Roads and Maritime Services

The Northern Road / Bringelly Road Grade Separated Interchange

Traffic and Transport Impact Assessment

November 2015

Glossary and abbreviations

Term	Description
CTMP	Construction Traffic Management Plan
DoS	Degree of Saturation
EP&A Act	Environment Planning and Assessment Act 1979
CEMP	Construction Environmental Management Plan
IDM	Intersection Diagnostics Monitor
LGA	Local Government Area
LoS	Level of Service
Mitigation	Reduction in severity
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services
TCP	Traffic Control Plan
TfNSW	Transport for NSW
vph	Vehicles per hour
vpd	Vehicles per day
vtph	Vehicle trips per hour
vtpd	Vehicle trips per day

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1. Introduction

1.1 Overview

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 within the Western Sydney Priority Growth Area and South West Priority Land Release Area (formerly known as the South West Growth Centre), about 45 km south-west of the Sydney central business district and 12 km west of Liverpool (refer to Figure 1).

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.

This report has been prepared by GHD as part of the environmental assessment of the project. Roads and Maritime is the proponent of the proposal, and an environmental assessment in the form of a review of environmental factors (REF) is being prepared by GHD in accordance with the requirements of Part 5 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act).

This report assesses and documents the potential traffic impacts of the proposal.

1.2 Proposal outline

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 and include:

- Widening and upgrading about 400 m of Bringelly Road, between Kelvin Park Drive and Greendale Road, to provide:
  - Two 3.5 m wide traffic lanes in each direction between Kelvin Park Drive and The Northern Road/Bringelly Road interchange, with wide central medians to allow for a future third traffic lane in each direction
  - Two 3.5 m 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
- Constructing a new section of The Northern Road, to the 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, which would pass beneath Bringelly Road, would be about one kilometre long and about 50 m wide (including embankments), and would include:
  - Two 3.5 m wide traffic lanes in each direction
  - Four metre wide shoulders connecting to the on and off ramps of the interchange, allowing for the future provision of bus lanes
  - An underpass about 60 m long beneath the upgraded section of Bringelly Road

  - 2.5 m wide shoulders along The Northern Road under the interchange for a length of about one kilometre
  - A wide central median to allow construction of a future third traffic lane in each direction
- Providing a new signalised intersection on Bringelly Road over The Northern Road, with turning movements provided in all directions
- Providing 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 the bus stops on the existing The Northern Road
  - 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 for buses travelling north and south along The Northern Road at the traffic lights on Bringelly Road
- Providing three metre wide shared paths for pedestrians and cyclists
- Providing a new road connection between Robinson Road and The Northern Road via an extension of the realigned Belmore Road intersection, and building a cul-de-sac at the western end of Robinson Road
- Converting the existing section of 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.

1.3 Study area

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 (to the east of The Northern Road) and Greendale Road (to the west of The Northern Road). The study area is dominated by rural residential land uses, and also includes commercial, education, community and recreation uses. The study area is provided in Figure 1.

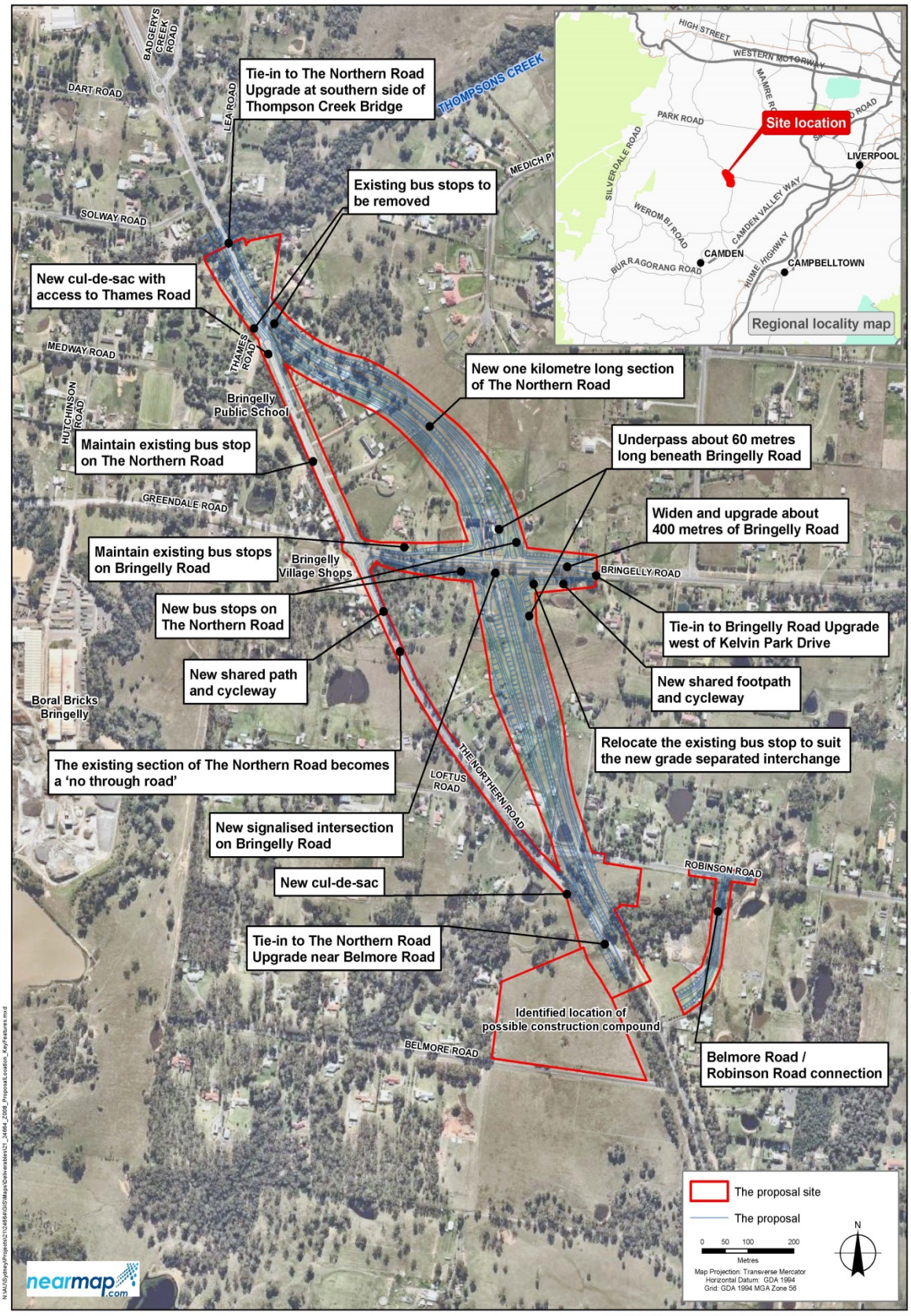


Figure 1.1 Proposal location and key features

Source: Nearmap modified by GHD

Figure 1 – Proposed location and key features

1.4 Scope of this assessment

The purpose of this report is to document the results of the assessment the potential traffic and transport impacts of the operation and construction of the proposal. The report supports the REF for the proposal. The scope of assessment included:

- Consideration of short, medium and long term planning strategies within the area in respect to land use, public transport, pedestrian, cyclists and other planned projects in the area
- Identification of the current and future travel patterns and volumes on roads within the study area
- Evaluation of the proposal in terms of intersection and network performance in relation to the desired design criteria under future traffic conditions
- Appraisal of the proposed bus priority options as part of the proposal on potential travel time improvement for public transport
- Provision of construction impact assessment.

1.5 Report structure

The report is comprised of the following sections:

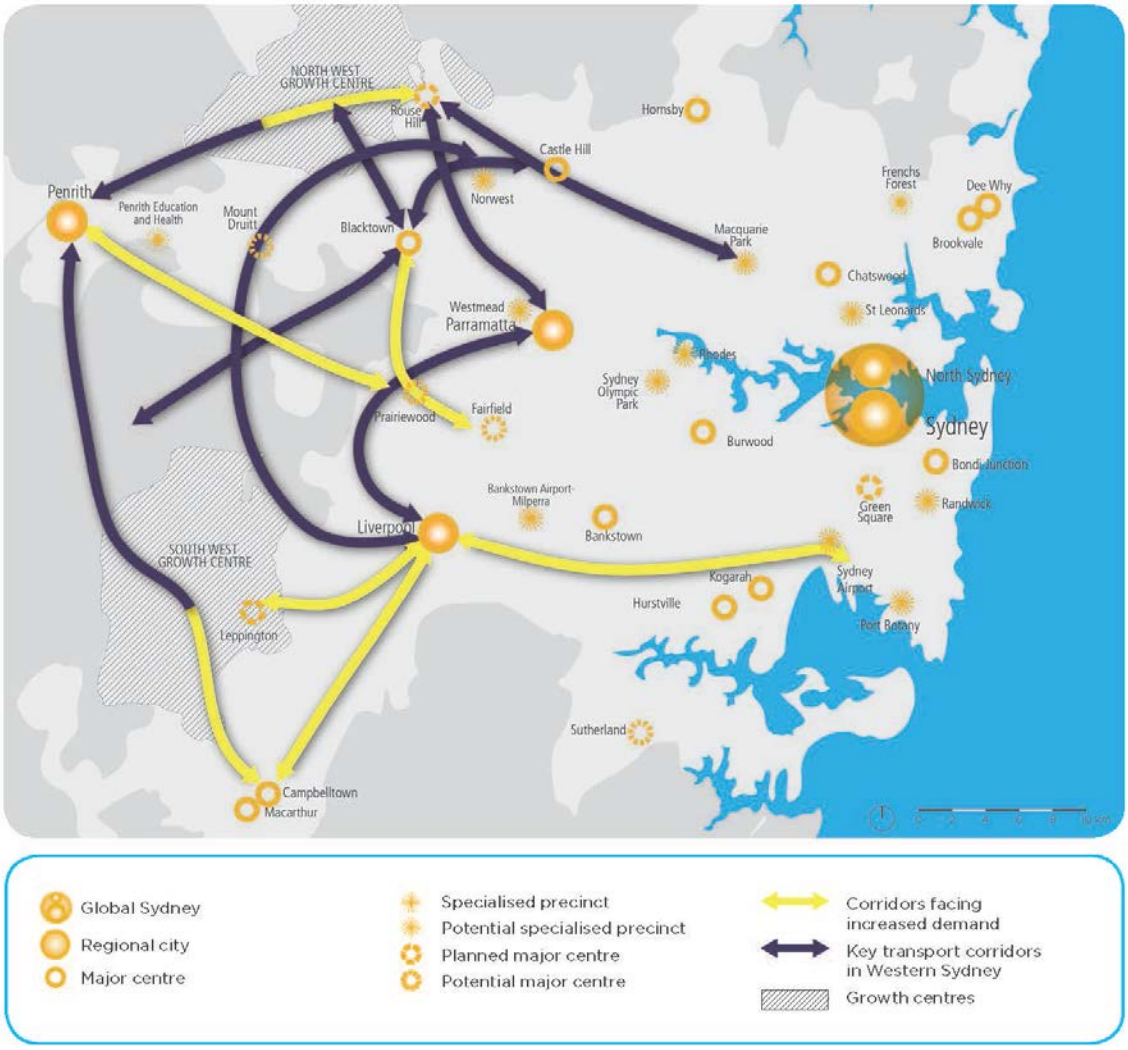
- **Section 2 – Methodology:** summaries the methods used for the assessment of the proposal including assumptions and assessment criteria
- **Section 3 – Existing conditions:** summarises the existing conditions along The Northern Road and Bringelly Road corridors and their surrounds
- **Section 4 – Planned road network improvements:** summarises the proposed improvement as part of the proposal
- **Section 5 – Construction traffic assessment** discusses the results of the traffic analysis during construction and impacts associated with the construction of the road upgrade
- **Section 6 – Operational traffic assessment:** discusses the results of the transport evaluation process and considers the impacts on the road network once operational
- **Section 7 – Recommended mitigation measures**: describes the proposed mitigation measures to limit the impacts of the proposal
- **Section 8 - Summary and conclusion:** presents a summary of the study findings and sets out the principal conclusions for the study.

1.6 Strategic context

This section provides an understanding of the strategic context of the proposal and the surrounding forecasted land use demand.

1.6.1 NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2014) identifies The Northern Road corridor as one of the corridors that will face increased demand. This is shown in Figure 2.



Source: Transport for NSW, 2014

Figure 2 – Western Sydney corridors facing increased demand

1.6.2 South West Growth Centre Structure Plan

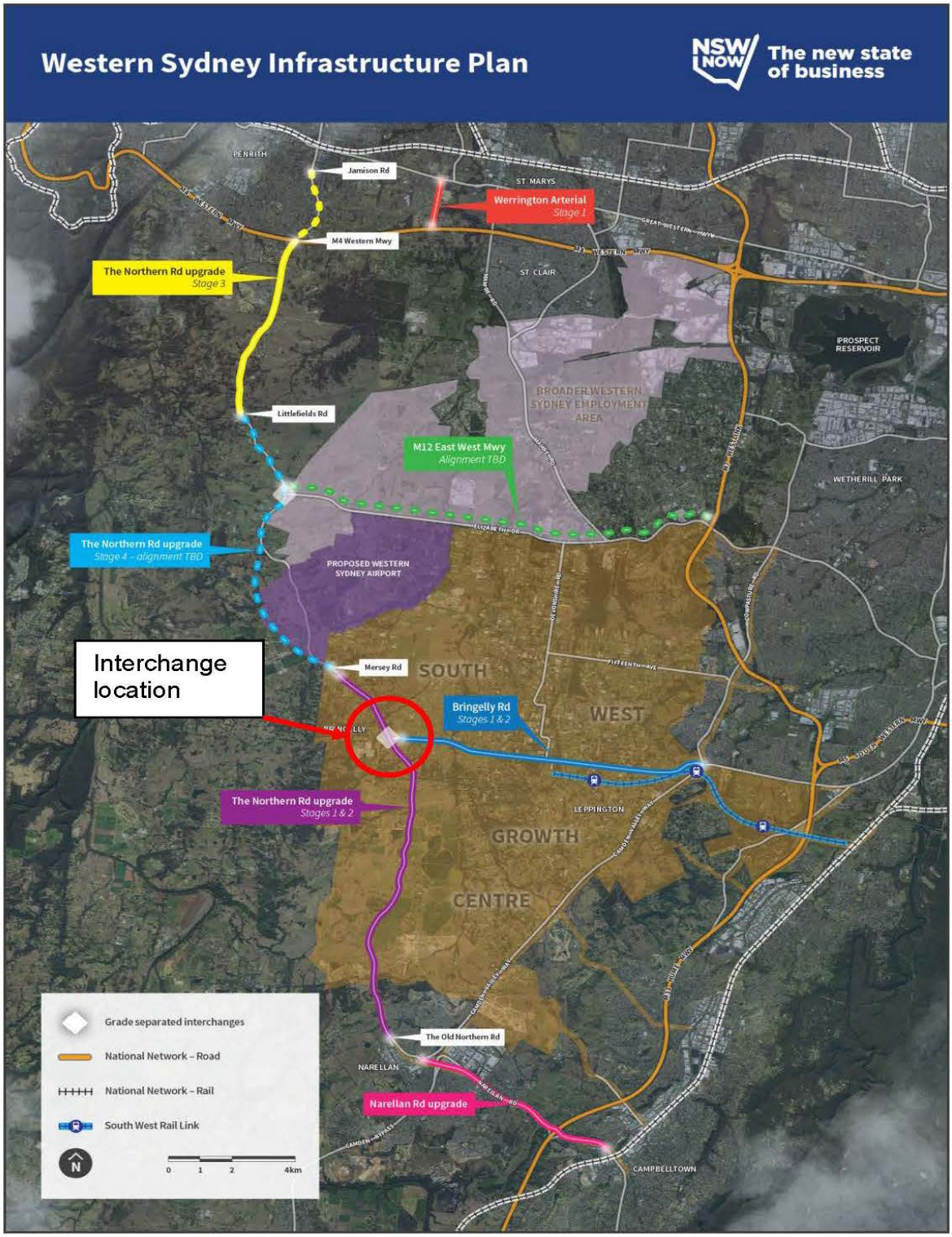
The *Structure Plan for the South West Growth Centre* was released in 2005. The structure plan provides guidance for the future planning of the growth centre and its key elements, including the location of the Leppington major centre and surrounding town and village centres. The Leppington major centre 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 '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 the substantial traffic growth predicted due to increased residential and commercial development within and around the growth area. The proposal is consistent with the structure plan, as it required in conjunction with the upgrade of The Northern Road and Bringelly Road.

1.6.3 Western Sydney Infrastructure Plan

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 million in road infrastructure improvements over the next 10 years. The proposal forms part of the Western Sydney Infrastructure Plan. This is shown in Figure 3.



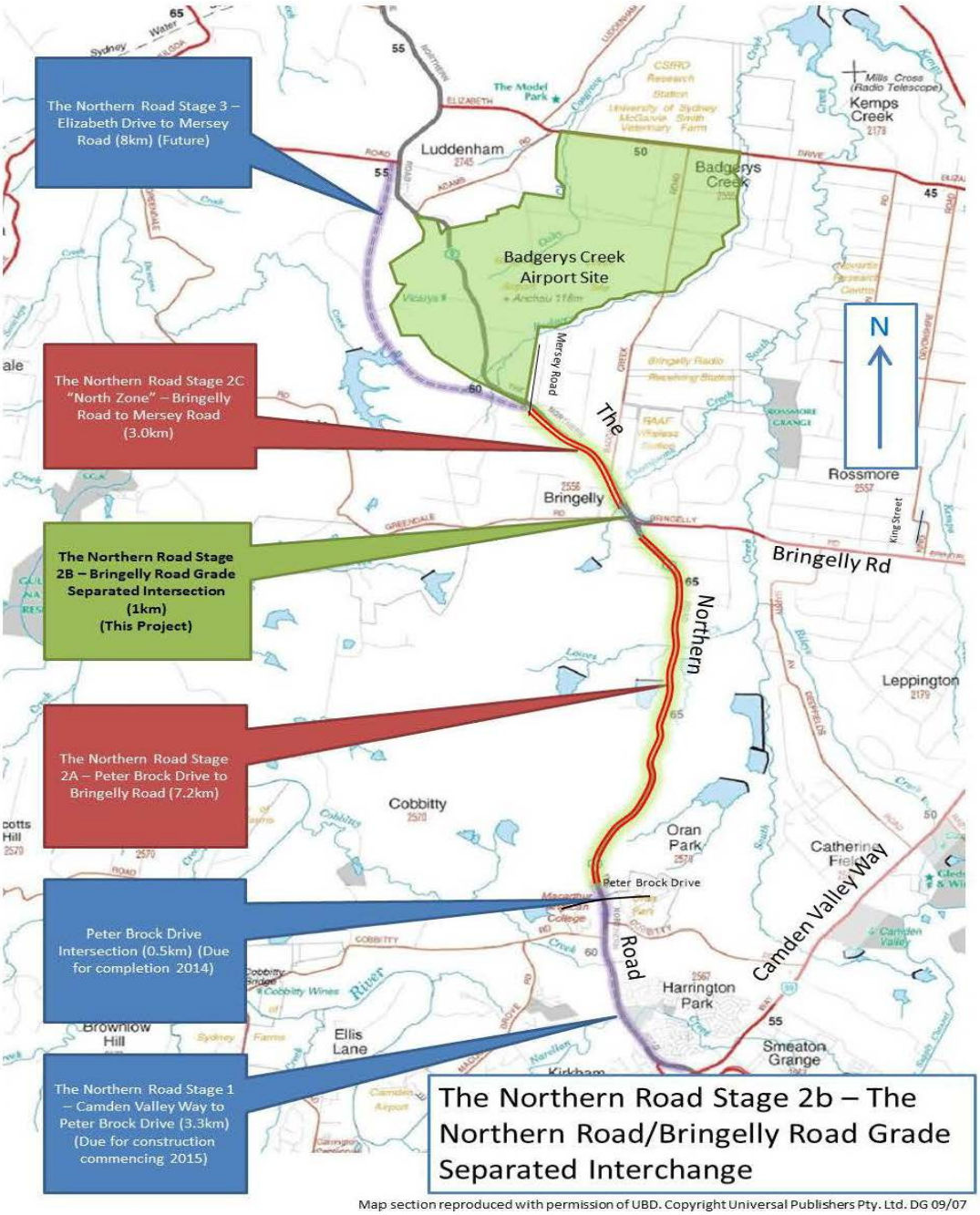
Source: Roads and Maritime, 2015

Figure 3 – Western Sydney Infrastructure Plan

1.6.4 The Northern Road Corridor Strategy

The Northern Road Corridor Strategy (Roads and Maritime, 2009) 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.

The Northern Road upgrade strategy is being delivered in stages. The stages are shown in Figure 4. The proposal forms stage 2B, upgrade of The Northern Road / Bringelly Road intersection, of the overall The Northern Road upgrade strategy, delivering on the Long Term Transport Master Plan and Western Sydney Infrastructure Plan's objectives to improve connectivity to and from the South West Growth Centre.



Source: Roads and Maritime, 2009

Figure 4 – Site locality in relation to the overall The Northern Road upgrade strategy

2. Methodology

This section provides an understanding of the study assumptions, limitations, data sources, modelling approach and land use forecasts.

2.1 Study assumptions and limitations

2.1.1 Strategic traffic modelling and land use assumptions

This report has been limited by the following assumptions regarding the strategic modelling undertaken for this report:

- Future year strategic modelling (Strategic Traffic Model 3 [STM3]) was undertaken by Transport for NSW (TfNSW)
- The STM3 models used as part of this assessment are as follows:
  - 2011_Std - Finalised version (data extracted 15/05/15)
  - 2026_WSAr02_AP_PROJ - working version run by TMA (data extracted 15/05/15)
  - 2036_WSAr02_AP_PROJ - working version run by TMA (data extracted 15/05/15)
- Intersection modelling was undertaken using the SIDRA 6.1 intersection modelling software, with future years estimated at 2016, 2019, 2029 and 2039
- Forecast traffic volumes have been extracted from the STM3. The strategic model has taken into consideration all the proposed growth centres within the Broader Western Sydney area up to the year 2039. GHD have not checked or corroborated the inputs and calculations used in the model. GHD disclaims liability arising from any of the assumptions or inputs being incorrect
- The STM3 is strategic in nature and is not intended for the forecasting of detailed turn count data. However the model includes details of proposed forecast growth in the South West Growth Centre, North West Growth Centre, Greater MacArthur Investigation Area and Western Sydney Employment Area and the proposed western Sydney airport at Badgerys Creek. This model is considered to be a reasonable source of traffic growth forecasts in the context of this study
- For opening years and horizon years that do not coincide with STM3 modelled years, extrapolation or interpolation has been used to calculate the forecast traffic volumes.

2.1.2 Intersection traffic modelling

The following assumptions / modelling decisions have been made regarding the traffic modelling undertaken for this report:

- The traffic surveys provided by Roads and Maritime were categorised into light, rigid, semi-trailer, B-double and cyclists
- Heavy vehicles were modelled as the sum of rigid and semi-trailers
- The B-double counts were modelled as large trucks in SIDRA as these are different vehicle types than light vehicles and heavy vehicles.

The peak period was calculated by the summation of all traffic movements in the intersection, for each time period. The corresponding time periods with the highest volumes were deemed as the Network Peak hours including:

- 7.00 am - 8.00 am in the AM peak period
- 4.00 pm - 5.00 pm in the PM peak period

- 10:45 am – 11:45 am in the weekend peak period.

The 2019, 2029 and 2039 traffic flows were analysed using the SIDRA program to obtain the future operation of existing The Northern Road and Bringelly Road intersection. The existing intersection layout is shown in Figure 22.

The growth in traffic is estimated using the STM 4-stage approach. The four stages were:

1. Trip generation (calculates the number of trips from and to each travel zone, based on the population and employment forecast to inhabit each zone)
2. Trip distribution (where each trip goes to or comes from)
3. Mode choice (which mode will be used to make the trip)
4. Traffic assignment (specific private vehicle route choice and public transport service choice).

2.1.3 Analysis assumptions

The Level of Service (LoS) method for vehicles uses the LoS criteria given in Table 2-2 and the Degree of Saturation (DoS) for optimisation purposes. It is based on the Roads and Maritime guidelines *Guide to Traffic Generating Developments*, 2002). This is the default method when the NSW model is used in SIDRA 6.1.

Further SIDRA modelling assumptions and overall setting are listed below:

- Lane Approach Lengths:
  - Not applicable as the intersection is being modelled as a single site
  - 500 m according to SIDRA default input.
- Volumes:
  - Turning movement volumes are taken from traffic surveys carried out on 16 June 2015 and 20 June 2015
  - During the determined network peak hour, recorded 15 minute intervals in the traffic surveys were found to be relatively linear with little discrepancy. Therefore, peak flow periods were set at 60 minutes.
- Intersection Phasing:
  - Phase sequences have been set from observed existing sequences in the Traffic Control Plan (TCS) provided by Roads and Maritime dated 1992 (TCS no 2952)
  - Timing set as optimum with an upper limit of 150 seconds and at an increment of one second
  - Performance Measures set at Degree of Saturation (DoS).
- Pedestrian Crossings:
  - Pedestrian crossing distances were automatically configured by SIDRA input of north and west approaches
  - Minimum pedestrian walking time was assumed to be eight seconds based on the Intersection Diagnostics Monitor (IDM) data.
- Pedestrian Protection:
  - Filter right and left turns give way to pedestrian crossings
  - Pedestrian protection time is determined by SIDRA when opposing pedestrian movements are detected with turning vehicles

– SIDRA determines Extra Start Loss and Saturation Flow Adjustment values automatically using a method adopted from a related method described in Highway Capacity Manual 2010, Chapter 31 (TRB 2010a).

2.1.4 Construction assumptions

For the assessment of future traffic volumes the following assumptions have been made:

- 10% of construction vehicles accessing the site in the peak hours
- 100% of workers arriving outside the AM peak and departing in the PM peak
- Minimum walk time and clearance time according to available Intersection Diagnostics Monitor (IDM) data
- Pedestrian movements in the peak hour are zero. As a result, pedestrians were modelled using default SIDRA values
- Employees cars were not considered as the traffic data shows the peak hours generally do not include the time period employees and works are travelling within the boundaries of the study area
- Light construction vehicles were distributed given traffic split proportions of the intersection.

The construction traffic is assumed to include a five per cent background traffic growth compared to base, with the additional of four light vehicles and five heavy vehicles. This is believed to be additional forecasted movements during the modelled peak periods in the construction phase.

2.2 Background traffic growth

For opening years and horizon years that do not coincide with STM3 modelled years, extrapolation or interpolation has been used to calculate the forecast traffic volumes.

Table 2-1 summarises the forecasted traffic growth percentages for the 2016, 2019, 2029 and 2039 assessment years.

Table 2-1 – Background traffic growth

Location	2016 % increase from base		2019 % increase from base		2029 % increase from base		2039 % increase from base	
	AM	PM	AM	PM	AM	PM	AM	PM
The Northern Road north of Bringelly Road	3%	5%	14%	18%	42%	55%	57%	66%
The Northern Road south of Bringelly Road	5%	6%	20%	26%	68%	82%	109%	120%
Bringelly Road east of The Northern Road	5%	6%	20%	25%	66%	82%	108%	113%
Greendale Road west of The Northern Road	4%	7%	17%	28%	83%	117%	208%	263%

Source GHD 2015 adapted from STM3 data

2.3 Assessment criteria

2.3.1 Intersection Performance

The performance of the road network is largely dependent on the operating performance of key intersections, which are critical capacity control points on the road network. SIDRA intersection modelling software has been used to assess the proposed peak hour operating performance of intersections on the surrounding road network. The criteria for evaluating the operational performance of intersections is provided by the *Guide to Traffic Generating Developments* (Roads and Maritime 2002) and reproduced in Table 2-2. The criteria for evaluating the operational performance of intersections is based on a qualitative measure (i.e. Level of Service), which is applied to each band of average vehicle delay.

Table 2-2 – Performance criteria at intersections

Level of Service (LoS)	Average Delay Per Vehicle (secs/vehicle)	Traffic Signals, Roundabout	Give-Way and Stop Signs
A	Less than 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory but accident study required
D	43 to 56	Operating near capacity	Near capacity and other accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity and requires other control mode

Notes:

a. The average delay for priority-controlled intersections is selected from the movement on the approach with the highest average delay.

b. The level of service for priority-controlled intersections is based on the highest average delay per vehicle for the most critical movement.

c. The degree of saturation is defined as the ratio of the arrival flow (demand) to the capacity of each approach.

3. Existing conditions

3.1 Overview

This section outlines the existing conditions around the site including traffic conditions on The Northern Road, Bringelly Road and Greendale Road. This includes the existing transport and accessibility conditions and the existing road network performance.

3.2 Existing road network characteristics

3.2.1 Functional road hierarchy

Roads are classified according to the functions that they perform. The main purpose of defining a road's functional class is to provide a basis for establishing the policies which guide the management of the road according to their intended service or qualities. Functional road classification involves the relative balance of the mobility and access functions.

Roads and Maritime define four levels in a typical functional road hierarchy, ranking from high mobility and low accessibility, to high accessibility and low mobility. These road classes are:

- **Arterial roads** – generally controlled by Roads and Maritime, typically no limit in flow and designed to carry vehicles long distance between regional centres
- **Sub-arterial roads** – can be managed by either council or Roads and Maritime under a joint agreement. Typically their operating capacity ranges between 10,000 and 20,000 vehicles per day, and their aim is to carry through traffic between specific areas in a sub region, or provide connectivity from arterial road routes (regional links)
- **Collector roads** – provide connectivity between local sites and the-arterial road network, and typically carry between 2,000 and 10,000 vehicles per day
- **Local roads** – provide direct access to properties and the collector road system and typically carry between 500 and 4,000 vehicles per day.

3.2.2 The Northern Road

The Northern Road is a state road under the care and control of Roads and Maritime. The Northern Road is an arterial road that connects from Narellan in the south-west through to the Great Western Highway in Penrith. The Northern Road, generally, has an undivided carriageway with one lane in each direction. In the vicinity of Bringelly, the speed limit is 60 km/h and rises to 80 km/h away from the Bringelly Township and a school zone with a posted speed limit of 40 km/h is in place along The Northern Road, Bringelly Road and Greendale Road around the Bringelly Public School. The school zone operates between 8 am – 9.30 am and 2.30 pm - 4 pm on school days. Photos of The Northern Road are shown in Figure 5, Figure 6, Figure 7 and Figure 8.

Source: GHD 2015

Figure 5 – The Northern Road / Bringelly Road intersection southern approach facing north

Source: GHD 2015

Figure 6 – The Northern Road / Bringelly Road intersection southern approach facing northeast

Source: GHD 2015

Figure 7 – The Northern Road / Bringelly Road intersection northern approach facing north

Source: GHD 2015

Figure 8 – The Northern Road / Bringelly Road intersection southern approach facing south

3.2.3 Bringelly Road

Bringelly Road is an arterial road under the care and control of Roads and Maritime which connects The Northern Road at Bringelly, through to Camden Valley Way at Horningsea Park. Bringelly Road is around 10 km in length and is an undivided carriageway with one lane in each direction, unsealed shoulders and a sign posted speed limit of 80 km/h. However, residential precincts are sign posted at 60 km/h speed limit. Rossmore Public School is located on Bringelly Road west of North Avenue. In the vicinity of the school, there is a school zone with a posted speed limit of 40 km/h. Photos of Bringelly Road are shown in Figure 9 and Figure 10 below.

The Australian and NSW governments have provided $509 million to upgrade Bringelly Road between Camden Valley Way and The Northern Road to support the development of growth centres, employment and the proposed Western Sydney Airport at Badgerys Creek.

This 10 km project will include the upgrade of Bringelly Road from two lanes 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 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.

Source: GHD 2015

Figure 9 – Bringelly Road facing west towards The Northern Road

Source: GHD 2015

Figure 10 – Bringelly Road facing east

3.2.4 Greendale Road

Greendale Road is a collector road under the care and control of Liverpool City Council, which connects from Park Road at Wallacia, through Greendale rural area to Bringelly Road and The Northern Road signalised intersection at Bringelly. Greendale Road is around 16 km in length and is an undivided carriageway with one lane in each direction with unsealed shoulders.

Greendale Road in general has a sign posted speed limit of 80 km/h with residential precincts sign posted at 60 km/h speed limit.

Photos of Greendale Road are shown in Figure 11 and Figure 12.

Source: GHD 2015

Figure 11 – Greendale Road facing east

Source: GHD 2015

Figure 12 – Greendale Road facing west

3.2.5 Robinson Road

Robinson Road is a local road of rural nature under the care and control of Camden Council. Robinson Road provides connection from The Northern Road through to Jersey Road which connects to Bringelly Road to the north and Carrington Road to the south. Robinson Road connects to The Northern Road at a give–way controlled intersection. Robinson Road is about 1.2 km in length and is an undivided carriageway with one lane in each direction with unsealed shoulders with a sealed road width of about 6 – 7 metres.

3.2.6 Jersey Road

Jersey Road is a local road of rural nature under the care and control of Camden Council. Jersey Road provides connection from Bringelly Road through to Robinson Road and Carrington Road. Jersey Road connects to Bringelly Road at a give–way controlled intersection. Jersey Road is about 1.6 km in length and is an undivided carriageway with one lane in each direction with unsealed shoulders and a sealed road width of about seven metres.

3.2.7 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 stage 2A upgrade.

3.2.8 Carrington Road

Carrington Road is a local road of rural nature under the care and control of Camden Council. Carrington Road provides a connection from The Northern Road through to Jersey Road which connects to Robinson Road and Bringelly Road to the north. Carrington Road connects to The Northern Road at an uncontrolled intersection. Carrington Road is about 850 m in length and is an undivided carriageway with one lane in each direction. It has unsealed shoulders with a sealed road width of about six metres.

3.3 Existing travel times

Existing travel times were calculated to determine the current conditions for motorists in the study area. Driver travel times were calculated based on desktop research analysis using Google Maps. The average travel times were derived by examining morning, afternoon and weekend peak periods.

The average travel times were examined for the following:

- From Badgerys Creek to:
  - Robinson Road
  - Medway Road
  - Jersey Road
- From Jersey Road to:
  - Robinson Road
  - Medway Road
  - Badgerys Creek Road

- Robinson Road to:
  - Medway Road
  - Badgerys Creek Road
  - Jersey Road

The results indicated that the average travel times in minutes for the sections examined above resulted in about three minutes each. The travel time calculation maps are shown in Appendix A.

3.4 Existing daily and peak hour traffic volumes

This section provides an understanding of current traffic volumes on the road network surrounding the proposal.

3.4.1 Traffic queue lengths

The average traffic queue lengths shown in Table 3-1 were observed at the intersection on 15 July 2015 between 5.45-6.45 pm and on 16 July 2015 between 8.15–9.15 am. The observations were used to give an indication of the intersection performance. The traffic vehicles predominantly comprised of light vehicles with occasional heavy vehicles.

Table 3-1 – Traffic queue lengths

Road names	Traffic queue lengths (vehicles)	
	AM peak	PM peak
The Northern Road north	10	13
The Northern Road south	6	8
Bringelly Road	3	11
Greendale Road	2	2

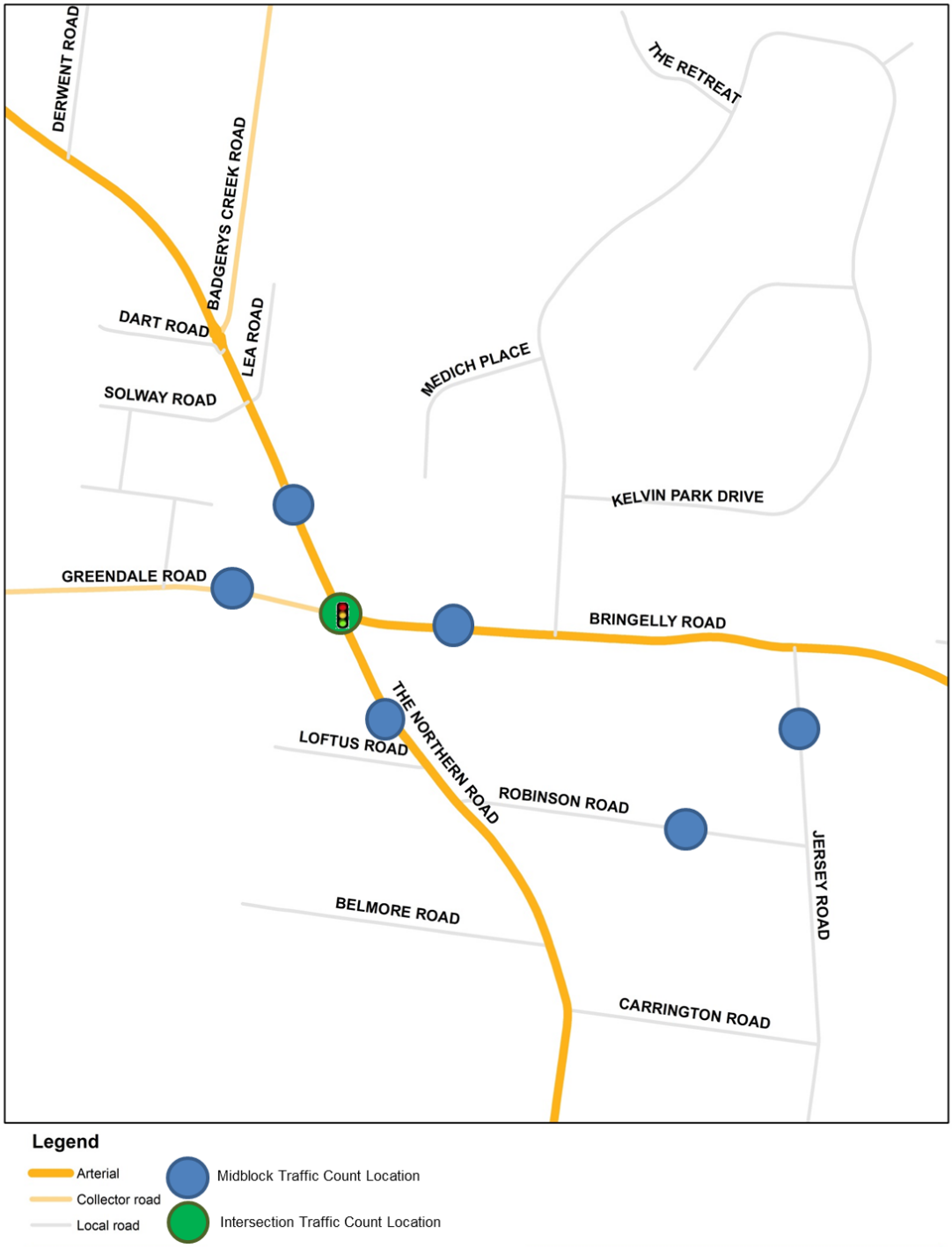
Source: GHD 2015

3.4.2 Intersection and mid-block traffic counts

Roads and Maritime commissioned Skyhigh Traffic Data Australia Pty Ltd (Skyhigh) to undertake intersection traffic surveys and seven day Automatic Traffic Counts (ATC) to obtain an understanding of the current peak and daily traffic volume characteristics. Additional ATC surveys were undertaken by TTM in July 2015 on Robinson Road and Jersey Road.

The intersection traffic surveys were carried out on Tuesday 16 June 2015 and Saturday 20 June 2015 between 6 am and 7 pm to reflect the intersection traffic behaviour. The weekday peak hour periods were identified between 7-8 am for the morning peak and between 4-5 pm for the afternoon peak, while the weekend peak hour period was recorded between 10.45 am-11.45 am.

The traffic count locations are shown in Figure 13.



Source: GHD 2015

Figure 13 – Traffic count locations

The mid-block seven day traffic counts were undertaken between 16 and 22 June 2015. These flows are summarised in Table 3-2 and the traffic flow behaviours patterns are shown in Figure 14 to Figure 21.

The weekday and weekend mid-block traffic patterns recorded by Skyhigh for The Northern Road north of Bringelly Road are shown in Figure 14 and Figure 15. Full traffic volume counts are shown in Appendix B.

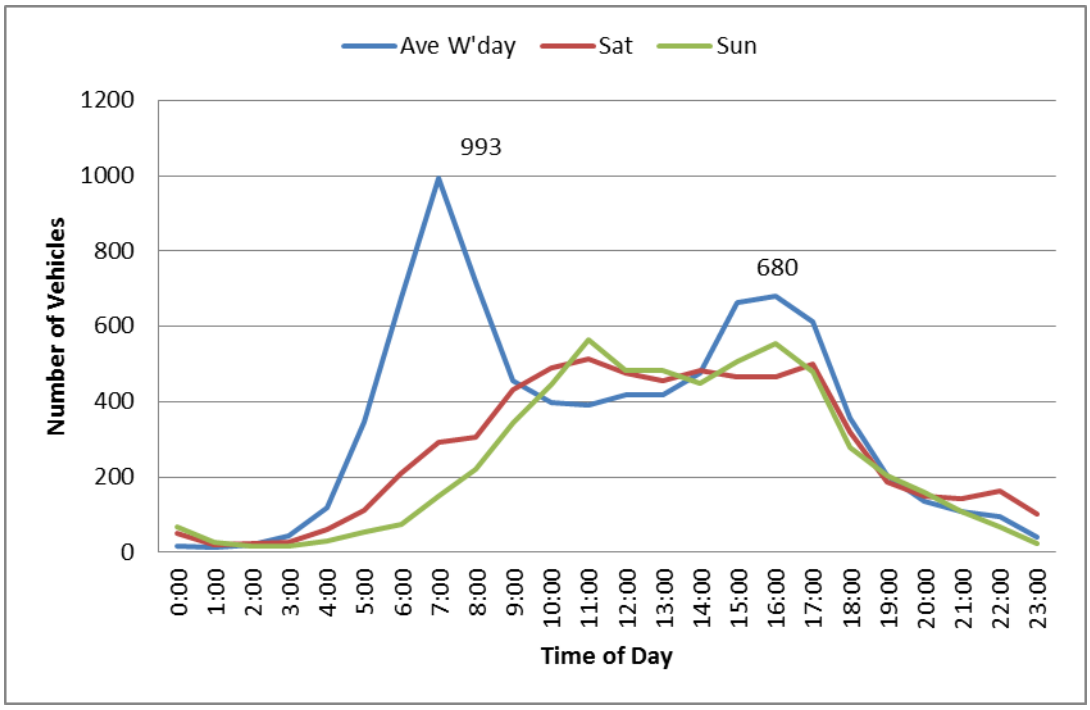
Table 3-2 – Surveyed traffic volumes per day– 2015

Road Leg	Direction	Weekdays Average (vpd)*	Saturdays Average (vpd)*
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

Source: GHD 2015 adapted from Skyhigh and TTM traffic data

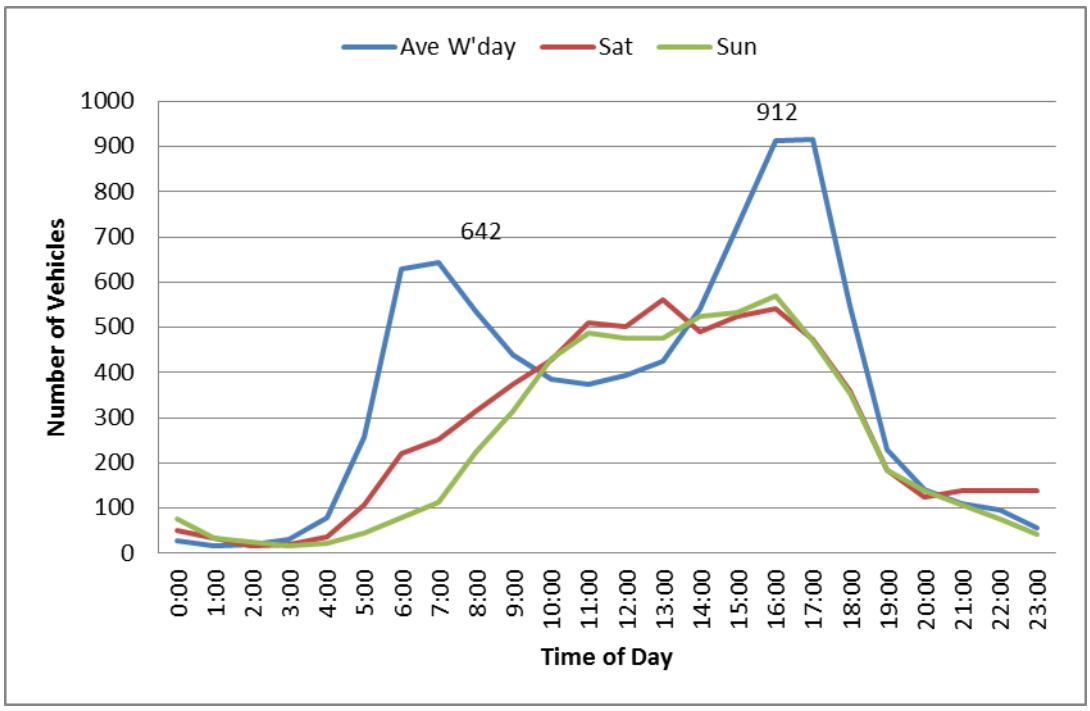
*Notes: *. vpd = vehicles per day*

Based on the existing traffic volumes shown in Table 3-2, all roads within the study area are within the expected functional classification as outlined in Section 3.2.1.



Source: GHD 2015 adapted from Skyhigh traffic data

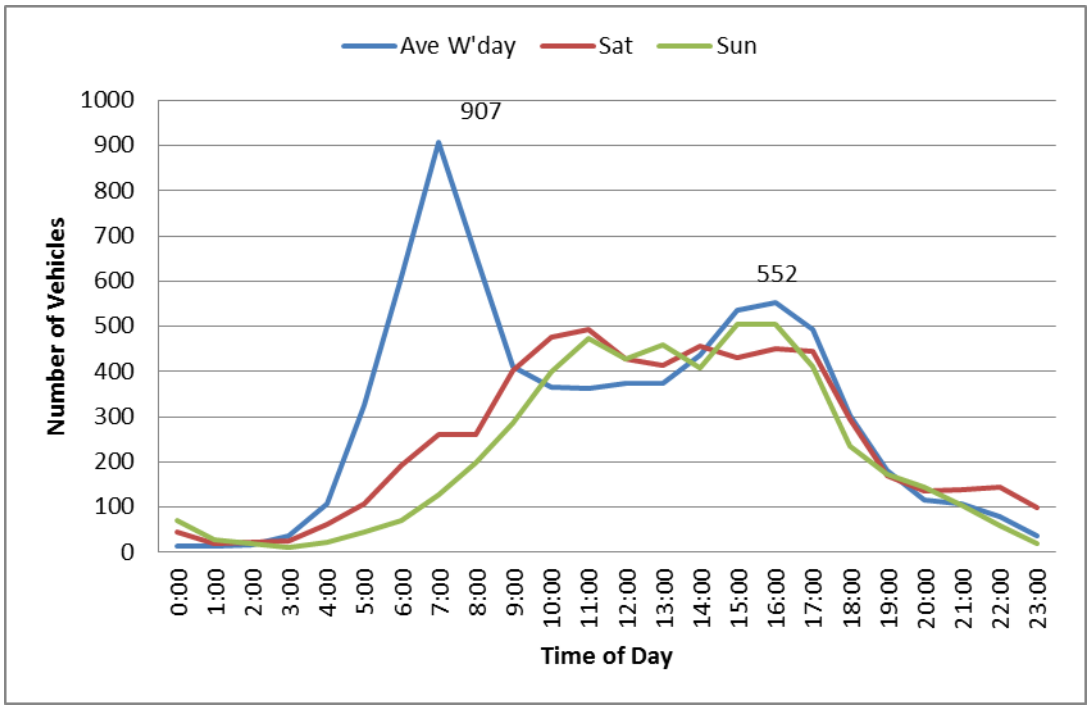
Figure 14 – The Northern Road north of Bringelly Road – Northbound



Source: GHD 2015 adapted from Skyhigh traffic data

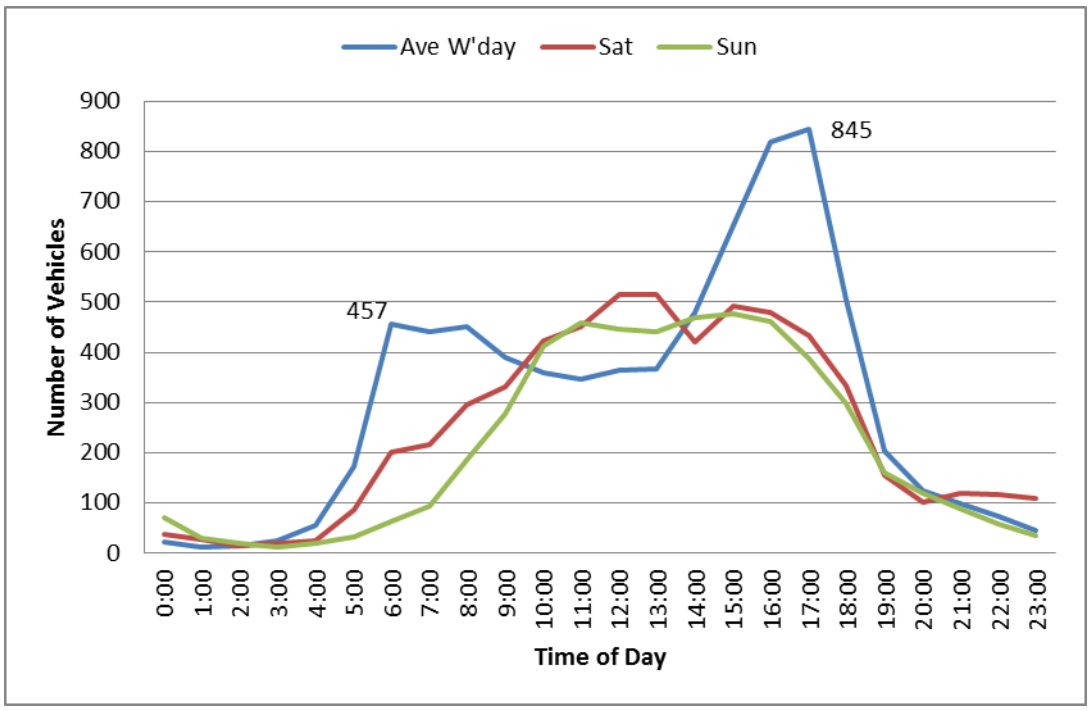
Figure 15 – The Northern Road north of Bringelly Road – Southbound

The weekday and weekend mid-block traffic counts recorded by Skyhigh for The Northern Road south of Bringelly Road are shown in Figure 16 and Figure 17 respectively.



