilities would need to be relocated or protected during construction. The management of utilities is considered in section 3.6.</p>
5(a) (iv) To encourage the provision of land for public purposes.	<p>The proposal involves work for the purpose of a road, which is for a public purpose.</p>

Object	Comment
5(a) (v) To encourage the provision and co-ordination of community services and facilities.	The proposal involves work for the purpose of a road and would not impact on any community services or facilities.
5(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	Construction of the proposal would require limited clearing or permanent modification of existing vegetation within biodiversity certified land of the South West Growth Centre. The potential impacts on vegetation, threatened species, population and ecological communities are discussed in section 6.5.
5(a) (vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in section 8.2.
5(a) (viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the proposal.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the proposal.
5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	Consultation with the community and relevant government agencies was undertaken during the development of the proposal. Details of this consultation can be found in section 5.

An objective of the EP&A Act is to encourage ecologically sustainable development. The principles of ecologically sustainable development have been considered throughout development of the proposal and are considered further below.

#### 8.2.1 The precautionary principle

This principle states *“if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”*.

Evaluation and assessment of alternative options have aimed to reduce the risk of serious and irreversible impacts on the environment. Stakeholder consultation considered issues raised by stakeholders and a range of specialist studies were undertaken for key issues to provide accurate and impartial information to assist in the evaluation of options.

The concept design has sought to minimise impacts on the amenity of the study area while maintaining engineering feasibility and safety for all road users. A number of safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed as a result of lack of scientific certainty.

A construction environment management plan would be prepared before construction starts. This requirement would ensure the proposal achieves a high-level of environmental performance. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

#### 8.2.2 Intergenerational equity

The principle states, *“the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations”*.

The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations.

The proposal, together with the upgrades of The Northern Road and Bringelly Road would cater for the future population and traffic growth in the region. The proposal would benefit future generations by addressing the future increases in traffic volumes and traffic congestion associated with movement of traffic, including road freight, within the Western Sydney Priority Growth Area and South West Priority Land Release Area, and to and from the Western Sydney Employment Area and the proposed western Sydney airport. While the proposal would have some adverse impacts, they were not considered to be of a nature or extent that would result in disadvantage to any specific section of the community or to future generations.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a lower level of service associated with the performance of The Northern Road and Bringelly Road.

#### 8.2.3 Conservation of biological diversity and ecological integrity

This principle states the *"diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival"*.

The environment in which the proposal would be undertaken is a modified semi-rural environment. A thorough assessment of the existing local environment was undertaken to identify and manage any potential impacts of the proposal on local biodiversity. The proposal would result in the removal of 4.26 ha from biodiversity certified land of the South West Growth Centre.

The proposal would not have a significant impact on biological diversity and ecological integrity. A biodiversity assessment and appropriate site-specific safeguards are provided in section 6.5.

#### 8.2.4 Improved valuation, pricing and incentive mechanisms

This principle requires *"costs to the environment should be factored into the economic costs of a project"*.

The REF has examined the environmental consequences of the proposal and identified mitigation measures to manage the potential for adverse impacts. The requirement to implement these mitigation measures would result in an economic cost to Roads and Maritime. The implementation of mitigation measures would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

The concept design has been developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the proposal is being developed with an environmental objective in mind.

### 8.3 Conclusion

The proposal is subject to assessment under Part 5 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity. This has included consideration of conservation agreements and plans of management under the NPW Act, joint management and bio banking agreements under the TSC Act, wilderness areas, critical habitat, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants.

A number of potential environmental impacts from the proposal have been avoided or reduced during the options assessment and concept design process. The proposal as described in the REF best meets the proposal objectives, but would still result in some potential impacts. These would be mainly short-term and temporary, and associated with construction, including potential traffic and

access disruptions, noise and vibration impacts, potential to encounter contaminated materials and parking loss. Some vegetation removal would be required. The mitigation measures detailed in this REF would ameliorate or minimise these potential impacts. The proposal would also reduce travel times and congestion, improve safety for road users, improve driving conditions and intersection performance and provide for safe pedestrian and cyclist crossing. On balance the proposal is considered justified.