Source: GHD 2015 adapted from Skyhigh traffic data

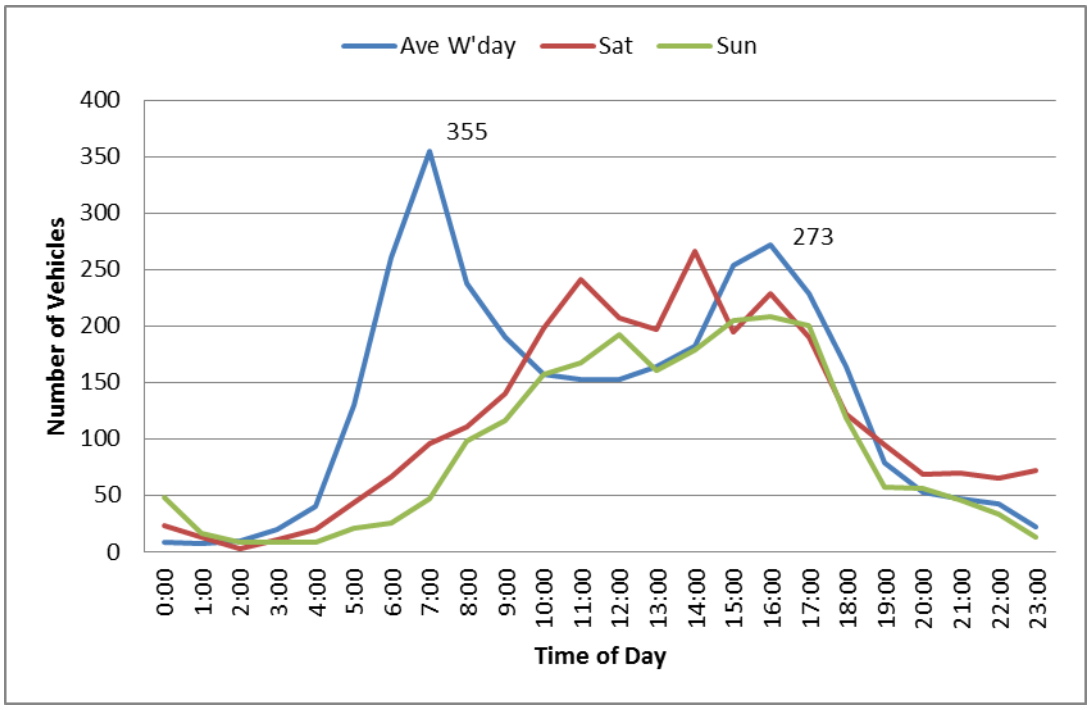
Figure 16 – The Northern Road south of Bringelly Road - Northbound



Source: GHD 2015 adapted from Skyhigh traffic data

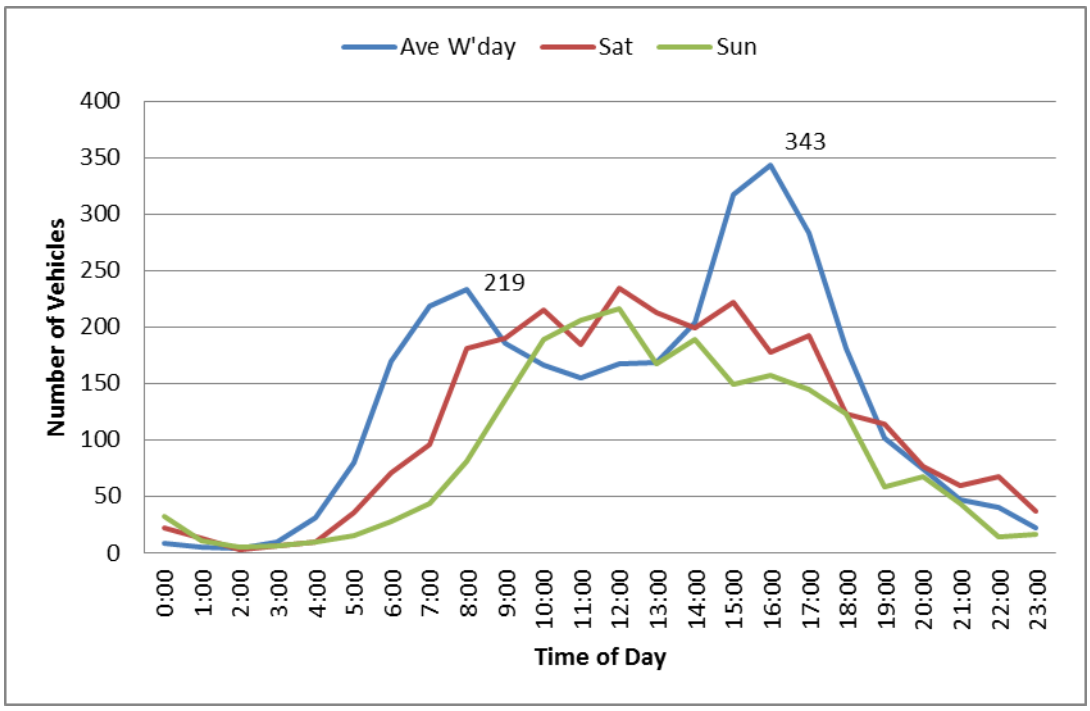
Figure 17 – The Northern Road south of Bringelly Road - Southbound

The weekday and weekend mid-block traffic counts recorded by Skyhigh for Bringelly Road east of The Northern Road are shown in Figure 18 and Figure 19 respectively.



Source: GHD 2015 adapted from Skyhigh traffic data

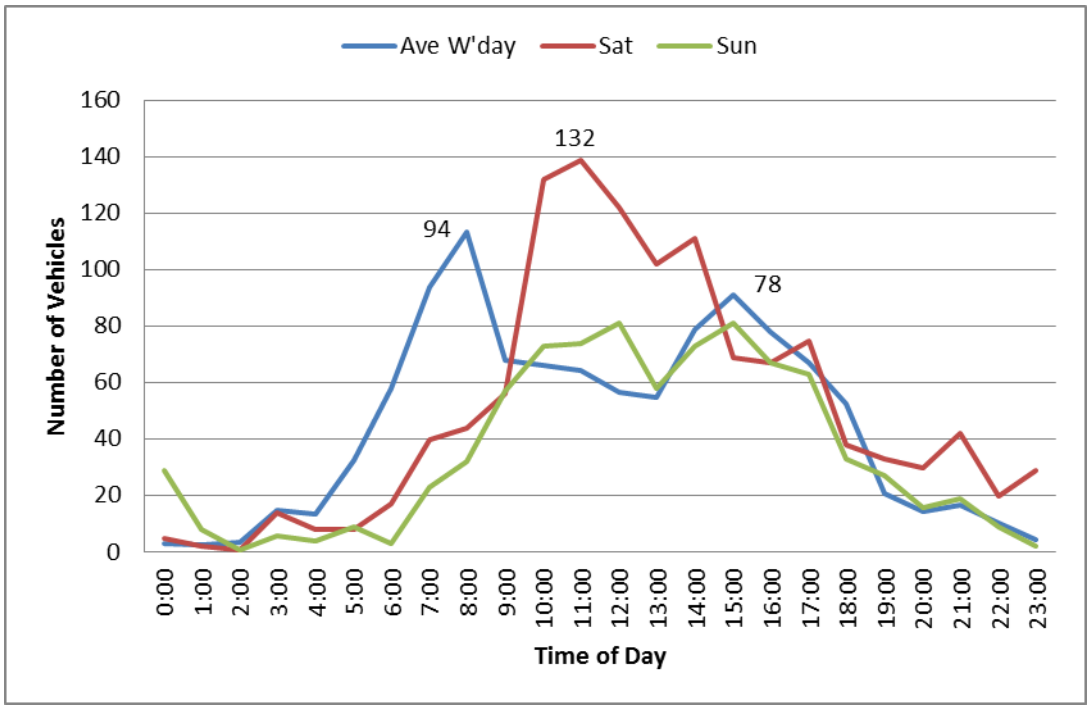
Figure 18 – Bringelly Road east of The Northern Road - Eastbound



Source: GHD 2015 adapted from Skyhigh traffic data

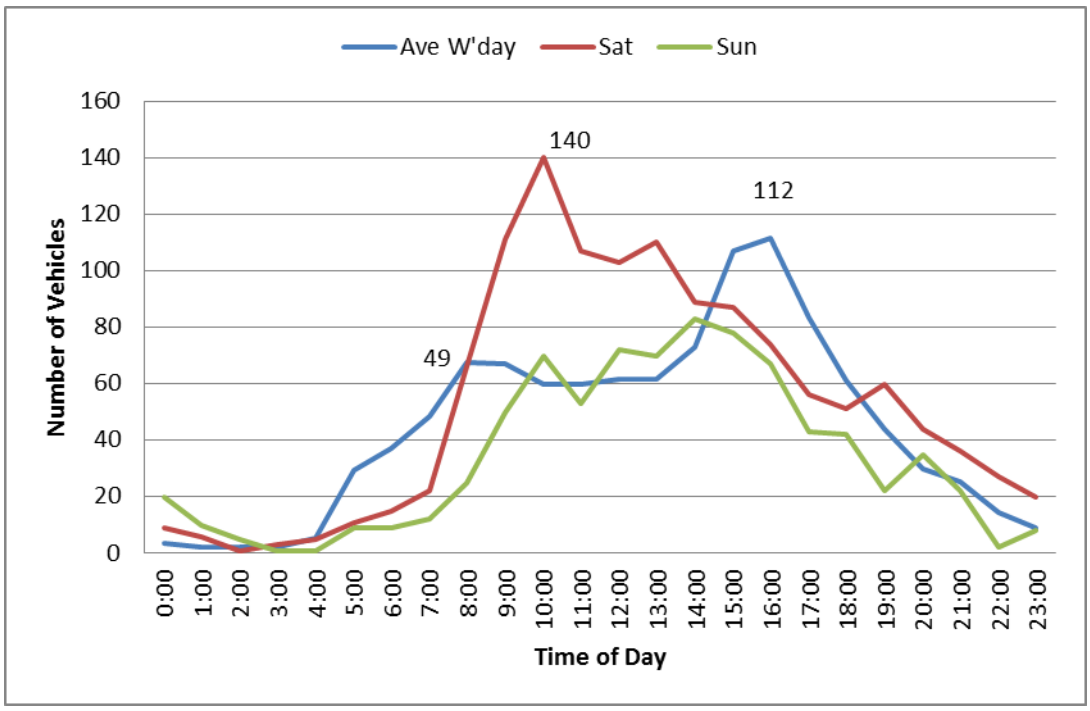
Figure 19 – Bringelly Road east of the Northern Road - Westbound

The weekday and weekend mid-block traffic counts recorded by Skyhigh for Greendale Road west The Northern Road are shown in Figure 20 and Figure 21 respectively.



Source: GHD 2015 adapted from Skyhigh traffic data

Figure 20 – Greendale Road west of The Northern Road, Eastbound



Source: GHD 2015 adapted from Skyhigh traffic data

Figure 21 – Greendale Road west of The Northern Road, Westbound

3.4.3 Peak hour traffic volumes

Table 3-3 outlines the existing peak hour traffic volumes and the heavy vehicle percentages.

Table 3-3 – Peak hour – volumes and proportion - 2015

Road section	AM peak (7.00-8.00 am)		PM peak (4.00 – 5.00 pm)		Saturday peak (11.00 – 12.00 pm)	
	Total vehicles (vph)**	HCV* (%)	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%

Source: GHD adapted from Skyhigh traffic data

Note:

1. HCV – heavy commercial vehicles*

*2.** (vph) = vehicles per hour.*

The intersection traffic survey data is provided in Appendix B.

3.5 Intersection capacity assessments

3.5.1 Intersection assessment criteria

The LoS is the standard measure used to understand the operational performance of the network and intersections. This is defined as the qualitative assessment of the quantitative effect of factors such as speed, traffic volume, geometric features, delays and freedom of movement. The level of service concept is applied to intersections through measures of effectiveness, as summarised in Table 3-4.

Table 3-4 – Measures of effectiveness for level of service definition for intersections

Intersection Control	Measure of Effectiveness
Priority controlled	Degree of Saturation Delay to critical movements (sec/vehicle) Queue length for critical movements
Traffic signals	Average Delay (sec/vehicle) Delay to critical movements Degree of Saturation Cycle Length Queue length for critical movements
Roundabout	Average Delay (sec/vehicle) Delay to critical movements Degree of Saturation Queue length for critical movements

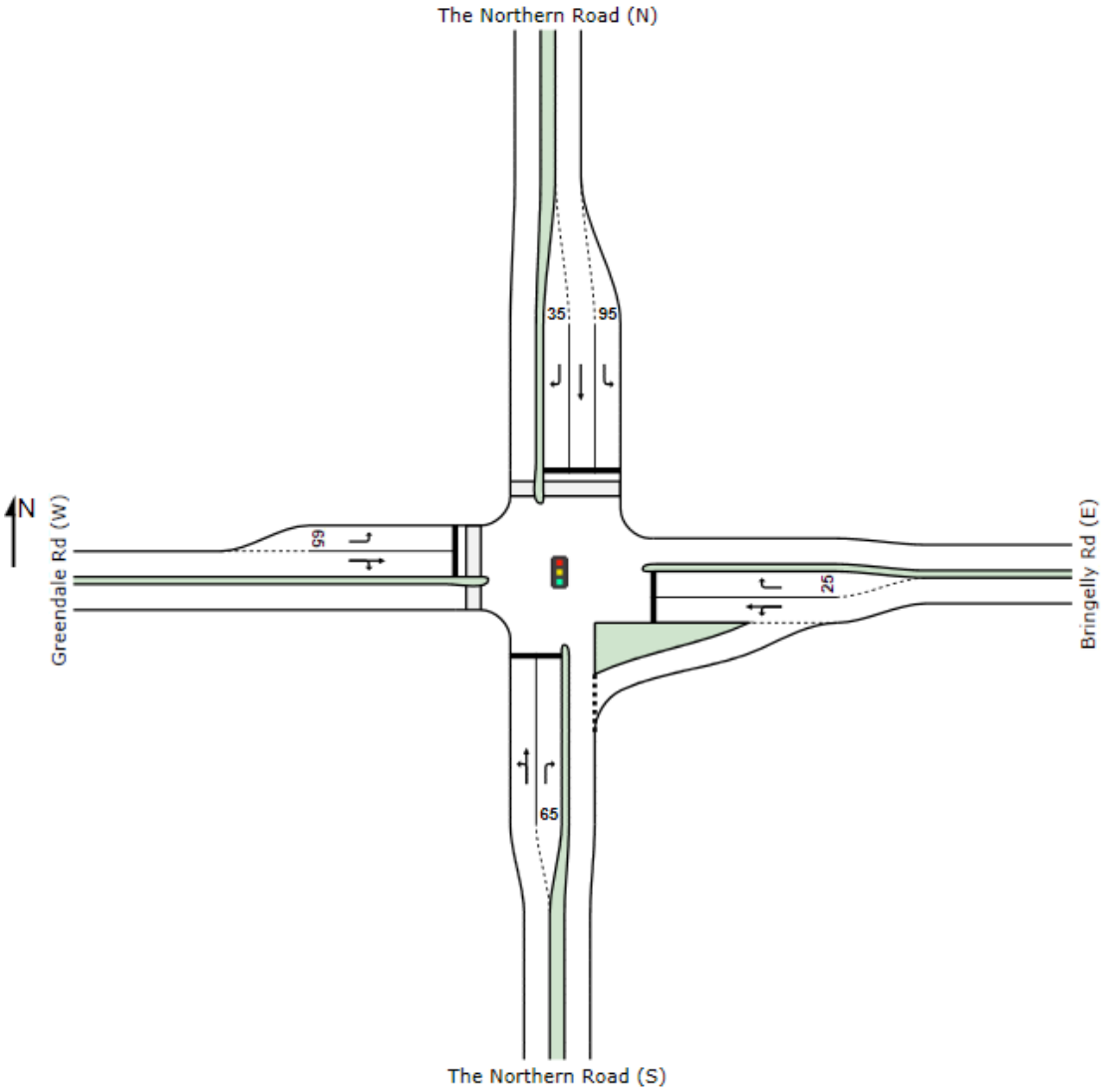
The assessment of intersection operation is based on criteria outlined in Table 2-2 as defined by the *Guide to Traffic Generating Developments* (Roads and Maritime 2002). The operational performance of intersections has been assessed using SIDRA. The LoS 'C' is generally an accepted operating condition along urban roads.

3.5.2 Intersection capacity

The 2015 traffic flows were analysed using SIDRA to obtain the current operation of The Northern Road and Bringelly Road intersection. The existing intersection layout is shown in Figure 22 and the results of the SIDRA assessment are summarised in Table 3-5. The SIDRA outputs are provided in Appendix C.

Table 3-5 – SIDRA results – 2015 existing base traffic flows

Year	Priority Type	AM peak				PM peak			
		LoS	Average Delay (s)	Queue	Degree of Saturation	LoS	Average Delay (s)	Queue	Degree of Saturation
2015	Signals	C	33	388 (S)	0.862	C	41	309(N)	1.014



Source: GHD 2015

Figure 22 – Existing intersection layout (2015)

Table 3-5 indicates that the existing intersection of The Northern Road and Bringelly Road currently operates satisfactorily at LoS C in both the AM and PM peaks. Although the operation of the intersection overall is satisfactory the results show substantial queue lengths. Table 3-6 provides an understanding of the 'through movement' queues that obstruct access to the right turn bay therefore delaying the right turning traffic movements during peak periods.

Table 3-6 – Through movement queues - 2015

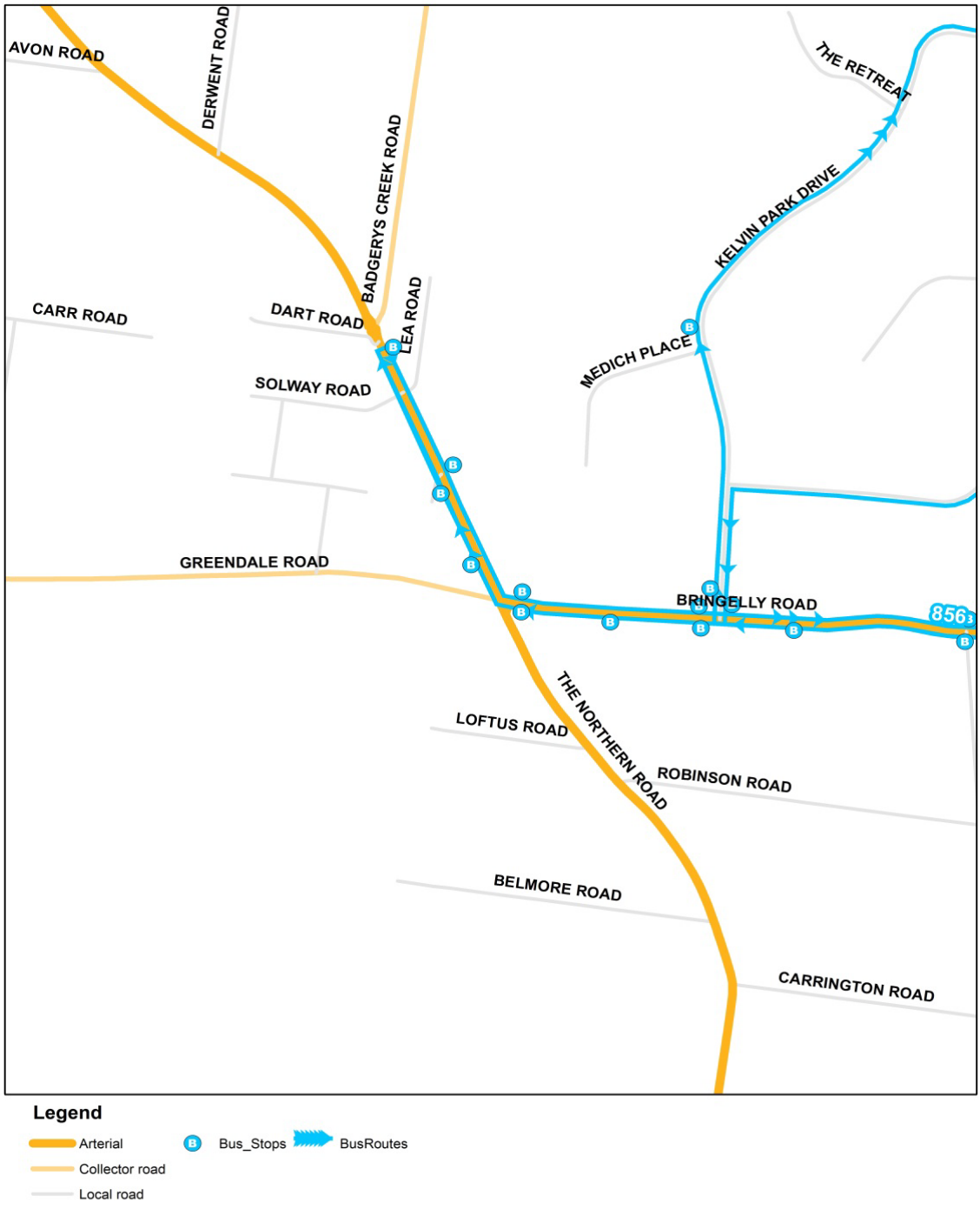
Year	Approach	Peak	Queue Length	Bay Length	Notes
2015	South	AM	388 m	R - 65 m	At times, it will block the right turning traffic from entering the turning bay
	North	PM	309 m	L - 95 m R - 35 m	At times, it will block the left turning traffic from entering the turning bay

Source: SIDRA analysis 2015

3.6 Public transport

3.6.1 Buses

One bus route operates through the intersection of The Northern Road, Bringelly Road and Greendale Road (route 856). Bus stops are located on Bringelly Road and The Northern Road within the study area. A map providing existing bus stop locations is provided in Figure 23 and the service frequency is provided in Table 3-7. For modelling purposes, only one bus in each direction was considered according to the 2015 bus route timetables. Existing weekday bus timetables for route 856 are provided in Appendix D.



Source: GHD 2015

Figure 23 – Bus route 856 map

Table 3-7 – Bus service frequency

Route	Service	Via	Service Frequency	
			Weekday	Saturday
856	Bringelly to Liverpool	Prestons and Churchill Gardens	45 mins to 3 hours 35 mins	3 hrs
856	Liverpool to Bringelly	Churchill Gardens and Prestons	2.5 – 3.5 hours	2-3 hrs

Source: Transport for NSW 856 Bus Timetable

3.6.2 School bus services

School bus services operate in the area to both Bringelly Public School and Rossmore Primary School before and after school. Table 3-8 and Table 3-9 provide an understanding of the bus routes and associated operating times.

Table 3-8 – Bringelly Public School bus services

Route	From /To	Time	Bus routes
852	Rossmore Bringelly	8:32am	EX ROSSMORE PUBLIC SCHOOL Bringelly Rd – Via Bringelly, L Jersey, R Carrington, R The Northern Rd, (Dwyer & The Northern Rds 0842) L Dwyer, L Findley (North), complete loop, L Dwyer, L Greendale, L The Northern Rd to School 08.50.
1014	Bringelly Badgerys Creek	7:55am	EX THE NORTHERN RD & MERSEY RD – Via L The Northern Rd, L Badgerys Creek Rd to (Badgerys Creek Post Office 0805) turns around and returns via Badgerys Creek Rd, L The Northern Rd, L Bringelly Rd, (Kelvin Park Dr & Bringelly Rd 0814) L Kelvin Park Dr complete loop clockwise back to Bringelly Rd, R The Northern Rd to School 08.27.
2017	Bringelly Badgerys Creek	3:05pm	EX BRINGELLY PUBLIC SCHOOL – Via The Northern Rd, R Badgerys Creek Rd to Badgerys Creek Post Office, turns around and returns via Badgerys Creek Rd, L The Northern Rd, L Carrington, L Jersey, L Bringelly Rd, R Kelvin Park Dr, complete loop clockwise, L Bringelly Rd, L North, R Wynyard, L King, L Devonshire (Fifteenth Ave & Devonshire Rd 1544).
2076	Bringelly Badgerys Creek	3:05pm	EX BRINGELLY PUBLIC SCHOOL – Via The Northern Rd, R Derwent to Shannon Rd turns around and returns via Derwent, R The Northern Rd, L Dwyer, L Findley (North), L Dwyer, R Greendale Rd to University Farm gate, turns around and returns via Greendale Rd, L The Northern Rd to Mersey Rd 15.18.

Source: http://www.interlinebus.com.au/school.html

Table 3-9 – Rossmore Primary School bus services

Route	From /To	Time	Bus routes
1010	Rossmore	8:48am	EX BRINGELLY RD & ALLENBY RD – Via Allenby, L Rossmore Cr, L Polo, L McCann, R Allenby, L Bringelly Rd, R Church, L Rossmore Ave, R May, R Wynyard, L Ramsay, R Emmetts Farm Rd to Good Sir Cl, turn around & return via Emmetts Farm Rd, L Ramsay, L Wynyard, R King, R Bringelly Rd to Rossmore Public School 0908.
2041	Rossmore	3:44pm	TO BRINGELLY RD & KELLY ST – Bringelly Rd, L Allenby, L Rossmore Rd, L Polo, L McCann, R Allenby, R Bringelly Rd, L King, L Wynyard, May, L Belfield, L North , L Wynyard, R Ramsay, R Emmetts Farm to Good Sir Cl, turn around and return via Emmetts Farm, R Ramsay, R Fifteenth, R Fourth, R Tenth, L Kelly (Bringelly Rd & Kelly St 1622).

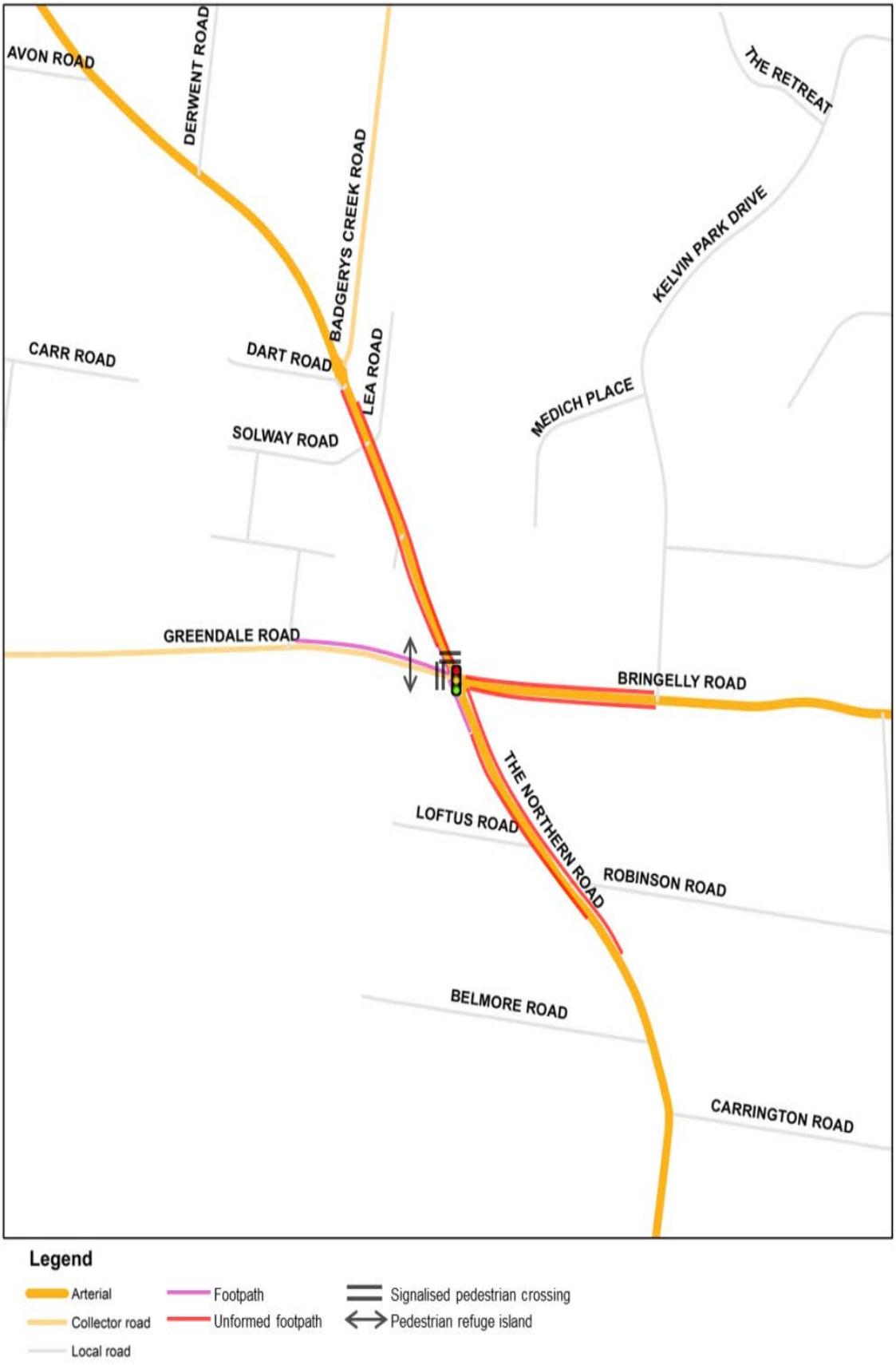
Source: Interlinebus school website

3.7 Pedestrian and cyclist access

Marked pedestrian crossings (signalised) are currently provided on the northern and western legs of the signalised intersection at The Northern Road, Bringelly Road and Greendale Road. A pedestrian refuge is located on Greendale Road, just west of The Northern Road, to assist pedestrians crossing to and from Bringelly Public School.

Sealed 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.

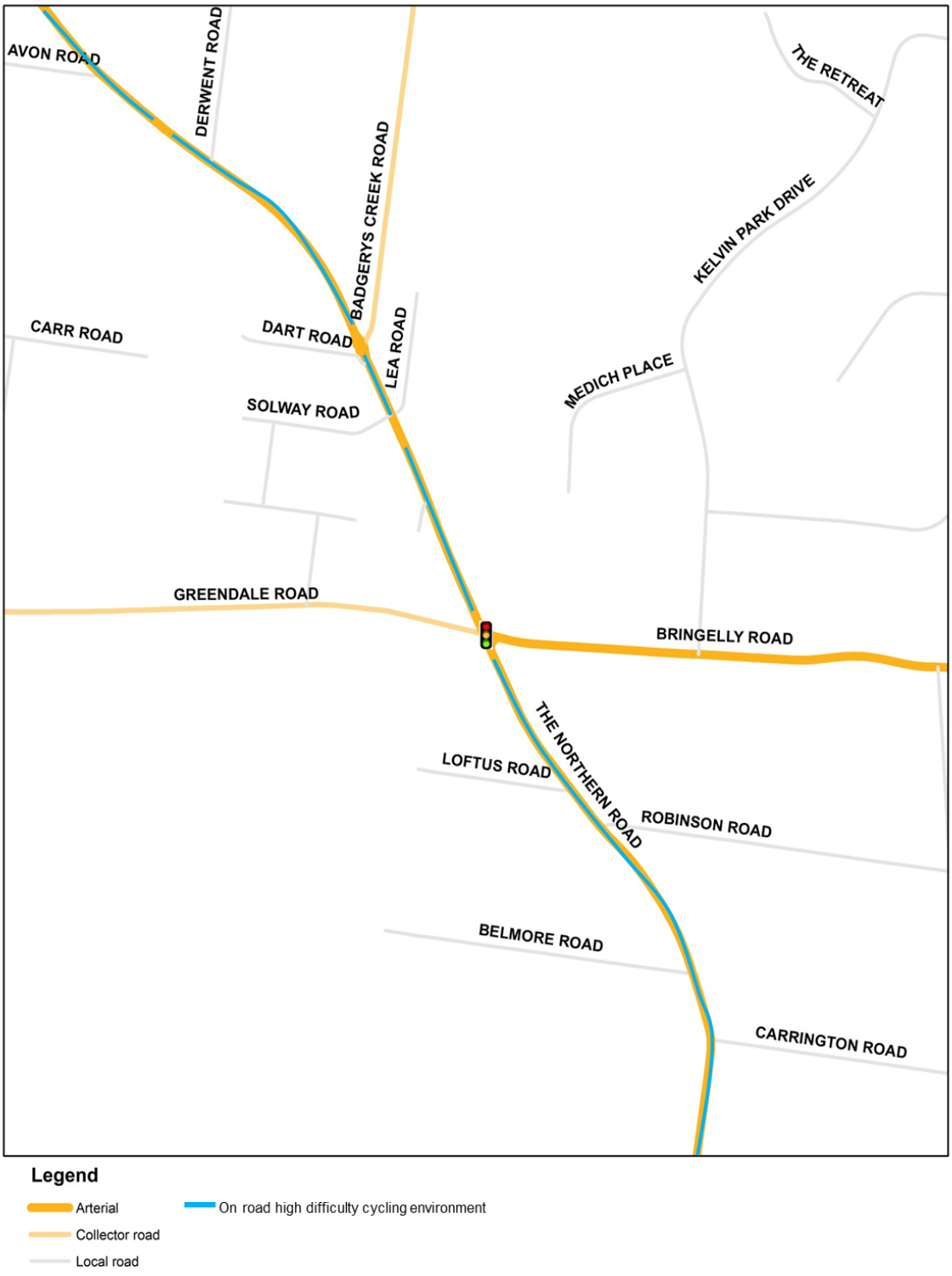
Existing pedestrian crossings are shown in Figure 24.



Source: GHD 2015

Figure 24 – Existing pedestrian facilities

There are no dedicated cycling facilities in the study area. Cyclists can travel within The Northern Road shoulder lanes which have been classified as a 'high difficulty' on-road environment according to the online *Roads and Maritime Cycleway Finder (http://www.rms.nsw.gov.au/roads/using-roads/bicycles/cyclewayfinder/index.html)*. It was noted that across several sections, cyclists would need to ride in the road carriageway, particularly at intersections and creek crossings. Existing cycling conditions are shown in Figure 25.

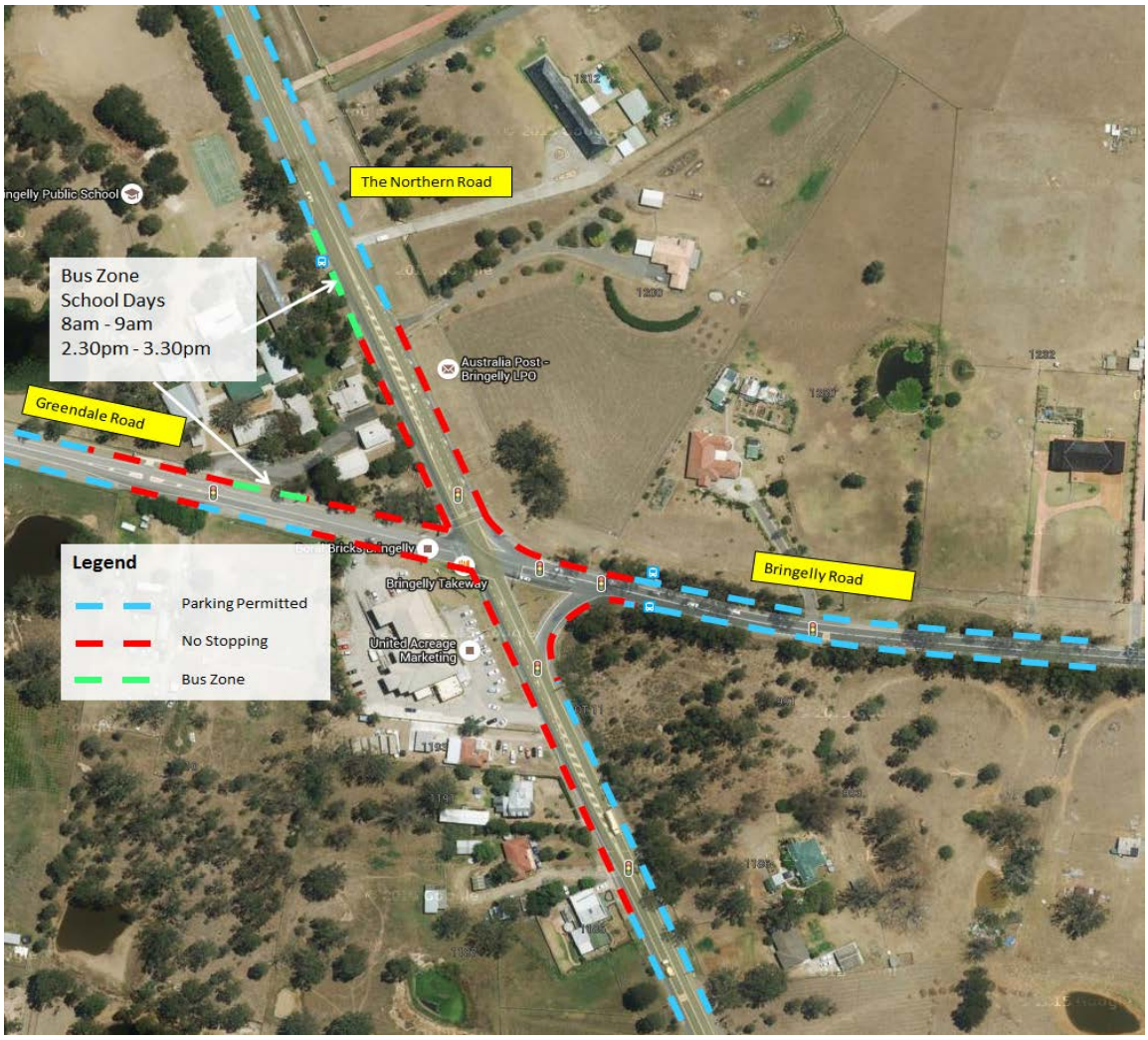


Source: Roads and Maritime cycleway finder (online) modified by GHD

Figure 25 – Existing on-road cycling

3.8 Parking

Parking was investigated within the study area. Figure 26 illustrates the 'no stopping' restrictions and school day bus zones. Kerbside parking is permitted at other locations. There are number of private car spaces available at the front and back of the Bringelly village shops on the south western corner of The Northern Road and Greendale Road.



Source: GHD 2015

Figure 26 – Parking map

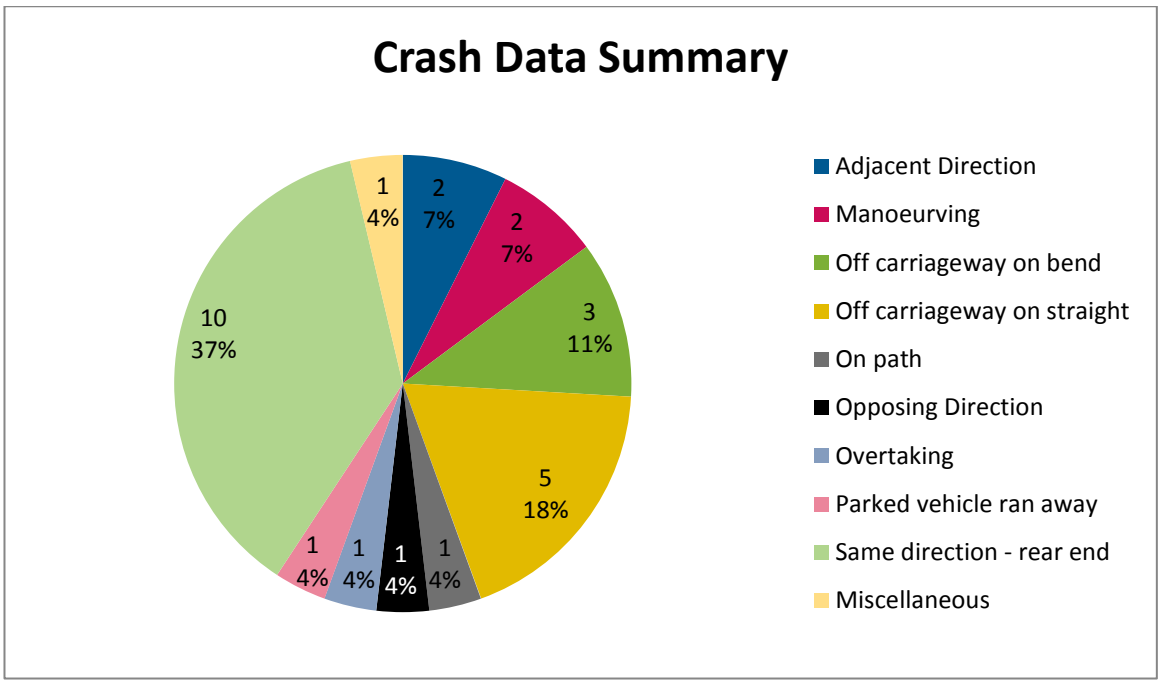
3.9 Crash analysis

Transport for NSW has provided five years of crash data between July 2009 and June 2014 for a one kilometre distance along each approach of The Northern Road / Bringelly Road intersection. This crash data was used to determine crash trends and the likely causes of crashes. Detailed crash reports are provided in 0.

A total of 27 crashes were reported within the study area:

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

A summary of the crash data is shown in Figure 27.



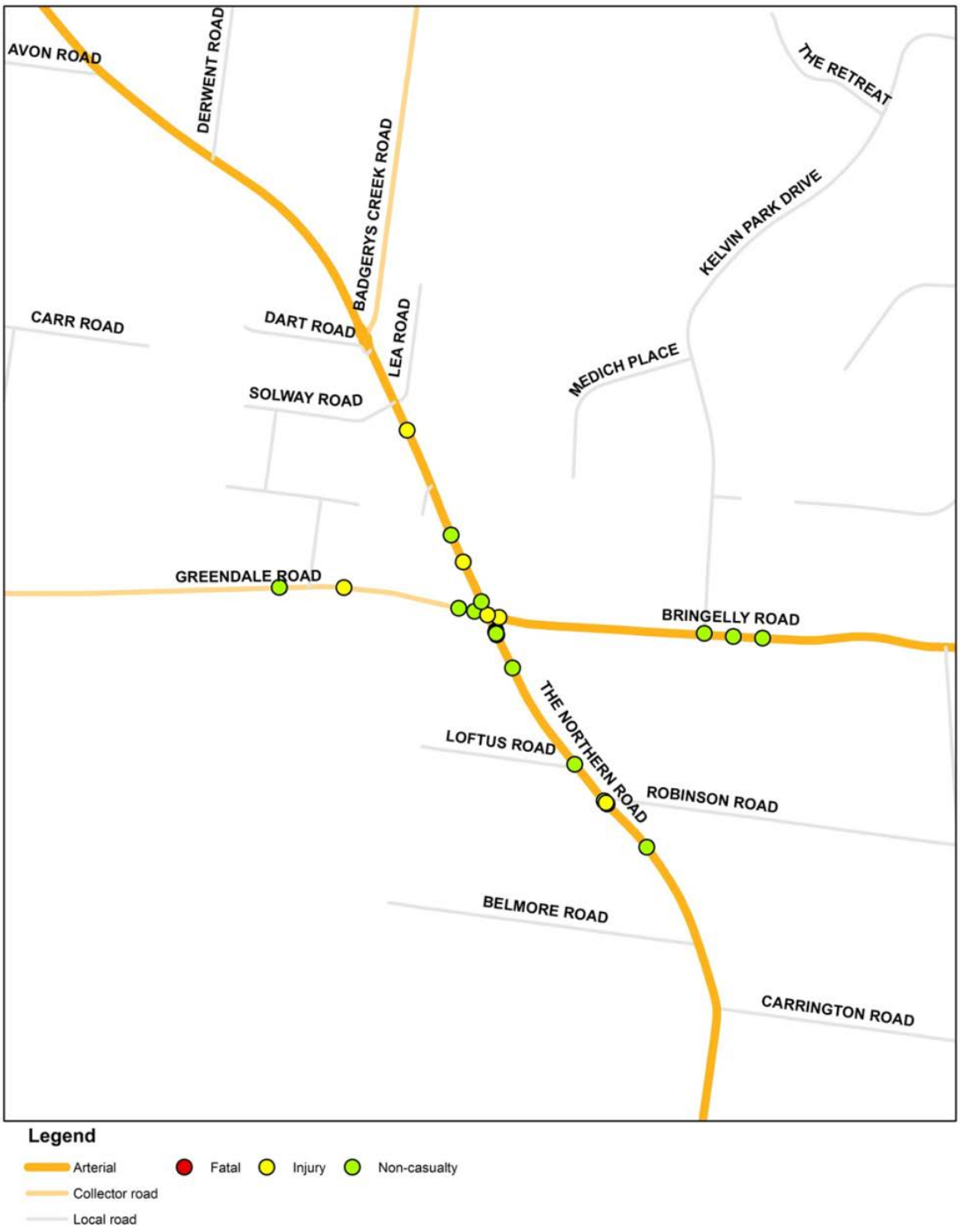
Source: GHD from NSW Centre for Road Safety data

Figure 27 – Crash data summary chart

Rear end crashes were recorded predominantly on The Northern Road with eight crashes in total occurring on the north and southern approaches. Of all rear end crashes, six occurred during peak hour times suggesting that higher traffic volumes were a possible cause.

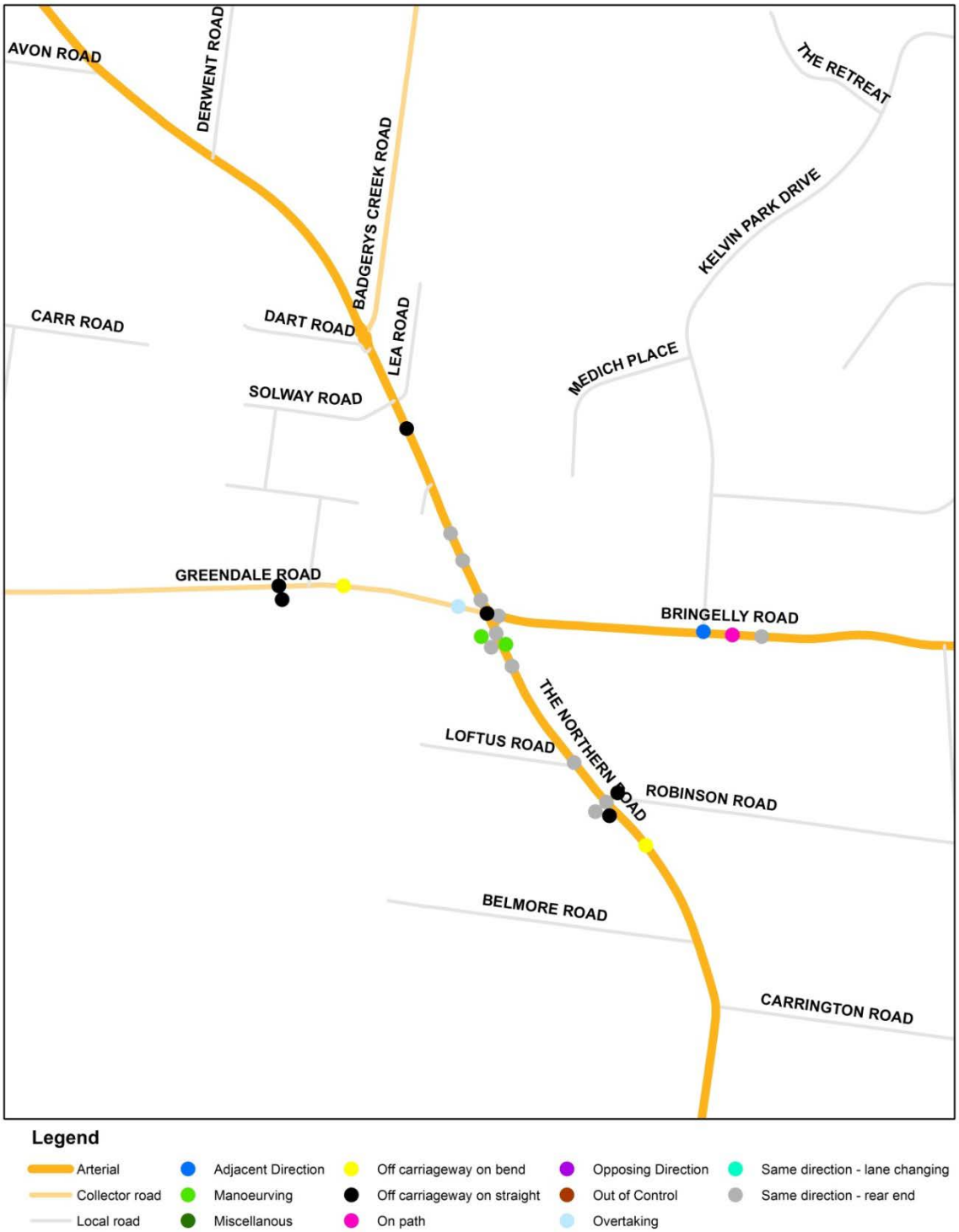
A number of crashes (eight) involved vehicles veering off the road and hitting objects. These crashes tended to occur on approach to the intersection of The Northern Road and Bringelly Road.

A map representing the location and degree of severity of crashes in the study area is shown in Figure 28. Figure 29 represents the type of crashes in the study area.



Source: GHD adapted from NSW Centre for Road Safety data

Figure 28 – Degree and type of crash locations



Source: GHD adapted from NSW Centre for Road Safety data

Figure 29 – Road user movement crash type locations

Table 3-10 summarises the crash data for crash types and the number of injuries and non-casualty crashes occurring within the study area. It was reported that 52 per cent of crashes were non casualty and 48 per cent were crashes causing injury. The majority of casualty crashes were reported on The Northern Road (refer to Table 3-11).

Table 3-10 – Crash data summary table

Crash Type	Injury	Non-casualty	Grand Total
Adjacent Direction	1	1	2
Manoeuvring	-	2	2
Off carriageway on bend	1	1	2
Off carriageway on straight	4	2	6
On path	-	1	1
Opposing Direction	1	-	1
Overtaking	-	1	1
Parked vehicle ran away	-	1	1
Same direction - rear end	6	5	11
Grand Total	13	14	27

Source: GHD adapted from NSW Centre for Road Safety Data

Table 3-11 – Casualty and non-casualty crashes summary table

Crash Type	Bringelly Rd	Greendale Rd	The Northern Rd	Total
Injury	1	2	10	13
Non-casualty (tow away)	3	3	8	14
Grand Total	4	5	18	27

Source: GHD adapted from NSW Centre for Road Safety Data

3.10 Property access

Property accesses within the project area are shown in Figure 30. The number of property accesses, some of which may be affected by the project are shown in Table 3-12.

Table 3-12 – Number of property accesses

Road	Section	Side of road	No of driveways / property accesses
The Northern Road	Loftus Road to Bringelly Road	East	5
		West	3
	Bringelly Road to Solway Road	East	9
		West	6
Greendale Road	The Northern Road To Medway Road	North	5
		South	6
Bringelly Road	The Northern Road to Kelvin Park Drive	North	7
		South	3

Road	Section	Side of road	No of driveways / property accesses
Loftus Road	East of The Northern Road	North	6
		South	8
Robinson Road	The Northern Road to 50 Robinson Road	North	7
		South	1

Figure 30 – Existing property access within project area

Roads and Maritime will consult with individual property owners to identify appropriate access arrangements that are consistent with the proposal.

4. Construction traffic impact assessment

A construction traffic impact assessment has been undertaken to obtain an understanding of the likely impacts from construction scheduling and sequencing. Construction is anticipated to commence in late 2016 and would take around three years to complete. This section of the report provides a summary of the construction methodology and assesses traffic and transport impacts during the construction period.

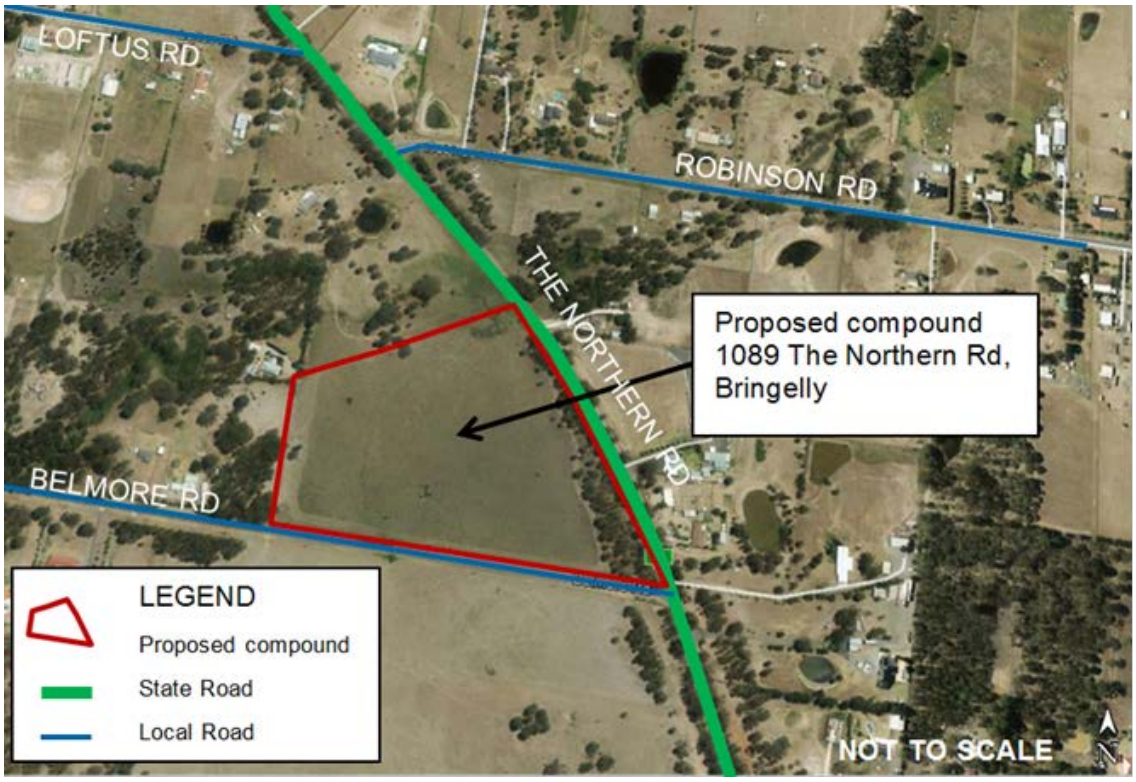
4.1 Construction methodology

The proposal would involve the following general work methodology and sequencing:

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

4.1.1 Proposed compound location

A location has been identified as a possible site for the storage of construction equipment and temporary office spaces. This location is described as 1089 The Northern Road, Bringelly and is shown in Figure 31. This site is likely to be used by The Northern Road stage 2A upgrade and may not be available during construction. In the event of this occurring, alternative locations for a site compound would be investigated during detailed design.



Source: GHD adapted from Google Earth

Figure 31 – Proposed construction compound location

4.1.2 Proposed working hours

Construction works are likely to be undertaken during the following working hours:

- 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 and disturbance to surrounding land owners and businesses, it would be necessary to carry out some work outside of these hours. Prior notice would be given to the community if any works are planned to be undertaken outside normal construction hours.

4.1.3 Heavy vehicle generation

Heavy vehicle traffic would mainly be generated by activities associated with the following:

- Delivery of construction materials
- Spoil removal
- Delivery and removal of construction equipment and machinery
- Movement of construction personnel, including contractors, site labour force and specialist supervisory personnel.

On average about 25 heavy vehicles would be required on-site per day, resulting in about 50 two-way heavy vehicles movements (in and out) of the compound site per day. Heavy vehicles would peak to around 50 heavy vehicles per day resulting in about 100 two-way heavy vehicle movements during the early stages of construction. These heavy vehicle movements are likely to be spread through the day, however for a worst case assessment of the traffic impacts during the peak construction stage it has been assumed that 10 per cent or 10 vehicle movements (5 in and 5 out) would occur during the peak hour.

Spoil haulage is likely to be hauled north to The Northern Road stage 2C. It is expected that this would peak around five trucks per hour and have a minimal impact on the surrounding road network.

It is noted that Roads and Maritime is considering the construction of multiple projects in this area at the same time. The construction traffic along multiple work sites would need to be considered in the construction traffic management plan, depending on the contract form for the construction.

The movement of materials would be managed through the scheduling of deliveries and availability of fleet, and would aim to minimise the number of haulage and delivery vehicles during peak periods and on weekends. An exception to this would be the delivery of Super “T” girders for the construction of the interchange. This would require approval from Roads and Maritime in the form of a Heavy Vehicle Permit and would most likely occur overnight during the period with the lowest volumes of traffic on the state road network.

4.1.4 Light vehicle generation

Light vehicle traffic generation would be associated with staff movements to the site as well as various small vehicle movements associated with the construction.

Staff would comprise project managers, various trades and general construction staff. For the purpose of this study, 30 employee vehicles per day are assumed to be associated with the construction, it is expected that construction workers would arrive before the AM peak and depart during the PM peak, and therefore only the PM vehicles have been included within the peak hour assessment.

Up to an additional 40 light vehicle would access the site per day, resulting in about 80 two-way vehicle movements (in and out) these light vehicle movements are likely to be spread through the day, however for a worst case assessment of the traffic impacts during the peak construction stage it has been assumed that 10 per cent, or eight vehicle movements (4 in and 4 out) would occur during the peak hour.

Adequate parking is expected to be available at the compound site as public transport to the site is very limited or non-existent. Moderate light vehicle traffic generation associated with staff movements to the site is predicted.

4.1.5 Construction traffic generation

A summary of the total construction traffic movements is provided in Table 4-1. In the worst case scenario during the early stages of construction there would likely be about 240 daily traffic movements.

Table 4-1 – Proposed construction traffic movements per day

Vehicle type	Number of vehicles per day (average)	Vehicle movements per day (average)	Number of vehicles per day (peak construction)	Vehicle movements per day (peak construction)
Employee cars	30	60	30	60
Light construction vehicles/utilities	40	80	40	80
Heavy vehicles/trucks	25	50	50	100
Total	**95**	**190**	**120**	**240**

Source: GHD

Table 4-2 provides a summary of the total construction traffic movements during peak construction.

Table 4-2 – Proposed construction traffic movements – worst case peak hour

Activity	AM peak (vtph)**		PM peak (vtph)**		Daily (vtpd)*	
	In	Out	In	Out	In	Out
Light vehicles	4	4	4	34	110	110
Heavy vehicles	5	5	5	5	50	50
Total	**9**	**9**	**9**	**39**	**160**	**160**

Source: GHD

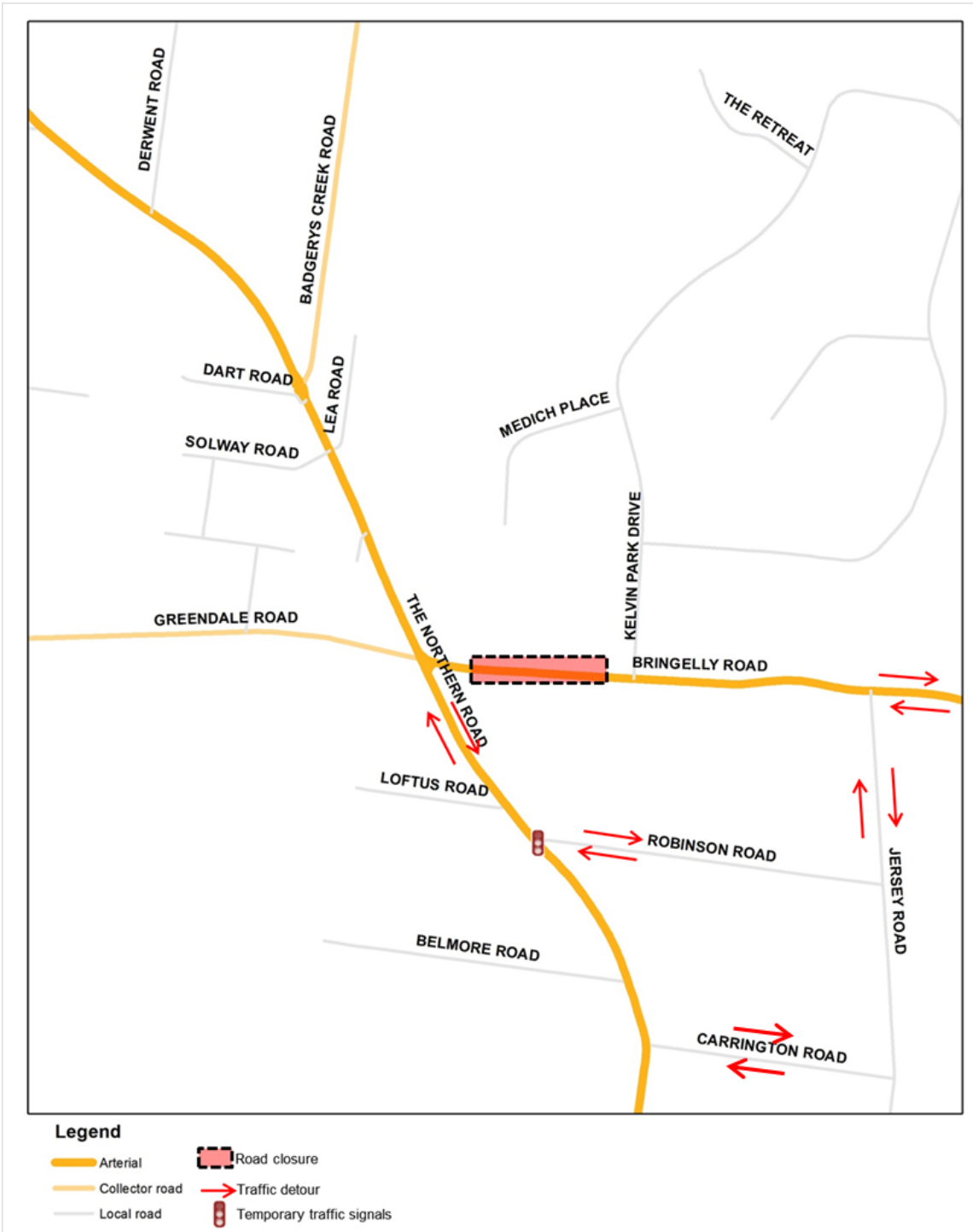
*Note: * vtpd – vehicle trips per day*

***vtph – vehicle trips per hour*

4.1.6 Construction access

The main access routes for construction vehicles during the majority of the construction timeframe would include The Northern Road (north and south from the site), Bringelly Road and Badgerys Creek Road.

A section of Bringelly Road between The Northern Road and Kelvin Park Drive is proposed to be closed during the construction of the underpass. Access would be retained for residents located on Bringelly Road between Kelvin Park Drive and The Northern Road. During this closure a detour is proposed through Robinson Road and Jersey Road as shown in Figure 32.



Source: GHD

Figure 32 – Proposed traffic detour during the closure of Bringelly Road

4.2 Construction traffic impacts

4.2.1 Road network

It is likely that the construction traffic would arrive and depart from The Northern Road (north), The Northern Road (south) and Bringelly Road. For the purpose of this assessment it is assumed that construction traffic would be distributed equally.

The Northern Road already carries a high volume of traffic and therefore the additional construction vehicle traffic would mostly have a minor traffic impact. This is due to this additional construction vehicle traffic being within the range of daily variation in traffic on these routes.

The proposed closure of Bringelly Road and associated traffic detour would result in increased traffic on Robinson Road and Jersey Road. Table 4-3 shows the expected traffic increase during the peak hour on Robinson Road and Jersey Road.

Table 4-3 – Proposed traffic increase in the peak hour

Road	Existing average weekday traffic volumes (vph)*	Construction traffic (vph)*	Diverted traffic (vph)*	Total traffic (vph)*	Percentage increase
Robinson Road	30	16	334	380	1,166%
Jersey Road	226	16	231	473	109%

Note: * vph – vehicles per hour

Source: GHD

Robinson Road and Jersey Road both show a large increase in traffic due to the diversion, however the peak hour volumes are within reasonable limits for a local road when comparing to the typical capacity for a local road as outlined in Section 3.2.1. It is also noted that this diversion could be for around 12–18 months. It is recommended that further investigation be undertaken on Robinson Road and Jersey Road to assess if the existing road conditions can accommodate the additional vehicles to ensure suitable traffic management, geometric and pavement stability management processes are put in place.

It is noted that Robinson Road is subject to flooding. In the event that this occurs during the diversion, traffic could be temporarily diverted on to Carrington Road.

During the closure of Bringelly Road traffic will need to travel a longer distance through the traffic diversion. Table 4-4 provides a comparison between the existing and proposed diversion in terms of distance and travel time.

Table 4-4 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.

The proposed diversion will impact on the intersections of:

- The Northern Road / Robinson Road
- Robinson Road / Jersey Road
- Bringelly Road / Jersey Road.

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 and construction 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 will need to be made at the following intersections:

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

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

There are other local roads in the vicinity of the compound site. As most of these roads are no through roads, the impact on the majority of the local road network will be limited. Carrington Road however does provide a through link between Bringelly Road and The Northern Road; this may need to be considered in the Construction Vehicle Movement Plan. As a part of the construction management plan it is expected that heavy vehicle traffic would be constrained, as much as possible to the state road network and the impact on local roads would be minimised. Any disruption to access side streets and properties would be minimised and would only be undertaken following consultation with the community and with individual property owners affected by the proposed works.

4.2.2 Cumulative construction traffic impacts

A number of major developments and road upgrade projects are currently proposed for the Western Sydney Priority Growth Area and South West Priority Land Release Area as part of the Western Sydney Infrastructure Plan (refer to Table 4-5). Construction of some of these projects may occur at the same time as the proposal and could result in cumulative construction traffic impacts.

Table 4-5 Projects considered for cumulative construction traffic impacts

Project	Description	Likelihood of interaction
The Northern Road stage 2A upgrade (Peter Brock Dive to Belmore Road)	**Construction period:** Mid 2016 – mid 2019 **Construction duration:** 36 months **Description:** 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.	High – concurrent with the proposal with potential increases to peak period traffic volumes
The Northern Road stage 2C upgrade (Thames Road to Mersey Road)	**Construction period:** Mid 2016 – mid 2019 **Construction duration:** 36 months **Description:** Stage 2C, which forms part of the stage 2 upgrade, extends from Thames Road to Mersey Road, with a length of about 3 km.	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)	**Construction period:** Late 2017 – late 2019 **Construction duration:** 24 months **Description:** 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.	High – concurrent with the proposal with potential increases to peak period traffic volumes
The Northern Road stage 4 upgrade (Mersey Road to Littlefields Road)	**Construction period:** Late 2017 – late 2019 **Construction duration:** 24 months **Description:** 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.	High – concurrent with the proposal with potential increases to peak period traffic volumes
Bringelly Road stage 2 upgrade (King Street to The Northern Road)	**Construction period:** Early 2017 – mid 2019 **Construction duration:** 30 months **Description:** 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.	High – concurrent with the proposal with potential increases to peak period traffic volumes
Proposed western Sydney airport at Badgerys Creek	**Construction period:** Early 2016 - mid 2020 **Construction duration:** 54 months **Description:** 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.	High – concurrent with the proposal with potential increases to peak period traffic volumes
Bringelly Brickworks extension	**Construction period:** Details not yet known **Construction duration:** Details not yet known **Description:** 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).	Moderate – although the timing of construction of the extension 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 4-5 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 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.

4.2.3 Intersection performance

With the proposed closure of Bringelly Road during construction, turning traffic movements in and out of Bringelly Road for local traffic will be removed from the intersection of The Northern Road / Bringelly Road; however a small portion of construction vehicles will still retain access to this section of Bringelly Road. Intersection arrangements during this time will need to be managed through the CTMP.

The intersection was analysed during the construction scenario using SIDRA to obtain the understanding of the operation of The Northern Road / Bringelly Road and The Northern Road / Robinson Road intersections during the construction period. The turning volumes for the intersection of Robinson Road and The Northern Road during the detour were obtained from the turning movement counts undertaken at The Northern Road / Bringelly Road intersection that would be diverted to Robinson Road during the detour. No existing condition surveys have been obtained at the intersection of Robinson Road and The Northern Road.

The results of the assessment of the temporary construction arrangements are summarised in Table 4-6. SIDRA outputs are provided in Appendix C.

Table 4-6 – SIDRA results – temporary construction arrangements during 2016

Intersection	Priority Type	AM peak				PM peak			
		LoS	Average Delay (s)	Queue	Degree of Saturation (DoS)	LoS	Average Delay (s)	Queue	Degree of Saturation
The Northern Road / Bringelly Road	Signals	B	15	191 (S)	0.767	B	18	307 (N)	0.758
The Northern Road / Robinson Road	Signals	B	24	297 (S)	0.929	F	364	1495 (S)	1.585

Source: SIDRA analysis

Table 4-6 indicates that during construction the intersection of The Northern Road and Bringelly Road would operate satisfactorily at LoS B in the AM peak and LoS B during the PM peak. The traffic detour will redirect traffic through the intersection of The Northern Road and Robinson Road which would operate with spare capacity (LoS B) in the AM peak period, and over capacity in the PM peak period (LoS F). The intersection of Robinson Road and The Northern Road currently does not provide any turning bays and with the additional traffic flow the intersection performance during the PM peak is operating over capacity at LoS F. Temporary widening of the intersection to accommodate construction traffic during the diversion would improve the operation of this intersection.

4.2.4 Lane and footpath closures

During stages of construction, some sections of the footpath along The Northern Road and Bringelly Road may be closed for safety reasons. Pedestrian access will be maintained to Bringelly Public School and the Bringelly Village shops during construction.

4.2.5 Parking

During construction, there may be impacts to on-street parking and driveway access. Proposed changes to this access would need to be communicated in advance with the local residents and businesses to ensure that access is available.

4.2.6 Public transport

Bus services would be impacted during the closure of Bringelly Road between Kelvin Park Drive and The Northern Road. Bus services would be diverted through Robinson Road and Jersey Road. The bus stops located on Bringelly Road between Jersey Road and The Northern Road would be closed with the nearest operating bus stops being located on Bringelly Road near Jersey Road and on The Northern Road near Bringelly Public School. Impacts to the bus tops would be managed through a Construction Traffic Management Plan (CTMP). Consultation will be required with TfNSW and its contracted bus operators as part of the CTMP in order to provide appropriate bus stop replacement locations where bus stops are located more than 400 metres away from their existing position

Table 4-7 provides an understanding of the bus stops that would be impacted during the closure of Bringelly Road between The Northern Road and Kelvin Park Drive.

Table 4-7 – Impacts on bus stops during construction

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

4.2.7 School bus services

The impacts to bus services accessing both Bringelly Public School and Rossmore Primary School would need to be addressed in the CTMP during the closure of Bringelly Road. The services would need to divert through Robinson Road and Jersey Road during construction.

5. Operational traffic impact assessment

5.1 Introduction

An operational traffic assessment of the proposal was undertaken to determine the impacts of the proposal on the traffic and transport networks within the study area. The assessment considered the following issues:

- Background traffic growth
- Future transport operations
- Committed developments
- Future intersection performance
- Property access.

The findings of this assessment are described in the following sections.

5.2 Future transport options in the study area

5.2.1 Future road network

The Commonwealth and NSW Government have committed $3.6 billion over 10 years in major road infrastructure upgrades in Western Sydney. These upgrades will relieve pressure on existing infrastructure and provide connectivity to the proposed western Sydney airport and surrounding areas. The projects which comprise the Western Sydney Infrastructure Plan are shown in Figure 3.

Based on information provided by TfNSW, a summary of the future road network projects are provided in Table 5-1.

Table 5-1 – Future road network changes by 2031

Project	Comments
Western Sydney Infrastructure Plan (Stage 1)	Upgrade of The Northern Road to a minimum of four lanes from Narellan to the Jamison Road; Construction of the M12 motorway between the M7 Motorway and The Northern Road; Upgrade of Bringelly Road to a minimum of four lanes from Camden Valley Way to The Northern Road; Werrington Arterial Road; Ross Street / Great Western Highway intersection upgrade; A $200 million local roads package.
Western Sydney Employment hub roads	Proposed road network to support the Growth Centre, as identified in the Broader Western Sydney Employment Area Structure Plan.
Great Western Highway, Blue Mountains	Widening from 1 to 2 lanes
NorthConnex	Due for completion by 2019.
WestConnex (stages 1, 2 and 3)	All three stages of WestConnex are targeted for completion by 2023. Includes: • M4 widening Church Street to Strathfield and M4 East (stage 1); • new M5 tunnel and St Peters interchange (stage 2); • M4 to M5 link including CityWest Link/Victoria Road and Camperdown interchanges, Airport Gateway and Southern Connector to President Ave, Monterey (stage 3)
Western Harbour Tunnel	Final business case for the Western Harbour Tunnel expected the end of 2015, with the aim of delivering the project immediately after WestConnex Stage 3.

Project	Comments
Western Sydney Infrastructure Plan (Stage 2)	A link from the M4 Motorway to the WSA Prospect Highway Moorebank Precinct South West Growth Centre Roads
North West Growth Centre Roads	Proposed road network to support the Growth Centre, as identified in the North West Growth Structure Plan.
South West Growth Centre Roads	Proposed road network to support the Growth Centre, as identified in the North West Growth Centre Structure Plan.
M4 Widening, Church Street to Mamre Road	
M7 Widening (M4 to M5)	Widening from 2 to 3 lanes between the M4 and M5 Motorways

Source: TfNSW Western Sydney Strategic Modelling Assumptions Book v1

The Northern Road

The Northern Road will be diverted around the area required for the operation of the proposed western Sydney airport by Roads and Maritime.

The Northern Road, or a connection to The Northern Road, will be constructed to the proposed western Sydney airport by Roads and Maritime as part of the construction of The Northern Road realignment. The number of traffic lanes on The Northern Road will vary along the length. At the northern end of The Northern Road, there will be three lanes and a bus lane in each direction. However other sections of the road will include two lanes and a bus lane in each direction with the potential to increase to three lanes in each direction in the future. The Northern Road will have a maximum design speed limit of 90 km/h and maximum posted speed limit of 80 km/h for the main carriageways. Provision for walking and cycling through shared paths will be provided along its route.

Bringelly Road

Bringelly Road is being upgraded between Camden Valley Way and The Northern Road to support the development of growth centres, employment and the proposed western Sydney airport. The project consists of improving the two lane segment between the eastern side of Upper Canal bridge and the western side of the Eastwood Road intersection, through the forthcoming Leppington Town Centre into a six lane divided road by 2018. Furthermore, the remaining sections of Bringelly Road will also be upgraded from two lanes to a four lane divided road with a central median which will cater for future extra capacity by widening Bringelly Road into six lanes if needed.

M12 Motorway

This new motorway is proposed to connect the M7 near Cecil Park to The Northern Road near Luddenham, to provide access and traffic capacity for the proposed western Sydney airport. The future M12 is likely to be built as a four lane road with capacity for six lanes in the future.

The primary public access road to the airport site will be from the future M12. Roads and Maritime will construct the M12 connection from the M12 to the proposed western Sydney airport site boundary.

The main public access road (from Elizabeth Drive connection with the future M12) will include:

- A maximum design speed of 90 km/h and maximum posted speed of 80 km/h for the main carriageways including the connections to the M12 Motorway, decreasing to safe speeds in the vicinity of the terminal forecourt and Ground Transportation Centre (maximum design speed of 40 km/h)
- A minimum of two, and up to three, trafficable lanes for each carriageway on the main carriageways with provision for bus lanes in the shoulder
- Connection to allow efficient and safe vehicle movement around the ground transport hub within the terminal forecourt, including access to the commercial precinct, support areas and airport parking.

Badgerys Creek Road

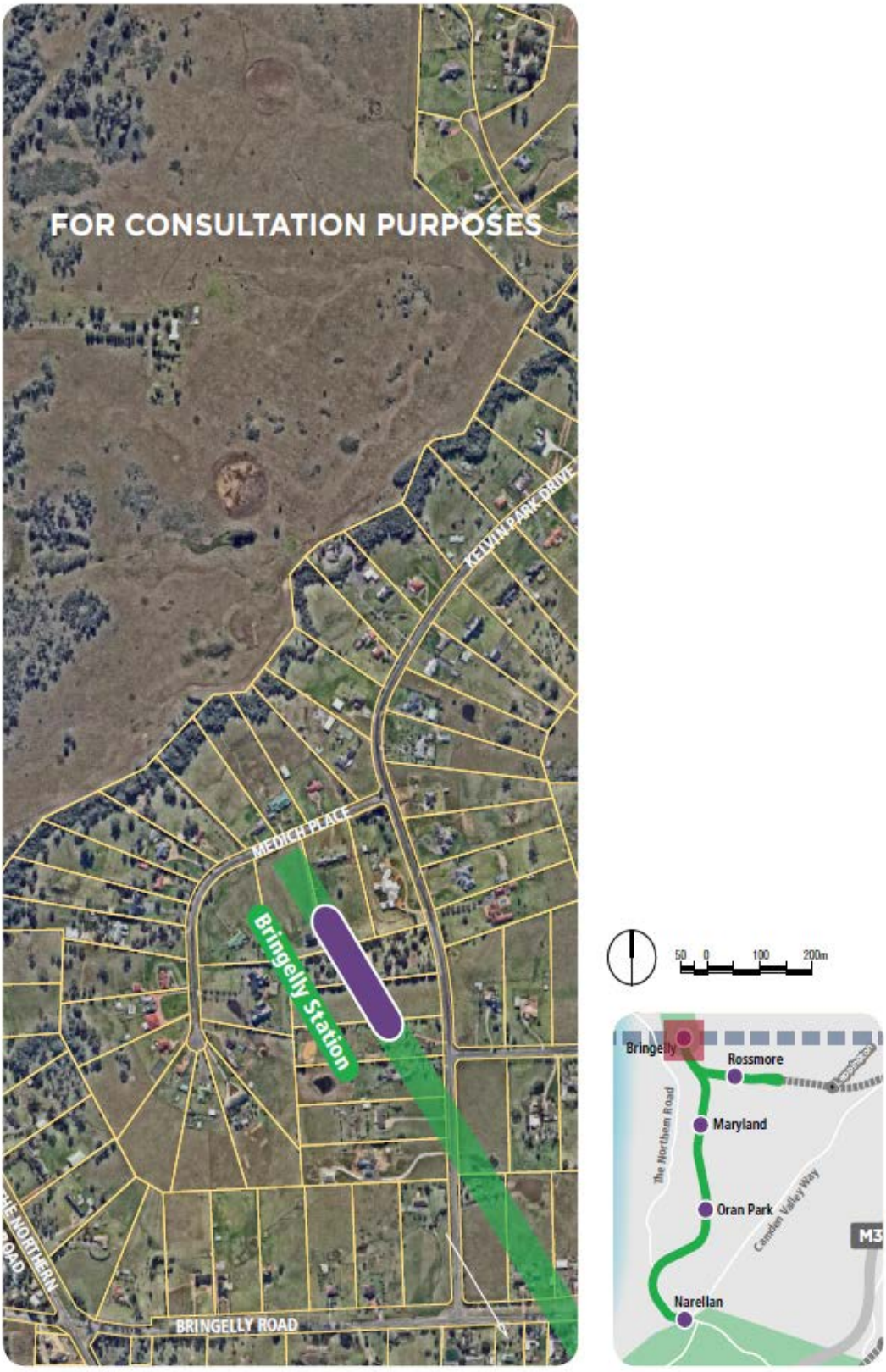
Badgerys Creek Road is a local road under the control of Liverpool City Council. It is expected to remain a public road to the boundary of the proposed western Sydney airport site. Badgerys Creek Road will remain open to public transport and private vehicles on the airport site prior to the construction of the proposed second (southern) runway, depending on the requirements for additional access to landside facilities and the location of the airport security fence.

5.2.2 Parking

Once the proposal is operational there are no expected impacts to the existing parking on The Northern Road.

5.2.3 Train services

The NSW Government has started planning for a continuation of the South West Rail Link to extend to Badgerys Creek and on to St Marys, where it would connect with Western Line services as well as south to Narellan. This is shown in Figure 33. Bringelly station will offer the nearest train service within the study area and is just to the north east of the proposal.

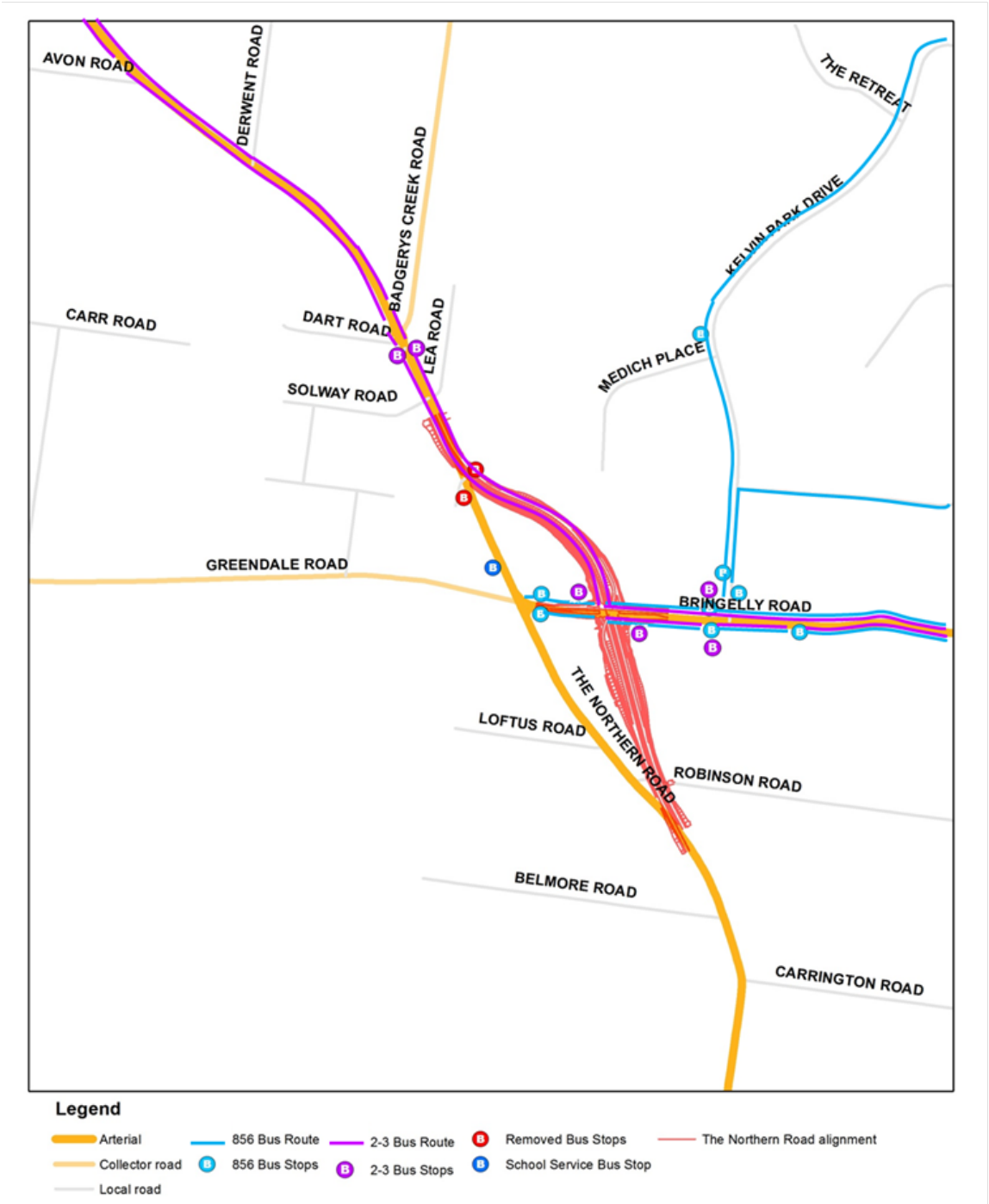


Source: Transport for New South Wales 2015

Figure 33 – Southwest Rail Link extension recommended corridor within the study area

5.2.4 Bus services

The potential future bus routes in the study area are shown in Figure 34. Bus routes and frequencies have been extracted from the STM3. Route 856 is expected to be moved to the diverted 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. The bus routes highlighted in purple and blue in Figure 34 are an indication of where the existing and proposed buses may operate.



Source: GHD adapted from STM3 data

Figure 34 – Future bus routes in study area

5.2.5 Bus stop locations

Table 5-2 provides an understanding of the impact to bus stops once the proposal is operational.

Table 5-2 – Impacts on bus stops during operation

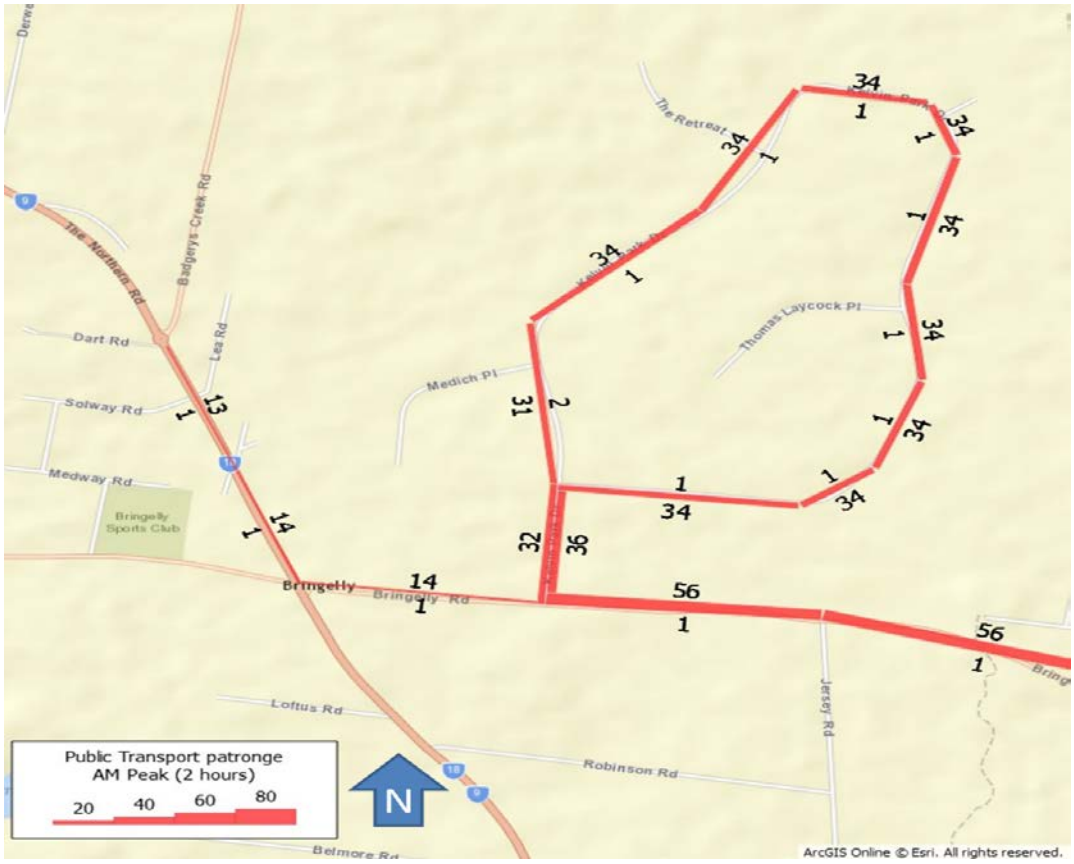
Bus stop reference	Location	Route	Route description	Impacts post proposal
2171443	The Northern Road near Thames Road	856	Bringelly to Liverpool via Prestons and Churchill Gardens	Removed
2171442	The Northern Road opposite Thames Road	856	Liverpool to Bringelly via Churchill Gardens and Prestons	Removed
2171178	The Northern Road near Bringelly Public School	856	Liverpool to Bringelly via Churchill Gardens and Prestons	Retained as a school bus 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

5.2.6 Bus patronage forecast

Bus patronage forecasting was carried out using STM3. The model uses inputs from population and land use forecasts to predict the demand and mode of transport used throughout the network in the future. Future bus patronage has been calculated for:

- The 2021 AM peak with no airport
- The 2026 AM peak with western Sydney airport operational
- The 2036 AM peak with western Sydney airport operational.

The future bus patronage for the AM peak as determined by Transport for NSW through its strategic modelling is shown in Figure 35 through to Figure 37. These figures show the average number of passengers for buses travelling in each direction between each road segment.

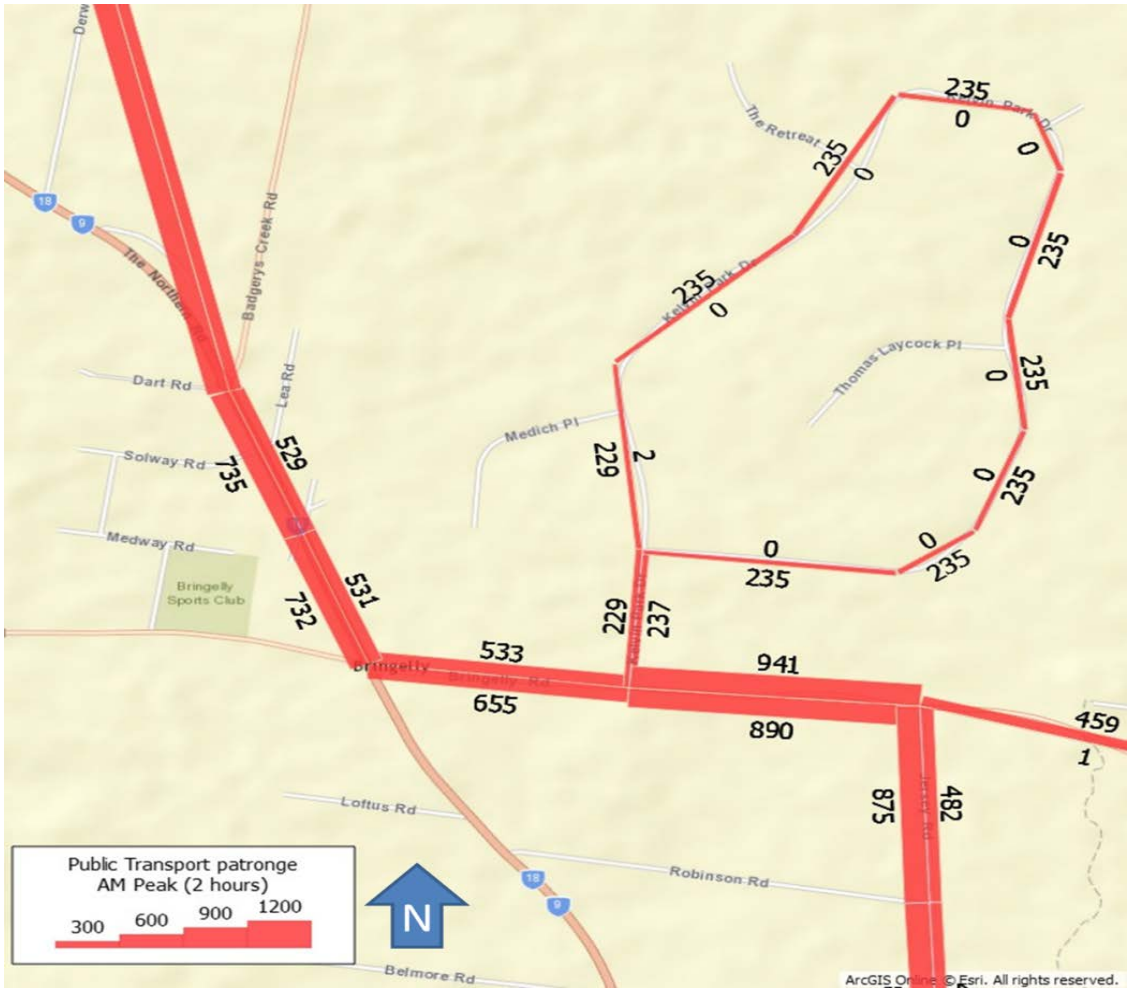


Source: GHD 2015 adapted from STM version 3

Figure 35 – Bus patronage data 2021 AM peak no airport

Source: GHD 2105 adapted from STM version 3

Figure 36 – Bus patronage data 2026 AM peak with airport



Source: GHD 2015 adapted from STM version 3

Figure 37 – Bus patronage data 2036 AM peak with airport

5.2.7 Pedestrian and cyclist access

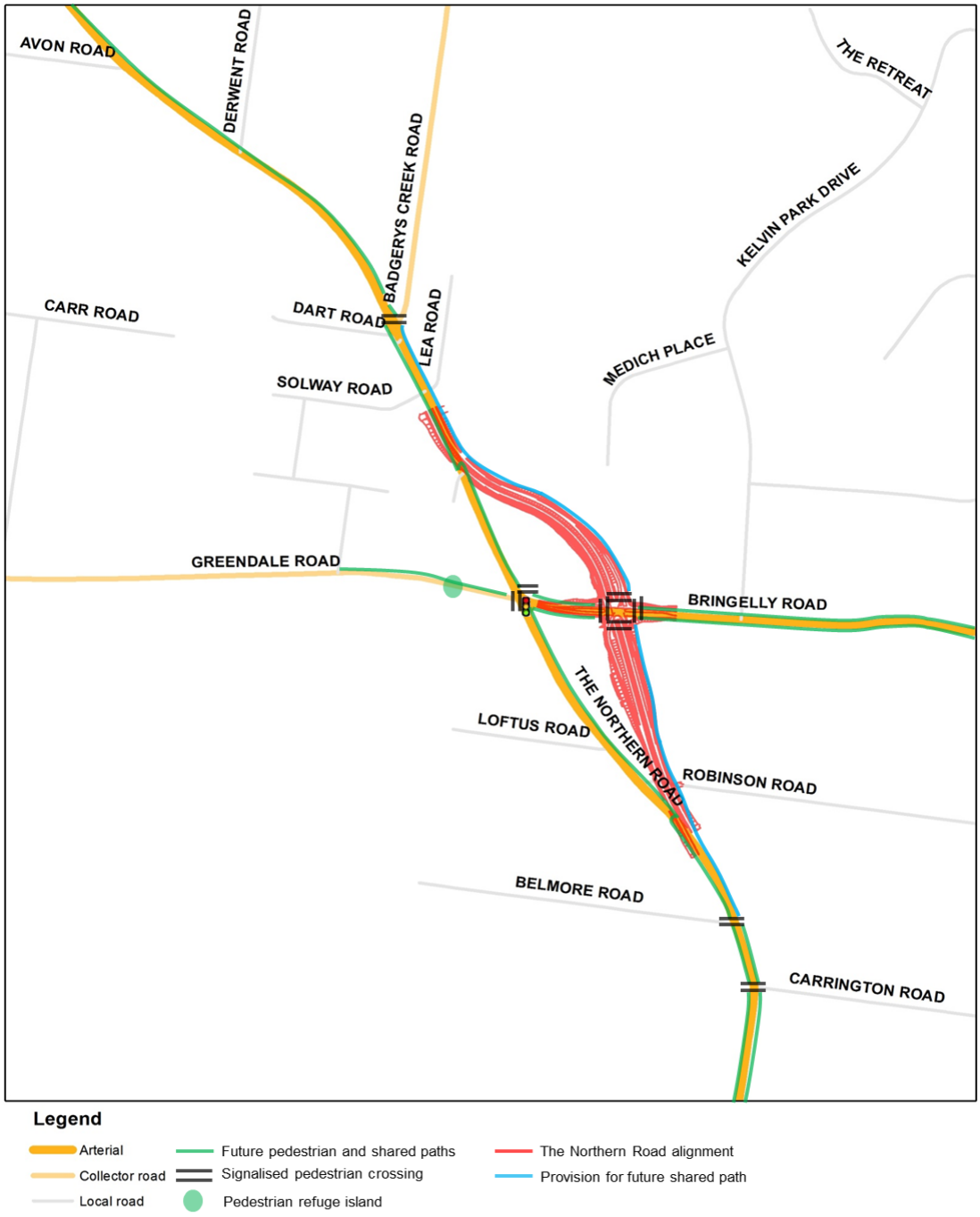
Sydney's Cycling Future (Transport for NSW, 2013) is a plan to encourage people to ride more often and safely. It includes actions to promote and improve cycling which are relevant to the proposal. One of these actions includes providing shared off-road pedestrian and cycle facilities in appropriate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

As the priority growth areas lands develop additional cycleway links are to be enhanced and integrated within the Liverpool cycleway network. By 2018, the expected Bringelly Road Stage 1 and Stage 2 upgrades described in the Western Sydney Infrastructure Plan will deliver more than 10 km of shared pedestrian and cyclist paths between Leppington and The Northern Road.