The environmental impacts of the proposal are not likely to be significant and therefore it is not necessary for an environmental impact statement to be prepared and approval sought for the proposal from the Minister for Planning under Part 5.1 of the EP&A Act. The proposal is unlikely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the TSC Act or FM Act and therefore a species impact statement is not required. The proposal is also unlikely to significantly impact Commonwealth land or any matters of national environmental significance. Therefore, a referral to the Australian Government Department of the Environment is not required under the EPBC Act.



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## 9. Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.



Sarah Viney  
Environmental Scientist  
GHD Pty Ltd  
Date: 13 November 2015



Amanda Raleigh  
Principal Environmental Planner  
GHD Pty Ltd  
Date: 13 November 2015

I have examined this review of environmental factors and the certification by GHD and accept the review of environmental factors on behalf of Roads and Maritime Services.



Deanne Forest  
Project Manager  
Roads and Maritime Services Sydney Region  
Date: 13 November 2015



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# 11. Terms and abbreviations used in this REF

Term	Definition
AADT	Average Annual Daily Traffic
ABS	Australian Bureau of Statistics
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
BoM	Bureau of Meteorology
Camden LEP	Camden Local Environmental Plan 2010
CEMP	Construction Environmental Management Plan
Clover interchange	A two-level interchange in which turns are handled by eight total ramp or slip roads, four of which form loops that give the interchange the shape of a cloverleaf from the air. Each ramp allows traffic from one direction of a roadway to access only one direction of the crossroad.
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DEWHA	Department of Environment, Water, Heritage and Arts
Diamond interchange	A diamond interchange is usually used where a freeway crosses a minor road. It involves four ramps that enter and leave the freeway at two intersections to meet the non-freeway road. In this interchange, the ramps make a diamond shape.
EIA – N04	Environmental Impact Assessment Guidance Note – Guidelines for landscape character and visual impact assessment
EPA	Environment Protection Authority
EPL	Environmental Protection License
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW). Provides the legislative framework for land use planning and development assessment in NSW.
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Australian Government). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESCP	Erosion and Sediment Control Plan
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GHD	GHD Pty Ltd
Growth Centres SEPP	State Environment Planning Policy (Sydney Region Growth Centres) 2006
ICNG	Interim Construction Noise Guideline
Interchange	A road junction that typically uses grade separation, and one or more ramps, to permit traffic on at least one road to pass through the junction without directly crossing any other traffic stream.
ISEPP	<i>State Environmental Planning Policy (Infrastructure) 2007</i>

Term	Definition
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act
Liverpool LEP	Liverpool Local Environmental Plan 2008
LoS	The level of service is the standard measure used to assess the operational performance of the network and intersections. There are six levels of service from LoS A to LoS F, with LoS A representing the best performance and LoS F the worst.
NCA	Noise Catchment Area
NCG	Noise Criteria Guideline
NMG	Noise Mitigation Guideline
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation
PAD	Potential Archaeological Deposit
PEMP	Project Environmental Management Plan
POEO Act	Protection of the Environment Operations Act 1997
Proposal site	The area that would be directly impacted by the proposal
REF	Review of environmental factors
RNP	Road Noise Policy
RTA	NSW Roads and Traffic Authority - now Roads and Maritime
RTA QA Specifications	Specifications developed by Roads and Maritime for use with roadwork and bridgework contracts let by Roads and Maritime
SA1 areas	Statistical area level 1 - The smallest level of population data collected by the Australian Bureau of Statistics
State Environmental Planning Policy	A type of planning instrument made under Part 3 of the EP&A Act
SMM	Spackman Mossop and Michaels
SREP 20	Sydney Regional Environmental Plan No. 20 – Hawkesbury Nepean River (No.2 – 1997)
Study area	The wider area surrounding the proposal site, including land that has the potential to be indirectly impacted by the proposal (for example, as a result of any noise impacts). The boundaries of the study area will differ for each specialist study.
SWMP	Soil and Water Management Plan
Trumpet interchange	A trumpet interchange allows for interchange of secondary two-way streets to a multi-lane roadway with minimal traffic mix. It takes the place of a T-intersection.
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>