Also, according to the Western Sydney Infrastructure Plan, The Northern Road is expected to have shared pedestrian and cyclist paths between Narellan area and the M4 Motorway by 2019.

The proposal will improve walking and cycling access within the Bringelly area by providing shared paths along the new The Northern Road and Bringelly Road. Additionally, new shared paths will be provided along the existing sections of The Northern Road within the project area.

The future pedestrian and cyclist infrastructure is shown in Figure 38.



Source: GHD 2015

Figure 38 – Future pedestrian and shared path facilities

5.3 Committed developments

5.3.1 Expansion of the Boral Bringelly Brickworks

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. This included approval to (as per consent condition no. 7):

- 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).

Traffic generation associated with the expansion has been considered and included in the future year traffic forecasts. The forecast heavy vehicle traffic generation is shown in Table 5-3. It should be noted that this development traffic is not included in the forecast background growth volumes.

The forecasted traffic generation of the approved brickworks expansion has been obtained from the development application for the proposal, provided in the Traffic Impact Assessment Report (Hyder, June 2013). The traffic associated with this approved development has been included in the SIDRA modelling.

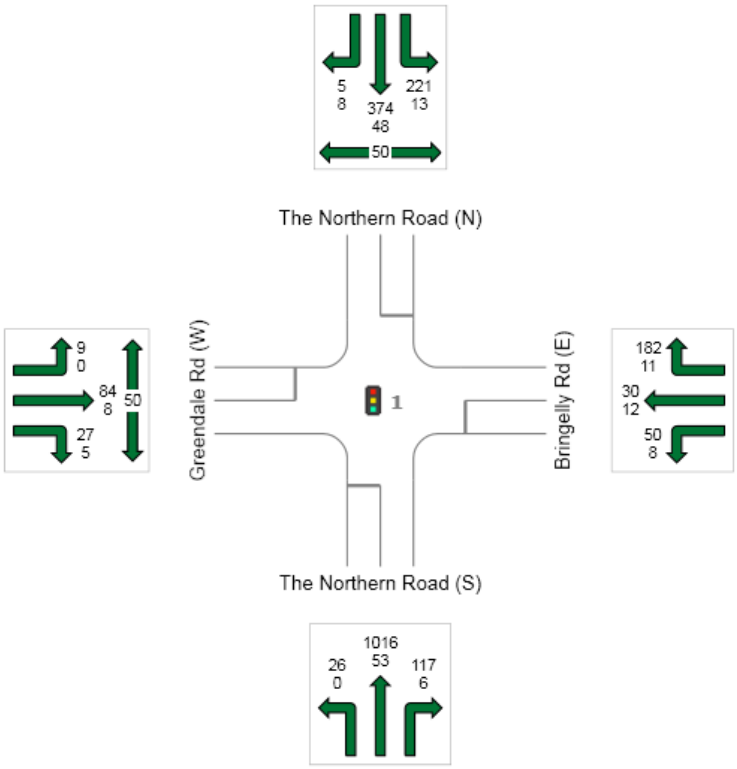
Table 5-3 – Summary of forecasted heavy vehicle peak traffic volumes to be generated by the Brickworks expansion - 2017

Location	AM Peak Hour (7 - 8 am) (vph)	PM Peak Hour (4 pm - 5 pm) (vph)
The Northern Road north of Bringelly Road	53	60
The Northern Road south of Bringelly Road	39	29
Bringelly Road east of The Northern Road	11	19
Greendale Road west of The Northern Road	100	118

Source: Hyder 2013

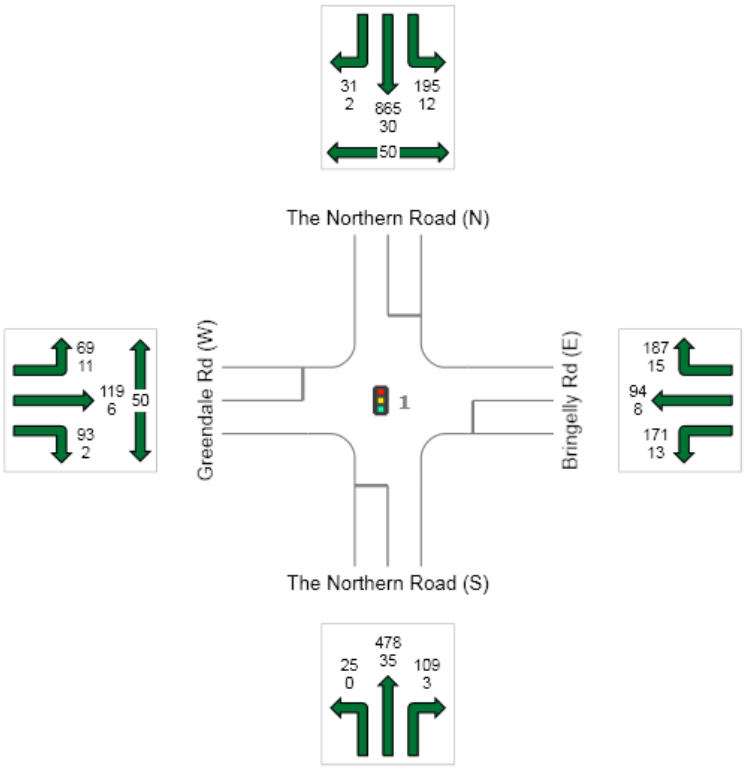
5.4 Future traffic demand

The future traffic volumes that will use the intersection use the proposal have been derived from the modelling assumptions (refer to section 2.2) and projected forward to the analysis years for 2019, 2029 and 2039. These volumes are shown in Figure 39 to Figure 44.



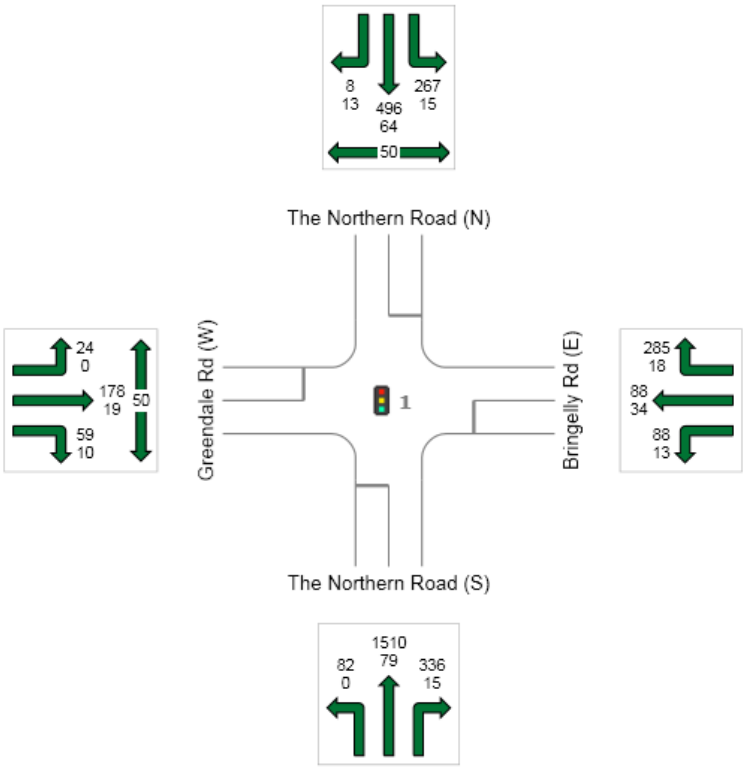
Source: GHD 2015

Figure 39 – 2019 AM traffic demand (without the proposal)



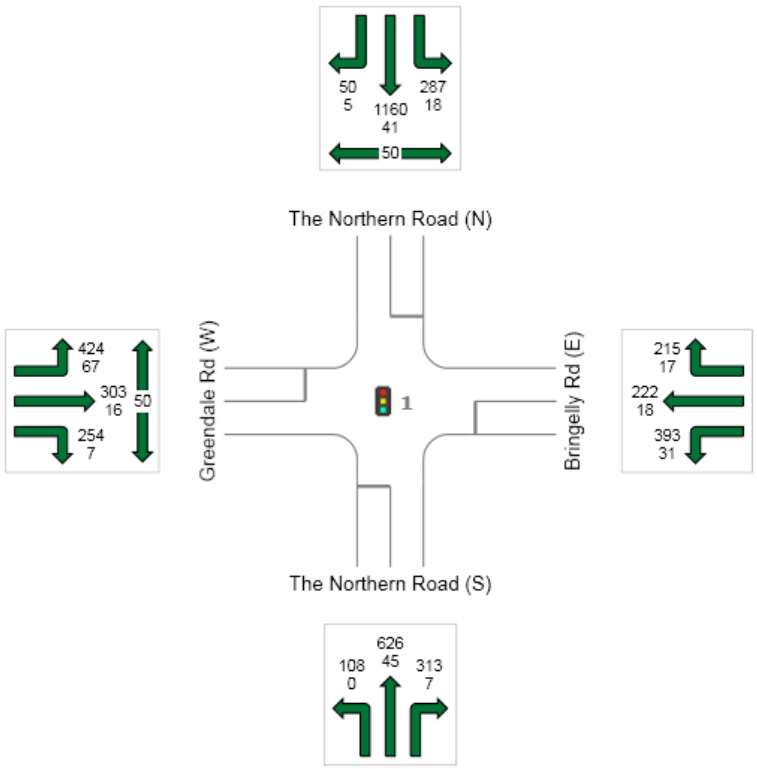
Source: GHD 2015

Figure 40 – 2019 PM traffic demand (without the proposal)



Source: GHD 2015

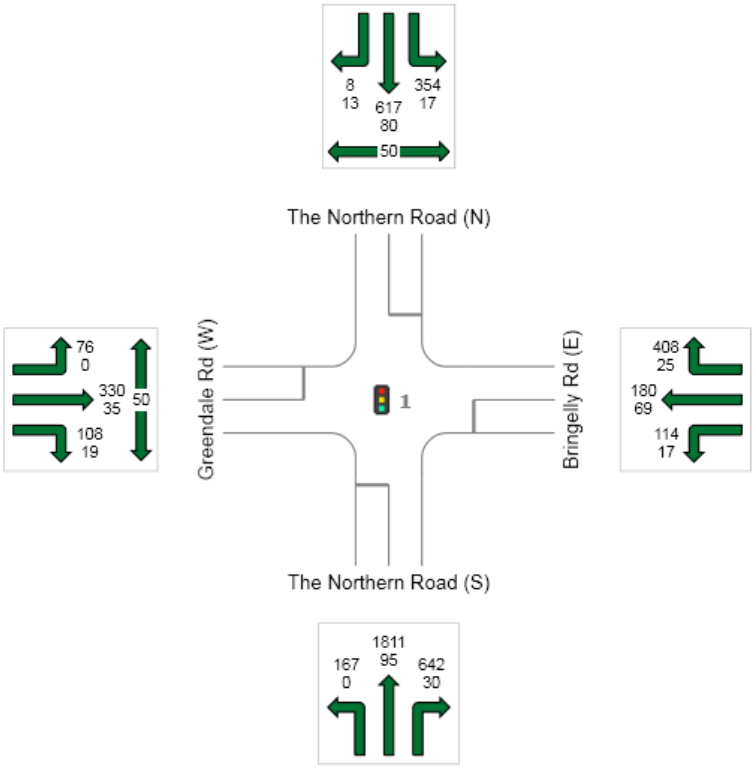
Figure 41 – 2029 AM traffic demand (without the proposal)



Source: GHD 2015

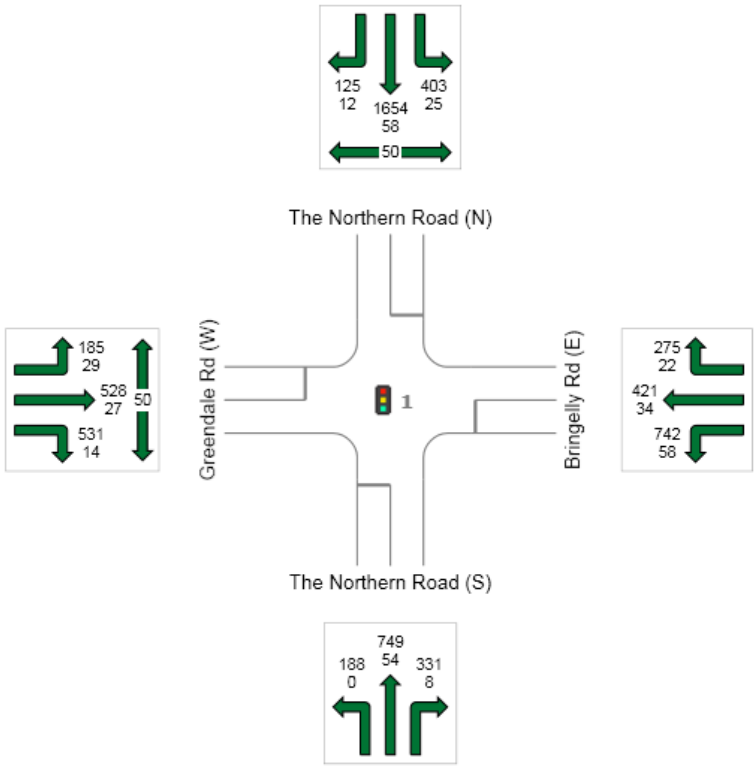
Figure 42 – 2029 PM traffic demand (without the proposal)

The figure shows future traffic volumes that will use the intersection, 2019 AM



Source: GHD 2015

Figure 43 – 2039 AM traffic demand (without the proposal)



Source: GHD 2015

Figure 44 – 2039 PM traffic demand (without the proposal)

5.5 Future intersection capacity – existing intersection layout

The operations of the existing intersection during the forecast traffic for the years of 2019, 2029 and 2039 has been analysed using SIDRA to determine operational capacity and delays at the intersection under a “do nothing” scenario where no upgrade is provided.

Table 5-4 provides the results of the intersection analysis for the future year scenarios.

Table 5-4 – The Northern Road and Bringelly Road future intersection capacity - existing intersection layout

Year	Priority Type	AM peak				PM peak			
		LoS	Average Delay (s)	Queue (m)	DoS	LoS	Average Delay (s)	Queue (m)	DoS
2019	Signals	F	324	2,155 (S)	1.334	F	454	2,205 (N)	2.153
2029	Signals	F	1039	5,632 (S)	1.939	F	2,074	4,780 (N)	6.85
2039	Signals	F	2898	9,675	3.792	F	3,154	8,222 (N)	7.280

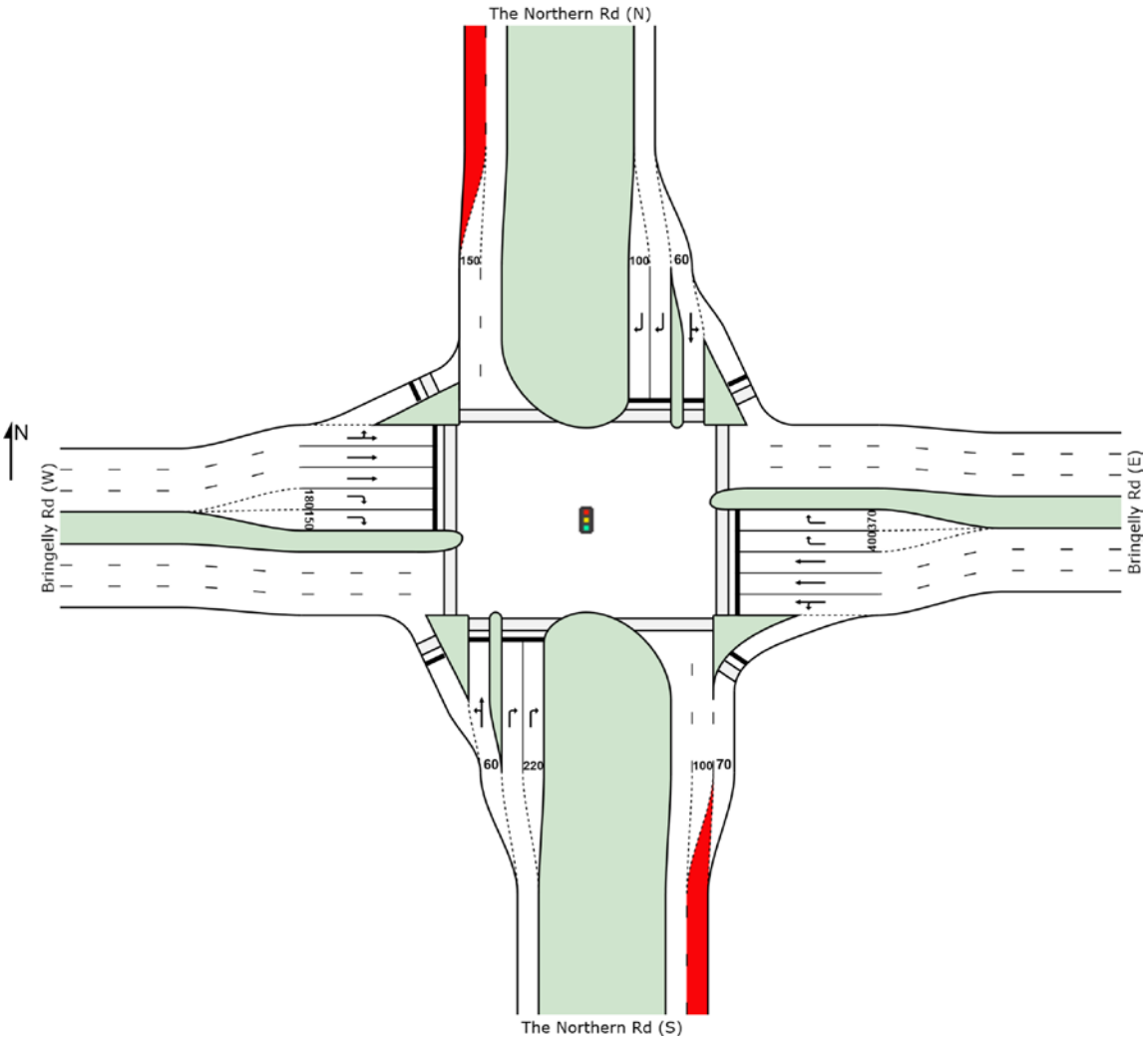
Source: SIDRA analysis 2015

Table 5-4 indicates that the existing intersection of The Northern Road and Bringelly Road during the forecasted years of 2019, 2029 and 2039 would operate over capacity at LoS F during both the AM and PM peaks for all three years analysed.

5.6 Future intersection performance – Bringelly Road and grade separated interchange signals

Future scenarios were analysed using SIDRA to obtain the proposed operation of The Northern Road and Bringelly Road grade separated interchange. The results are summarised in Table 5-5 with detailed SIDRA outputs are provided in Appendix C.

Figure 45 provides the proposed layout of the grade separated interchange.



Source: GHD 2015

Figure 45 – Future intersection layout – Bringelly Road and grade separated interchange signals used for modelling analysis

Table 5-5 – Proposal upgrade SIDRA results – grade separated interchange

Year	Priority Type	AM peak				PM peak				Queue Space (m)
		LoS	Average Delay (s)	Queue (m)	DoS	LoS	Average Delay (s)	Queue (m)	DoS	
2019	Signals	B	28	29{E}	0.267	B	25	32{E}	0.292	500
2029	Signals	C	29	45(S)	0.405	C	29	73{E}	0.511	500
2039	Signals	C	35	110 (S)	0.713	C	33	243{E}	0.926	500

Source: SIDRA analysis

Table 5-5 indicates that the intersection of The Northern Road and Bringelly Road and the proposed grade separated interchange will operate satisfactorily at LoS B in the AM and PM peak in 2019 and at LoS C in the AM and PM peaks for both 2029 and 2039.

5.7 Future intersection performance of existing The Northern Road and Bringelly Road intersection

Future year scenarios were analysed using SIDRA modelling to obtain the performance of The Northern Road and Bringelly Road intersection once the proposed grade separated interchange is operational. The results of the future year assessment are summarised Table 5-6.

Table 5-6 – Proposal upgrade SIDRA results – The Northern Road, Bringelly Road and Greendale Road

Year	Priority Type	AM peak				PM peak			
		LoS	Average Delay (s)	Queue (m)	DoS	LoS	Average Delay (s)	Queue (m)	DoS
2019	Signals	B	17	20 (W)	0.392	B	21	57 (W)	0.542
2029	Signals	B	23	63 (W)	0.539	F	112	691 (W)	1.047
2039	Signals	C	40	248 (W)	0.831	F	1,221	4,620(W)	1.922

Source: SIDRA analysis

Table 5-6 indicates that with the proposal upgrade the intersection of The Northern Road, Bringelly Road and Greendale Road will operate with spare capacity at LoS B in both the AM and PM peaks for 2019 and 2029 AM peak. The intersection will then operate over capacity in 2029 and 2039 PM peaks.

5.8 Intersection comparison

Table 5-7 and Table 5-8 provide a comparison between the Do Nothing scenario (where the intersection of The Northern Road and Bringelly Road remains as per the existing arrangements) for the future years and the proposed grade separated interchange associated with the bypass.

Table 5-7 – AM peak do nothing and proposal upgrade comparison

	Do Nothing / Existing Layout				Proposed Layout			
Year	AM peak				AM peak			
	LoS	Average Delay (s)	Queue (m)	DoS	LoS	Average Delay (s)	Queue (m)	DoS
2019	F	324	2,155 (S)	1.334	B	28	29{E}	0.267
2029	F	1039	5,632 (S)	1.939	C	29	45(S)	0.405
2039	F	2898	9,675	3.792	C	35	110 (S)	0.713

Table 5-8 – PM – peak do nothing and proposal upgrade comparison

Year	Do Nothing / Existing Layout				Proposed Layout			
	PM peak				PM peak			
	LoS	Average Delay (s)	Queue (m)	DoS	LoS	Average Delay (s)	Queue (m)	DoS
2019	F	454	2,205 (N)	2.153	B	25	32{E}	0.292
2029	F	2,074	4,780 (N)	6.85	C	29	73{E}	0.511
2039	F	3,154	8,222 (N)	7.280	C	33	243{E}	0.926

The level of service improvement for the existing intersection is mainly due to the cul-de-sac arrangements at the northern and southern tie-ins and the construction of the proposal. This would alleviate the existing intersection traffic constraints.

The existing intersection of The Northern Road, Bringelly Road and Greendale Road would operate over capacity in the PM peak of the future modelled years 2029 and 2039 even with the grade separated intersection constructed. This is due to a predicted land release in the area.

5.9 Property access

Property access within the project area is shown in Figure 30. 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. 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 are included below preliminary review of property access indicates the following:

- 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.

With the proposal, there would be changes to the average travel times and distances in the study area as a result of the following changes:

- The intersection of Robinson Road and The Northern Road is proposed to be a cul-de-sac, compelling traffic to take alternate routes via Bringelly Road or Carrington Road to access The Northern Road

- The Northern Road at Thames Road and Robinson Road would be a cul-de-sac due to the proposal and would make road users take alternative routes to reach their destinations
- The extension of Belmore Road will provide a new connection between Robinson Road and The Northern Road.

The proposed average travel distances are shown in Table 5-9. Travel distance calculations using Google maps are shown in Appendix A.

Table 5-9 – Proposed average travel distances from Robinson Road

From	To	Additional travel distance (m)	Additional travel time (minutes)*
Robinson Road at The Northern Road	The Northern Road / Carrington Road Intersection	2,700	2
	The Northern Road / Bringelly Road Intersection	3,400	2.6
	The Northern Road / Loftus Road Intersection	4,000	3
Thames Road at The Northern Road	The Northern Road / Badgerys Creek Road	1,500	0.8

Source: GHD 2015

*Note: * travel time based on the existing speed environment of 80 km/h.*

6. Recommended mitigation measures

A summary of the recommended mitigation measures is provided below.

6.1 Construction mitigation measures

The following proposed traffic management principles would be adopted during the construction period:

- A traffic management plan would be developed and incorporated into the Construction Environmental Management Plan (CEMP)
- Property owners would be consulted in advance regarding temporary impacts to property access
- Disruption to all road users during the construction period would be kept to a minimum
- The movement of materials would be managed through the scheduling of deliveries and availability of fleet, and would aim to minimise the number of haulage and delivery vehicles during peak periods and on weekends. An exception to this would be the delivery of Super “T” girders for the construction of the interchange. This would require approval from Roads and Maritime in the form of a Heavy Vehicle Permit and would most likely occur overnight during the period with the lowest volumes of traffic on the state road network
- Construction and delivery vehicles entering or leaving the site compound and/or stockpile sites would use arterial roads wherever possible. Vehicle deliveries would be restricted to nominated times within the approved Construction Traffic Management Plan
- A detailed Construction Traffic Management Plan is developed as part of the detailed design stage
- Provisions for safe pedestrian access across the construction site would be maintained during construction
- Consultation would be undertaken with Bringelly Public School to ensure safe walking to School can be maintained during the construction period
- Consultation with the Transport Management Centre would be undertaken to manage cumulative construction traffic impacts
- A speed limit review of the traffic diversion through Robinson Road and Jersey Road should be undertaken to determine if a temporary speed reduction is required during the temporary diversion
- The relocation of bus stops would be done in consultation with local bus service providers
- Clear signage would be available to notify the public of relocated bus stop locations
- In most cases property access would be maintained throughout the construction period with suitable alternative access arrangements provided otherwise.

6.2 Operational mitigation measures

Based on the assessment within this report, there are no additional operational mitigation measures required should the proposal proceed. The proposal provides for an improved LoS for vehicles and improves public transport, and pedestrian and cycling facilities.

7. Summary and conclusion

7.1 Overview

The purpose of this study was to assess the traffic and transport impact from the operation and construction of the proposed The Northern Road / Bringelly Road grade separated interchange. The key findings of the assessment are detailed below.

7.2 Key findings

7.2.1 Existing conditions

The existing traffic volumes indicate that all roads within the study area are within the expected functional classification.

There is one bus service operating within the study area currently operating with an infrequent service throughout the day.

The intersection of Bringelly Road / The Northern Road currently operates satisfactorily at a LoS C in both the AM and PM peak periods.

The majority of crashes in the study area were rear end crashes. These crashes occurred predominantly on The Northern Road, with eight crashes recorded on the north and southern legs. Out of all rear end crashes, six of these occurred during peak hour. Off road accidents were also common on approaches of Greendale Road and The Northern Road South of Bringelly Road.

7.2.2 Construction traffic impact

During the peak construction stage up to 50 truck movements per day would be generated. The majority of these truck movements would take place outside the peak periods, and based on a worst case scenario, about 10 movements would be expected to access the site in the AM and PM peak hours.

It is noted that Roads and Maritime is considering the construction of multiple projects in this area at the same time. The construction traffic along multiple work sites would need to be considered in the construction traffic management plan, depending on the contract form for the construction.

During construction, the existing intersection of The Northern Road and Bringelly Road would improve in operation to LoS B in both the AM and PM peaks; this is due to the closure of Bringelly Road resulting in reduced movements at this intersection.

The traffic detour will redirect traffic through the intersection of The Northern Road and Robinson Road which would operate with spare capacity (LoS B) in the AM peak period and over capacity in the PM peak period (LoS F). It is recommended that temporary widening be undertaken at the intersection to accommodate construction traffic during the diversion would improve the operation of this intersection. A detailed Construction Traffic Management Plan is to be developed prior to construction commencing

7.2.3 Operational traffic impact

The Commonwealth and NSW Government have committed $3.6 billion over 10 years in major road infrastructure upgrades in Western Sydney. These upgrades will relieve pressure on existing infrastructure and provide connectivity to the proposed western Sydney airport and surrounding areas.

The NSW Government has started planning for a continuation of the South West Rail Link to extend to Badgerys Creek and on to St Marys, where it would connect with Western Line services as well as south to Narellan.

The future bus route is expected to have seven buses in each direction during peak periods.

The Bringelly Road Stage 1 and Stage 2 upgrades described in the Western Sydney Infrastructure Plan will deliver more than 10 km of shared pedestrian and cyclist paths between Leppington and The Northern Road.

The existing intersection of The Northern Road and Bringelly Road during the forecasted years of 2019, 2029 and 2039 would operate over capacity at LoS F during both the AM and PM peaks for all three years analysed

The intersection of The Northern Road and Bringelly Road under the proposed grade separated interchange will operate with spare capacity at LoS B in both the AM and PM peaks for the future scenarios modelled in 2019, 2029 and 2039.

The existing intersection of The Northern Road, Bringelly Road and Greendale Road would operate over capacity in the PM peak of the future modelled years 2029 and 2039 even with the grade separated intersection constructed. This is due to a predicted land release in the area. Upgrading of this intersection is outside the scope of this study and will need to be investigated further. 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.

7.2.4 Mitigation measures

Mitigation measures are to be undertaken to minimise the construction stage impacts on the surrounding road network. A CTMP will be prepared and approved prior to construction commencement.

7.3 Conclusion

The existing signalised intersection of The Northern Road / Bringelly Road /Greendale Road is currently operating at LoS C with minimal delays and queuing.

With the forecasted growth rate figures for the surrounding area, this existing intersection, with no improvements would operate over capacity at LoS of F in 2019, 2029 and 2039, resulting in lengthy queues and extended delays.

Under the proposed grade separated arrangement the modelling indicates that the proposed intersection would operate with spare capacity at LoS B in both the AM and PM peak periods in the future analysed years of 2019, 2029 and 2039 when including the forecasted traffic growth figures.

The proposed grade separation intersection will assist greatly to alleviate the intersection delays with the forecasted traffic growth along The Northern Road and Bringelly Road by ensuring that both The Northern Road and Bringelly Road have sufficient capacity to cater to future traffic growth associated with both the South West Growth Centre and western Sydney airport; and inter-regional traffic prior to the development of the Outer Sydney Orbital.

Based on the assessment within this report, the proposal provides for an improved Level of Service for vehicles and improves public transport, walking and cycling.

8. References

Transport for NSW 856 Bus Timetable

Structure Plan for the South West Growth Centre (2005)

The *Northern Road Corridor Strategy* (Roads and Maritime, 2009)

SIDRA 6.1 user guide (Ackelik and Associates) (7 August 2014)

Highway Capacity Manual 2010, Chapter 31 (TRB 2010a)

Skyhigh Traffic Data Australia Pty Ltd (Skyhigh

Intersection Diagnostics Monitor (IDM) information - Roads and Maritime (June 2014).

Roads and Maritime Cycleway Finder

http://www.rms.nsw.gov.au/roads/using-roads/bicycles/cyclewayfinder/index.html (accessed 01 August 2015)

Transport for NSW Crash statistics

Maps: Southern Section, Transport for NSW 2015 (http://www.transport.nsw.gov.au/sites/default/files/b2b/projects/swrl-phase2-maps.pdf)

Sydney's Cycling Future (Transport for NSW, 2013)

AUSTROADS, 2009, *Guide to Traffic Management, Part 4 - Network Management*.

Hyder, June 2013, Bringelly Brickworks and Quarry Expansion Environmental Impact Statement Volumes 1 and 2

Roads and Maritime Services, 2014, Journey Information & Digital, Strategy & Engagement.

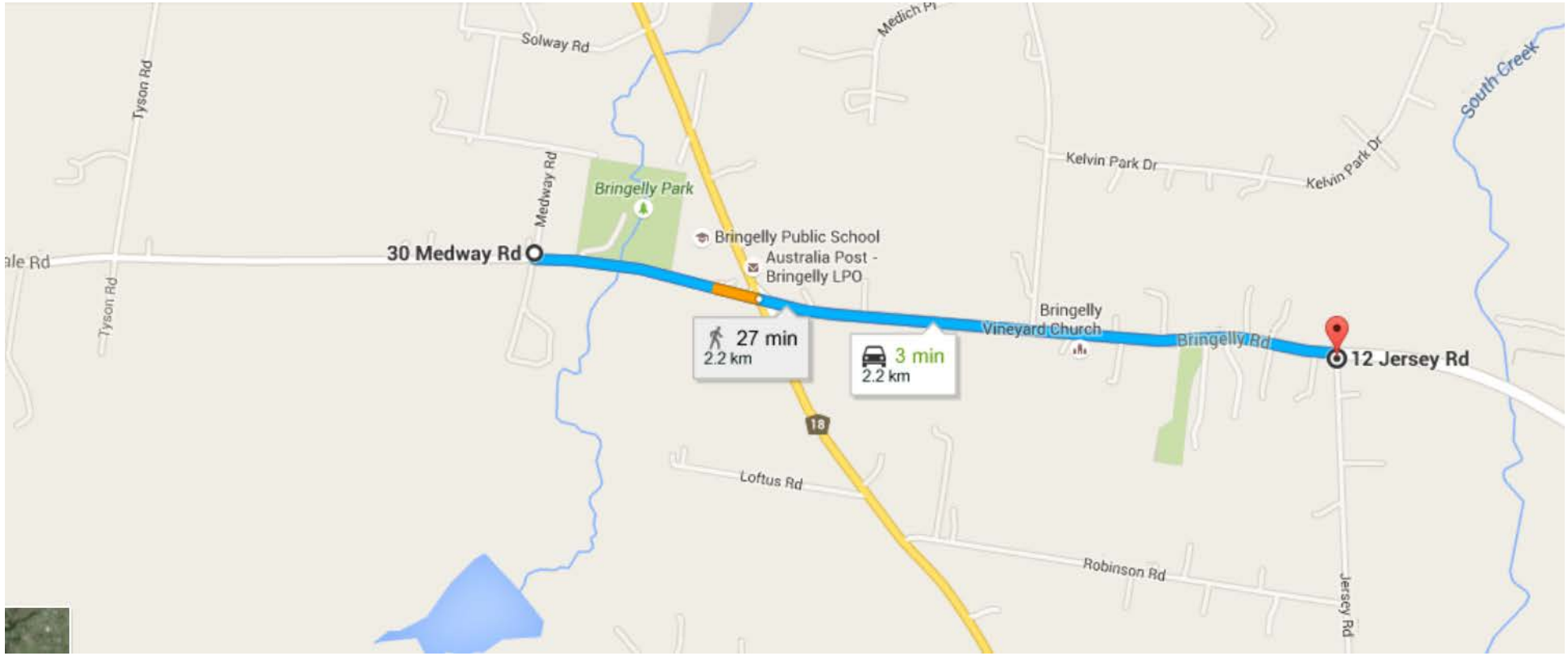
Roads and Maritime Services, 2002, Guide to Traffic Generating Developments.

The Northern Road Stage 2B – The Northern Road / Bringelly Road Grade Separated Interchange Property Access Strategy, GHD September 2015(Appendix F)

Google, 2015, Google Earth

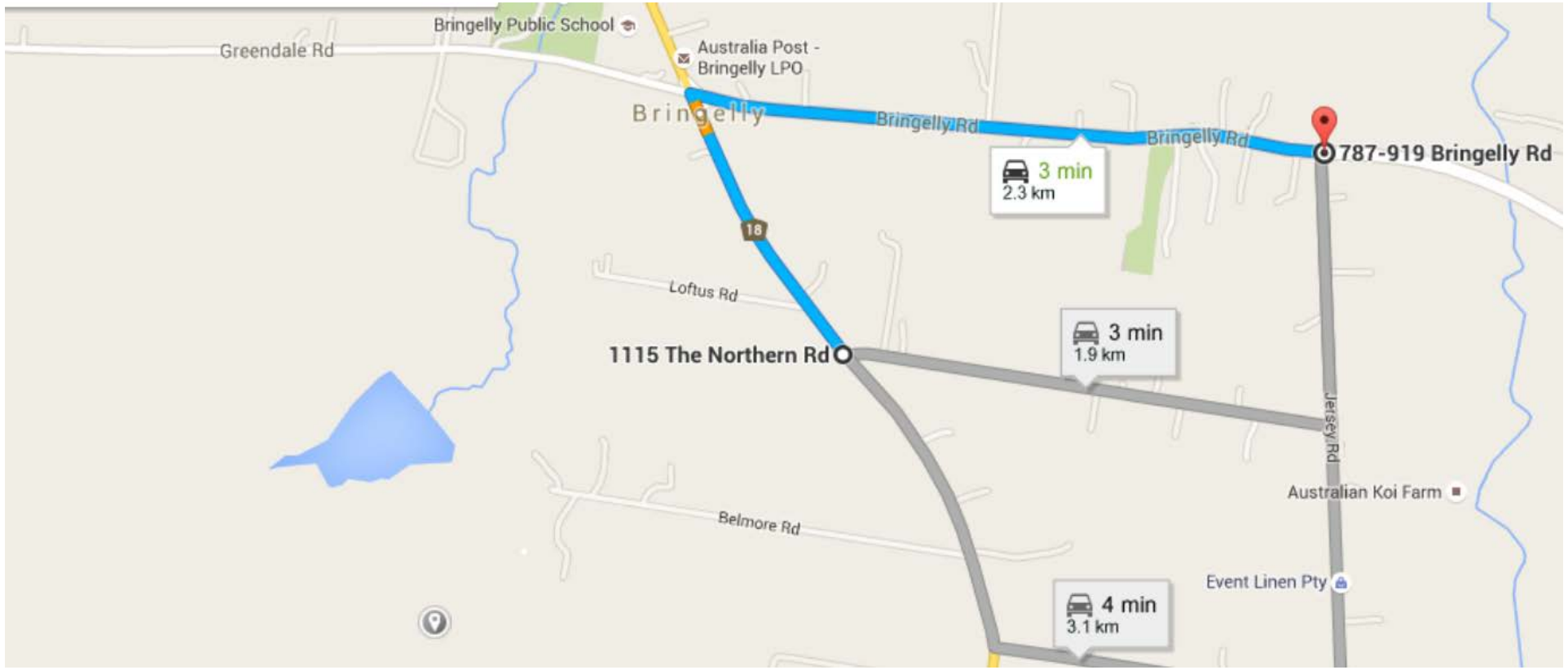
Appendix A – Travel Time and Distance Maps

Average travel time between Medway Road/Greendale intersection to Jersey Road/Bringelly Road intersection



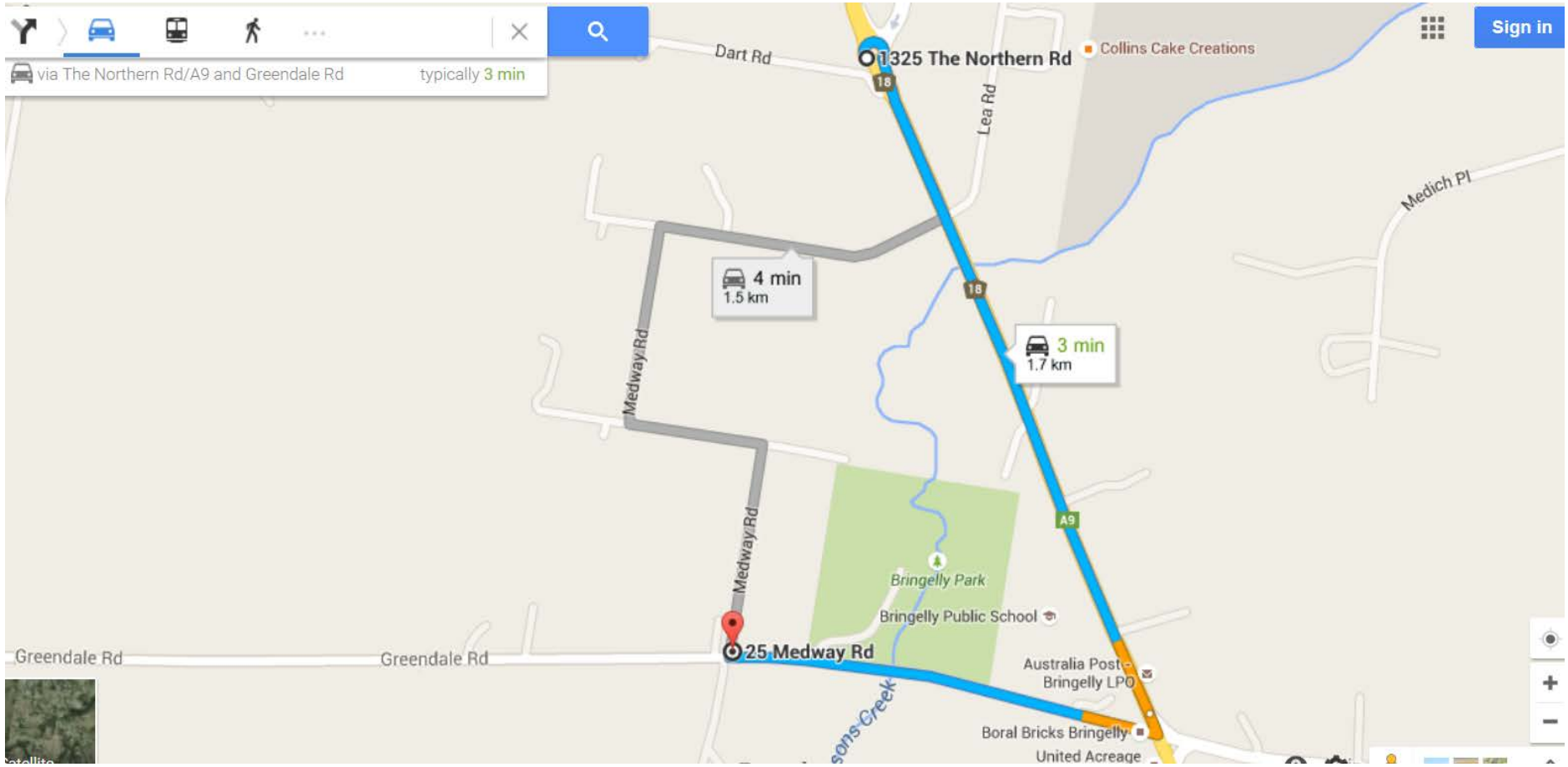
Route 1

Average travel time between Robinson Road/The Northern Road intersection to Jersey Road/Bringelly Road intersection



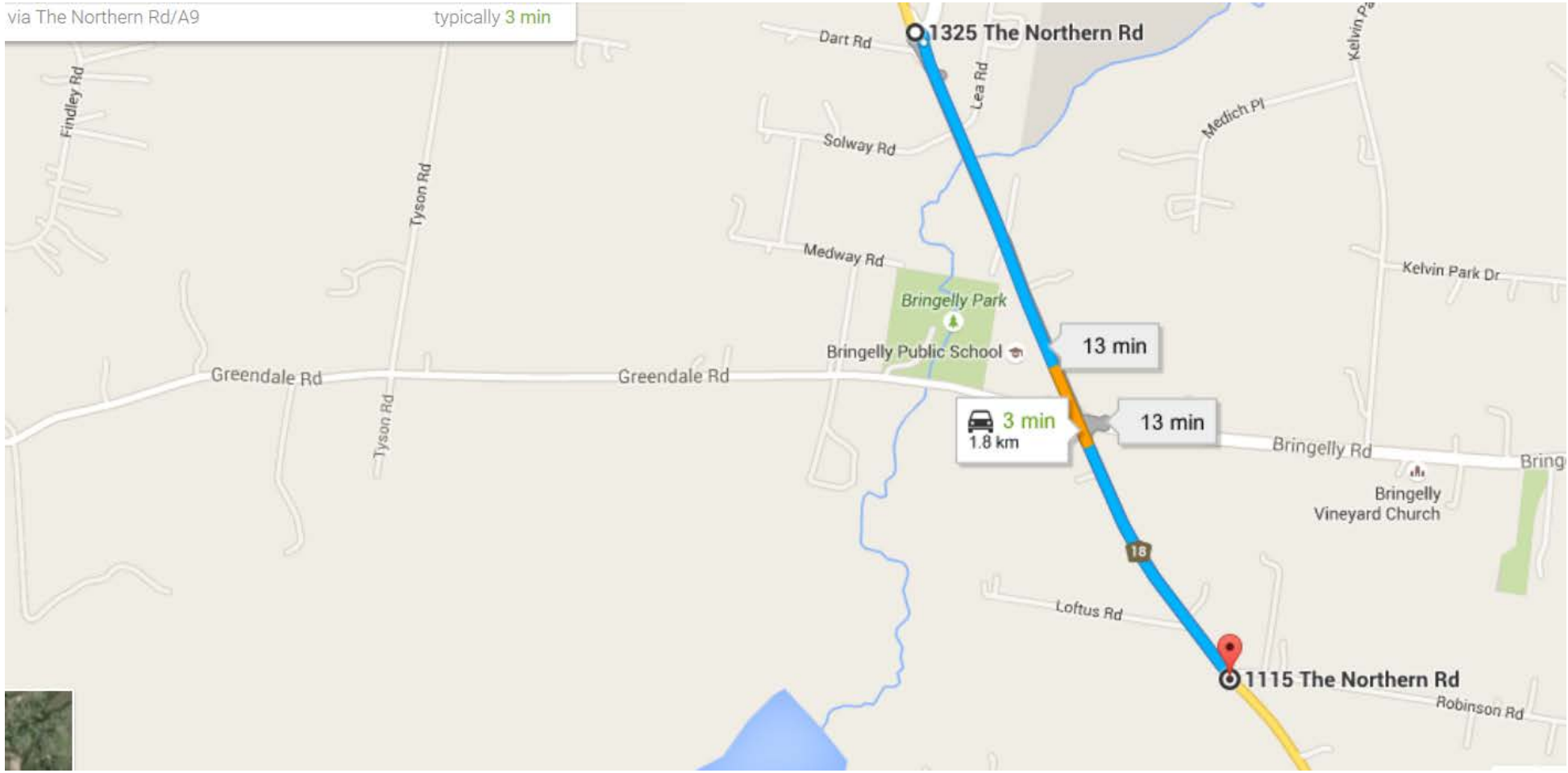
Route 2

Average travel time between The Northern Road/Badgerys Creek Road intersection to Medway Road/Greendale Road intersection



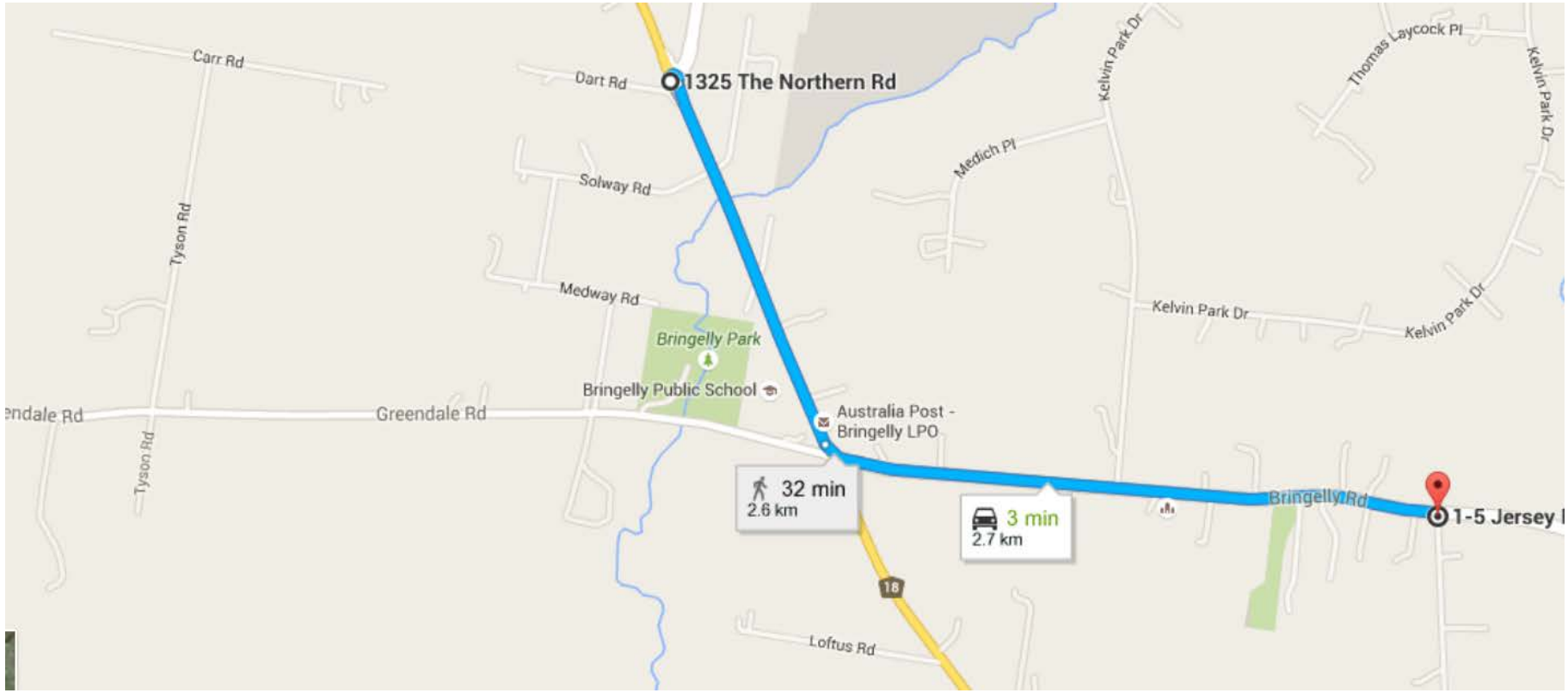
Route 3

Average travel time between The Northern Road/ Badgerys Creek Road intersection to The Northern Road/Robinson Road intersection