## Appendices



# Appendix A Consideration of clause 228(2) factors and matters of environmental significance



## Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
<p><b>a. Any environmental impact on a community?</b></p> <p>Construction of the proposal would result in traffic and noise impacts to the local community for the duration of construction as discussed in section 6. Potential traffic impacts include an increase in the volume of heavy vehicles, disruptions to access and local traffic changes. Construction noise impacts would be managed by adopting noise management measures identified in the <i>Interim Construction Noise Guideline</i> (DECC, 2009) in order to reduce noise levels as much as practicable during construction.</p> <p>The proposal would result in property impacts as discussed in section 3.7. These include total or partial property acquisitions and changes to access arrangements for some properties. Design of the proposal has aimed to minimise these property impacts where possible and this would be further investigated during detailed design. There would be some changes to transport facilities as discussed in section 3.2.5 and 6.1.</p> <p>Long-term positive impacts would include an increase in the road capacity, improved safety and congestion for all road users.</p>	<p>Short term – minor negative</p> <p>Long term – positive</p>
<p><b>b. Any transformation of a locality?</b></p> <p>The proposal would result in the introduction of a large and visible piece of transport infrastructure in what is currently a semi-rural area. This would result in a change in the character of those properties that are directly impacted by the proposal, and a change in views from those viewpoints and properties with views to the proposal. These impacts would be more substantial in the short to medium term. As the Bringelly precinct is developed, urban densities increase, and additional roads and transport infrastructure are developed, the difference between the character of the proposal and the study area would be less.</p>	<p>Short to medium term – negative</p> <p>Long term – neutral</p>
<p><b>c. Any environmental impact on the ecosystems of the locality?</b></p> <p>Most of the proposal site (with the exception of a small section in the north-east corner) is located within the biodiversity certified land. Construction of the proposal would result in the removal of about 4.26 hectares of native vegetation and up to 17 hollow-bearing trees within biodiversity certified land.</p> <p>In relation to Part 5 activities undertaken on biodiversity certified land, sections 126I(4) and (5) of the TSC Act provide that activities are taken to be not likely to significantly affect any threatened species, population or ecological community; and a determining authority is not required to consider the effect on biodiversity values of the activity (despite section 111 of the EP&amp;A Act).</p>	<p>Neutral</p>
<p><b>d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</b></p> <p>During construction, the proposal would result in a reduction in the aesthetic quality of the locality as a result of dust generation, noise, visual and traffic movements. These impacts would be minimised through implementation of the management measures and safeguards summarised in section 7.</p>	<p>Short term – minor negative</p>