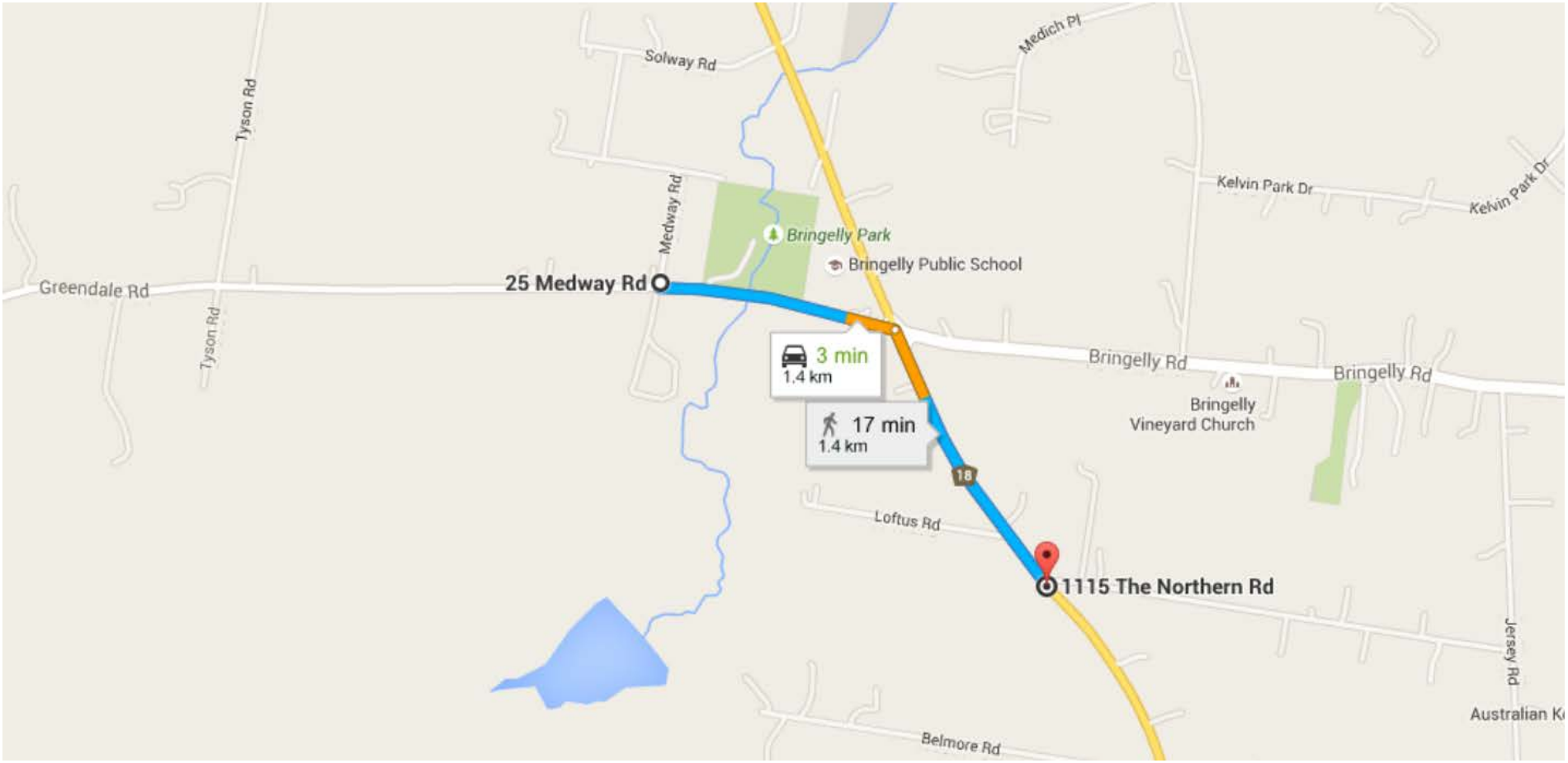
Route 4

Average travel time between The Northern Road/ Badgerys Creek Road intersection to Bringelly Road/Jersey Road intersection



Route 5

Average travel time between Greendale Road/ Medway Road intersection to Robinson Road/The Northern Road intersection

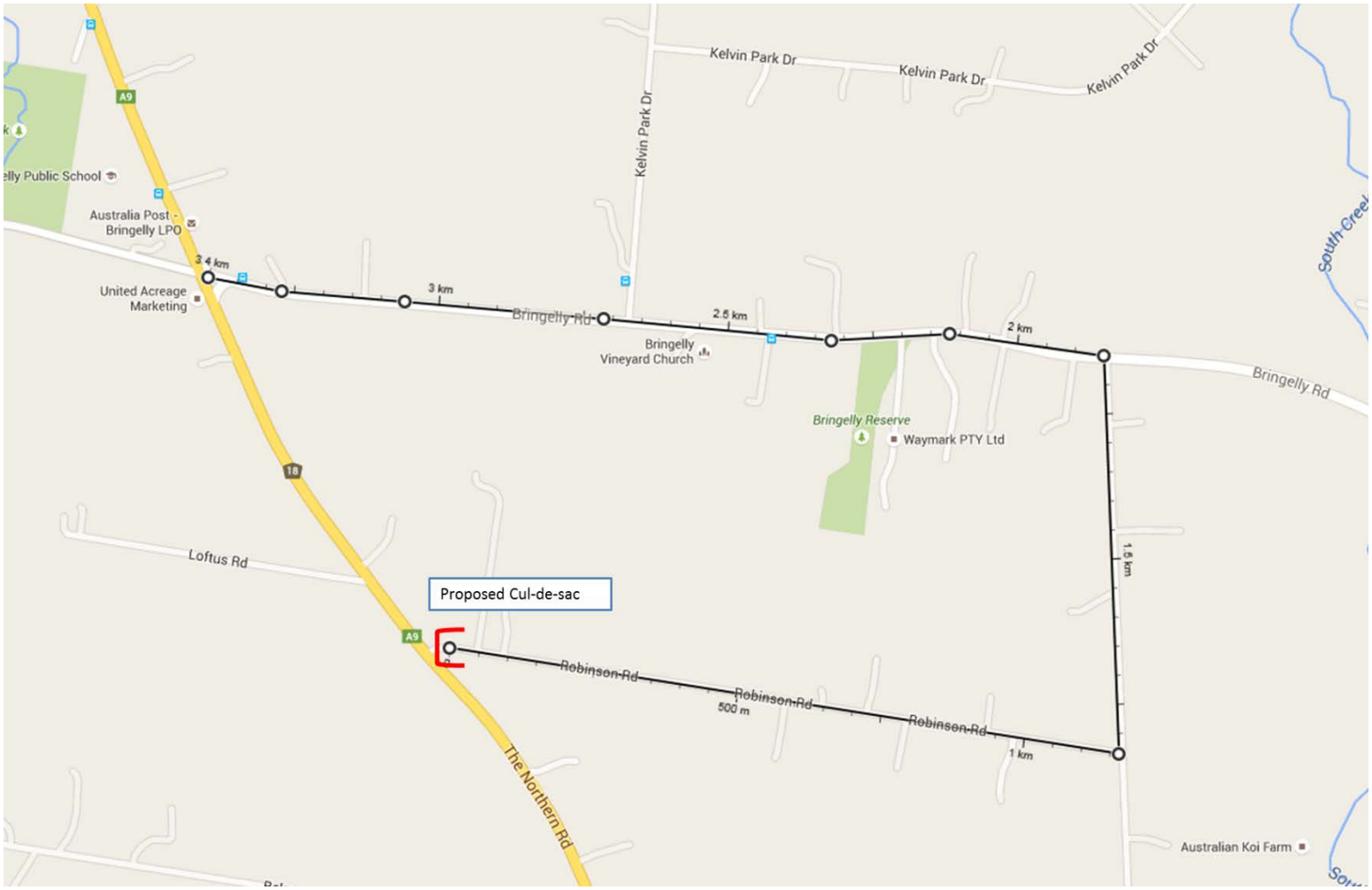


Route 6

Travel distance southbound from Robinson Road / The Northern Road intersection to The Northern Road / Carrington Road intersection, due to the proposed Robinson Road Cul-de-sac.

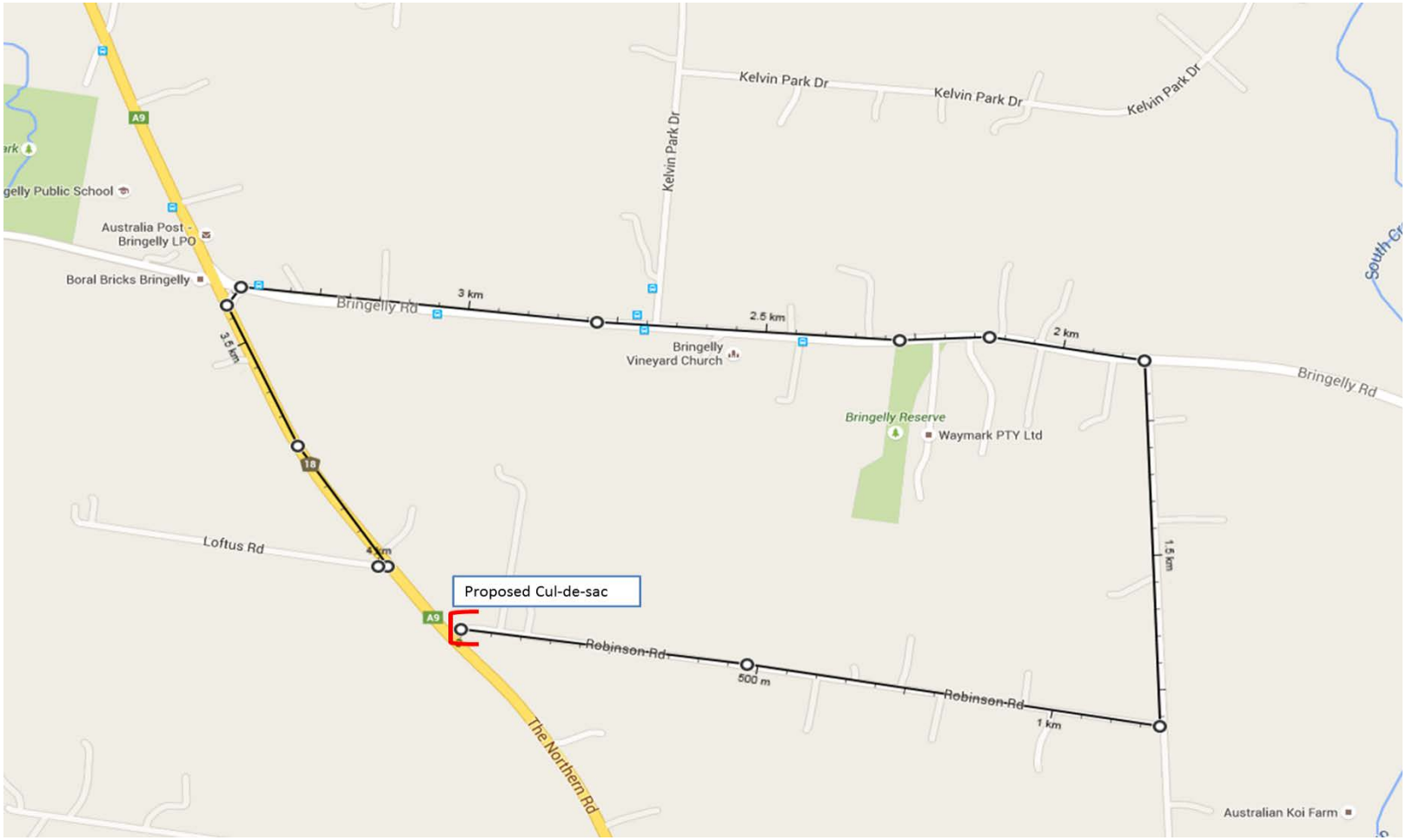
Southbound detour

Travel distance northbound from Robinson Road / The Northern Road intersection to The Northern Road / Bringelly Road intersection, due to the proposed Robinson Road Cul-de-sac.



Northbound detour 1

Travel distance northbound from Robinson Road / The Northern Road intersection to The Northern Road / Loftus Road intersection, due to the proposed Robinson Road Cul-de-sac.



Northbound detour 2

Appendix B – Traffic Survey Data

The Northern Road, north of Bringelly Road – Southbound Traffic Volumes

Job No	N1840
Client	RMS
Road	The Northern Rd - north of Bringelly Rd
Location	Bringelly
Site No.	16
Start Date	16-Jun-15
Description	Volume Summary
Direction	SB

Average Weekday	8,526
7 Day Average	7,854

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun		
AM Peak	713	709	643	603	616	511	486		
PM Peak	952	881	906	992	916	561	570		
0:00	21	26	28	30	27	51	77	26	37
1:00	11	18	20	14	15	33	34	16	21
2:00	23	23	17	14	14	16	25	18	19
3:00	35	29	33	27	35	18	16	32	28
4:00	87	66	69	79	86	37	23	77	64
5:00	283	257	239	268	236	106	46	257	205
6:00	713	709	634	603	491	222	79	630	493
7:00	662	690	643	600	616	251	114	642	511
8:00	541	514	567	526	530	313	223	536	459
9:00	445	430	435	448	443	373	315	440	413
10:00	387	361	388	359	433	429	431	386	398
11:00	352	388	352	381	392	511	486	373	409
12:00	357	432	379	390	412	501	475	394	421
13:00	404	428	398	402	497	561	475	426	452
14:00	553	511	498	547	594	489	523	541	531
15:00	714	707	723	720	756	523	532	724	668
16:00	883	871	900	992	916	542	570	912	811
17:00	952	881	906	927	914	472	469	916	789
18:00	595	515	529	521	576	361	355	547	493
19:00	228	189	226	238	259	185	183	228	215
20:00	121	121	120	166	179	125	138	141	139
21:00	97	103	81	139	136	138	106	111	114
22:00	63	86	114	89	131	138	75	97	99
23:00	42	44	79	38	79	138	41	56	66
Total	8569	8399	8378	8518	8767	6533	5811	8526	7854

7-19	6845	6728	6718	6813	7079	5326	4968	6837	6354
6-22	8004	7850	7779	7959	8144	5996	5474	7947	7315
6-24	8109	7980	7972	8086	8354	6272	5590	8100	7480
0-24	8569	8399	8378	8518	8767	6533	5811	8526	7854

The Northern Road, north of Bringelly Road – Northbound Traffic Volumes

Job No	N1840
Client	RMS
Road	The Northern Rd - north of Bringelly Rd
Location	Bringelly
Site No.	16
Start Date	16-Jun-15
Description	Volume Summary
Direction	NB

Average Weekday	8,389
7 Day Average	7,739

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun		
AM Peak	1073	1009	987	995	900	513	563		
PM Peak	759	672	623	711	680	499	553		
0:00	18	16	16	15	17	51	69	16	29
1:00	12	15	13	11	13	20	25	13	16
2:00	21	16	20	14	20	24	17	18	19
3:00	53	49	36	39	38	26	17	43	37
4:00	128	114	119	115	109	62	29	117	97
5:00	406	334	348	322	317	113	52	345	270
6:00	738	690	670	677	615	210	73	678	525
7:00	1073	1009	987	995	900	291	149	993	772
8:00	787	726	710	734	636	305	219	719	588
9:00	468	445	462	431	470	432	343	455	436
10:00	385	416	367	403	414	491	444	397	417
11:00	339	440	367	397	404	513	563	389	432
12:00	384	418	417	409	460	477	483	418	435
13:00	377	434	406	396	471	454	483	417	432
14:00	484	446	455	472	526	483	447	477	473
15:00	692	616	615	711	680	465	505	663	612
16:00	759	672	623	679	665	464	553	680	631
17:00	640	570	563	628	661	499	479	612	577
18:00	353	324	369	329	411	318	280	357	341
19:00	184	174	185	218	255	188	202	203	201
20:00	119	119	124	138	179	149	158	136	141
21:00	96	109	80	138	118	141	107	108	113
22:00	61	72	98	86	155	163	66	94	100
23:00	29	24	51	32	69	103	22	41	47
Total	8606	8248	8101	8389	8603	6442	5785	8389	7739
7-19	6741	6516	6341	6584	6698	5192	4948	6576	6146
6-22	7878	7608	7400	7755	7865	5880	5488	7701	7125
6-24	7968	7704	7549	7873	8089	6146	5576	7837	7272
0-24	8606	8248	8101	8389	8603	6442	5785	8389	7739

Bringelly Road, east of The Northern Road – Eastbound Traffic Volumes

Job No	N1840
Client	RMS
Road	Bringelly Rd - east of The Northern Rd
Location	Bringelly
Site No.	17
Start Date	16-Jun-15
Description	Volume Summary
Direction	EB

Average Weekday	3,237
7 Day Average	3,019

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun		
AM Peak	372	363	353	351	334	242	168		
PM Peak	289	268	246	293	267	266	208		
0:00	9	9	8	10	8	24	49	9	17
1:00	7	12	6	9	7	13	17	8	10
2:00	10	7	8	11	11	3	9	9	8
3:00	24	21	18	16	19	11	9	20	17
4:00	46	35	37	40	45	20	9	41	33
5:00	141	129	130	134	116	44	21	130	102
6:00	282	281	266	245	228	67	26	260	199
7:00	372	363	353	351	334	96	47	355	274
8:00	234	235	259	222	243	111	99	239	200
9:00	178	192	185	205	193	140	117	191	173
10:00	147	165	153	164	159	198	157	158	163
11:00	152	159	149	165	142	242	168	153	168
12:00	161	148	136	159	160	207	193	153	166
13:00	155	166	180	150	173	197	161	165	169
14:00	185	198	161	199	170	266	179	183	194
15:00	287	240	242	251	248	195	205	254	238
16:00	289	268	246	293	267	229	208	273	257
17:00	237	206	229	242	233	190	201	229	220
18:00	171	137	175	145	193	122	119	164	152
19:00	74	75	80	84	84	95	58	79	79
20:00	53	56	41	61	52	69	56	53	55
21:00	40	50	36	63	48	70	46	47	50
22:00	31	35	62	30	57	66	34	43	45
23:00	11	16	27	13	46	72	13	23	28
Total	3296	3203	3187	3262	3236	2747	2201	3237	3019

7-19	2568	2477	2468	2546	2515	2193	1854	2515	2374
6-22	3017	2939	2891	2999	2927	2494	2040	2955	2758
6-24	3059	2990	2980	3042	3030	2632	2087	3020	2831
0-24	3296	3203	3187	3262	3236	2747	2201	3237	3019

Bringelly Road, east of The Northern Road – Westbound Traffic Volumes

Job No	N1840
Client	RMS
Road	Bringelly Rd - east of The Northern Rd
Location	Bringelly
Site No.	17
Start Date	16-Jun-15
Description	Volume Summary
Direction	WB

Average Weekday	3,225
7 Day Average	2,999

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun		
AM Peak	224	244	231	242	237	215	206		
PM Peak	375	347	305	359	331	235	216		
0:00	8	5	9	9	11	23	33	8	14
1:00	3	4	6	7	5	13	11	5	7
2:00	9	5	4	3	3	3	5	5	5
3:00	7	14	11	7	9	6	6	10	9
4:00	34	43	27	26	28	10	10	32	25
5:00	93	75	79	81	74	36	16	80	65
6:00	205	167	160	159	160	71	28	170	136
7:00	224	230	231	217	194	96	44	219	177
8:00	223	244	219	242	237	181	82	233	204
9:00	194	194	179	178	186	190	136	186	180
10:00	142	189	174	155	174	215	189	167	177
11:00	144	160	145	173	156	185	206	156	167
12:00	160	192	163	176	150	235	216	168	185
13:00	144	192	160	183	164	213	168	169	175
14:00	208	205	204	191	214	200	189	204	202
15:00	331	326	279	332	318	222	150	317	280
16:00	375	347	305	359	331	178	157	343	293
17:00	295	259	288	283	292	193	145	283	251
18:00	178	160	195	170	205	123	124	182	165
19:00	112	81	97	105	116	114	59	102	98
20:00	69	63	79	67	96	77	68	75	74
21:00	41	51	32	58	55	60	44	47	49
22:00	31	32	38	49	54	68	15	41	41
23:00	8	11	31	23	37	37	17	22	23
Total	3238	3249	3115	3253	3269	2749	2118	3225	2999
7-19	2618	2698	2542	2659	2621	2231	1806	2628	2454
6-22	3045	3060	2910	3048	3048	2553	2005	3022	2810
6-24	3084	3103	2979	3120	3139	2658	2037	3085	2874
0-24	3238	3249	3115	3253	3269	2749	2118	3225	2999

The Northern Road, south of Bringelly Road – Northbound Traffic Volumes

Job No	N1840
Client	RMS
Road	The Northern Rd - south of Bringelly Rd
Location	Bringelly
Site No.	18
Start Date	16-Jun-15
Description	Volume Summary
Direction	NB

Average Weekday	7,408
7 Day Average	6,885

	Day of Week								
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	7 Day
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	W'day	Ave
AM Peak	993	933	879	902	826	494	473		
PM Peak	601	525	519	590	574	455	503		
0:00	15	16	12	13	15	46	71	14	27
1:00	13	21	10	9	13	19	27	13	16
2:00	14	12	21	18	20	23	18	17	18
3:00	48	35	30	28	35	26	11	35	30
4:00	118	106	100	110	103	61	22	107	89
5:00	376	321	326	298	301	107	44	324	253
6:00	672	605	590	643	534	193	70	609	472
7:00	993	933	879	902	826	260	128	907	703
8:00	741	633	653	648	615	260	197	658	535
9:00	423	421	414	393	405	401	285	411	392
10:00	364	373	341	373	375	475	400	365	386
11:00	337	404	341	354	371	494	473	361	396
12:00	353	371	378	359	407	427	429	374	389
13:00	330	386	383	343	426	414	460	374	392
14:00	462	397	441	429	458	455	408	437	436
15:00	548	471	519	590	547	430	503	535	515
16:00	601	525	514	546	574	450	503	552	530
17:00	516	467	443	490	545	444	412	492	474
18:00	305	293	284	269	360	295	235	302	292
19:00	145	186	163	190	219	169	171	181	178
20:00	109	104	101	126	143	135	143	117	123
21:00	80	98	85	151	116	138	104	106	110
22:00	49	61	80	65	141	144	58	79	85
23:00	25	24	42	24	69	98	20	37	43
Total	7637	7263	7150	7371	7618	5964	5192	7408	6885

7-19	5973	5674	5590	5696	5909	4805	4433	5768	5440
6-22	6979	6667	6529	6806	6921	5440	4921	6780	6323
6-24	7053	6752	6651	6895	7131	5682	4999	6896	6452
0-24	7637	7263	7150	7371	7618	5964	5192	7408	6885

The Northern Road, south of Bringelly Road – Southbound Traffic Volumes

Job No	N1840
Client	RMS
Road	The Northern Rd - south of Bringelly Rd
Location	Bringelly
Site No.	18
Start Date	16-Jun-15
Description	Volume Summary
Direction	SB

Average Weekday	7,337
7 Day Average	6,819

	Day of Week								
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	7 Day
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	W'day	Ave
AM Peak	539	517	458	442	481	452	459		
PM Peak	857	830	824	886	839	516	477		
0:00	13	20	27	23	24	37	70	21	31
1:00	9	13	17	11	16	28	29	13	18
2:00	16	22	14	13	8	16	19	15	15
3:00	26	20	28	20	30	21	12	25	22
4:00	62	44	48	56	67	25	20	55	46
5:00	203	178	155	177	153	86	33	173	141
6:00	539	517	439	439	350	202	64	457	364
7:00	432	475	458	433	410	217	95	442	360
8:00	455	428	454	442	481	296	185	452	392
9:00	409	387	383	392	383	331	279	391	366
10:00	357	339	371	332	398	424	412	359	376
11:00	340	370	315	345	369	452	459	348	379
12:00	329	405	361	346	388	514	446	366	398
13:00	341	364	337	363	432	516	440	367	399
14:00	474	445	472	478	534	421	469	481	470
15:00	649	639	629	627	719	492	477	653	605
16:00	799	760	816	886	835	479	461	819	719
17:00	857	830	824	875	839	433	387	845	721
18:00	543	484	493	491	520	333	299	506	452
19:00	217	172	189	197	248	156	159	205	191
20:00	101	98	112	150	168	101	119	126	121
21:00	83	103	68	129	115	120	90	100	101
22:00	46	64	75	75	110	118	59	74	78
23:00	32	38	65	36	56	108	35	45	53
Total	7332	7215	7150	7336	7653	5926	5118	7337	6819

7-19	5985	5926	5913	6010	6308	4908	4409	6028	5637
6-22	6925	6816	6721	6925	7189	5487	4841	6915	6415
6-24	7003	6918	6861	7036	7355	5713	4935	7035	6546
0-24	7332	7215	7150	7336	7653	5926	5118	7337	6819

Greendale Road, west of The Northern Road – Eastbound Traffic Volumes

Job No	N1840
Client	RMS
Road	Greendale Rd - west of The Northern Rd
Location	Bringelly
Site No.	19
Start Date	16-Jun-15
Description	Volume Summary
Direction	EB

Average Weekday	1,079
7 Day Average	1,064

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun		
AM Peak	116	112	98	118	122	139	74		
PM Peak	100	93	79	80	106	122	81		
0:00	0	5	4	4	3	5	29	3	7
1:00	3	3	1	2	4	2	8	3	3
2:00	1	4	2	6	4	1	1	3	3
3:00	15	16	14	15	15	14	6	15	14
4:00	15	15	16	12	10	8	4	14	11
5:00	39	34	31	36	22	8	9	32	26
6:00	62	64	60	54	49	17	3	58	44
7:00	93	97	93	98	89	40	23	94	76
8:00	116	112	98	118	122	44	32	113	92
9:00	70	69	71	71	58	56	57	68	65
10:00	58	79	69	65	59	132	73	66	76
11:00	66	72	56	65	63	139	74	64	76
12:00	54	63	51	55	61	122	81	57	70
13:00	57	43	61	55	59	102	58	55	62
14:00	74	88	67	80	86	111	73	79	83
15:00	100	93	79	78	106	69	81	91	87
16:00	81	79	69	78	84	67	67	78	75
17:00	56	72	62	80	66	75	63	67	68
18:00	40	41	72	50	59	38	33	52	48
19:00	26	16	17	21	24	33	27	21	23
20:00	10	17	15	14	15	30	16	14	17
21:00	18	35	10	12	8	42	19	17	21
22:00	5	8	16	5	17	20	9	10	11
23:00	0	5	5	3	9	29	2	4	8
Total	1059	1130	1039	1077	1092	1204	848	1079	1064
7-19	865	908	848	893	912	995	715	885	877
6-22	981	1040	950	994	1008	1117	780	995	981
6-24	986	1053	971	1002	1034	1166	791	1009	1000
0-24	1059	1130	1039	1077	1092	1204	848	1079	1064

Greendale Road, west of The Northern Road – Westbound Traffic Volumes

Job No	N1840
Client	RMS
Road	Greendale Rd - west of The Northern Rd
Location	Bringelly
Site No.	19
Start Date	16-Jun-15
Description	Volume Summary
Direction	WB

Average Weekday	1,068
7 Day Average	1,057

Time	Day of Week							Ave W'day	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	22-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun		
AM Peak	73	69	71	71	73	140	70		
PM Peak	102	126	107	122	135	110	83		
0:00	2	4	3	5	4	9	20	4	7
1:00	1	3	1	2	3	6	10	2	4
2:00	1	1	2	3	3	1	5	2	2
3:00	0	4	3	2	2	3	1	2	2
4:00	10	5	5	4	3	5	1	5	5
5:00	23	30	32	34	28	11	9	29	24
6:00	52	45	29	31	28	15	9	37	30
7:00	62	55	47	37	42	22	12	49	40
8:00	73	55	71	70	69	66	25	68	61
9:00	67	69	63	71	65	111	50	67	71
10:00	49	67	50	61	73	140	70	60	73
11:00	63	66	57	55	57	107	53	60	65
12:00	52	61	56	86	54	103	72	62	69
13:00	64	75	60	59	50	110	70	62	70
14:00	83	71	83	53	76	89	83	73	77
15:00	102	95	107	122	109	87	78	107	100
16:00	97	126	94	106	135	74	67	112	100
17:00	90	80	80	76	92	56	43	84	74
18:00	60	61	63	50	73	51	42	61	57
19:00	38	59	37	44	41	60	22	44	43
20:00	28	29	38	26	29	44	35	30	33
21:00	20	22	22	34	29	36	22	25	26
22:00	12	14	9	19	19	27	2	15	15
23:00	4	5	14	7	16	20	8	9	11
Total	1053	1102	1026	1057	1100	1253	809	1068	1057

7-19	862	881	831	846	895	1016	665	863	857
6-22	1000	1036	957	981	1022	1171	753	999	989
6-24	1016	1055	980	1007	1057	1218	763	1023	1014
0-24	1053	1102	1026	1057	1100	1253	809	1068	1057

Appendix C - SIDRA Outputs

SIDRA Outputs

2015
Existing Conditions

MOVEMENT SUMMARY

Site: 2015 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 143 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	9	11.1	0.872	39.2	LOS C	50.1	370.6	0.88	0.84	37.7
2	T1	831	5.4	0.872	33.5	LOS C	50.1	370.6	0.88	0.84	38.7
3	R2	46	4.3	0.144	35.7	LOS C	2.0	14.8	0.65	0.72	37.0
Approach		886	5.4	0.872	33.7	LOS C	50.1	370.6	0.87	0.83	38.6
East: Bringelly Rd (E)											
4	L2	38	13.2	0.129	33.4	LOS C	2.2	18.0	0.76	0.68	38.9
5	T1	18	27.8	0.129	27.7	LOS B	2.2	18.0	0.76	0.68	39.5
6	R2	154	5.8	0.523	58.3	LOS E	9.1	67.2	0.87	0.78	30.2
Approach		210	9.0	0.523	51.2	LOS D	9.1	67.2	0.84	0.76	32.2
North: The Northern Road (N)											
7	L2	221	5.4	0.155	9.5	LOS A	3.6	26.2	0.25	0.65	50.5
8	T1	368	11.7	0.408	22.2	LOS B	15.0	115.9	0.62	0.55	44.0
9	R2	8	62.5	0.102	64.7	LOS E	0.5	5.4	0.85	0.70	28.0
Approach		597	10.1	0.408	18.0	LOS B	15.0	115.9	0.49	0.59	45.8
West: Greendale Rd (W)											
10	L2	9	0.0	0.049	70.8	LOS F	0.6	4.0	0.91	0.67	27.4
11	T1	64	10.9	0.374	65.2	LOS E	5.5	43.1	0.93	0.74	28.7
12	R2	20	15.0	0.374	70.9	LOS F	5.5	43.1	0.93	0.74	28.1
Approach		93	10.8	0.374	67.0	LOS E	5.5	43.1	0.93	0.73	28.4
All Vehicles		1786	7.7	0.872	32.3	LOS C	50.1	370.6	0.74	0.73	39.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	62.9	LOS F	0.2	0.2	0.94	0.94
P4	West Full Crossing	50	22.4	LOS C	0.1	0.1	0.56	0.56
All Pedestrians		100	42.7	LOS E			0.75	0.75

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2015 PM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 102 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	25	0.0	0.537	25.0	LOS B	16.2	123.6	0.71	0.64	44.3
2	T1	460	10.0	0.537	19.5	LOS B	16.2	123.6	0.71	0.64	45.3
3	R2	47	10.6	0.447	55.3	LOS D	2.4	18.6	0.94	0.76	30.8
Approach		532	9.6	0.537	22.9	LOS B	16.2	123.6	0.73	0.65	43.4
East: Bringelly Rd (E)											
4	L2	71	9.9	0.363	36.9	LOS C	4.2	32.7	0.87	0.80	38.0
5	T1	69	11.6	0.363	31.2	LOS C	4.2	32.7	0.87	0.80	38.6
6	R2	206	9.2	1.015	138.2	LOS F	16.3	124.0	1.00	1.14	18.2
Approach		346	9.8	1.015	96.1	LOS F	16.3	124.0	0.95	1.00	23.1
North: The Northern Road (N)											
7	L2	172	7.6	0.130	9.6	LOS A	2.4	17.6	0.29	0.65	50.4
8	T1	788	5.6	0.936	36.4	LOS C	42.0	311.9	0.93	0.97	37.5
9	R2	23	8.7	0.079	32.0	LOS C	0.8	6.0	0.69	0.70	38.4
Approach		983	6.0	0.936	31.6	LOS C	42.0	311.9	0.81	0.90	39.3
West: Greendale Rd (W)											
10	L2	23	13.0	0.124	52.8	LOS D	1.1	8.3	0.91	0.71	31.5
11	T1	62	6.5	0.400	46.2	LOS D	4.8	35.2	0.93	0.75	33.5
12	R2	40	5.0	0.400	51.8	LOS D	4.8	35.2	0.93	0.75	32.8
Approach		125	7.2	0.400	49.2	LOS D	4.8	35.2	0.93	0.74	32.9
All Vehicles		1986	7.7	1.015	41.6	LOS C	42.0	311.9	0.82	0.84	35.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	42.5	LOS E	0.1	0.1	0.91	0.91
P4	West Full Crossing	50	20.1	LOS C	0.1	0.1	0.63	0.63
All Pedestrians		100	31.3	LOS D			0.77	0.77

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA Outputs

2016
Construction

MOVEMENT SUMMARY

Site: 2016 AM Construction The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 43 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	9	11.1	0.128	10.0	LOS A	1.2	9.0	0.46	0.40	53.8
2	T1	834	5.6	0.639	6.5	LOS A	10.0	74.3	0.66	0.59	54.2
Approach		843	5.7	0.639	6.5	LOS A	10.0	74.3	0.66	0.59	54.2
North: The Northern Road (N)											
8	T1	592	9.6	0.458	5.6	LOS A	6.0	45.8	0.57	0.50	54.9
9	R2	8	62.5	0.036	17.2	LOS B	0.1	1.3	0.67	0.66	44.1
Approach		600	10.3	0.458	5.8	LOS A	6.0	45.8	0.57	0.50	54.7
West: Greendale Rd (W)											
10	L2	9	0.0	0.041	25.2	LOS B	0.2	1.2	0.89	0.66	41.6
12	R2	84	11.9	0.351	25.8	LOS B	1.7	13.7	0.92	0.75	40.9
Approach		93	10.8	0.351	25.8	LOS B	1.7	13.7	0.92	0.74	41.0
All Vehicles		1536	7.8	0.639	7.4	LOS A	10.0	74.3	0.64	0.56	53.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	13.5	LOS B	0.0	0.0	0.79	0.79
P4	West Full Crossing	50	10.5	LOS B	0.0	0.0	0.70	0.70
All Pedestrians		100	12.0	LOS B			0.75	0.75

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2016 PM Construction The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	25	0.0	0.063	10.6	LOS A	1.5	11.0	0.30	0.37	52.6
2	T1	473	10.1	0.313	7.8	LOS A	10.7	82.1	0.37	0.34	53.0
Approach		498	9.6	0.313	8.0	LOS A	10.7	82.1	0.37	0.34	53.0
North: The Northern Road (N)											
8	T1	963	6.1	0.615	10.4	LOS A	27.5	204.7	0.48	0.44	51.3
9	R2	23	8.7	0.045	16.6	LOS B	0.6	4.6	0.38	0.65	45.8
Approach		986	6.2	0.615	10.5	LOS A	27.5	204.7	0.48	0.45	51.1
West: Greendale Rd (W)											
10	L2	23	13.0	0.077	63.2	LOS E	1.4	11.0	0.85	0.71	28.9
12	R2	102	5.9	0.283	62.4	LOS E	6.3	46.6	0.87	0.77	29.1
Approach		125	7.2	0.283	62.5	LOS E	6.3	46.6	0.86	0.76	29.1
All Vehicles		1609	7.3	0.615	13.8	LOS A	27.5	204.7	0.47	0.44	48.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	58.2	LOS E	0.2	0.2	0.88	0.88
P4	West Full Crossing	50	9.7	LOS A	0.1	0.1	0.36	0.36
All Pedestrians		100	34.0	LOS D			0.62	0.62

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2016 PM Construction The Northern Road and Bringelly Road (Heavy Vehicles Allowed)

New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	25	0.0	0.383	14.9	LOS B	13.9	106.4	0.41	0.39	50.6
2	T1	473	10.1	0.383	9.4	LOS A	13.9	106.4	0.41	0.39	51.8
3	R2	5	100.0	0.064	38.2	LOS C	0.2	3.1	0.62	0.68	35.4
Approach		503	10.5	0.383	9.9	LOS A	13.9	106.4	0.42	0.39	51.5
East: Bringelly Rd (E)											
4	L2	5	100.0	0.026	19.8	LOS B	0.2	2.0	0.45	0.63	43.9
6	R2	5	100.0	0.114	88.7	LOS F	0.4	5.0	0.97	0.66	23.9
Approach		10	100.0	0.114	54.2	LOS D	0.4	5.0	0.71	0.64	31.0
North: The Northern Road (N)											
7	L2	5	100.0	0.006	9.8	LOS A	0.1	1.0	0.22	0.61	49.0
8	T1	963	6.1	0.758	14.4	LOS A	41.2	306.9	0.64	0.60	48.5
9	R2	23	8.7	0.049	18.3	LOS B	0.7	5.0	0.41	0.66	44.8
Approach		991	6.7	0.758	14.5	LOS A	41.2	306.9	0.64	0.60	48.4
West: Greendale Rd (W)											
10	L2	23	13.0	0.100	69.5	LOS E	1.5	11.6	0.89	0.71	27.5
12	R2	102	5.9	0.425	73.3	LOS F	7.0	51.3	0.94	0.78	26.8
Approach		125	7.2	0.425	72.6	LOS F	7.0	51.3	0.93	0.77	26.9
All Vehicles		1629	8.5	0.758	17.8	LOS B	41.2	306.9	0.59	0.55	46.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	56.5	LOS E	0.2	0.2	0.87	0.87
P4	West Full Crossing	50	10.5	LOS B	0.1	0.1	0.37	0.37
All Pedestrians		100	33.5	LOS D			0.62	0.62

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2016 AM Construction The Northern Road and Robinson Road

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
2	T1	834	5.6	0.502	1.0	LOS A	1.8	13.4	0.17	0.04	58.4
3	R2	50	8.0	0.502	12.7	LOS A	1.8	13.4	0.17	0.04	55.9
Approach		884	5.8	0.502	1.7	NA	1.8	13.4	0.17	0.04	58.2
East: Robinson Rd (E)											
4	L2	44	15.9	0.774	18.5	LOS B	4.1	30.9	0.85	1.22	39.6
6	R2	184	7.6	0.774	31.4	LOS C	4.1	30.9	0.85	1.22	39.5
Approach		228	9.2	0.774	28.9	LOS C	4.1	30.9	0.85	1.22	39.5
North: The Northern Road (N)											
7	L2	291	6.5	0.366	5.7	LOS A	0.0	0.0	0.00	0.26	55.7
8	T1	371	12.1	0.366	0.1	LOS A	0.0	0.0	0.00	0.26	57.5
Approach		662	9.7	0.366	2.5	NA	0.0	0.0	0.00	0.26	56.7
All Vehicles		1774	7.7	0.774	5.5	NA	4.1	30.9	0.19	0.27	54.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2016 PM Construction The Northern Road and Robinson Road

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
2	T1	483	12.0	0.457	6.9	LOS A	4.1	31.9	0.51	0.10	52.5
3	R2	63	11.1	0.457	22.8	LOS B	4.1	31.9	0.51	0.10	50.3
Approach		546	11.9	0.457	8.7	NA	4.1	31.9	0.51	0.10	52.2
East: Robinson Rd (E)											
4	L2	76	11.8	0.852	20.4	LOS B	4.6	35.4	0.93	1.39	43.4
6	R2	282	9.6	0.852	21.2	LOS B	4.6	35.4	0.93	1.39	43.1
Approach		358	10.1	0.852	21.0	LOS B	4.6	35.4	0.93	1.39	43.2
North: The Northern Road (N)											
7	L2	244	7.0	0.556	5.7	LOS A	0.0	0.0	0.00	0.14	56.7
8	T1	791	5.8	0.556	0.1	LOS A	0.0	0.0	0.00	0.14	58.5
Approach		1035	6.1	0.556	1.4	NA	0.0	0.0	0.00	0.14	58.1
All Vehicles		1939	8.5	0.852	7.1	NA	4.6	35.4	0.31	0.36	53.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2016 AM Construction The Northern Road and Robinson Road (Signals)

New Site
Signals - Actuated Isolated Cycle Time = 83 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
2	T1	834	5.6	0.929	28.3	LOS B	40.1	296.6	0.98	1.01	40.8
3	R2	50	8.0	0.929	33.9	LOS C	40.1	296.6	0.98	1.01	39.5
Approach		884	5.8	0.929	28.6	LOS C	40.1	296.6	0.98	1.01	40.7
East: Robinson Rd (E)											
4	L2	44	15.9	0.512	36.2	LOS C	8.1	61.3	0.89	0.81	36.7
6	R2	184	7.6	0.512	36.0	LOS C	8.1	61.3	0.89	0.81	36.7
Approach		228	9.2	0.512	36.0	LOS C	8.1	61.3	0.89	0.81	36.7
North: The Northern Road (N)											
7	L2	291	6.5	0.608	17.2	LOS B	16.8	127.6	0.66	0.69	47.4
8	T1	371	12.1	0.608	11.6	LOS A	16.8	127.6	0.66	0.69	48.7
Approach		662	9.7	0.608	14.0	LOS A	16.8	127.6	0.66	0.69	48.1
All Vehicles		1774	7.7	0.929	24.1	LOS B	40.1	296.6	0.85	0.86	42.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2016 PM Construction The Northern Road and Robinson Road (Signals)

New Site
Signals - Actuated Isolated Cycle Time = 91 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
2	T1	483	12.0	1.585	1103.0	LOS F	191.6	1494.8	1.00	5.32	3.1
3	R2	63	11.1	1.585	1108.6	LOS F	191.6	1494.8	1.00	5.32	3.1
Approach		546	11.9	1.585	1103.6	LOS F	191.6	1494.8	1.00	5.32	3.1
East: Robinson Rd (E)											
4	L2	76	11.8	0.645	35.9	LOS C	13.8	106.0	0.89	0.83	36.9
6	R2	282	9.6	0.645	35.8	LOS C	13.8	106.0	0.89	0.83	36.7
Approach		358	10.1	0.645	35.8	LOS C	13.8	106.0	0.89	0.83	36.7
North: The Northern Road (N)											
7	L2	244	7.0	1.011	91.3	LOS F	85.0	631.7	1.00	1.44	24.3
8	T1	791	5.8	1.011	85.6	LOS F	85.0	631.7	1.00	1.44	24.7
Approach		1035	6.1	1.011	87.0	LOS F	85.0	631.7	1.00	1.44	24.6
All Vehicles		1939	8.5	1.585	363.8	LOS F	191.6	1494.8	0.98	2.42	8.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA Outputs

Existing scenario with background growth

MOVEMENT SUMMARY

Site: 2019 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 98 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	29	10.3	1.334	657.3	LOS F	290.4	2154.6	1.00	4.64	5.1
2	T1	1074	5.4	1.334	651.7	LOS F	290.4	2154.6	1.00	4.64	5.1
3	R2	123	4.9	0.430	32.6	LOS C	4.6	33.5	0.78	0.78	38.2
Approach		1226	5.5	1.334	589.7	LOS F	290.4	2154.6	0.98	4.26	5.6
East: Bringelly Rd (E)											
4	L2	58	13.8	0.306	28.1	LOS B	2.9	24.1	0.86	0.73	41.5
5	T1	42	28.6	0.306	22.4	LOS B	2.9	24.1	0.86	0.73	42.2
6	R2	193	5.7	0.909	52.3	LOS D	9.3	68.4	0.96	0.85	31.8
Approach		293	10.6	0.909	43.3	LOS D	9.3	68.4	0.93	0.81	34.6
North: The Northern Road (N)											
7	L2	234	5.6	0.176	9.9	LOS A	3.3	24.5	0.32	0.66	50.2
8	T1	423	11.6	0.463	17.0	LOS B	12.8	98.8	0.67	0.59	46.9
9	R2	13	61.5	0.191	61.5	LOS E	0.7	7.1	0.98	0.67	28.8
Approach		670	10.4	0.463	15.4	LOS B	12.8	98.8	0.55	0.61	47.4
West: Greendale Rd (W)											
10	L2	9	0.0	0.039	48.1	LOS D	0.4	2.7	0.89	0.67	33.0
11	T1	93	9.7	0.487	44.7	LOS D	5.7	44.3	0.94	0.76	34.2
12	R2	32	15.6	0.487	50.4	LOS D	5.7	44.3	0.94	0.76	33.3
Approach		134	10.4	0.487	46.3	LOS D	5.7	44.3	0.94	0.75	33.9
All Vehicles		2323	7.8	1.334	323.8	LOS F	290.4	2154.6	0.85	2.57	9.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	40.5	LOS E	0.1	0.1	0.91	0.91
P4	West Full Crossing	50	18.4	LOS B	0.1	0.1	0.61	0.61
All Pedestrians		100	29.5	LOS C			0.76	0.76

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2019 PM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 134 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	25	0.0	0.815	46.2	LOS D	31.2	245.8	0.92	0.82	35.3
2	T1	528	9.5	0.815	40.7	LOS C	31.2	245.8	0.92	0.82	35.9
3	R2	120	9.2	2.153	2161.5	LOS F	61.2	510.7	1.00	3.21	1.6
Approach		673	9.1	2.153	419.0	LOS F	61.2	510.7	0.93	1.25	7.6
East: Bringelly Rd (E)											
4	L2	189	9.5	0.570	48.6	LOS D	13.3	105.7	0.88	0.91	33.7
5	T1	105	10.5	0.570	42.8	LOS D	13.3	105.7	0.88	0.91	34.1
6	R2	205	8.8	1.160	457.0	LOS F	38.8	298.6	1.00	1.70	7.0
Approach		499	9.4	1.160	215.2	LOS F	38.8	298.6	0.93	1.23	13.2
North: The Northern Road (N)											
7	L2	211	7.6	0.175	13.8	LOS A	4.8	36.8	0.37	0.68	47.6
8	T1	909	4.8	1.440	860.1	LOS F	294.9	2204.5	1.00	4.26	4.0
9	R2	33	6.1	0.258	66.2	LOS E	2.0	15.0	0.91	0.74	28.3
Approach		1153	5.4	1.440	682.5	LOS F	294.9	2204.5	0.88	3.50	4.9
West: Greendale Rd (W)											
10	L2	80	13.8	0.232	55.9	LOS D	4.4	34.5	0.85	0.76	30.7
11	T1	127	6.3	0.545	51.7	LOS D	13.0	98.2	0.91	0.79	31.8
12	R2	97	4.1	0.545	57.3	LOS E	13.0	98.2	0.91	0.79	31.2
Approach		304	7.6	0.545	54.6	LOS D	13.0	98.2	0.90	0.78	31.3
All Vehicles		2629	7.3	2.153	453.7	LOS F	294.9	2204.5	0.91	2.18	7.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	50.3	LOS E	0.2	0.2	0.87	0.87
P4	West Full Crossing	50	34.5	LOS D	0.1	0.1	0.72	0.72
All Pedestrians		100	42.4	LOS E			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2029 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 88 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	92	10.9	1.939	1741.5	LOS F	753.7	5632.2	1.00	8.69	2.0
2	T1	1597	5.4	1.939	1735.8	LOS F	753.7	5632.2	1.00	8.69	2.0
3	R2	351	4.3	1.799	1495.1	LOS F	145.3	1054.0	1.00	4.51	2.3
Approach		2040	5.5	1.939	1694.7	LOS F	753.7	5632.2	1.00	7.97	2.1
East: Bringelly Rd (E)											
4	L2	101	12.9	0.786	40.5	LOS C	8.1	67.2	0.99	0.87	36.7
5	T1	122	27.9	0.786	34.7	LOS C	8.1	67.2	0.99	0.87	37.2
6	R2	303	5.9	1.640	1227.7	LOS F	111.0	816.2	1.00	4.25	2.8
Approach		526	12.4	1.640	723.1	LOS F	111.0	816.2	1.00	2.82	4.7
North: The Northern Road (N)											
7	L2	282	5.3	0.221	10.6	LOS A	4.2	30.5	0.36	0.68	49.8
8	T1	561	11.6	0.643	18.6	LOS B	17.8	137.0	0.78	0.69	46.0
9	R2	21	61.9	0.277	56.1	LOS D	1.0	10.4	0.98	0.69	30.0
Approach		864	10.8	0.643	16.9	LOS B	17.8	137.0	0.65	0.69	46.5
West: Greendale Rd (W)											
10	L2	24	0.0	0.094	43.3	LOS D	0.9	6.5	0.88	0.70	34.5
11	T1	200	11.0	0.947	48.0	LOS D	13.1	102.4	1.00	0.94	33.1
12	R2	69	14.5	0.947	53.7	LOS D	13.1	102.4	1.00	0.94	32.3
Approach		293	10.9	0.947	49.0	LOS D	13.1	102.4	0.99	0.92	33.1
All Vehicles		3723	8.1	1.939	1038.5	LOS F	753.7	5632.2	0.92	5.00	3.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	35.5	LOS D	0.1	0.1	0.90	0.90
P4	West Full Crossing	50	18.5	LOS B	0.1	0.1	0.65	0.65
All Pedestrians		100	27.0	LOS C			0.77	0.77