Factor	Impact
<p><b>e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</b></p> <p>The proposal would impact on six Aboriginal heritage sites as discussed in section 6.6. Four of these sites are subject to an existing AHIP.</p> <p>There are two listed non-Aboriginal heritage items, one item of local heritage significance and two potential archaeological sites near the proposal site. It is not expected that there will be any direct impact on these items or sites. This is further discussed in section 6.7.</p>	Long term negative
<p><b>f. Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?</b></p> <p>The proposal would not impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>).</p>	Nil
<p><b>g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</b></p> <p>The proposal would not endanger any species of animal, plant or other form of life.</p>	Nil
<p><b>i. Any degradation of the quality of the environment?</b></p> <p>Construction would have the potential to result in water quality, noise and air quality impacts. These potential impacts would be managed by the implementation of safeguards listed in section 7.</p>	Short term – minor negative Long term – nil
<p><b>j. Any risk to the safety of the environment?</b></p> <p>Traffic management safeguards including the preparation of a traffic management plan, would address safety risks during construction.</p> <p>The proposal would improve safety for road users during operation by reducing congestion, improved intersection performance and pedestrian/cyclist facilities.</p>	Short term – potential negative Long term – positive
<p><b>k. Any reduction in the range of beneficial uses of the environment?</b></p> <p>The proposal would not reduce the range of beneficial uses of the environment.</p>	Nil
<p><b>l. Any pollution of the environment?</b></p> <p>During construction the proposal could potentially result in minor short-term water pollution from sediments, soil nutrients, waste, and spilt fuels and chemicals. Management of water quality impacts would be undertaken in accordance with the mitigation measures outlined in sections 6.3.3 and 6.4.3.</p> <p>The proposal would result in minor short-term air pollution from plant and machinery and the generation of dust during construction.</p> <p>These potential impacts would be managed by the implementation of safeguards listed in section 7.</p>	Short term – minor negative Long term – nil
<p><b>m. Any environmental problems associated with the disposal of waste?</b></p> <p>Waste streams generated during construction are common and would pose no difficulty in their disposal. Waste would be recycled wherever possible.</p>	Nil
<p><b>n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</b></p> <p>All resources required for the proposal are readily available and are not in short supply.</p>	Nil

Factor	Impact
<p><b>o. Any cumulative environmental effect with other existing or likely future activities?</b></p> <p>Temporary potential cumulative impacts may occur as a result of construction activities occurring simultaneously with the construction of the proposed adjoining road upgrades, extension of the Bringelly Brickworks and proposed western Sydney airport.</p> <p>The long-term effect of the proposal would have a positive cumulative impact on travel times, road safety and efficiency, facilitating the anticipated increase in traffic volumes as a result of future traffic predictions and population growth.</p>	<p>Short term minor negative</p> <p>Long term – positive</p>
<p><b>p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?</b></p> <p>The proposal is not located within a coastal area. As such, the proposal would not result in any impact on coastal processes and coastal hazards.</p>	<p>Nil</p>

## Matters of national environmental significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999* the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of the Environment.

### Consideration of matters of national environmental significance

Factor	Impact
<p><b>a. Any impact on a World Heritage property?</b></p> <p>No world heritage listed properties are located within a one kilometre radius of the proposal site.</p>	<p>Nil</p>
<p><b>b. Any impact on a National Heritage place?</b></p> <p>No National Heritage places are identified within a one kilometre radius of the proposal site.</p>	<p>Nil</p>
<p><b>c. Any impact on a wetland of international importance?</b></p> <p>The proposal would not impact on a wetland of international importance. There are no wetlands of international importance within a one kilometre radius of the proposal site.</p>	<p>Nil</p>
<p><b>d. Any impact on a listed threatened species or communities?</b></p> <p>The proposal would not result in significant impacts on any threatened species or communities.</p>	<p>Refer to section 6.5</p>
<p><b>e. Any impacts on listed migratory species?</b></p> <p>The proposal is considered unlikely to impact upon migratory species due to the lack of suitable habitat in the vicinity of the proposal.</p>	<p>Refer to section 6.5</p>
<p><b>f. Any impact on a Commonwealth marine area?</b></p> <p>The proposal would not have any impact on a Commonwealth marine area.</p>	<p>Nil</p>
<p><b>g. Does the proposal involve a nuclear action (including uranium mining)?</b></p> <p>The proposal does not involve a nuclear action.</p>	<p>Nil</p>
<p><b>h. Additionally, any impact (direct or indirect) on Commonwealth land?</b></p> <p>There are five parcels of Commonwealth land located within 10 km of the proposal site.</p> <p>The proposal is not located within and would not impact Commonwealth land.</p>	<p>Nil</p>
<p><b>i. Any impact on the Great Barrier Reef Marine Park?</b></p> <p>The proposal would not impact on the Great Barrier Reef Marine Park.</p>	<p>Nil</p>
<p><b>j. Any impact on a water resource, in relation to coal seam gas development and large coal mining development?</b></p> <p>The proposal is not a coal seam gas development or large coal mining development.</p>	<p>Nil</p>