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2029 PM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	108	0.0	1.565	1110.6	LOS F	301.0	2344.6	1.00	4.21	3.1
2	T1	691	9.4	1.565	1105.1	LOS F	301.0	2344.6	1.00	4.21	3.1
3	R2	342	8.5	6.847	10624.4	LOS F	266.1	2203.5	1.00	4.27	0.3
Approach		1141	8.2	6.847	3958.9	LOS F	301.0	2344.6	1.00	4.22	0.9
East: Bringelly Rd (E)											
4	L2	436	9.9	1.584	1096.3	LOS F	244.6	1940.3	1.00	2.84	3.2
5	T1	247	10.1	1.584	1090.6	LOS F	244.6	1940.3	1.00	2.84	3.2
6	R2	235	8.5	1.724	1548.5	LOS F	99.7	764.3	1.00	3.00	2.3
Approach		918	9.6	1.724	1210.5	LOS F	244.6	1940.3	1.00	2.88	2.9
North: The Northern Road (N)											
7	L2	310	7.4	0.267	17.1	LOS B	9.1	69.7	0.43	0.70	45.7
8	T1	1220	4.9	2.182	2212.1	LOS F	638.9	4780.2	1.00	6.15	1.6
9	R2	55	9.1	1.074	230.5	LOS F	7.6	57.4	1.00	1.06	12.4
Approach		1585	5.6	2.182	1714.1	LOS F	638.9	4780.2	0.89	4.91	2.1
West: Greendale Rd (W)											
10	L2	491	13.6	1.675	1323.1	LOS F	201.0	1571.3	1.00	2.89	2.6
11	T1	324	6.5	1.702	1363.8	LOS F	247.0	1877.1	1.00	4.02	2.6
12	R2	268	5.2	1.702	1369.4	LOS F	247.0	1877.1	1.00	4.02	2.6
Approach		1083	9.4	1.702	1346.7	LOS F	247.0	1877.1	1.00	3.51	2.6
All Vehicles		4727	7.9	6.847	2074.0	LOS F	638.9	4780.2	0.96	4.03	1.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	50.5	LOS E	0.2	0.2	0.82	0.82
P4	West Full Crossing	50	41.9	LOS E	0.2	0.2	0.75	0.75
All Pedestrians		100	46.2	LOS E			0.78	0.78

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2039 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 44 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	188	11.2	3.546	4619.5	LOS F	1285.2	9674.9	1.00	17.08	0.8
2	T1	1915	5.4	3.546	4613.9	LOS F	1285.2	9674.9	1.00	17.08	0.8
3	R2	672	4.5	3.792	5059.3	LOS F	420.3	3054.7	1.00	10.60	0.7
Approach		2775	5.6	3.792	4722.1	LOS F	1285.2	9674.9	1.00	15.51	0.8
East: Bringelly Rd (E)											
4	L2	131	13.0	1.394	729.9	LOS F	94.0	786.0	1.00	4.13	4.7
5	T1	249	27.7	1.394	724.2	LOS F	94.0	786.0	1.00	4.13	4.7
6	R2	433	5.8	1.762	1403.6	LOS F	163.6	1201.9	1.00	7.51	2.5
Approach		813	13.7	1.762	1086.9	LOS F	163.6	1201.9	1.00	5.93	3.2
North: The Northern Road (N)											
7	L2	374	5.3	0.353	10.9	LOS A	4.2	31.3	0.54	0.73	49.5
8	T1	699	11.7	1.213	408.4	LOS F	118.9	920.3	1.00	4.94	7.8
9	R2	21	61.9	0.138	29.4	LOS C	0.5	5.0	0.95	0.68	38.5
Approach		1094	10.5	1.213	265.2	LOS F	118.9	920.3	0.84	3.42	11.2
West: Greendale Rd (W)											
10	L2	76	0.0	0.356	27.3	LOS B	1.7	11.6	0.94	0.75	40.7
11	T1	371	11.1	2.048	1914.0	LOS F	220.4	1734.0	1.00	8.92	1.9
12	R2	127	15.0	2.048	1919.7	LOS F	220.4	1734.0	1.00	8.92	1.8
Approach		574	10.5	2.048	1665.4	LOS F	220.4	1734.0	0.99	7.84	2.1
All Vehicles		5256	8.4	3.792	2898.3	LOS F	1285.2	9674.9	0.97	10.68	1.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	13.9	LOS B	0.0	0.0	0.80	0.80
P4	West Full Crossing	50	13.9	LOS B	0.0	0.0	0.80	0.80
All Pedestrians		100	13.9	LOS B			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2039 PM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	188	0.0	2.050	1986.9	LOS F	506.6	3923.8	1.00	5.44	1.8
2	T1	827	9.4	2.050	1981.4	LOS F	506.6	3923.8	1.00	5.44	1.8
3	R2	363	8.8	7.280	11404.2	LOS F	285.0	2372.0	1.00	4.31	0.3
Approach		1378	8.0	7.280	4464.4	LOS F	506.6	3923.8	1.00	5.15	0.8
East: Bringelly Rd (E)											
4	L2	823	9.8	2.611	2952.1	LOS F	721.7	5732.3	1.00	4.17	1.2
5	T1	469	10.2	2.611	2946.3	LOS F	721.7	5732.3	1.00	4.17	1.2
6	R2	301	8.6	1.874	1796.4	LOS F	139.2	1069.1	1.00	3.25	2.0
Approach		1593	9.7	2.611	2732.0	LOS F	721.7	5732.3	1.00	4.00	1.3
North: The Northern Road (N)											
7	L2	436	7.6	0.373	17.7	LOS B	13.8	106.0	0.47	0.72	45.3
8	T1	1739	4.9	3.080	3832.5	LOS F	1099.3	8222.4	1.00	7.43	0.9
9	R2	137	8.8	2.673	3108.4	LOS F	81.1	610.2	1.00	3.23	1.2
Approach		2312	5.6	3.080	3070.2	LOS F	1099.3	8222.4	0.90	5.91	1.2
West: Greendale Rd (W)											
10	L2	214	13.6	0.552	63.3	LOS E	13.9	108.6	0.91	0.82	28.9
11	T1	555	4.9	2.560	2897.5	LOS F	635.0	4586.9	1.00	5.38	1.2
12	R2	545	2.6	2.560	2903.0	LOS F	635.0	4586.9	1.00	5.38	1.2
Approach		1314	5.3	2.560	2438.2	LOS F	635.0	4586.9	0.99	4.64	1.5
All Vehicles		6597	7.0	7.280	3153.9	LOS F	1099.3	8222.4	0.96	5.04	1.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	51.4	LOS E	0.2	0.2	0.83	0.83
P4	West Full Crossing	50	44.2	LOS E	0.2	0.2	0.77	0.77
All Pedestrians		100	47.8	LOS E			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA Outputs

Grade separated intersection

MOVEMENT SUMMARY

Site: 2019 AM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 92 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Rd (S)											
1	L2	29	10.3	0.031	7.5	LOS A	0.3	2.4	0.25	0.48	53.0
2	T1	6	100.0	0.031	1.8	LOS A	0.3	2.4	0.25	0.48	53.4
3	R2	123	4.9	0.136	35.7	LOS C	2.2	15.7	0.79	0.72	37.1
Approach		158	9.5	0.136	29.1	LOS C	2.2	15.7	0.67	0.67	39.7
East: Bringelly Rd (E)											
4	L2	58	13.8	0.102	29.9	LOS C	2.4	19.6	0.88	0.73	40.1
5	T1	42	28.6	0.102	36.4	LOS C	2.4	19.6	0.92	0.68	36.9
6	R2	193	5.7	0.267	39.4	LOS C	4.0	29.1	0.84	0.75	34.6
Approach		293	10.6	0.267	37.1	LOS C	4.0	29.1	0.86	0.74	36.0
North: The Northern Rd (N)											
7	L2	234	5.6	0.166	6.4	LOS A	1.2	9.2	0.18	0.59	52.8
8	T1	2	100.0	0.166	0.8	LOS A	1.2	9.2	0.18	0.59	53.4
9	R2	13	61.5	0.013	26.4	LOS B	0.2	2.0	0.64	0.63	39.3
Approach		249	9.2	0.166	7.4	LOS A	1.2	9.2	0.21	0.60	51.9
West: Bringelly Rd (W)											
10	L2	9	0.0	0.239	43.2	LOS D	1.8	13.4	0.92	0.68	35.0
11	T1	93	9.7	0.239	44.1	LOS D	1.8	13.4	0.94	0.69	34.8
12	R2	32	15.6	0.055	37.5	LOS C	0.7	5.7	0.80	0.68	35.9
Approach		134	10.4	0.239	42.5	LOS C	1.8	13.4	0.91	0.68	35.0
All Vehicles		834	10.0	0.267	27.6	LOS B	4.0	29.1	0.64	0.67	40.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P11	South Stage 1	50	4.6	LOS A	0.0	0.0	0.32	0.32
P12	South Stage 2	50	15.2	LOS B	0.1	0.1	0.81	0.81
P1S	South Slip/Bypass Lane Crossing	50	0.5	LOS A	0.0	0.0	0.15	0.15
P21	East Stage 1	50	5.2	LOS A	0.0	0.0	0.34	0.34
P22	East Stage 2	50	34.9	LOS D	0.1	0.1	0.87	0.87
P2S	East Slip/Bypass Lane Crossing	50	0.5	LOS A	0.0	0.0	0.15	0.15
P31	North Stage 1	50	8.7	LOS A	0.1	0.1	0.44	0.44
P32	North Stage 2	50	40.3	LOS E	0.1	0.1	0.94	0.94
P3S	North Slip/Bypass Lane Crossing	50	0.5	LOS A	0.0	0.0	0.15	0.15
P41	West Stage 1	50	5.2	LOS A	0.0	0.0	0.34	0.34
P42	West Stage 2	50	40.3	LOS E	0.1	0.1	0.94	0.94
P4S	West Slip/Bypass Lane Crossing	50	0.5	LOS A	0.0	0.0	0.15	0.15
All Pedestrians		600	13.0	LOS B			0.47	0.47

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2019 PM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 92 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: The Northern Rd (S)											
1	L2	43	0.0	0.035	6.1	LOS A	0.2	1.3	0.15	0.51	53.9
2	T1	4	100.0	0.035	0.5	LOS A	0.2	1.3	0.15	0.51	54.0
3	R2	122	10.7	0.146	36.8	LOS C	2.2	16.7	0.80	0.72	36.6
Approach		169	10.1	0.146	28.0	LOS B	2.2	16.7	0.62	0.66	40.1
East: Bringelly Rd (E)											
4	L2	190	10.0	0.212	12.9	LOS A	2.6	19.7	0.56	0.69	48.9
5	T1	107	12.1	0.207	40.0	LOS C	2.2	16.9	0.90	0.68	36.3
6	R2	206	9.2	0.292	39.7	LOS C	4.3	32.3	0.85	0.76	34.4
Approach		503	10.1	0.292	29.6	LOS C	4.3	32.3	0.75	0.72	39.4
North: The Northern Rd (N)											
7	L2	211	7.6	0.160	6.4	LOS A	1.1	8.7	0.18	0.57	52.9
8	T1	8	100.0	0.160	0.8	LOS A	1.1	8.7	0.18	0.57	53.6
9	R2	34	8.8	0.033	31.3	LOS C	0.5	4.1	0.72	0.67	38.0
Approach		253	10.7	0.160	9.4	LOS A	1.1	8.7	0.26	0.58	50.2
West: Bringelly Rd (W)											
10	L2	23	13.0	0.078	24.0	LOS B	1.2	9.1	0.67	0.60	42.5
11	T1	62	6.5	0.078	32.1	LOS C	1.2	9.1	0.81	0.62	39.0
12	R2	40	5.0	0.064	37.4	LOS C	0.9	6.6	0.80	0.69	36.1
Approach		125	7.2	0.078	32.3	LOS C	1.2	9.1	0.78	0.64	38.6
All Vehicles		1050	9.9	0.292	24.9	LOS B	4.3	32.3	0.61	0.67	41.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P11	South Stage 1	50	4.6	LOS A	0.0	0.0	0.32	0.32
P12	South Stage 2	50	17.4	LOS B	0.1	0.1	0.87	0.87
P1S	South Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
P21	East Stage 1	50	7.9	LOS A	0.1	0.1	0.41	0.41
P22	East Stage 2	50	40.3	LOS E	0.1	0.1	0.94	0.94
P2S	East Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
P31	North Stage 1	50	6.3	LOS A	0.0	0.0	0.37	0.37
P32	North Stage 2	50	37.5	LOS D	0.1	0.1	0.90	0.90
P3S	North Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
P41	West Stage 1	50	7.9	LOS A	0.1	0.1	0.41	0.41
P42	West Stage 2	50	40.3	LOS E	0.1	0.1	0.94	0.94
P4S	West Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
All Pedestrians		600	13.7	LOS B			0.49	0.49

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2029 AM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 84 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Rd (S)											
1	L2	92	10.9	0.080	6.3	LOS A	0.4	3.1	0.17	0.52	53.4
2	T1	9	100.0	0.080	0.6	LOS A	0.4	3.1	0.17	0.52	54.0
3	R2	351	4.3	0.405	36.4	LOS C	6.2	45.0	0.87	0.78	36.8
Approach		452	7.5	0.405	29.5	LOS C	6.2	45.0	0.71	0.72	39.5
East: Bringelly Rd (E)											
4	L2	101	12.9	0.316	25.8	LOS B	2.9	23.0	0.87	0.75	41.6
5	T1	122	27.9	0.316	39.1	LOS C	2.9	23.0	0.93	0.71	36.5
6	R2	303	5.9	0.403	37.0	LOS C	5.9	43.2	0.87	0.78	35.5
Approach		526	12.4	0.403	35.4	LOS C	5.9	43.2	0.88	0.76	36.8
North: The Northern Rd (N)											
7	L2	282	5.3	0.230	7.8	LOS A	2.7	19.9	0.31	0.63	51.7
8	T1	3	100.0	0.230	2.1	LOS A	2.7	19.9	0.31	0.63	52.2
9	R2	21	61.9	0.027	29.5	LOS C	0.3	3.3	0.71	0.65	37.9
Approach		306	10.1	0.230	9.2	LOS A	2.7	19.9	0.34	0.63	50.4
West: Bringelly Rd (W)											
10	L2	24	0.0	0.329	35.4	LOS C	3.3	24.5	0.89	0.70	37.9
11	T1	200	11.0	0.329	36.7	LOS C	3.3	24.5	0.92	0.71	37.3
12	R2	69	14.5	0.113	34.7	LOS C	1.4	11.3	0.80	0.71	37.0
Approach		293	10.9	0.329	36.2	LOS C	3.3	24.5	0.89	0.71	37.3
All Vehicles		1577	10.3	0.405	28.8	LOS C	6.2	45.0	0.73	0.71	39.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P11	South Stage 1	50	4.7	LOS A	0.0	0.0	0.33	0.33
P12	South Stage 2	50	15.5	LOS B	0.1	0.1	0.86	0.86
P1S	South Slip/Bypass Lane Crossing	50	0.8	LOS A	0.0	0.0	0.19	0.19
P21	East Stage 1	50	6.9	LOS A	0.0	0.0	0.41	0.41
P22	East Stage 2	50	36.3	LOS D	0.1	0.1	0.93	0.93
P2S	East Slip/Bypass Lane Crossing	50	0.8	LOS A	0.0	0.0	0.19	0.19
P31	North Stage 1	50	6.5	LOS A	0.0	0.0	0.39	0.39
P32	North Stage 2	50	36.3	LOS D	0.1	0.1	0.93	0.93
P3S	North Slip/Bypass Lane Crossing	50	0.8	LOS A	0.0	0.0	0.19	0.19
P41	West Stage 1	50	6.9	LOS A	0.0	0.0	0.41	0.41
P42	West Stage 2	50	36.3	LOS D	0.1	0.1	0.93	0.93
P4S	West Slip/Bypass Lane Crossing	50	0.8	LOS A	0.0	0.0	0.19	0.19
All Pedestrians		600	12.7	LOS B			0.50	0.50

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Organisation: GHD SERVICES PTY LTD | Processed: Tuesday, 8 September 2015 9:00:22 AM
Project: G:\21\24664\Technical\Traffic and transport\SIDRA\2015 TNR & Bringelly Road_gm - 3092015.sip6

MOVEMENT SUMMARY

Site: 2029 PM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 107 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: The Northern Rd (S)											
1	L2	108	0.0	0.096	6.6	LOS A	0.7	5.4	0.19	0.52	53.7
2	T1	12	100.0	0.096	1.0	LOS A	0.7	5.4	0.19	0.52	53.8
3	R2	350	10.6	0.511	49.6	LOS D	8.3	63.7	0.92	0.80	32.3
Approach		470	10.4	0.511	38.3	LOS C	8.3	63.7	0.73	0.73	35.9
East: Bringelly Rd (E)											
4	L2	436	9.9	0.484	17.0	LOS B	9.5	72.5	0.68	0.77	46.3
5	T1	252	11.9	0.321	40.0	LOS C	5.6	43.3	0.86	0.69	36.3
6	R2	237	9.3	0.391	48.9	LOS D	6.0	45.4	0.89	0.77	31.4
Approach		925	10.3	0.484	31.4	LOS C	9.5	72.5	0.78	0.75	38.8
North: The Northern Rd (N)											
7	L2	310	7.4	0.282	9.7	LOS A	5.0	37.6	0.37	0.65	50.3
8	T1	7	100.0	0.282	4.0	LOS A	5.0	37.6	0.37	0.65	50.7
9	R2	55	9.1	0.054	35.9	LOS C	1.0	7.8	0.73	0.69	36.1
Approach		372	9.4	0.282	13.4	LOS A	5.0	37.6	0.42	0.65	47.5
West: Bringelly Rd (W)											
10	L2	501	15.4	0.405	7.2	LOS A	4.5	35.8	0.27	0.63	51.8
11	T1	324	6.5	0.399	40.8	LOS C	7.4	54.3	0.88	0.72	36.1
12	R2	268	5.2	0.501	49.4	LOS D	8.1	59.2	0.91	0.78	32.1
Approach		1093	10.2	0.501	27.5	LOS B	8.1	59.2	0.61	0.70	40.2
All Vehicles		2860	10.2	0.511	28.7	LOS C	9.5	72.5	0.66	0.71	39.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P11	South Stage 1	50	4.2	LOS A	0.0	0.0	0.28	0.28
P12	South Stage 2	50	14.6	LOS B	0.1	0.1	0.74	0.74
P1S	South Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.15	0.15
P21	East Stage 1	50	10.8	LOS B	0.1	0.1	0.45	0.45
P22	East Stage 2	50	42.3	LOS E	0.1	0.1	0.89	0.89
P2S	East Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.15	0.15
P31	North Stage 1	50	7.5	LOS A	0.1	0.1	0.37	0.37
P32	North Stage 2	50	36.3	LOS D	0.1	0.1	0.82	0.82
P3S	North Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.15	0.15
P41	West Stage 1	50	10.8	LOS B	0.1	0.1	0.45	0.45
P42	West Stage 2	50	47.8	LOS E	0.1	0.1	0.95	0.95
P4S	West Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.15	0.15
All Pedestrians		600	14.7	LOS B			0.46	0.46

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Organisation: GHD SERVICES PTY LTD | Processed: Tuesday, 8 September 2015 9:00:17 AM
Project: G:\21\24664\Technical\Traffic and transport\SIDRA\2015 TNR & Bringelly Road_gm - 3092015.sip6

MOVEMENT SUMMARY

Site: 2039 AM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: The Northern Rd (S)											
1	L2	188	11.2	0.162	6.6	LOS A	1.1	9.1	0.19	0.56	53.0
2	T1	10	100.0	0.162	0.9	LOS A	1.1	9.1	0.19	0.56	53.6
3	R2	671	4.3	0.713	43.8	LOS D	15.2	110.3	0.94	0.84	34.2
Approach		869	6.9	0.713	35.2	LOS C	15.2	110.3	0.77	0.77	37.2
East: Bringelly Rd (E)											
4	L2	131	13.0	0.433	27.6	LOS B	4.8	37.8	0.88	0.76	41.0
5	T1	249	27.7	0.433	41.7	LOS C	5.0	43.2	0.92	0.74	35.6
6	R2	433	5.8	0.686	48.5	LOS D	11.0	80.5	0.95	0.82	31.6
Approach		813	13.7	0.686	43.0	LOS D	11.0	80.5	0.93	0.78	34.1
North: The Northern Rd (N)											
7	L2	374	5.3	0.337	8.5	LOS A	5.1	37.7	0.35	0.66	51.1
8	T1	1	100.0	0.337	2.9	LOS A	5.1	37.7	0.35	0.66	51.6
9	R2	21	61.9	0.029	35.3	LOS C	0.4	4.0	0.73	0.65	35.6
Approach		396	8.6	0.337	9.9	LOS A	5.1	37.7	0.37	0.66	49.9
West: Bringelly Rd (W)											
10	L2	76	0.0	0.460	36.2	LOS C	7.5	55.8	0.86	0.73	37.3
11	T1	371	11.1	0.460	40.2	LOS C	7.5	55.8	0.91	0.74	36.0
12	R2	127	15.0	0.249	44.5	LOS D	3.4	26.8	0.86	0.74	33.5
Approach		574	10.5	0.460	40.6	LOS C	7.5	55.8	0.89	0.74	35.6
All Vehicles		2652	10.0	0.713	35.0	LOS C	15.2	110.3	0.79	0.75	37.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P11	South Stage 1	50	6.1	LOS A	0.0	0.0	0.35	0.35
P12	South Stage 2	50	17.4	LOS B	0.1	0.1	0.83	0.83
P1S	South Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.16	0.16
P21	East Stage 1	50	8.0	LOS A	0.1	0.1	0.40	0.40
P22	East Stage 2	50	41.5	LOS E	0.1	0.1	0.91	0.91
P2S	East Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.16	0.16
P31	North Stage 1	50	6.9	LOS A	0.1	0.1	0.37	0.37
P32	North Stage 2	50	39.7	LOS D	0.1	0.1	0.89	0.89
P3S	North Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.16	0.16
P41	West Stage 1	50	8.0	LOS A	0.1	0.1	0.40	0.40
P42	West Stage 2	50	43.3	LOS E	0.1	0.1	0.93	0.93
P4S	West Slip/Bypass Lane Crossing	50	0.6	LOS A	0.0	0.0	0.16	0.16
All Pedestrians		600	14.5	LOS B			0.48	0.48

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Organisation: GHD SERVICES PTY LTD | Processed: Tuesday, 8 September 2015 9:00:10 AM
Project: G:\21\24664\Technical\Traffic and transport\SIDRA\2015 TNR & Bringelly Road_gm - 3092015.sip6

MOVEMENT SUMMARY

Site: 2039 PM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 95 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: The Northern Rd (S)											
1	L2	188	0.0	0.173	7.8	LOS A	1.8	12.9	0.30	0.61	52.4
2	T1	6	100.0	0.173	2.2	LOS A	1.8	12.9	0.30	0.61	52.3
3	R2	370	10.5	0.503	43.6	LOS D	7.8	59.2	0.91	0.80	34.2
Approach		564	8.0	0.503	31.2	LOS C	7.8	59.2	0.70	0.73	38.8
East: Bringelly Rd (E)											
4	L2	823	9.8	0.892	28.6	LOS C	32.0	243.2	0.95	0.97	40.2
5	T1	476	11.6	0.685	41.2	LOS C	10.6	81.4	0.96	0.80	35.9
6	R2	302	8.9	0.441	42.7	LOS D	6.8	50.9	0.89	0.78	33.4
Approach		1601	10.2	0.892	35.0	LOS C	32.0	243.2	0.94	0.88	37.5
North: The Northern Rd (N)											
7	L2	436	7.6	0.422	11.6	LOS A	8.8	67.1	0.50	0.69	48.9
8	T1	14	100.0	0.422	5.9	LOS A	8.8	67.1	0.50	0.69	49.3
9	R2	137	8.8	0.147	35.8	LOS C	2.4	18.4	0.78	0.73	36.1
Approach		587	10.1	0.422	16.9	LOS B	8.8	67.1	0.57	0.70	45.1
West: Bringelly Rd (W)											
10	L2	214	13.6	0.562	24.4	LOS B	11.9	90.8	0.77	0.73	42.2
11	T1	564	6.4	0.562	33.9	LOS C	11.9	90.8	0.89	0.76	38.3
12	R2	559	5.0	0.926	49.0	LOS D	17.7	129.4	0.97	0.87	32.2
Approach		1337	7.0	0.926	38.7	LOS C	17.7	129.4	0.90	0.80	36.0
All Vehicles		4089	8.8	0.926	33.1	LOS C	32.0	243.2	0.84	0.81	38.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P11	South Stage 1	50	4.4	LOS A	0.0	0.0	0.31	0.31
P12	South Stage 2	50	16.0	LOS B	0.1	0.1	0.82	0.82
P1S	South Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
P21	East Stage 1	50	9.8	LOS A	0.1	0.1	0.45	0.45
P22	East Stage 2	50	41.8	LOS E	0.1	0.1	0.94	0.94
P2S	East Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
P31	North Stage 1	50	6.1	LOS A	0.0	0.0	0.36	0.36
P32	North Stage 2	50	34.6	LOS D	0.1	0.1	0.85	0.85
P3S	North Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
P41	West Stage 1	50	9.8	LOS A	0.1	0.1	0.45	0.45
P42	West Stage 2	50	41.8	LOS E	0.1	0.1	0.94	0.94
P4S	West Slip/Bypass Lane Crossing	50	0.7	LOS A	0.0	0.0	0.17	0.17
All Pedestrians		600	13.9	LOS B			0.48	0.48

SIDRA Outputs

Existing intersection

(Greendale Road / The Northern Road / Bringelly Road)

With grade separated intersection operational

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2019 AM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 38 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: The Northern Road (S)											
1	L2	15	0.0	0.078	21.4	LOS B	0.3	2.9	0.86	0.67	43.5
2	T1	5	99.6	0.078	15.9	LOS B	0.3	2.9	0.86	0.67	44.4
3	R2	5	4.9	0.016	21.1	LOS B	0.1	0.6	0.85	0.63	43.4
Approach		25	20.9	0.078	20.2	LOS B	0.3	2.9	0.86	0.66	43.7
East: Bringelly Rd (E)											
4	L2	10	13.2	0.338	22.8	LOS B	1.7	13.6	0.91	0.70	45.1
5	T1	84	17.9	0.338	17.1	LOS B	1.7	13.6	0.91	0.70	46.5
6	R2	10	5.8	0.035	21.4	LOS B	0.2	1.2	0.85	0.66	43.5
Approach		104	16.3	0.338	18.1	LOS B	1.7	13.6	0.90	0.70	46.0
North: The Northern Road (N)											
7	L2	2	5.6	0.002	11.4	LOS A	0.0	0.1	0.53	0.60	49.2
8	T1	2	11.3	0.007	15.3	LOS B	0.0	0.3	0.85	0.52	47.9
9	R2	3	61.5	0.012	21.8	LOS B	0.0	0.5	0.85	0.62	41.8
Approach		7	31.2	0.012	17.0	LOS B	0.0	0.5	0.76	0.59	45.4
West: Greendale Rd (W)											
10	L2	1	0.0	0.003	19.7	LOS B	0.0	0.1	0.82	0.59	44.4
11	T1	135	8.4	0.392	15.4	LOS B	2.6	19.9	0.88	0.71	47.6
12	R2	15	18.5	0.392	21.1	LOS B	2.6	19.9	0.88	0.71	45.8
Approach		151	9.4	0.392	16.0	LOS B	2.6	19.9	0.88	0.71	47.4
All Vehicles		287	13.4	0.392	17.1	LOS B	2.6	19.9	0.88	0.70	46.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	11.1	LOS B	0.0	0.0	0.76	0.76
P4	West Full Crossing	50	11.1	LOS B	0.0	0.0	0.76	0.76
All Pedestrians		100	11.1	LOS B			0.76	0.76

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2019 PM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 58 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	15	0.0	0.078	30.6	LOS C	0.5	3.7	0.88	0.67	39.8
2	T1	5	10.0	0.078	25.1	LOS B	0.5	3.7	0.88	0.67	40.5
3	R2	5	10.6	0.021	30.3	LOS C	0.1	1.0	0.87	0.64	39.0
Approach		25	4.1	0.078	29.4	LOS C	0.5	3.7	0.88	0.67	39.8
East: Bringelly Rd (E)											
4	L2	10	9.9	0.440	27.3	LOS B	4.8	37.6	0.87	0.72	42.9
5	T1	184	10.1	0.440	21.7	LOS B	4.8	37.6	0.87	0.72	44.1
6	R2	10	9.2	0.024	24.5	LOS B	0.2	1.7	0.77	0.66	41.9
Approach		204	10.1	0.440	22.1	LOS B	4.8	37.6	0.87	0.71	43.9
North: The Northern Road (N)											
7	L2	3	7.6	0.003	14.1	LOS A	0.0	0.3	0.52	0.61	47.5
8	T1	2	5.6	0.008	24.2	LOS B	0.0	0.4	0.87	0.53	42.9
9	R2	2	8.7	0.009	30.0	LOS C	0.1	0.4	0.87	0.61	39.2
Approach		7	7.3	0.009	21.5	LOS B	0.1	0.4	0.72	0.59	43.5
West: Greendale Rd (W)											
10	L2	1	13.0	0.002	21.5	LOS B	0.0	0.2	0.71	0.59	43.2
11	T1	304	5.6	0.542	19.1	LOS B	7.7	56.5	0.86	0.73	45.5
12	R2	15	5.0	0.542	24.7	LOS B	7.7	56.5	0.86	0.73	44.3
Approach		320	5.6	0.542	19.4	LOS B	7.7	56.5	0.86	0.73	45.5
All Vehicles		556	7.2	0.542	20.9	LOS B	7.7	56.5	0.86	0.72	44.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	20.7	LOS C	0.1	0.1	0.85	0.85
P4	West Full Crossing	50	20.7	LOS C	0.1	0.1	0.85	0.85
All Pedestrians		100	20.7	LOS C			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2029 AM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 64 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	15	11.1	0.086	33.0	LOS C	0.6	4.8	0.88	0.68	38.5
2	T1	5	5.4	0.086	27.3	LOS B	0.6	4.8	0.88	0.68	39.6
3	R2	5	4.3	0.020	32.4	LOS C	0.1	1.0	0.87	0.64	38.3
Approach		25	8.6	0.086	31.8	LOS C	0.6	4.8	0.87	0.67	38.7
East: Bringelly Rd (E)											
4	L2	10	13.2	0.529	28.9	LOS C	6.8	54.7	0.88	0.74	42.1
5	T1	236	17.9	0.529	23.2	LOS B	6.8	54.7	0.88	0.74	43.4
6	R2	10	5.8	0.021	24.9	LOS B	0.2	1.7	0.74	0.66	41.7
Approach		256	17.2	0.529	23.5	LOS B	6.8	54.7	0.88	0.73	43.2
North: The Northern Road (N)											
7	L2	3	5.4	0.003	14.3	LOS A	0.0	0.3	0.50	0.61	47.4
8	T1	2	11.7	0.008	26.5	LOS B	0.1	0.4	0.86	0.53	41.8
9	R2	2	62.5	0.010	33.1	LOS C	0.1	0.6	0.86	0.62	37.0
Approach		7	23.5	0.010	23.1	LOS B	0.1	0.6	0.71	0.59	42.4
West: Greendale Rd (W)											
10	L2	1	0.0	0.002	23.5	LOS B	0.0	0.2	0.72	0.59	42.4
11	T1	293	9.5	0.539	20.9	LOS B	8.2	63.2	0.86	0.73	44.6
12	R2	15	15.0	0.539	26.6	LOS B	8.2	63.2	0.86	0.73	43.1
Approach		309	9.7	0.539	21.2	LOS B	8.2	63.2	0.86	0.73	44.5
All Vehicles		597	13.0	0.539	22.6	LOS B	8.2	63.2	0.86	0.73	43.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	23.7	LOS C	0.1	0.1	0.86	0.86
P4	West Full Crossing	50	23.7	LOS C	0.1	0.1	0.86	0.86
All Pedestrians		100	23.7	LOS C			0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2029 PM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 124 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	15	0.0	0.083	58.8	LOS E	1.1	7.7	0.89	0.68	30.4
2	T1	5	10.0	0.083	53.3	LOS D	1.1	7.7	0.89	0.68	30.8
3	R2	5	10.6	0.026	58.3	LOS E	0.3	2.1	0.88	0.65	30.0
Approach		25	4.1	0.083	57.6	LOS E	1.1	7.7	0.89	0.68	30.4
East: Bringelly Rd (E)											
4	L2	10	9.9	0.728	47.1	LOS D	22.7	172.8	0.92	0.81	34.9
5	T1	417	9.2	0.728	41.4	LOS C	22.7	172.8	0.92	0.81	35.7
6	R2	10	9.2	0.018	36.7	LOS C	0.4	3.1	0.69	0.66	36.8
Approach		437	9.2	0.728	41.4	LOS C	22.7	172.8	0.92	0.80	35.7
North: The Northern Road (N)											
7	L2	3	7.6	0.003	22.1	LOS B	0.1	0.7	0.50	0.62	43.0
8	T1	2	5.6	0.008	51.6	LOS D	0.1	0.8	0.87	0.54	32.5
9	R2	2	8.7	0.011	58.7	LOS E	0.1	0.8	0.88	0.62	30.0
Approach		7	7.3	0.011	41.0	LOS C	0.1	0.8	0.72	0.60	35.3
West: Greendale Rd (W)											
10	L2	1	13.0	0.002	31.1	LOS C	0.0	0.3	0.62	0.60	38.8
11	T1	786	5.6	1.047	153.5	LOS F	94.3	691.3	1.00	1.64	17.1
12	R2	15	5.0	1.047	159.1	LOS F	94.3	691.3	1.00	1.64	16.9
Approach		802	5.6	1.047	153.5	LOS F	94.3	691.3	1.00	1.64	17.1
All Vehicles		1271	6.8	1.047	112.4	LOS F	94.3	691.3	0.97	1.33	21.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	29.9	LOS C	0.1	0.1	0.69	0.69
P4	West Full Crossing	50	53.4	LOS E	0.2	0.2	0.93	0.93
All Pedestrians		100	41.7	LOS E			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2039 AM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 124 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	15	11.1	0.093	58.8	LOS E	1.1	9.2	0.89	0.69	30.3
2	T1	5	5.4	0.093	53.1	LOS D	1.1	9.2	0.89	0.69	30.9
3	R2	5	4.3	0.025	58.1	LOS E	0.3	1.9	0.88	0.65	30.2
Approach		25	8.6	0.093	57.6	LOS E	1.1	9.2	0.89	0.68	30.4
East: Bringelly Rd (E)											
4	L2	10	13.2	0.794	47.0	LOS D	25.4	205.1	0.94	0.83	34.9
5	T1	457	17.9	0.794	41.4	LOS C	25.4	205.1	0.94	0.83	35.7
6	R2	10	5.8	0.016	35.1	LOS C	0.4	2.9	0.67	0.66	37.4
Approach		477	17.5	0.794	41.3	LOS C	25.4	205.1	0.94	0.83	35.7
North: The Northern Road (N)											
7	L2	3	5.4	0.003	21.1	LOS B	0.1	0.6	0.49	0.61	43.6
8	T1	2	11.7	0.008	51.7	LOS D	0.1	0.8	0.87	0.55	32.4
9	R2	2	62.5	0.013	59.9	LOS E	0.1	1.2	0.88	0.63	29.1
Approach		7	23.5	0.013	40.9	LOS C	0.1	1.2	0.71	0.60	35.1
West: Greendale Rd (W)											
10	L2	1	0.0	0.001	32.3	LOS C	0.0	0.3	0.64	0.60	38.5
11	T1	574	9.5	0.831	38.3	LOS C	32.1	248.0	0.95	0.85	36.8
12	R2	15	15.0	0.831	44.0	LOS D	32.1	248.0	0.95	0.85	35.8
Approach		590	9.6	0.831	38.5	LOS C	32.1	248.0	0.95	0.85	36.8
All Vehicles		1099	13.1	0.831	40.2	LOS C	32.1	248.0	0.94	0.84	36.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	31.3	LOS D	0.1	0.1	0.71	0.71
P4	West Full Crossing	50	53.4	LOS E	0.2	0.2	0.93	0.93
All Pedestrians		100	42.4	LOS E			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 2039 PM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 135 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: The Northern Road (S)											
1	L2	15	0.0	0.085	63.7	LOS E	1.2	8.4	0.89	0.69	29.2
2	T1	5	10.0	0.085	58.1	LOS E	1.2	8.4	0.89	0.69	29.6
3	R2	5	10.6	0.027	63.3	LOS E	0.3	2.3	0.88	0.66	28.8
Approach		25	4.1	0.085	62.5	LOS E	1.2	8.4	0.89	0.68	29.2
East: Bringelly Rd (E)											
4	L2	10	9.9	1.209	446.9	LOS F	177.4	1376.4	1.00	2.84	7.3
5	T1	800	10.1	1.209	441.2	LOS F	177.4	1376.4	1.00	2.84	7.3
6	R2	10	9.2	0.015	34.7	LOS C	0.4	3.1	0.64	0.65	37.5
Approach		820	10.1	1.209	436.4	LOS F	177.4	1376.4	1.00	2.82	7.4
North: The Northern Road (N)											
7	L2	3	7.6	0.003	20.7	LOS B	0.1	0.7	0.46	0.61	43.7
8	T1	2	5.6	0.008	56.5	LOS D	0.1	0.8	0.88	0.55	31.1
9	R2	2	8.7	0.011	63.7	LOS E	0.1	0.9	0.89	0.62	28.8
Approach		7	7.3	0.011	43.2	LOS D	0.1	0.9	0.70	0.60	34.6
West: Greendale Rd (W)											
10	L2	1	13.0	0.002	36.2	LOS C	0.0	0.3	0.65	0.60	36.8
11	T1	1337	5.6	1.922	1725.6	LOS F	630.0	4619.6	1.00	6.05	2.0
12	R2	15	5.0	1.922	1731.2	LOS F	630.0	4619.6	1.00	6.05	2.0
Approach		1353	5.6	1.922	1724.4	LOS F	630.0	4619.6	1.00	6.05	2.1
All Vehicles		2205	7.2	1.922	1221.2	LOS F	630.0	4619.6	1.00	4.77	2.9

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P3	North Full Crossing	50	34.9	LOS D	0.1	0.1	0.72	0.72
P4	West Full Crossing	50	58.9	LOS E	0.2	0.2	0.94	0.94
All Pedestrians		100	46.9	LOS E			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA Phasing Summary

2015
Existing Conditions

PHASING SUMMARY

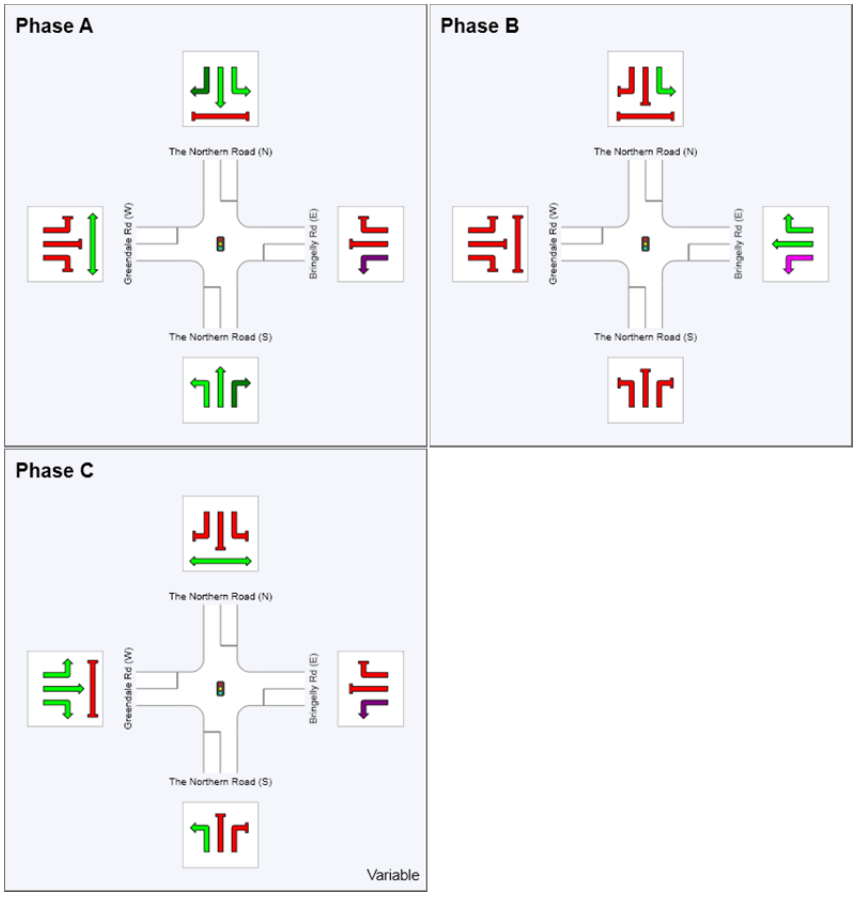
Site: 2015 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 143 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	81	119
Green Time (sec)	75	32	18
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	81	38	24
Phase Split	57 %	27 %	17 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

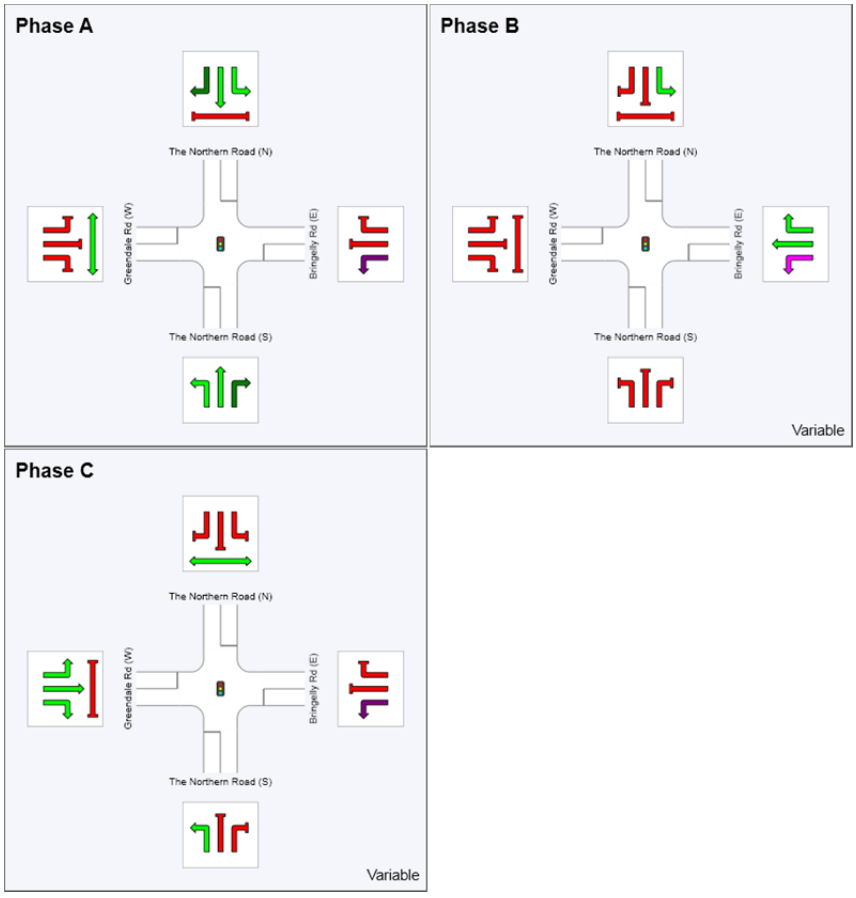
Site: 2015 PM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 102 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	56	82
Green Time (sec)	50	20	14
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	56	26	20
Phase Split	55 %	25 %	20 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

SIDRA Phasing Summary

2016
Construction

PHASING SUMMARY

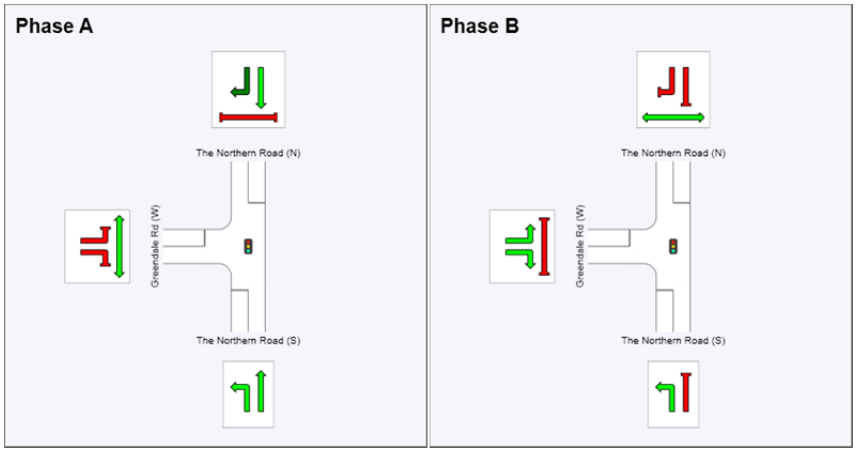
Site: 2016 AM Construction The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 43 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B
Output Sequence: A, B

Phase Timing Results

Phase	A	B
Reference Phase	Yes	No
Phase Change Time (sec)	0	31
Green Time (sec)	25	6
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	31	12
Phase Split	72 %	28 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

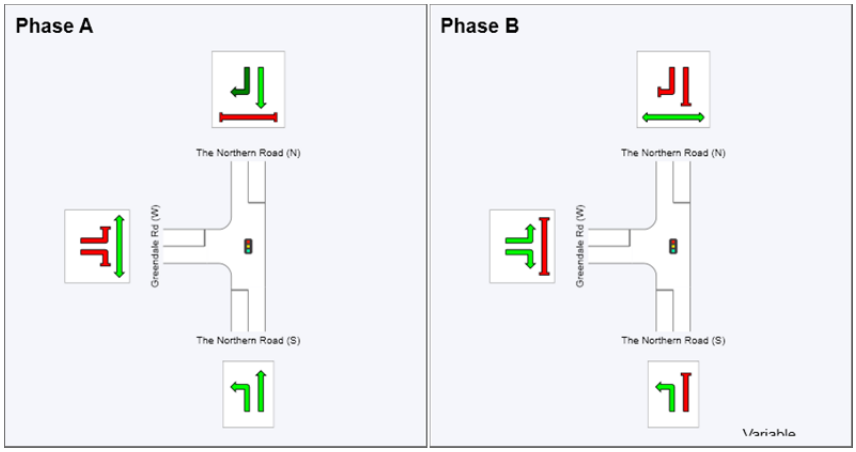
Site: 2016 PM Construction The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Variable Phasing
Movement Class: All Movement Classes
Input Sequence: A, B
Output Sequence: A, B

Phase Timing Results

Phase	A	B
Reference Phase	Yes	No
Phase Change Time (sec)	0	114
Green Time (sec)	108	30
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	114	36
Phase Split	76 %	24 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