# Appendix B Information on options considered



## Analysis of options presented by the options report (Roads and Maritime, 2015)

The key issues/potential impacts associated with each option are summarised below:

### ***Option 0 – no deviation***

- Does not meet proposal objectives
- Space available for the upgrade works is constrained by existing buildings, including Bringelly Public School and Bringelly Village shops
- Impacts on existing heritage items, including impacts on Bringelly Public School.

### ***Option 1 – western route***

- Impacts on accesses to the Bringelly Brickworks and dwellings on Greendale Road
- Impacts on Bringelly Public School and Bringelly Village shops
- Impacts on community facilities, including Bringelly Recreation Reserve/Bringelly Park and the Bringelly Community Centre
- Less visual impacts than options 2, 3 and 7 as it is located away from the geographical high point
- Impacts on Aboriginal heritage items
- Crosses Thompsons Creek
- Offers benefits in terms of construction staging and constructability, particularly in relation to impact on existing traffic flows.

### ***Option 2 – eastern route 1***

- Would require a roundabout or other method of control at the existing intersection due to the its close proximity
- Visual impacts associated with the need to elevate one of the roads near the geographical high point
- Impacts on Bringelly Public School, Bringelly Village shops and services associated with the substation
- Impacts on community facilities, including Bringelly Recreation Reserve/Bringelly Park and the Bringelly Community Centre
- Noise impacts during construction for properties around the existing intersection, including the school
- Requires two crossings of Thompsons Creek
- Impacts on non-Aboriginal heritage items
- Impacts on Aboriginal heritage items
- Offers benefits in terms of construction staging and constructability, particularly in relation to impact on existing traffic flows
- The least expensive option to construct and maintain (excluding option 0).

### ***Option 3 – southern route 1***

- Traffic management issues during construction as the intersection would remain on the existing alignment of The Northern Road
- Works associated with Bringelly Road to the east of the intersection would be temporary and Bringelly Road would require further upgrading in the future
- Property access along The Northern Road would also be impacted needing additional acquisition to provide a service road with limited access onto The Northern Road
- Option 3a would isolate the section of Greendale Road between The Northern Road and the new intersection with a 600 m long retaining wall. This would also require the design and construction of the new Bringelly Road and crossing of Thompsons Creek, which is likely to require a bridge. Option 3a would also have a greater visual impact.
- There would be similar impacts for options 3b and 3c
- Impacts on the Bringelly Brickworks access
- Noise impacts during construction for properties around the existing intersection, including the school
- Impacts on Bringelly Village shops
- Impacts on Aboriginal heritage items
- Impacts on non-Aboriginal heritage items
- Crosses Thompsons Creek.

### ***Option 4 – southern route 2***

- Traffic management issues during construction as the intersection would remain on the existing alignment of The Northern Road
- Works associated with Bringelly Road to the east of the intersection would be temporary and Bringelly Road would require further upgrading in the future
- Potential for impacts to the Bringelly Brickworks
- Impacts on Aboriginal heritage items
- Impacts on non-Aboriginal heritage items
- Crosses Thompsons Creek
- Less visual impacts than options 2, 3 and 7 as this option is located away from the geographical high point.

### ***Option 5 – combination of Option 2 and 4***

- Construction of the new intersection could be undertaken offline which would reduce traffic impacts and may assist in reducing the length of the period of construction
- Requires two crossings of Thompsons Creek
- Works associated with Bringelly Road to the east of the intersection would be temporary and Bringelly Road would require further upgrading in the future
- The design requirements are similar to option 3 relating to the need for a service road and a 600 m retaining wall along Bringelly Road
- Less visual impact than options 2, 3 and 7 as this option is located away from the geographical high point
- Impacts on the access to the Bringelly Brickworks

- Impacts on Aboriginal heritage items.

#### **Option 6 – eastern route 2**

- The construction of the new intersection could be undertaken offline which would reduce traffic impacts and may assist in reducing the length of the period of construction
- There is an opportunity to tie back into The Northern Road prior to the crossing of Thompsons Creek
- The option allows some flexibility for future expansion of Bringelly Road/Greendale Road
- The bridge elevation would be lower than for options 2 and 3
- Visual impacts due to the elevation of The Northern Road. However, there would be a lower visual impact compared with options 2, 3 and 7 as this option is located further away from the geographical high point
- Impacts on Aboriginal heritage items
- Requires the least amount of vegetation clearing and has the lowest potential for ecological impacts.

#### **Option 7 – combination of Option 4 and 6**

- As the majority of the alignment is outside the existing road corridor, the impact on construction staging and constructability, particularly in relation to impact on existing traffic flows, would be limited
- Allows for offline construction and may assist in reducing the length of the construction
- This option would have a greater visual impact as the bridge would be about eight metres high and located on the geographical high point
- Impacts to the access to the Bringelly Brickworks
- Impacts on Aboriginal heritage items
- Impacts on non-Aboriginal heritage items
- Requires the largest amount of vegetation clearing
- Requires two crossings of Thompsons Creek
- The most expensive option to construct and maintain.

#### **Multi-criteria analysis of options - weightings (Roads and Maritime, 2015)**

The performance of each option against the proposal objectives and considerations detailed in section 2.4.3, were scored 0-5 (poor – excellent) with 2.5 equating to neutral (no improvement or impact). The overall purpose of the proposal is to improve the accessibility of The Northern Road and Bringelly Road to accommodate for the future traffic growth generated from the Western Sydney Priority Growth Area and South West Priority Land Release Area and minimise forecast traffic congestion within the area. All options meet this overall purpose.

A summary of the weightings applied to each option is provided in Table 11.1 below. All options met the proposal objectives, with the exception of Option 0. As such, Options 1-7 have all been allocated the same score of 5. Due to the data gaps associated with Aboriginal heritage information, the scores were divided by 2.

Table 11.1 Summary table of weightings applied to each options (taken from Table 6.17 of Roads and Maritime, 2015)

Options	Meets objectives	Land use: Zoning, property, access and utilities	Non-Aboriginal heritage	Aboriginal heritage	Ecology/ biodiversity	Water and hydrology	Noise	Visual	Cost	Total score
0	0	0	3	0.5	3	4	2.5	5	5	23
1	5	0	4	1.5	4	3	3	4	3	27.5
2	5	0	1	1	3	3	2	1	4	20
3	5	2	2	2	4	3	2	1	3	24
4	5	2	3	2	3	3	3	4	2	27
5	5	3	5	1.5	4	3	3	4	2	30.5
6	5	2	5	1	5	4	3.5	4	4	33.5
7	5	2	5	0.5	2	3	3.5	1	1	23

# Appendix C Concept design plans



# Appendix D Traffic and transport assessment



# Appendix E Noise and vibration assessment



# Appendix F Biodiversity assessment



# Appendix G Aboriginal heritage assessment



# Appendix H Non-Aboriginal heritage assessment



# Appendix I Landscape character and visual impact assessment



# Appendix J Socio-economic assessment



# Appendix K Extract from the Western Sydney Infrastructure Plan Community Consultation Report



# Appendix L ISEPP consultation



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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S Viney	A Raleigh		D Kinniburgh		13.11.15



[rms.nsw.gov.au/projects/sydney-west/bringelly-the-northern-road-upgrade/bringelly-road-interchange](https://rms.nsw.gov.au/projects/sydney-west/bringelly-the-northern-road-upgrade/bringelly-road-interchange)



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November 2015  
RMS 15.587  
ISBN: 978-1-925421-33-0