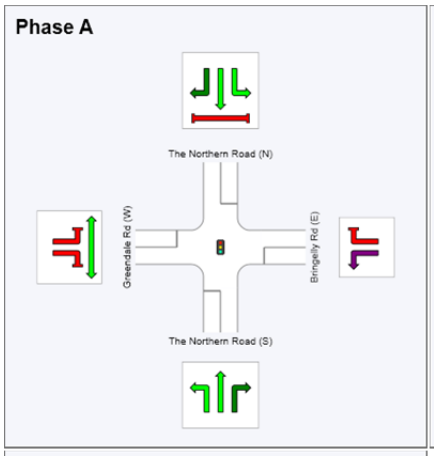
Site: 2016 AM Construction The Northern Road and Bringelly Road (Heavy Vehicles Allowed)

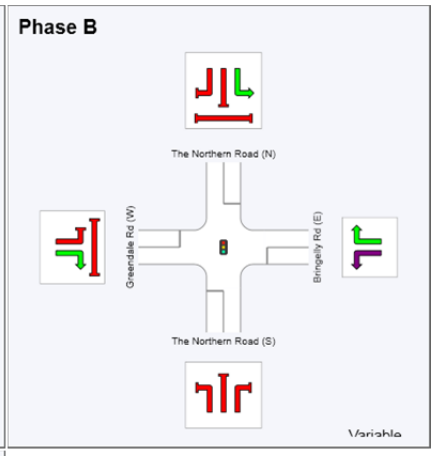
New Site
Signals - Actuated Isolated Cycle Time = 86 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

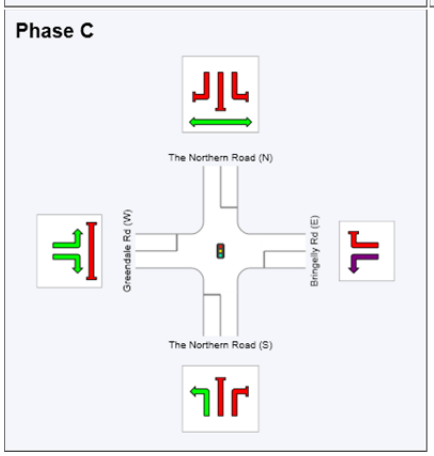
Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	56	68
Green Time (sec)	50	6	12
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	56	12	18
Phase Split	65 %	14 %	21 %







	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

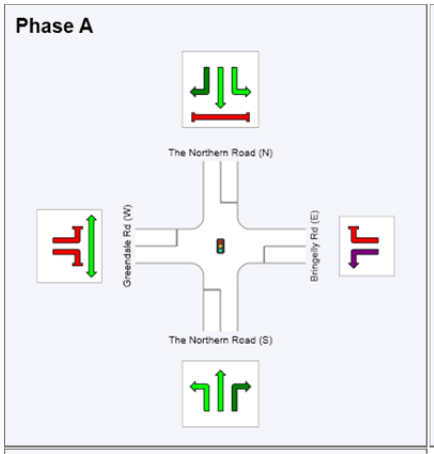
Site: 2016 PM Construction The Northern Road and Bringelly Road (Heavy Vehicles Allowed)

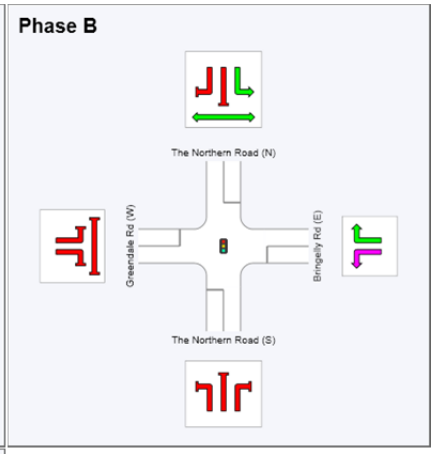
New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

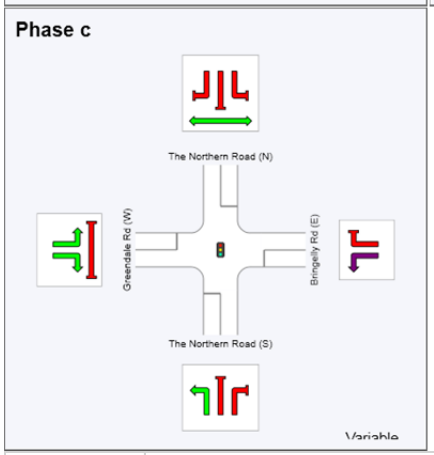
Phase times determined by the program
Sequence: Variable Phasing
Movement Class: All Movement Classes
Input Sequence: A, B, c
Output Sequence: A, B, c

Phase Timing Results

Phase	A	B	c
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	112	124
Green Time (sec)	106	6	20
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	112	12	26
Phase Split	75 %	8 %	17 %







	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

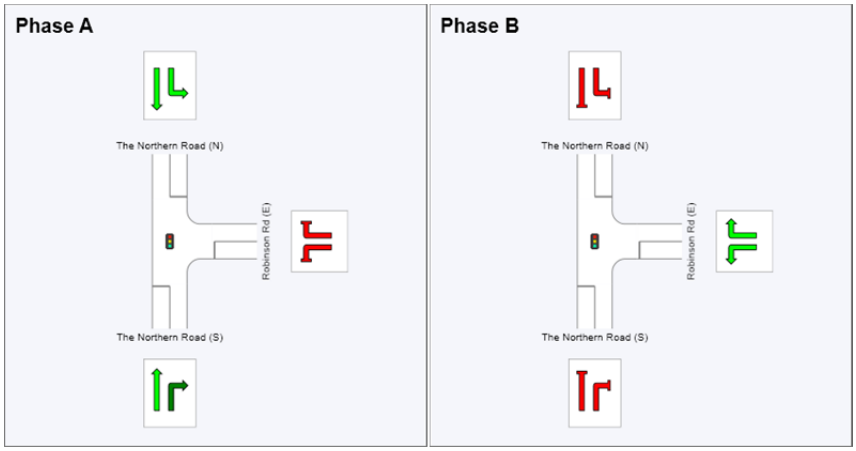
Site: 2016 AM Construction The Northern Road and Robinson Road (Signals)

New Site
Signals - Actuated Isolated Cycle Time = 83 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: Opposed Turns
Movement Class: All Movement Classes
Input Sequence: A, B
Output Sequence: A, B

Phase Timing Results

Phase	A	B
Reference Phase	Yes	No
Phase Change Time (sec)	0	56
Green Time (sec)	50	21
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	56	27
Phase Split	67 %	33 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

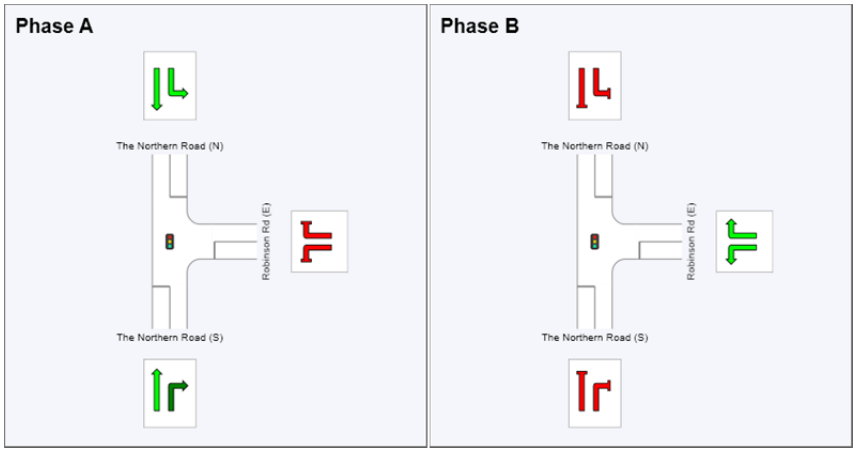
Site: 2016 PM Construction The Northern Road and Robinson Road (Signals)

New Site
Signals - Actuated Isolated Cycle Time = 91 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: Opposed Turns
Movement Class: All Movement Classes
Input Sequence: A, B
Output Sequence: A, B

Phase Timing Results

Phase	A	B
Reference Phase	Yes	No
Phase Change Time (sec)	0	56
Green Time (sec)	50	29
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	56	35
Phase Split	62 %	38 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

SIDRA Phasing Summary

Existing scenario with background growth

PHASING SUMMARY

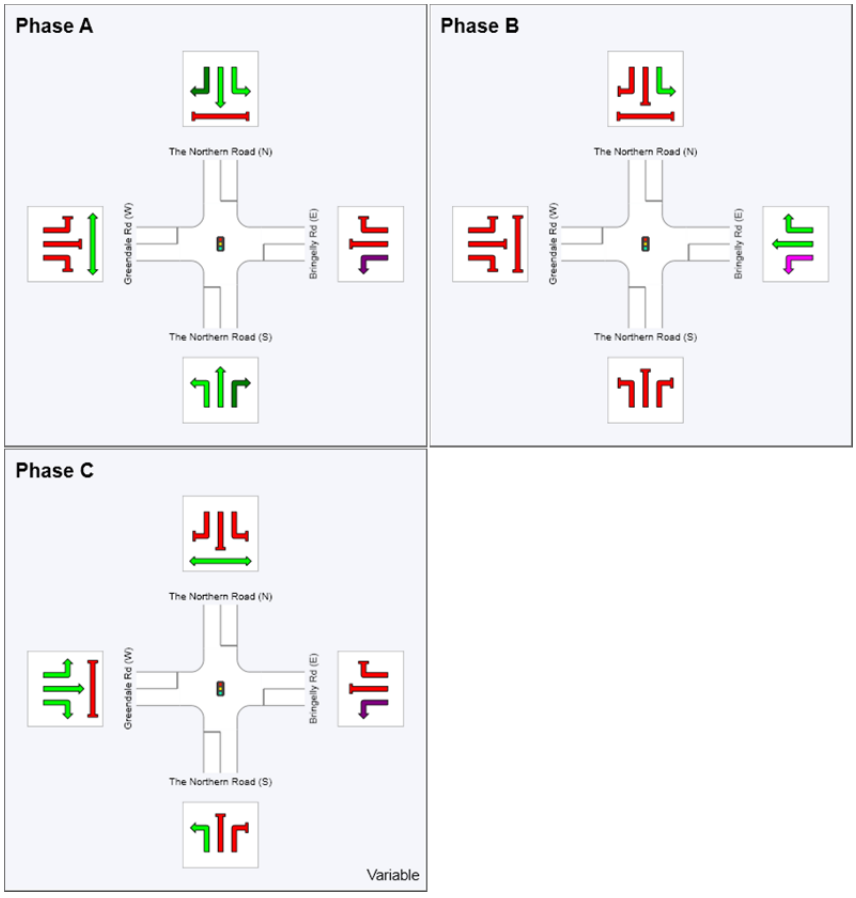
Site: 2019 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 98 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	56	78
Green Time (sec)	50	16	14
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	56	22	20
Phase Split	57 %	22 %	20 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

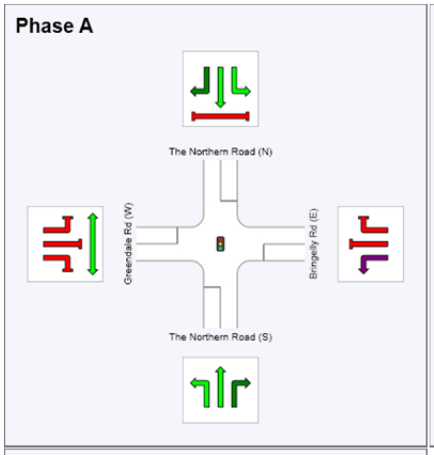
Site: 2019 PM The Northern Road and Bringelly Road

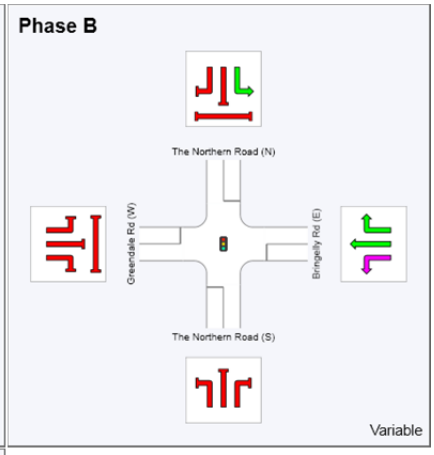
New Site
Signals - Actuated Isolated Cycle Time = 134 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

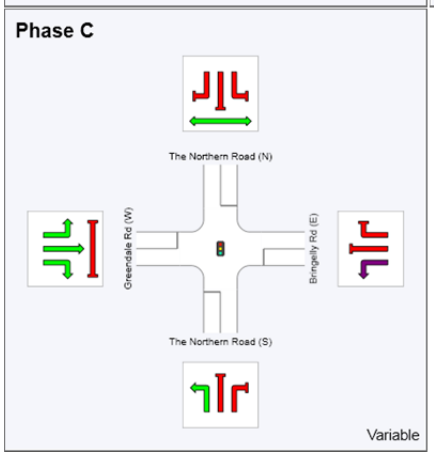
Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	56	98
Green Time (sec)	50	36	30
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	56	42	36
Phase Split	42 %	31 %	27 %







	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

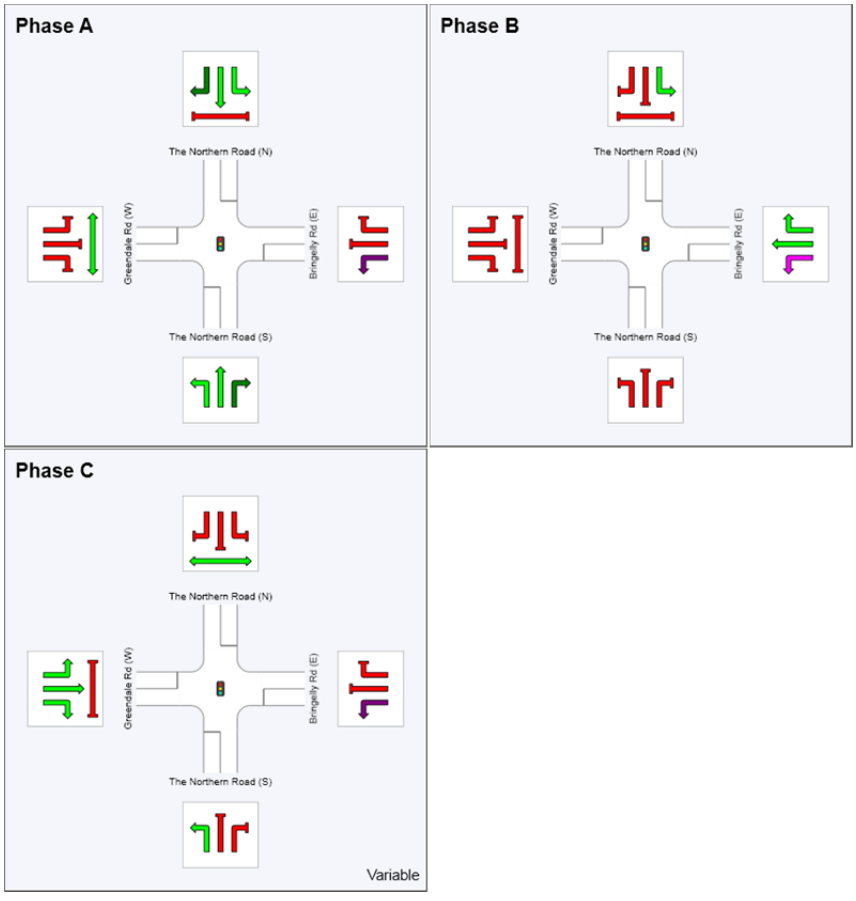
Site: 2029 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 88 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	49	68
Green Time (sec)	43	13	14
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	49	19	20
Phase Split	56 %	22 %	23 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

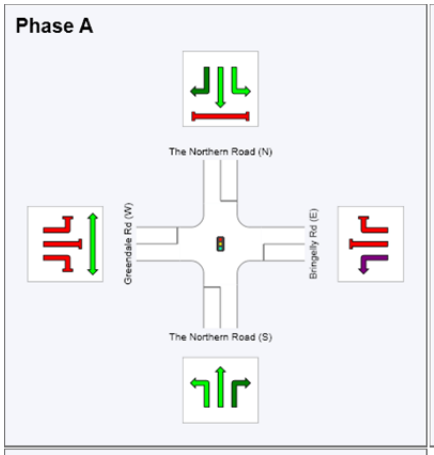
Site: 2029 PM The Northern Road and Bringelly Road

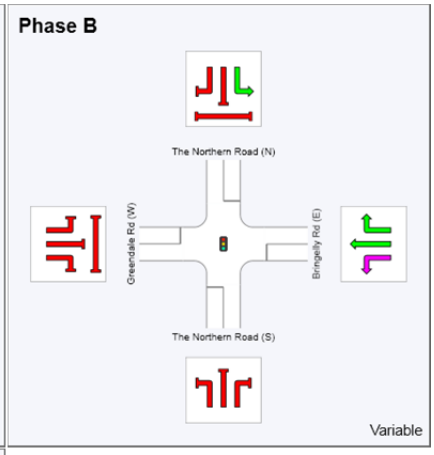
New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

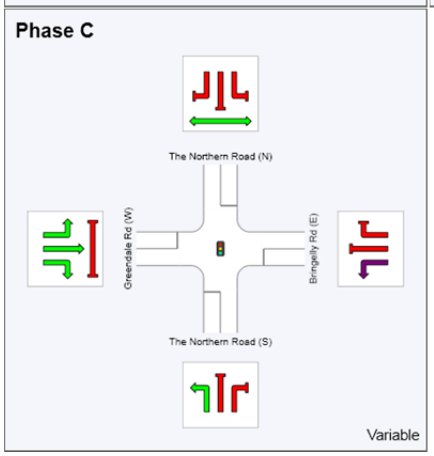
Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	56	105
Green Time (sec)	50	43	39
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	56	49	45
Phase Split	37 %	33 %	30 %







	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

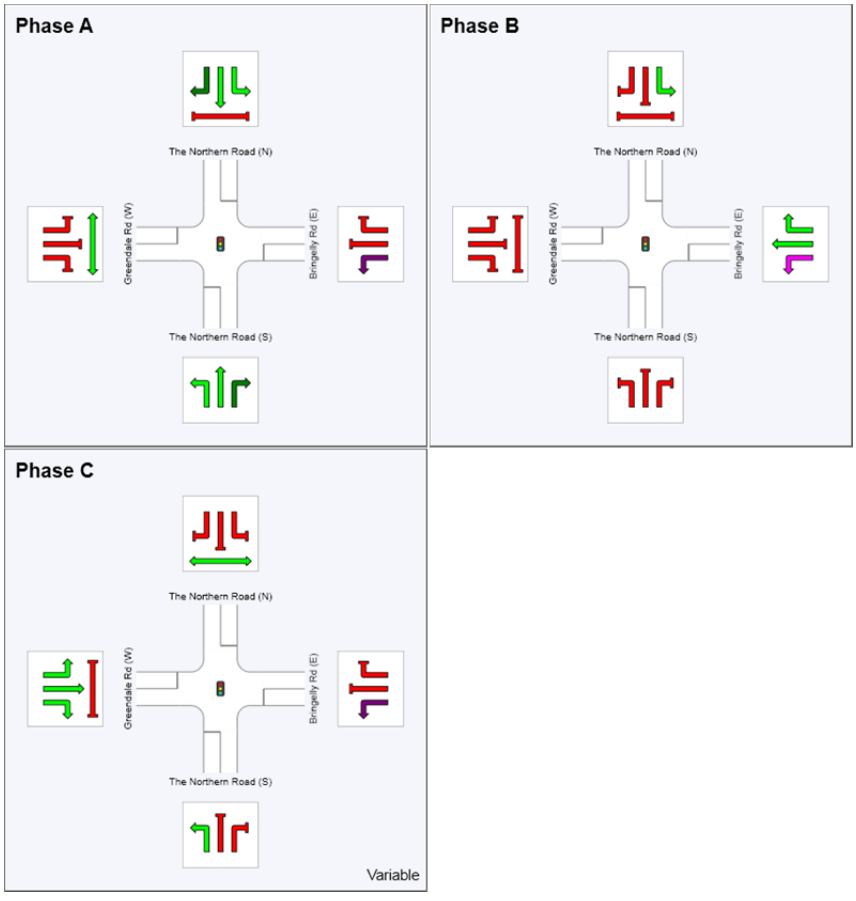
Site: 2039 AM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 44 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	20	32
Green Time (sec)	14	6	6
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	20	12	12
Phase Split	45 %	27 %	27 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

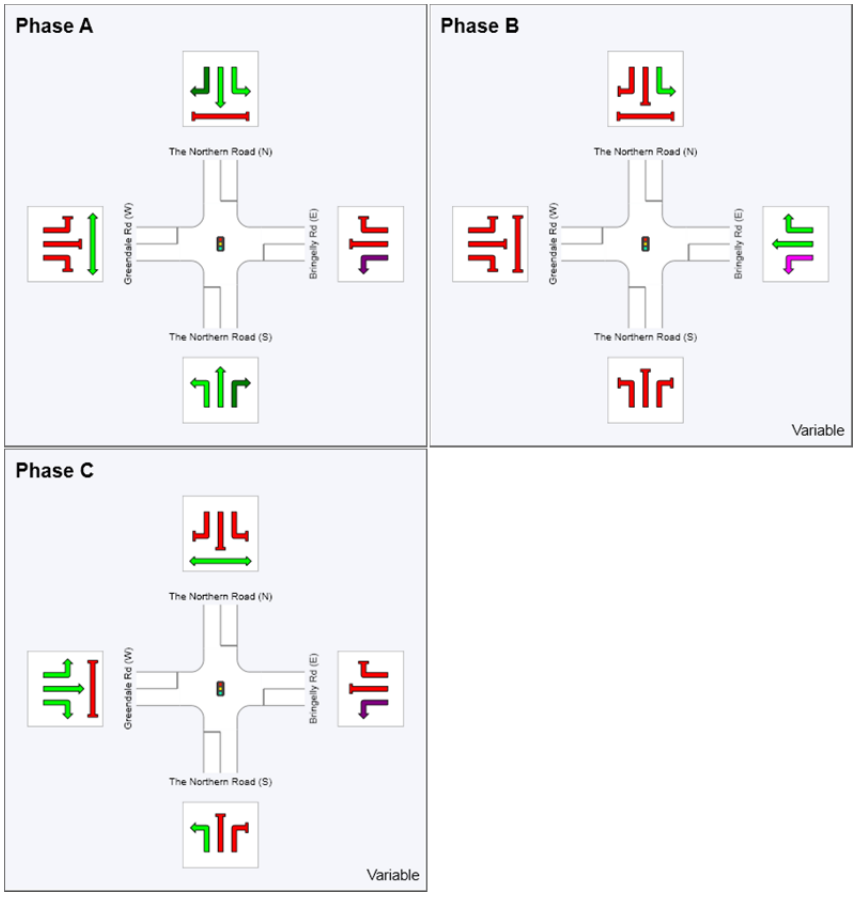
Site: 2039 PM The Northern Road and Bringelly Road

New Site
Signals - Actuated Isolated Cycle Time = 150 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	53	106
Green Time (sec)	47	47	38
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	53	53	44
Phase Split	35 %	35 %	29 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

SIDRA Phasing Summary

Grade separated intersection

PHASING SUMMARY

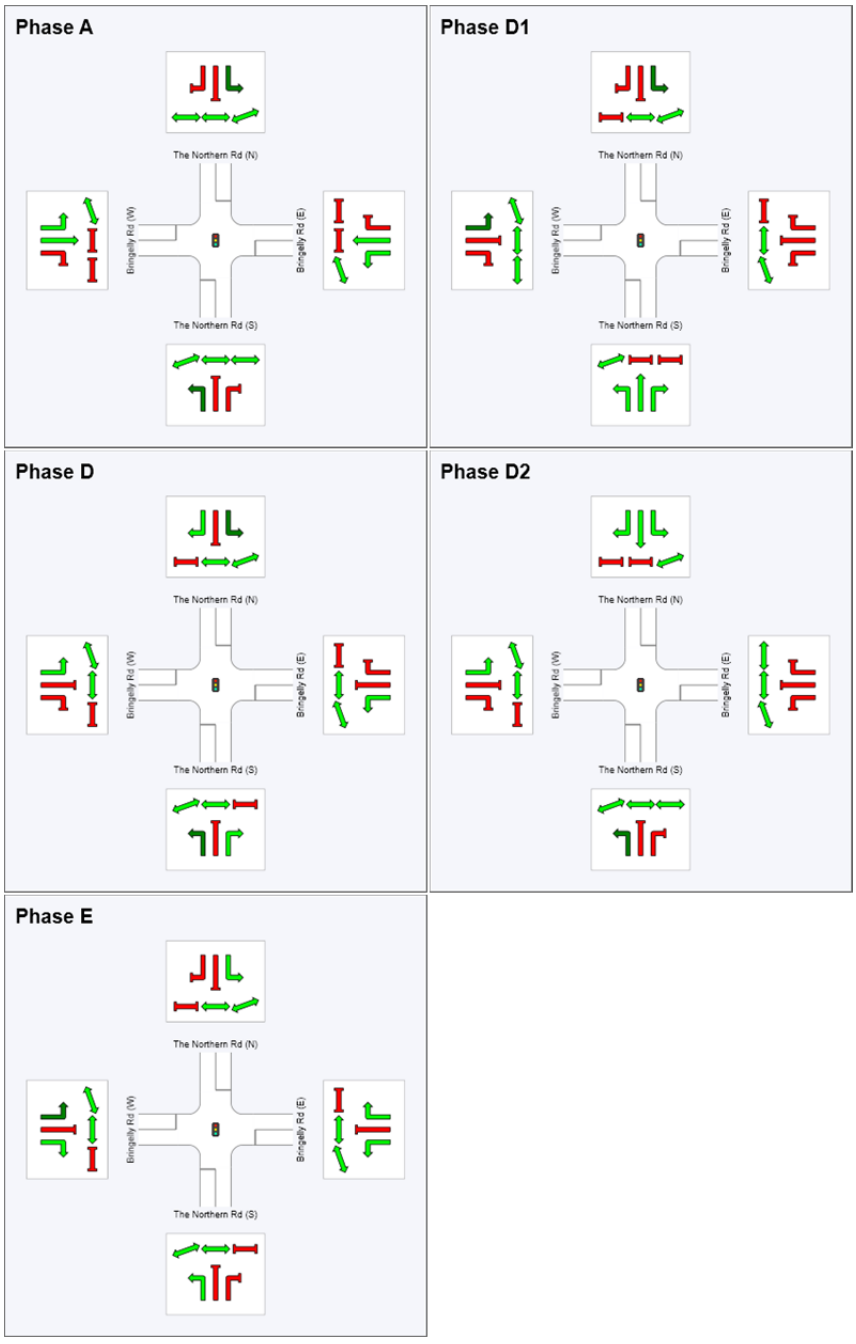
Site: 2019 AM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 92 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Two-Phase
Movement Class: All Movement Classes
Input Sequence: A, C, D1, D, D2, E
Output Sequence: A, D1, D, D2, E

Phase Timing Results

Phase	A	D1	D	D2	E
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	12	26	41	66
Green Time (sec)	6	8	9	19	20
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	12	14	15	25	26
Phase Split	13 %	15 %	16 %	27 %	28 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

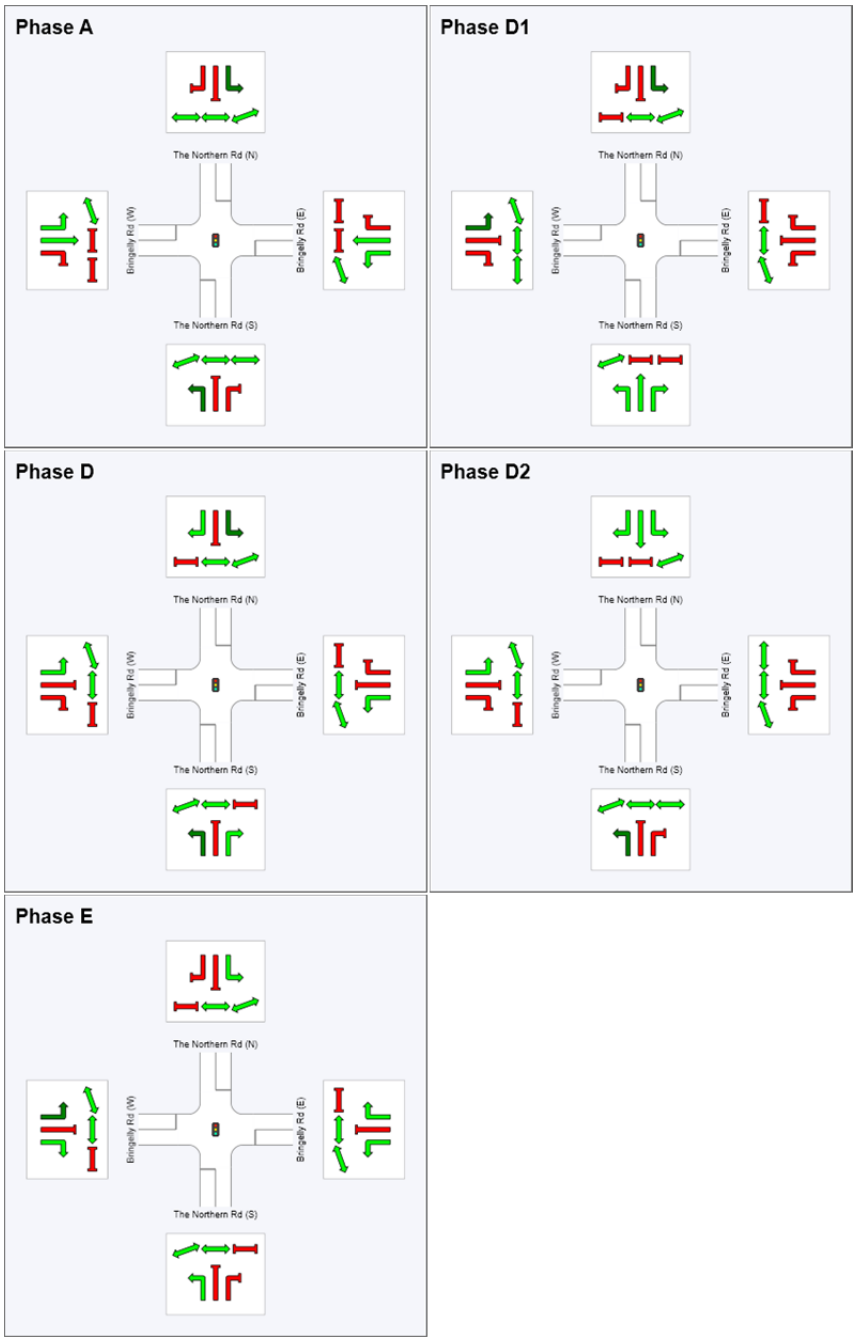
Site: 2019 PM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 92 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Two-Phase
Movement Class: All Movement Classes
Input Sequence: A, C, D1, D, D2, E
Output Sequence: A, D1, D, D2, E

Phase Timing Results

Phase	A	D1	D	D2	E
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	19	33	47	66
Green Time (sec)	13	8	8	13	20
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	19	14	14	19	26
Phase Split	21 %	15 %	15 %	21 %	28 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

PHASING SUMMARY

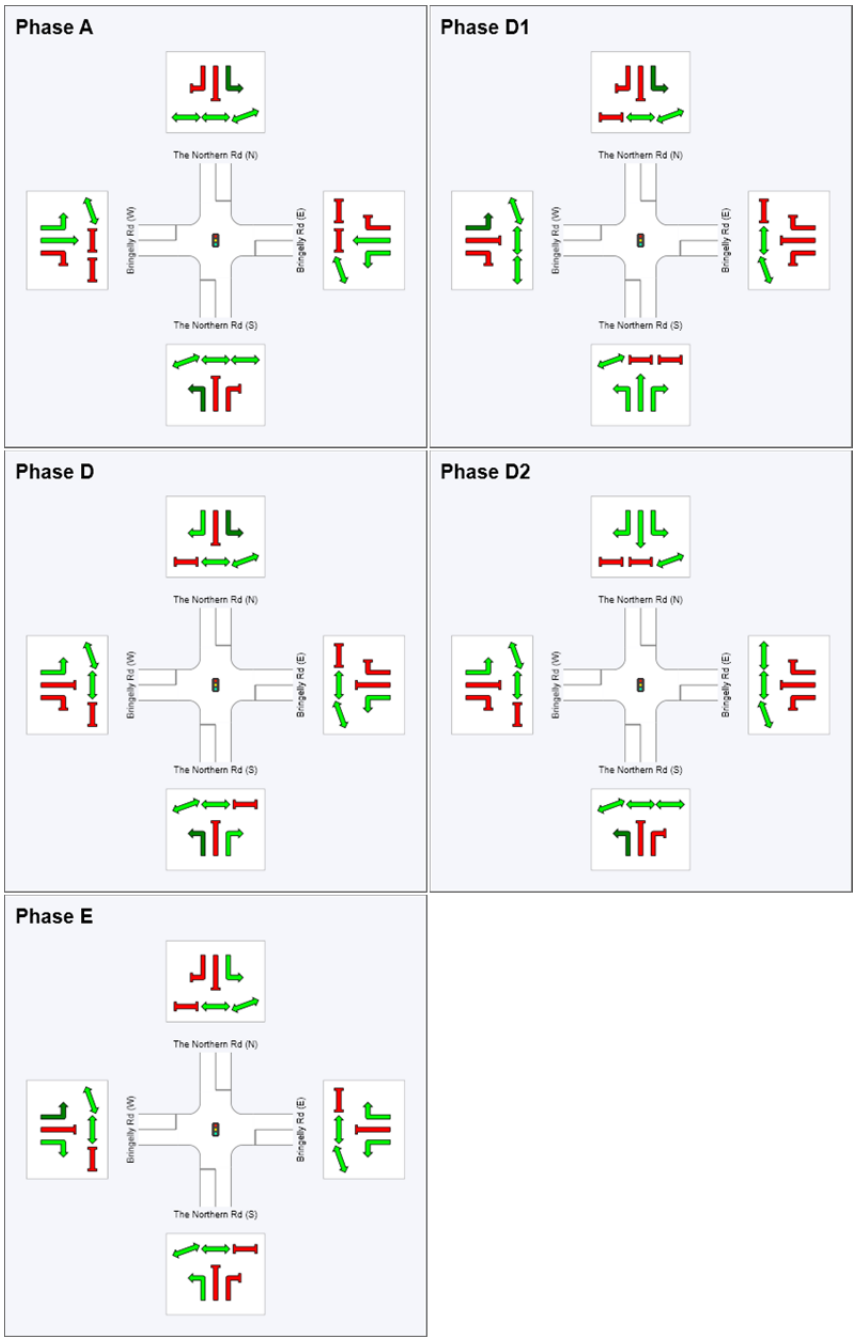
Site: 2029 AM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 84 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Two-Phase
Movement Class: All Movement Classes
Input Sequence: A, C, D1, D, D2, E
Output Sequence: A, D1, D, D2, E

Phase Timing Results

Phase	A	D1	D	D2	E
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	15	28	41	59
Green Time (sec)	9	7	7	12	19
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	15	13	13	18	25
Phase Split	18 %	15 %	15 %	21 %	30 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

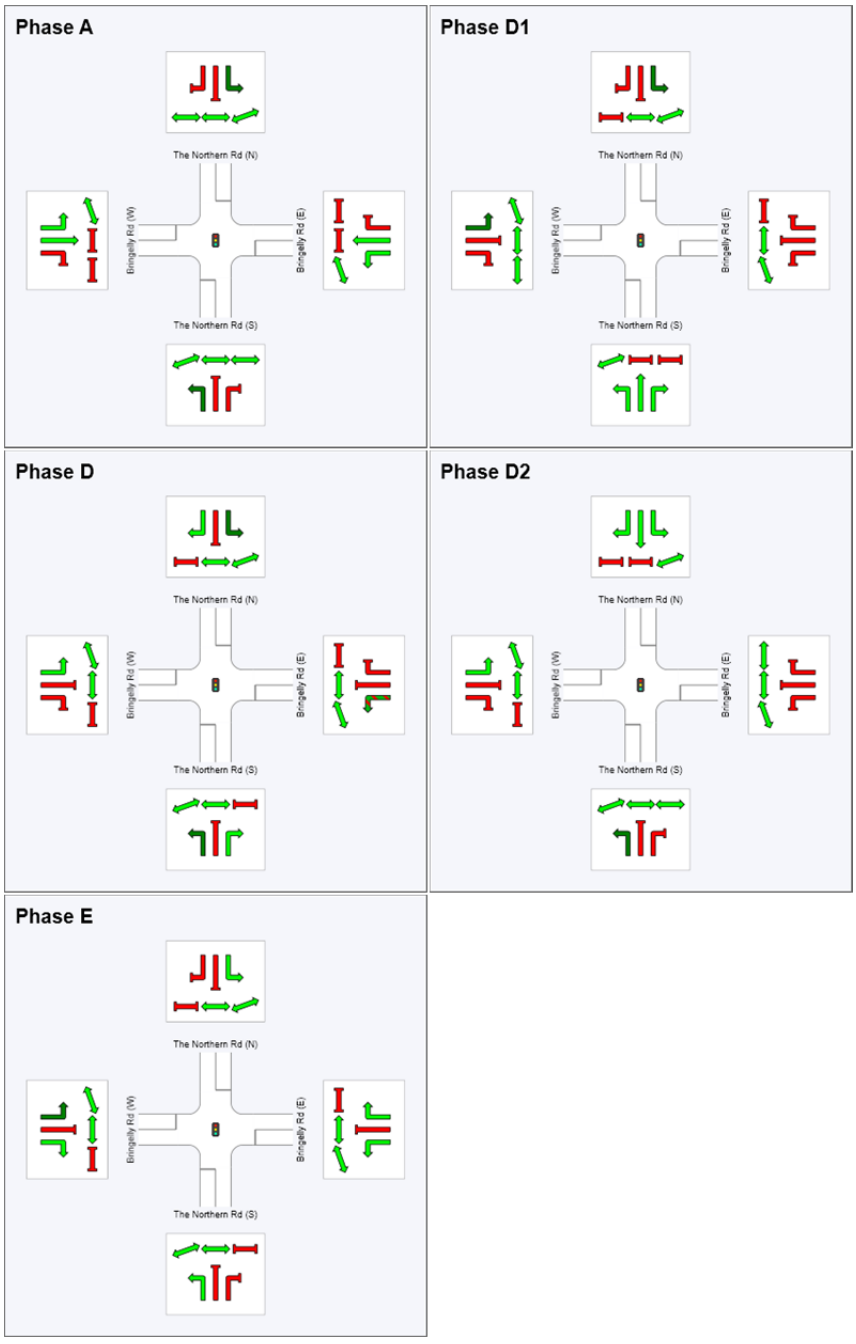
Site: 2029 PM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 107 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Two-Phase
Movement Class: All Movement Classes
Input Sequence: A, C, D1, D, D2, E
Output Sequence: A, D1, D, D2, E

Phase Timing Results

Phase	A	D1	D	D2	E
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	29	44	56	81
Green Time (sec)	23	9	6	19	20
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	29	15	12	25	26
Phase Split	27 %	14 %	11 %	23 %	24 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

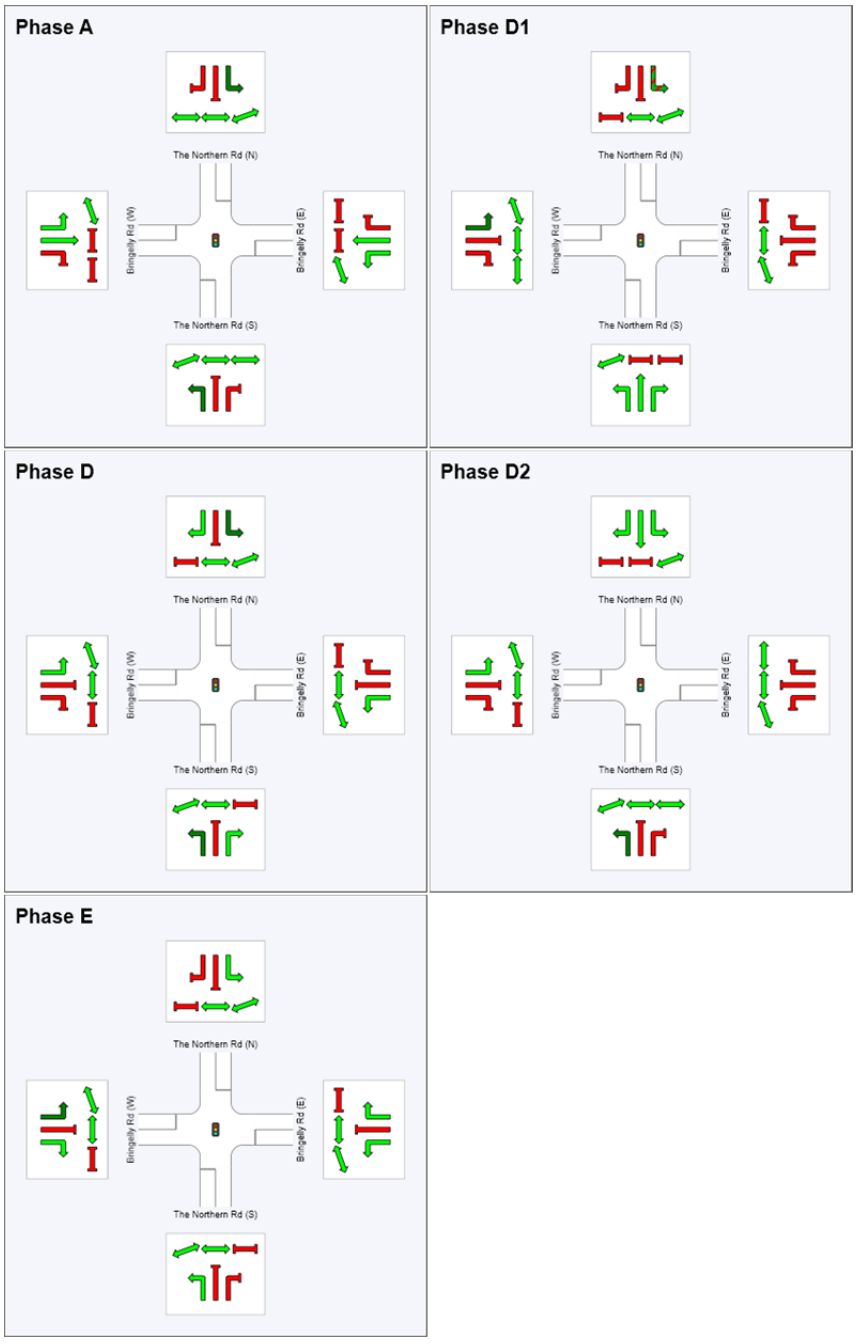
Site: 2039 AM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Two-Phase
Movement Class: All Movement Classes
Input Sequence: A, C, D1, D, D2, E
Output Sequence: A, D1, D, D2, E

Phase Timing Results

Phase	A	D1	D	D2	E
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	21	41	53	75
Green Time (sec)	15	14	6	16	19
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	21	20	12	22	25
Phase Split	21 %	20 %	12 %	22 %	25 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

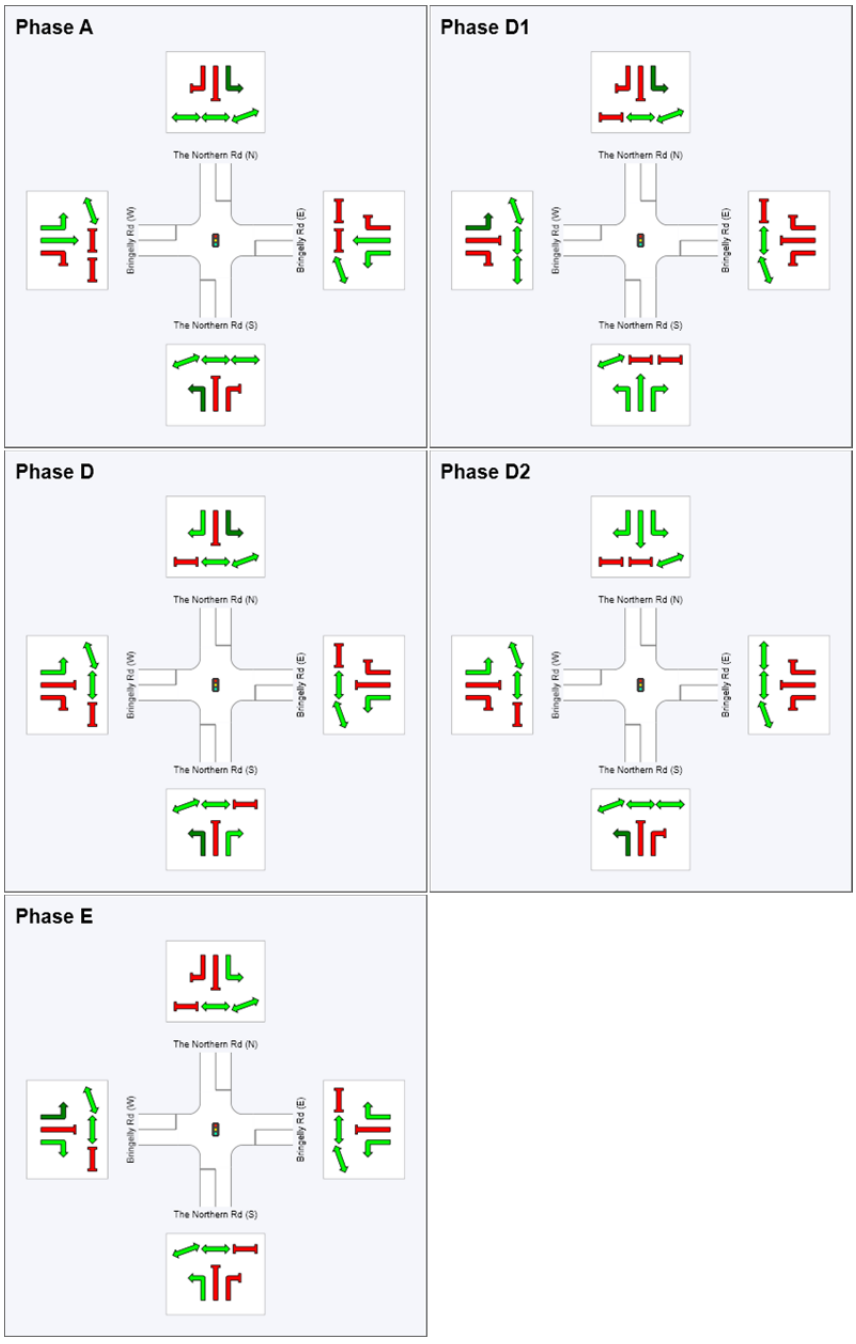
Site: 2039 PM The Northern Road and Bringelly Road GSI - v3

New Site
Signals - Actuated Isolated Cycle Time = 95 seconds (Optimum Cycle Time - Minimum Degree of Saturation)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: Two-Phase
Movement Class: All Movement Classes
Input Sequence: A, C, D1, D, D2, E
Output Sequence: A, D1, D, D2, E

Phase Timing Results

Phase	A	D1	D	D2	E
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	24	38	50	69
Green Time (sec)	18	8	6	13	20
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	24	14	12	19	26
Phase Split	25 %	15 %	13 %	20 %	27 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

SIDRA Phasing Summary

Existing intersection

(Greendale Road / The Northern Road / Bringelly Road)

With grade separated intersection operational

PHASING SUMMARY

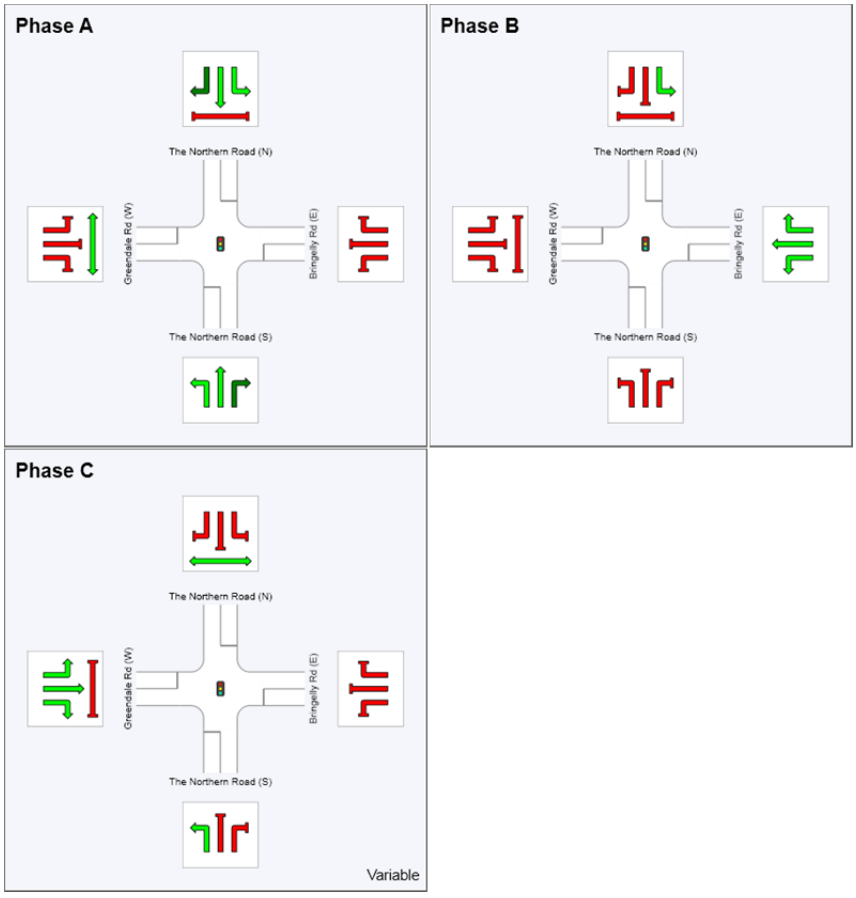
Site: 2019 AM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 38 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	12	24
Green Time (sec)	6	6	8
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	12	12	14
Phase Split	32 %	32 %	37 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

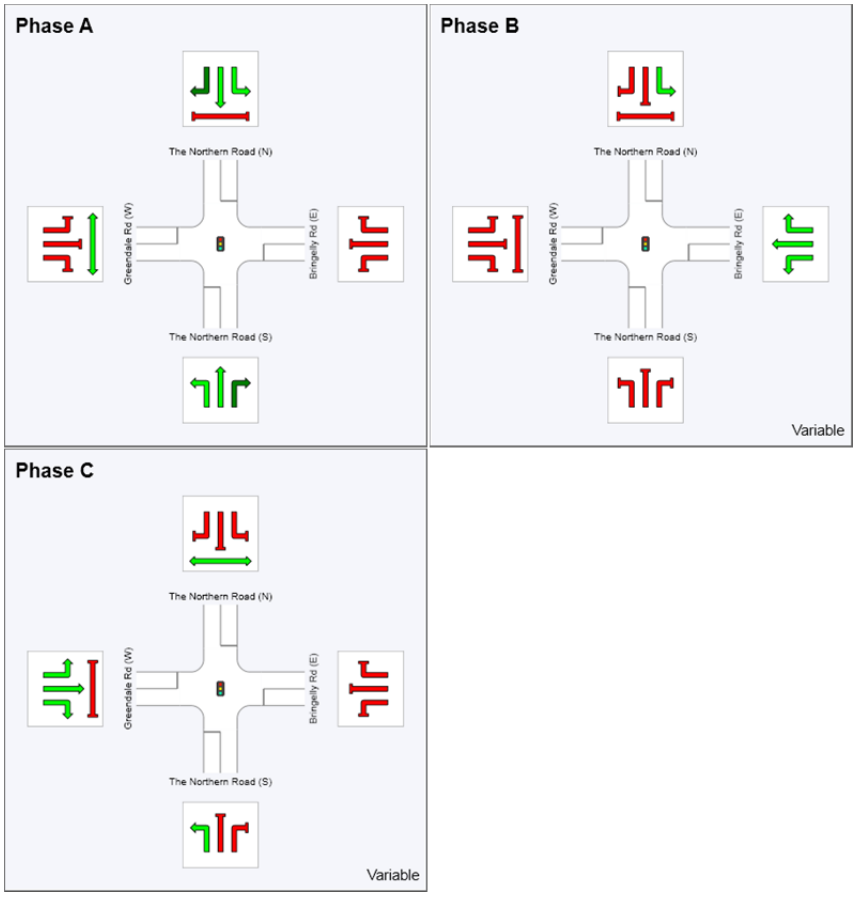
Site: 2019 PM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 58 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	14	34
Green Time (sec)	8	14	18
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	14	20	24
Phase Split	24 %	34 %	41 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

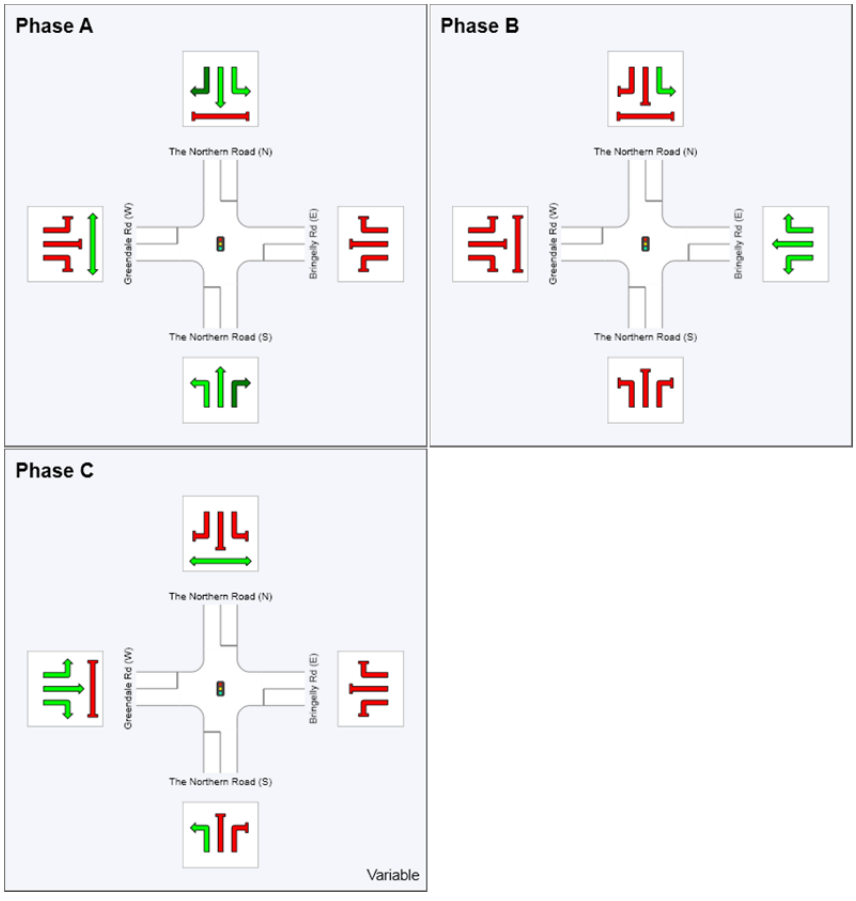
Site: 2029 AM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 64 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	15	38
Green Time (sec)	9	17	20
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	15	23	26
Phase Split	23 %	36 %	41 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

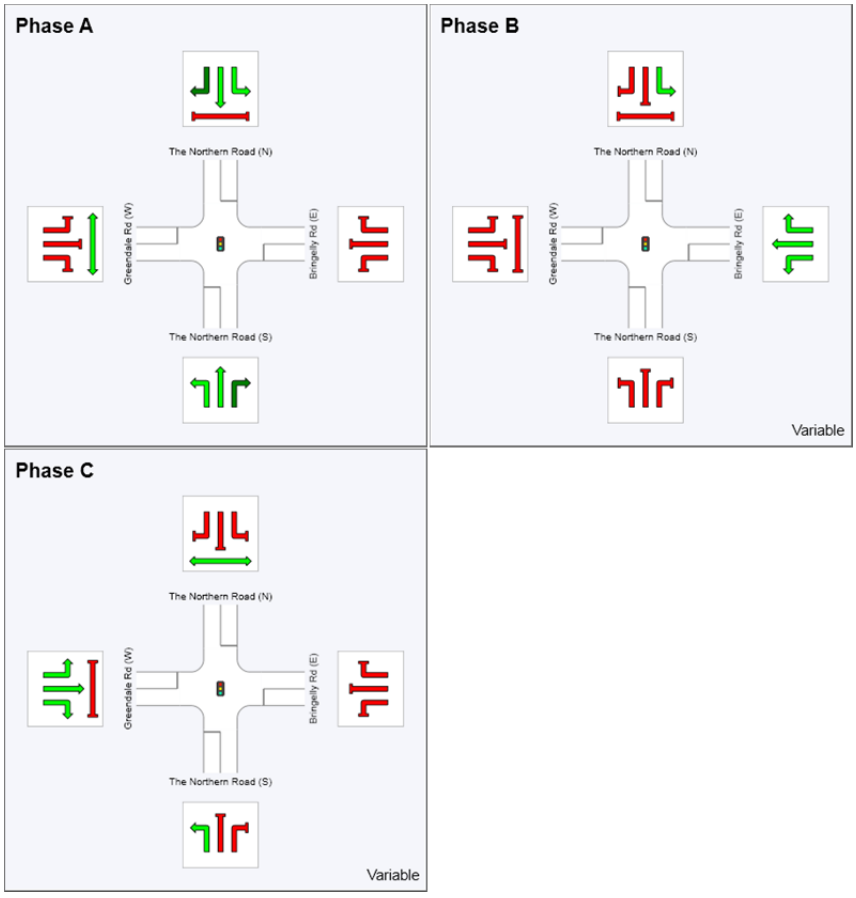
Site: 2029 PM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 124 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	22	68
Green Time (sec)	16	40	50
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	22	46	56
Phase Split	18 %	37 %	45 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

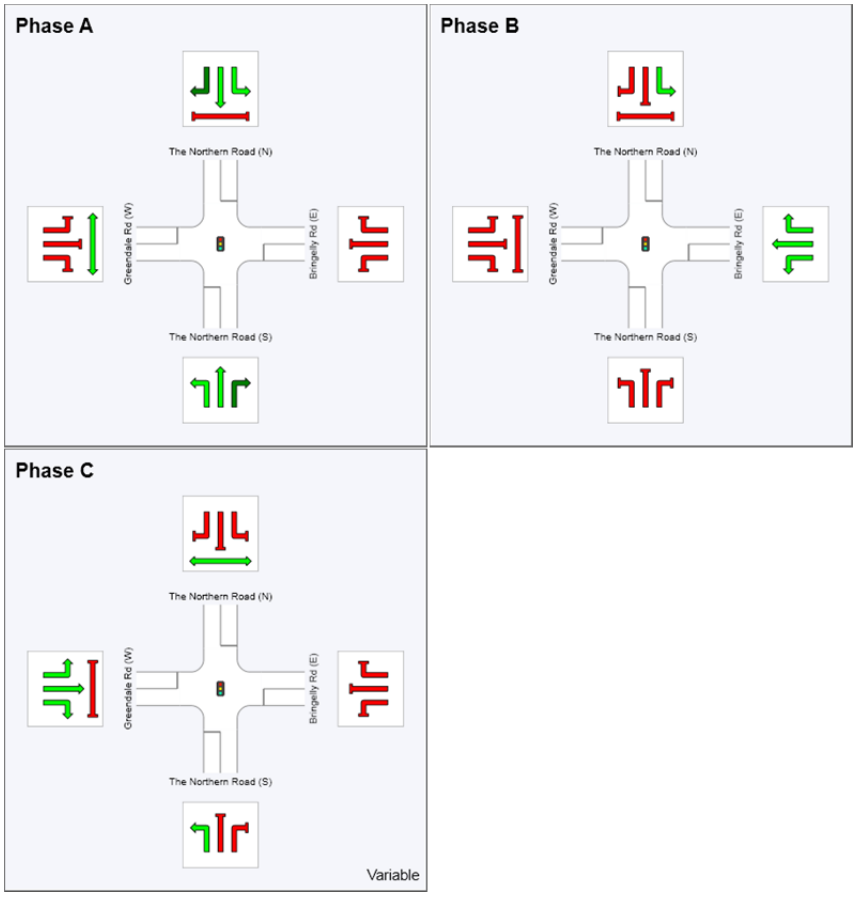
Site: 2039 AM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 124 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS PLan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	22	70
Green Time (sec)	16	42	48
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	22	48	54
Phase Split	18 %	39 %	44 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

PHASING SUMMARY

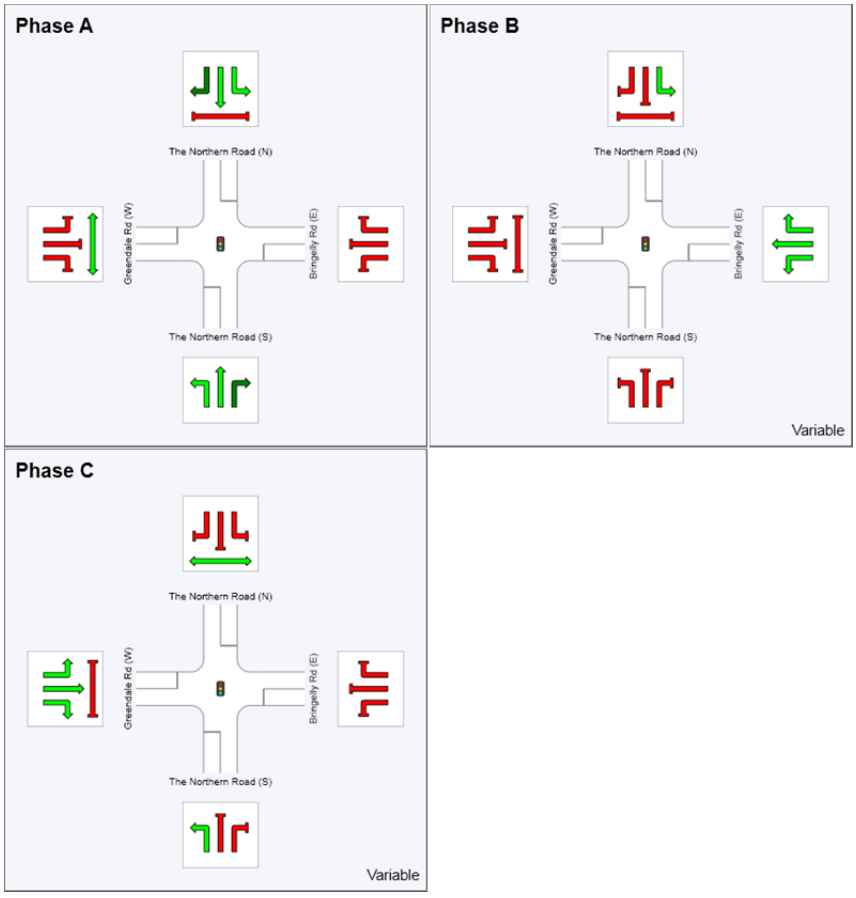
Site: 2039 PM The Northern Road and Bringelly Road Cul-de-sac

New Site
Signals - Actuated Isolated Cycle Time = 135 seconds (Practical Cycle Time)Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase times determined by the program
Sequence: TCS Plan
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	23	79
Green Time (sec)	17	50	50
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	23	56	56
Phase Split	17 %	41 %	41 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

Appendix D - Bus Timetables

856	
Tue 21 July (TODAY)	Bringelly to Liverpool via Prestons and Churchill Gardens

Timing point
W - Wheelchair accessible
Next day

	W	W	W	W	W	W	W
The Northern Rd near Dart Rd, Bringelly							
2171179	**05:38**	**06:23**	**07:09**	**09:07**	**11:07**	**14:15**	**17:49**
Northern Road Opposite Thames Road, Bringelly							
2171443	05:38	06:23	07:09	09:07	11:07	14:15	17:49
Bringelly Rd near The Northern Rd, Bringelly							
2171180	05:39	06:24	07:10	09:08	11:08	14:16	17:50
Bringelly Rd near Kelvin Park Dr, Bringelly							
2171181	05:39	06:24	07:11	09:08	11:08	14:16	17:50
Kelvin Park Dr near Bringelly Rd, Bringelly							
2171182		06:24		09:08	11:08		
Kelvin Park Dr at Medich Pl, Bringelly							
2171319		**06:26**		**09:10**	**11:10**		
Kelvin Park Dr near Bringelly Rd, Bringelly							
2171204		06:28		09:12	11:12		
Cnr Bringelly Road opposite Jersey Road, Bringelly							
2171444	05:40	06:30	07:12	09:14	11:14	14:17	17:51
Bringelly Rd near Church St, Rossmore							
255722		06:34	07:14	09:18	11:18		
Bringelly Rd near Allenby Rd, Rossmore							
2171205	05:42	06:34	07:14	09:18	11:18	14:19	17:53
Rossmore Public School and Shops Bringelly Rd, Rossmore							
2171206	**05:43**	**06:36**	**07:15**	**09:20**	**11:20**	**14:20**	**17:54**
Bringelly Rd near Glen Allen Rd, Rossmore							
2171207	05:43	06:36	07:15	09:20	11:20	14:20	17:54
Bringelly Rd near King St, Rossmore							
2171208	05:44	06:37	07:16	09:21	11:21	14:21	17:55
Bringelly Rd near Kelly St, Austral							
2171209	05:45	06:38	07:17	09:22	11:22	14:22	17:56
Eastwood Rd near Ingleburn Rd, Leppington							
2171211	05:46	06:39	07:18	09:23	11:23	14:23	17:57
Dickson Rd near Ingleburn Rd, Leppington							
2171447	**05:47**	**06:40**		**09:24**	**11:24**	**14:24**	**17:58**
Ingleburn Rd near Rickard Rd, Leppington							
2171213	05:48	06:41		09:25	11:25	14:25	17:59
Rickard Rd opp 106, Leppington							
217942	05:49	06:42		09:26	11:26	14:26	18:00
Leppington Public School Rickard Rd, Leppington							
2171214	05:49	06:42		09:26	11:26	14:26	18:00
Ingleburn Road near Eastwood Road, Leppington							
2171436			**07:19**				
Leppington Station, Stand A, Leppington							
217938	**05:51**	**06:44**	**07:27**	**09:28**	**11:28**	**14:28**	**18:02**
Leppington Public School Rickard Rd, Leppington							
2171166	05:51	06:44		09:29	11:29	14:29	18:02
106 Rickard Rd, Leppington							
217941	05:52	06:45		09:29	11:29	14:29	18:03
Ingleburn Road and Byron Road, Leppington							
2171446	05:53	06:46		09:30	11:30	14:30	18:04
Ingleburn Rd near Camden Valley Way, Leppington							
217926	05:53			09:31	11:31	14:31	18:04
Camden Valley Way near Denham Court Rd, Leppington							
2171186	**05:54**	**06:47**		**09:32**	**11:32**	**14:32**	**18:05**
Leppington Shopping Centre Camden Valley Way, Leppington							
2171187	05:54	06:47		09:32	11:32	14:32	18:05
Leppington Fruit Market and Casa Poloma, Leppington							
2171188	05:55	06:48		09:33	11:33	14:33	18:06
Forest Lawn Cemetery Camden Valley Way, Leppington							
2171190	05:56	06:49		09:34	11:34	14:34	18:07
Camden Valley Way Opposite Leppington Co-Op, Leppington							
2171448	05:56	06:49		09:35	11:35	14:35	18:08
Edmondson Av near Bringelly Rd, Austral							
2171215			07:32				

Scalabrini Village Edmondson Av near Fifth Av, Austral **2171216**			**07:36**				
Edmondson Av near Seventh Av, Austral 2171217			07:37				
Seventh Av near Browns Av, Austral 2171218			07:38				
Bringelly Rd near Cowpasture Rd, Austral 2171220			07:40				
Camden Valley Way after Horningsea Park Dr, Horningsea Park **2171222**	**05:58**	**06:51**	**07:45**	**09:37**	**11:37**	**14:37**	**18:10**
Camden Valley Way opp Rynan Av, Prestons 2170474	06:00	06:53	07:47	09:39	11:39	14:39	18:12
Corfield Rd near Camden Valley Way, Prestons **2170751**	**06:02**	**06:55**	**07:50**	**09:41**	**11:41**	**14:41**	**18:14**
Braidwood Dr near Brooman St, Prestons 2170467	06:02	06:55	07:50	09:41	11:41	14:41	18:14
Braidwood Dr near Minnamurra Cct, Prestons 2170468	06:02	06:55	07:50	09:41	11:41	14:41	18:14
Blue Hills Village, Tulich Av, Prestons **2170631**						**14:42**	
Braidwood Dr near Quaama Cl, Prestons 2170469	06:03	06:56	07:51	09:42	11:42	14:42	18:15
Wroxham St near Bomaderry Dr, Prestons 2170470	06:03	06:56	07:51	09:42	11:42	14:42	18:15
Bomaderry Dr before Dalmeny Dr, Prestons **2170741**	**06:04**	**06:57**	**07:52**	**09:43**	**11:43**	**14:43**	**18:16**
Dalmeny Dr near Balgownie Rd, Prestons 2170727	06:05	06:58	07:53	09:44	11:44	14:44	18:17
Dalmeny Drive between No. 33 - 35, Prestons 2170742	06:05	06:58	07:53	09:44	11:44	14:44	18:17
Mcdonalds Prestons, near Dalmeny Dr, Prestons **2170689**	**06:07**	**07:00**	**07:55**	**09:46**	**11:46**	**14:46**	**18:19**
Camden Valley Way near Ash Rd, Prestons 2170635	06:07	07:00	07:55	09:46	11:46	14:46	18:19
Wattle Rd and Beech Rd, Casula 2170647	06:10	07:04	07:59	09:49	11:49	14:49	18:22
Pine Rd near Willow St, Casula **2170623**	**06:12**	**07:06**	**08:01**	**09:51**	**11:51**	**14:51**	**18:24**
Pine Road outside No. 91, Casula 2170743	06:12	07:06	08:01	09:51	11:51	14:52	18:24
Pine Road between No's 69 - 67, Casula 2170744	06:12	07:07	08:02	09:52	11:52	14:54	18:25
Box Road near Pine Road, Casula 2170718	06:13	07:07	08:02	09:52	11:52	14:55	18:25
Myall Rd at Furlong Av, Casula 2170394	06:13	07:07	08:02	09:52	11:52	14:57	18:25
Casula High School, Myall Rd, Casula 2170395	06:14	07:08	08:03	09:53	11:53	14:59	18:26
Ingham Dr near Myall Rd, Casula 2170396	06:14	07:08	08:03	09:53	11:53	15:00	18:26
Ingham Dr near Guise Av, Casula 2170397	06:14	07:09	08:04	09:54	11:54	15:03	18:27
Casula Mall Rear Ingham Dr, Casula 2170398	06:15	07:10	08:05	09:55	11:55	15:06	18:28
Casula Mall Side Ingham Dr, Casula **2170399**	**06:16**	**07:11**	**08:06**	**09:56**	**11:56**	**15:08**	**18:29**
Hume Hwy near Lang Rd, Casula 2170364	06:17	07:12	08:08	09:57	11:57	15:09	18:30
Hume Hwy near Marsh Pde, Casula 2170322	06:18	07:13	08:09	09:58	11:58	15:10	18:31
Casula Shops Hume Hwy near Ashcroft Av, Casula 2170323	06:19	07:14	08:10	09:59	11:59	15:11	18:32
Hume Hwy after Graham Av, Casula **2170324**	**06:20**	**07:16**	**08:12**	**10:01**	**12:01**	**15:13**	**18:34**
Hume Hwy after Boundary Rd, Liverpool 2170325	06:21	07:18	08:14	10:02	12:02	15:14	18:35
Hume Hwy after Reilly St, Liverpool 2170326	06:22	07:19	08:15	10:03	12:03	15:15	18:36
Hume Hwy before Rose St, Liverpool 2170327	06:23	07:19	08:16	10:04	12:04	15:16	18:37

Hume Hwy at Passefield Rd, Liverpool 2170328	06:23	07:20	08:17	10:05	12:05	15:16	18:37
Moore St near Bathurst St, Liverpool 2170277	06:27	07:25					18:41
Macquarie T-Way Station - to Liverpool, Liverpool 2170696	06:28	07:26	08:22			15:21	18:42
Moore St after Bigge St, Liverpool 2170233			08:24			15:22	
Moore St before Northumberland St, Liverpool 2170719				10:09	12:09		
Liverpool Westfield Shops, Liverpool **2170556**				**10:11**	**12:11**		
Liverpool Elizabeth St near Goulburn St, Liverpool 2170243				10:13	12:13		
Liverpool Interchange - Stand 8, Liverpool **2170569**	**06:30**	**07:28**	**08:25**	**10:15**	**12:15**	**15:23**	**18:44**

856	
Tue 21 July (TODAY)	Liverpool to Bringelly via Churchill Gardens and Prestons

Timing point
W - Wheelchair accessible
Next day

	W	W	W	W	W	W
Liverpool Interchange - Stand 8, Liverpool						
2170569	**07:37**	**10:08**	**13:08**		**16:40**	**18:00**
Moore St before Macquarie St, Liverpool						
2170234	07:38	10:09	13:09		16:41	18:01
Presbyterian Church Moore St near Castlereagh St, Liverpool						
2170524	07:39	10:10	13:10		16:42	18:02
Shell Service Station Hume Hwy, Liverpool						
2170330	07:42	10:13	13:13		16:47	18:07
Hume Hwy near Rose St, Liverpool						
2170331	07:42	10:14	13:14		16:47	18:07
Hume Hwy near Reilly St, Liverpool						
2170348	07:43	10:15	13:15		16:48	18:08
Hume Hwy near Boundary Rd, Liverpool						
2170349	07:44	10:16	13:16		16:49	18:09
Bp Service Station Hume Hwy, Casula						
2170350	**07:46**	**10:18**	**13:18**		**16:52**	**18:12**
Hume Hwy near De Meyrick Av, Casula						
2170351	07:47	10:19	13:19		16:53	18:13
Hume Hwy near Marsh Pde, Casula						
2170352	07:47	10:20	13:20		16:54	18:14
Hume Hwy near Lang Rd, Casula						
2170558	07:48	10:20	13:20		16:54	18:14
Casula Mall Kurrajong Rd near Tallowood Av, Casula						
2170400	**07:51**					
Preston Public School Kurrajong Rd, Prestons						
2170432	07:52					
Kurrajong Rd near Wonga Rd, Prestons						
2170433	07:53					
Kurragong Rd near Beech Rd, Prestons						
2170595	07:54					
Kurrajong Rd near Skipton Rd, Prestons						
2170434	07:55					
Sule College Kurrajong Rd, Prestons						
2170453	07:56					
Kurrajong Rd near San Marino Dr, Prestons						
2170454	07:56					
Dalmeny Dr near Manildra St, Prestons						
2170746	07:57					
Dalmeny Dr near Venenzia St, Prestons						
2170720	07:58					
Casula Mall Side Ingham Dr, Casula						
2170389		**10:23**	**13:23**		**16:57**	**18:17**
Casula Mall Rear Ingham Dr, Casula						
2170390		10:23	13:23		16:57	18:17
Ingham Drive between No's 70 - 68B, Casula						
2170732		10:24	13:24		16:58	18:18
Ingham Drive opposite No. 95, Casula						
2170733		10:25	13:25		16:59	18:19
Myall Road opp Casula High School, Casula						
2170734		10:25	13:25		16:59	18:19
Myall Road opp Furlong Av, Casula						
2170735		10:25	13:25		16:59	18:19
Box Road, Casula						
2170736		10:26	13:26		17:00	18:20
Pine Road near Box Road, Casula						
2170737		10:26	13:26		17:00	18:20
Pine Road near Boab Place, Casula						
2170715		**10:28**	**13:28**		**17:02**	**18:22**
Beech Rd and Wattle Rd, Casula						
2170646		10:28	13:28		17:02	18:22
Camden Valley Way near Beech Rd, Casula						
2170437		10:29	13:29		17:03	18:23
Camden Valley Way near Ash Rd, Edmondson Park						
2171139		10:31	13:31		17:06	18:26

Mcdonalds Prestons, near Dalmeny Dr, Prestons **2170690**		**10:32**	**13:32**		**17:07**	**18:27**
Dalmeny Dr near Sligo Pl, Prestons 2170726		10:33	13:33		17:08	18:28
Dalmeny Dr, Prestons 2170686		10:33	13:33		17:08	18:28
Bomaderry Dr after Dalmeny Dr, Prestons **2170738**	**07:59**	**10:35**	**13:35**		**17:10**	**18:30**
Wroxham St and Rockton Cl, Prestons 2170659	07:59	10:35	13:35		17:10	18:30
Cnr Braidwood Drive near Tullich Av outside Doctors, Prestons 2170739	08:00	10:35	13:35		17:10	18:30
Braidwood Drive opposite No. 172, Prestons 2170716	08:01	10:36	13:36		17:11	18:31
Cnr Braidwood Drive near Corfield Road opposite No. 159, Prestons 2170717	08:01	10:36	13:36		17:11	18:31
Corfield Road opposite Nursery, Prestons **2170740**	**08:02**	**10:37**	**13:37**		**17:12**	**18:32**
Camden Valley Way after Gellibrand Rd, Edmondson Park 2171143	08:02	10:37	13:37		17:12	18:32
Camden Valley Way after Rynan Av, Prestons 2171145	08:04	10:39	13:39		17:15	18:35
Camden Valley Way after Talana Hill Dr, Horningsea Park **2171120**	**08:06**	**10:41**	**13:41**		**17:18**	**18:38**
Bringelly Rd near Cowpasture Rd, Leppington 2171200	08:14					
Bringelly Rd opp Browns Rd, Leppington 2171201	08:15					
Bringelly Rd and Edmondson Av, Leppington 2171392	08:18					
Leppington Co-Op Camden Valley Way, Leppington 217922		10:42	13:42		17:19	18:39
Forest Lawn Cemetery Camden Valley Way, Leppington 2171128		10:42	13:42		17:19	18:39
Leppington Fruit Market and Casa Poloma, Leppington 2171130		10:44	13:44		17:21	18:41
Leppington Shops Camden Valley Way, Leppington 2171131		10:45	13:45		17:22	18:42
Ingleburn Road opposite Hotel, Leppington 2171434		10:45	13:45		17:22	18:42
Ingleburn Road near Byron Road opposite Bus Shelter, Leppington **2171435**		**10:46**	**13:46**		**17:23**	**18:43**
Ingleburn Rd and Byron Rd, Leppington 2171382		10:46	13:46		17:23	18:43
Rickard Rd opp 106, Leppington 217942		10:47	13:47		17:24	18:44
Leppington Public School Rickard Rd, Leppington 2171214		10:48	13:48		17:25	18:45
Leppington Station, Stand B, Leppington **217939**		**10:50**	**13:50**	**13:52**	**17:27**	**18:47**
Leppington Public School Rickard Rd, Leppington 2171166		10:51	13:51	13:53	17:28	18:48
106 Rickard Rd, Leppington 217941		10:52	13:52	13:54	17:29	18:49
Ingleburn Rd near Rickard Rd, Leppington 2171167		10:53	13:53	13:55	17:30	18:50
Ingleburn Road near Eastwood Road, Leppington **2171436**		**10:55**	**13:55**	**13:57**	**17:32**	**18:52**
Bringelly Road No. 391, Leppington 2171418	08:22	10:56	13:56		17:33	18:53
Bringelly Rd near Kelly St, Leppington 2171172	08:24	10:56	13:56		17:33	18:53
Bringelly Rd near King St, Rossmore 2171173	08:27	10:57	13:57		17:34	18:54
Bringelly Road No.517, Rossmore 2171438	08:27	10:57	13:57		17:34	18:54
Bringelly Rd near Glen Allen Rd, Rossmore 2171174	08:29	10:58	13:58		17:35	18:55
Bringelly Road near North Av, Rossmore 2171439	08:31	10:58	13:58		17:35	18:55

Rossmore Public School and Shops Bringelly Rd, Rossmore **2171175**	**08:32**	**10:59**	**13:59**		**17:36**	**18:56**
Bringelly Rd near Allenby Rd, Rossmore 2171176	08:32	10:59	13:59		17:36	18:56
Brinelly Rd near Masterfield St, Rossmore 2171419	08:34	11:00	14:00		17:37	18:57
Bringelly Road near Rossmore Av, Rossmore 2171440	08:34	11:00	14:00		17:37	18:57
Bringelly Road near Jersey Road, Bringelly 2171420	08:36	11:01	14:01		17:38	18:58
Bringelly Road Nursery, Bringelly 2171441	08:37	11:02	14:02		17:39	18:59
Kelvin Park Dr near Bringelly Rd, Bringelly 2171182			14:02		17:39	18:59
Kelvin Park Dr at Medich Pl, Bringelly **2171319**			**14:04**		**17:41**	**19:01**
Kelvin Park Dr near Bringelly Rd, Bringelly 2171204			14:07		17:44	19:04
Bringelly Rd near Kelvin Park Dr, Bringelly 2171177	08:37	11:02	14:07		17:44	19:04
971 Bringelly Rd, Bringelly 2171421	08:38	11:02	14:08		17:45	19:05
Bringelly Rd before The Northern Rd, Bringelly 2171422	08:38	11:03	14:10		17:47	19:07
Bringelly Public School The Northern Rd, Bringelly 2171178	08:39	11:03	14:10		17:47	19:07
Northern Road near Thames Road, Bringelly **2171442**	**08:40**	**11:04**	**14:12**		**17:49**	**19:09**

Appendix E – Crash Statistics

Summary Crash Report

# Crash Type		
Car Crash	24	88.9%
Light Truck Crash	11	40.7%
Rigid Truck Crash	0	0.0%
Articulated Truck Crash	1	3.7%
'Heavy Truck Crash	(1)	(3.7%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(1)	(3.7%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	2	7.4%
Pedal Cycle Crash	0	0.0%
Pedestrian Crash	0	0.0%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	8	29.6%
Non intersection	19	70.4%

* Up to 10 metres from an intersection
~ 07:30-09:30 or 14:30-17:00 on school days

Collision Type		
Single Vehicle	10	37.0%
Multi Vehicle	17	63.0%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	0	0.0%
Other Classified Road	18	66.7%
Unclassified Road	9	33.3%

Contributing Factors		
Speeding	4	14.8%
Fatigue	2	7.4%
Alcohol	0	0.0%

Weather		
Fine	24	88.9%
Rain	3	11.1%
Overcast	0	0.0%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	3	11.1%
Dry	24	88.9%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	1	3.7%
Daylight	17	63.0%
Dusk	3	11.1%
Darkness	6	22.2%

Crash Movement		
Intersection, adjacent approaches	2	7.4%
Head-on (not overtaking)	0	0.0%
Opposing vehicles; turning	1	3.7%
U-turn	1	3.7%
Rear-end	10	37.0%
Lane change	0	0.0%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	1	3.7%
Overtaking; same direction	1	3.7%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	0	0.0%
Permanent obstruction on road	0	0.0%
Hit animal	1	3.7%
Off road, on straight	0	0.0%
Off road on straight, hit object	5	18.5%
Out of control on straight	0	0.0%
Off road, on curve	0	0.0%
Off road on curve, hit object	2	7.4%
Out of control on curve	0	0.0%
Other crash type	3	11.1%

CRASHES	27	
Fatal crash	0	0.0%
Injury crash	13	48.1%
Non-casualty crash	14	51.9%

CASUALTIES	19	
Killed	0	0.0%
Injured	19	100.0%
^ Unrestrained	0	0.0%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Time Group		% of Day	
00:01 - 02:59	2	7.4%	12.5%
03:00 - 04:59	0	0.0%	8.3%
05:00 - 05:59	0	0.0%	4.2%
06:00 - 06:59	1	3.7%	4.2%
07:00 - 07:59	1	3.7%	4.2%
08:00 - 08:59	1	3.7%	4.2%
09:00 - 09:59	4	14.8%	4.2%
10:00 - 10:59	1	3.7%	4.2%
11:00 - 11:59	0	0.0%	4.2%
12:00 - 12:59	2	7.4%	4.2%
13:00 - 13:59	1	3.7%	4.2%
14:00 - 14:59	1	3.7%	4.2%
15:00 - 15:59	2	7.4%	4.2%
16:00 - 16:59	4	14.8%	4.2%
17:00 - 17:59	3	11.1%	4.2%
18:00 - 18:59	0	0.0%	4.2%
19:00 - 19:59	1	3.7%	4.2%
20:00 - 21:59	2	7.4%	8.3%
22:00 - 24:00	1	3.7%	8.3%

Crashes		Casualties
5	2014	1
2	2013	1
4	2012	1
7	2011	7
1	2010	4
2	2009	3
6	2008	2

~ School Travel Time		
Involvement	8	29.6%

Street Lighting Off/Nil		% of Dark
4 of	6 in Dark	66.7%

McLean Periods			% Week
A	2	7.4%	17.9%
B	1	3.7%	7.1%
C	6	22.2%	17.9%
D	0	0.0%	3.5%
E	3	11.1%	3.6%
F	2	7.4%	10.7%
G	5	18.5%	7.1%
H	4	14.8%	7.1%
I	4	14.8%	12.5%
J	0	0.0%	10.7%

Speed Limit					
40 km/h or less	1	3.7%	~ 40km/h or less	1	12.5%
50 km/h zone	1	3.7%	80 km/h zone	11	40.7%
60 km/h zone	13	48.1%	90 km/h zone	0	0.0%
70 km/h zone	1	3.7%	100 km/h zone	0	0.0%
			110 km/h zone	0	0.0%

Day of the Week						# Holiday Periods		
Monday	5	18.5%	Thursday	7	25.9%	Sunday	3	11.1%
Tuesday	5	18.5%	Friday	2	7.4%	WEEKDAY	19	70.4%
Wednesday	0	0.0%	Saturday	5	18.5%	WEEKEND	8	29.6%

New Year	0	0.0%	Queen's BD	0	0.0%	Easter SH	1	3.7%
Aust. Day	1	3.7%	Labour Day	0	0.0%	June/July SH	3	11.1%
Easter	0	0.0%	Christmas	0	0.0%	Sept./Oct. SH	0	0.0%
Anzac Day	0	0.0%	January SH	1	3.7%	December SH	0	0.0%

Crashid dataset 6395 - Within 1km of The Northern Rd and Greendale Rd - July09 to June14
Note: Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Detailed Crash Report

NOTES: 6395 - Within 1km of The Northern Rd and Greendale Rd - July09 to June14

Crash No.	Date	Day of Week	Time	Distance		ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																					A S F
Sydney Region																					
Camden LGA																					
Bringelly																					
Bringelly Rd																					
728395	17/10/2010	Sun	10:30	40 m	E	THE NORTHERN RD	2WY	STR	Fine	Dry	70	3	CAR	M75	W in BRINGELLY RD	40	Proceeding in lane	I	0	4	
E43308708							RUM:	30	Rear end				CAR	M U	W in BRINGELLY RD	0	Stationary				
													CAR	M26	W in BRINGELLY RD	0	Stationary				
Greendale Rd																					
671887	16/06/2009	Tue	02:30	100 m	W	MEDWAY RD	2WY	STR	Fine	Dry	60	1	CAR	M18	W in GREENDALE RD	900	Proceeding in lane	I	0	2	S
E124538898							RUM:	71	Off rd left => obj				Utility pole								
783085	26/01/2012	Thu	00:27	100 m	W	MEDWAY RD	2WY	STR	Raining	Wet	80	1	4WD	M33	W in GREENDALE RD	70	Proceeding in lane	N	0	0	
E47226377							RUM:	71	Off rd left => obj				Tree/bush								
742743	29/01/2011	Sat	17:10	500 m	W	THE NORTHERN RD	2WY	CRV	Fine	Dry	80	1	CAR	F37	W in GREENDALE RD	80	Proceeding in lane	I	0	3	S
E43999742							RUM:	87	Off lft/lft bnd=>obj				Embankment								
The Northern Rd																					
610203	25/02/2008	Mon	12:20	60 m	S	BRINGELLY RD	2WY	STR	Fine	Dry	60	2	CAR	M74	S in THE NORTHERN RD	5	Pulling out	N	0	0	
E33129305							RUM:	42	Leaving parking				TRK	M54	S in THE NORTHERN RD	30	Proceeding in lane				
777261	02/12/2011	Fri	14:05	65 m	S	BRINGELLY RD	2WY	STR	Fine	Dry	60	2	TRK	M18	S in THE NORTHERN RD	60	Proceeding in lane	I	0	1	
E46547450							RUM:	32	Right rear				CAR	F47	S in THE NORTHERN RD	0	Wait turn right				
627394	17/06/2008	Tue	09:15	75 m	S	BRINGELLY RD	2WY	STR	Fine	Dry	80	2	TRK	M52	S in THE NORTHERN RD	20	Proceeding in lane	I	0	1	
E33746830							RUM:	32	Right rear				CAR	F23	S in THE NORTHERN RD	0	Wait turn right				
857670	14/11/2013	Thu	07:50	200 m	S	BRINGELLY RD	2WY	STR	Fine	Dry	60	3	CAR	F28	N in THE NORTHERN RD	50	Proceeding in lane	N	0	0	
E54906880							RUM:	30	Rear end				CAR	F52	N in THE NORTHERN RD	0	Stationary				
													CAR	M31	N in THE NORTHERN RD	0	Stationary				
790486	13/02/2012	Mon	06:00	970 m	S	BRINGELLY RD	2WY	CRV	Fine	Dry	80	1	TRK	M50	S in THE NORTHERN RD	70	Proceeding in lane	N	0	0	
E46958047							RUM:	81	Off left/rt bnd=>obj				Fence (prior to 2014)								
818579	22/11/2012	Thu	16:30	70 m	S	GREENDALE RD	DIV	STR	Fine	Dry	60	2	UTE	M U	E in THE NORTHERN RD	20	Forward from drive	N	0	0	
E49447735							RUM:	47	Emerging from drive				TRK	M35	N in THE NORTHERN RD	20	Pull out opposite				
1033715	01/07/2014	Tue	21:23	10 m	N	LOFTUS RD	TJN	STR	Fine	Dry	80	2	CAR	F34	S in THE NORTHERN RD	70	Proceeding in lane	N	0	0	
E55169918							RUM:	30	Rear end				CAR	M23	S in THE NORTHERN RD	0	Stationary				

Detailed Crash Report

Crash No.	Date	Day of Week	Time	Distance		ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																					A S F
1022915	01/02/2014	Sat	15:30	150 m	S	LOFTUS RD	2WY	STR	Fine	Dry	80	1	CAR	M24	S in THE NORTHERN RD	70	Proceeding in lane	N	0	0	F
E54189873							RUM:	71	Off rd left => obj				Fence								
623242	10/05/2008	Sat	16:50		at	ROBINSON RD	TJN	STR	Fine	Dry	80	1	CAR	F48	N in THE NORTHERN RD	70	Proceeding in lane	I	0	1	F
E35527585							RUM:	71	Off rd left => obj				Utility pole								
765368	25/08/2011	Thu	16:00		at	ROBINSON RD	TJN	STR	Fine	Dry	80	2	TRK	M23	N in THE NORTHERN RD	80	Proceeding in lane	I	0	1	
E44734110							RUM:	32	Right rear				UTE	M59	N in THE NORTHERN RD	0	Wait turn right				
662545	31/03/2009	Tue	15:50	5 m	S	ROBINSON RD	TJN	STR	Raining	Wet	80	2	CAR	F61	N in THE NORTHERN RD	60	Proceeding in lane	I	0	1	
E36899613							RUM:	32	Right rear				TRK	M54	N in THE NORTHERN RD	0	Wait turn right				
Liverpool LGA																					
Bringelly																					
Bringelly Rd																					
751849	11/04/2011	Mon	19:09	100 m	E	KELVIN PARK DR	2WY	STR	Fine	Dry	80	1	CAR	M18	E in BRINGELLY RD	75	Proceeding in lane	N	0	0	
E152370596							RUM:	67	Struck animal				Small animal								
649619	16/12/2008	Tue	23:10	200 m	E	KELVIN PARK DR	2WY	STR	Fine	Dry	80	2	CAR	M41	E in BRINGELLY RD	80	Proceeding in lane	N	0	0	
E36081303							RUM:	30	Rear end				CAR	M23	E in BRINGELLY RD	75	Proceeding in lane				
Greendale Rd																					
620937	29/03/2008	Sat	08:20	50 m	W	THE NORTHERN RD	2WY	STR	Fine	Dry	60	1	TRK	M19	E in GREENDALE RD	Unk	Other forward	N	0	0	
E33159947							RUM:	93	Pkd veh runaway=>obj				Fence (prior to 2014)								
761076	21/07/2011	Thu	16:45	100 m	W	THE NORTHERN RD	2WY	STR	Raining	Wet	60	2	CAR	M53	W in GREENDALE RD	70	Pull out opposite	N	0	0	S
E45427862							RUM:	53	Overtake turning				CAR	F38	W in GREENDALE RD	5	Turning right				
Kelvin Park Dr																					
635031	21/08/2008	Thu	09:15	5 m	N	BRINGELLY RD	TJN	STR	Fine	Dry	50	2	CAR	M14	E in BRINGELLY RD	20	Turning left	N	0	0	
E34902312							RUM:	12	Left far				TRK	F48	S in KELVIN PARK DR	Unk	Proceeding in lane				
The Northern Rd																					
836567	10/05/2013	Fri	17:55		at	BRINGELLY RD	XJN	STR	Fine	Dry	60	2	CAR	F50	N in THE NORTHERN RD	5	Turning right	I	0	1	
E99805102							RUM:	21	Right through				M/C	M43	S in THE NORTHERN RD	30	Proceeding in lane				
1050402	13/11/2014	Thu	20:55		at	BRINGELLY RD	XJN	STR	Fine	Dry	60	2	CAR	M48	W in BRINGELLY RD	15	Turning left	I	0	1	
E109443702							RUM:	16	Left near				TRK	M28	S in THE NORTHERN RD	20	Proceeding in lane				
756397	23/05/2011	Mon	09:00	200 m	N	BRINGELLY RD	2WY	STR	Fine	Dry	40	2	VAN	F41	N in THE NORTHERN RD	Unk	Proceeding in lane	I	0	1	
E45039043							RUM:	30	Rear end				SEM	M61	N in THE NORTHERN RD	40	Proceeding in lane				
1025140	25/05/2014	Sun	13:40	300 m	N	BRINGELLY RD	2WY	STR	Fine	Dry	60	2	CAR	M80	N in THE NORTHERN RD	10	Perform U-turn	N	0	0	
E217694895							RUM:	40	U turn				4WD	M55	N in THE NORTHERN RD	60	Proceeding in lane				

Detailed Crash Report

Crash No.	Date	Day of Week	Time	Distance		ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																					A S F
1026165	24/05/2014	Sat	17:25	50 m	S	BRINGELLY RD	2WY	STR	Fine	Dry	60	5	CAR	F35	S in THE NORTHERN RD	60	Proceeding in lane	N	0	0	
E54847926							RUM:	30	Rear end				CAR	M19	S in THE NORTHERN RD	0	Stationary				
													CAR	M22	S in THE NORTHERN RD	0	Stationary				
													CAR	F69	S in THE NORTHERN RD	0	Stationary				
													TRK	F17	S in THE NORTHERN RD	0	Stationary				
806186	08/07/2012	Sun	12:00		at	GREENDALE RD	XJN	CRV	Fine	Dry	60	1	M/C	M54	E in GREENDALE RD	20	Turning left	I	0	1	S
E51051583							RUM:	84	Off right/left bend												
763293	04/07/2011	Mon	09:36	105 m	S	SOLWAY RD	2WY	STR	Fine	Dry	60	1	CAR	M33	N in THE NORTHERN RD	50	Proceeding in lane	I	0	1	
E44886613							RUM:	71	Off rd left => obj				Fence (prior to 2014)								

Report Totals: Total Crashes: 27 Fatal Crashes: 0 Injury Crashes: 13 Killed: 0 Injured: 19

Crashid dataset 6395 - Within 1km of The Northern Rd and Greendale Rd - July09 to June14

Note: Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

Appendix F – Property Access Strategy

Roads and Maritime Services

The Northern Road Stage 2B - The Northern Road/Bringelly Road Grade Separated Interchange

Property Access Strategy

November 2015

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1. Introduction

This report proposes the property access strategy for the properties impacted by The Northern Road Upgrade (Stage 2B). This project includes the realignment of the existing The Northern Road and provision of a new grade separated interchange at Bringelly Road, Bringelly.

The purpose of this report is to confirm that access has been provided for all properties affected by the project.

The impact on travel distance for local residents will be assessed based on the availability of an access from/to their properties.

2. Proposed access strategy

2.1 Properties north of Bringelly Road

The existing The Northern Road between Thames Road and Robinson Road will be converted into a cul-de-sac; hence there will be no direct access to the proposed The Northern Road. Residents of properties 43, 44 and 45 will maintain access to the existing The Northern Road via a proposed shared driveway. Residents will need to travel to the existing Greendale Road / The Northern Road intersection and travel along Bringelly Road for approximately 300 metres to the proposed Bringelly Road / The Northern Road interchange. Figure 1 shows the access strategy for the properties north of Bringelly Road, as described below.

2.1.1 Outbound traffic leaving from residential property

Residents leaving their property to travel north, south or east will be required to travel south towards the existing Greendale Road / The Northern Road intersection and turn left onto Bringelly Road. From here residents will travel along Bringelly Road to the new Bringelly Road / The Northern Road interchange and turn onto the proposed The Northern Road to travel north or south or continue straight through the interchange to travel east.

2.1.2 Inbound traffic returning to residential property

Residents returning to their property from the proposed The Northern Road will need to travel the reverse route of the travel directions described above in Section 2.1.1.

2.1.3 Travel distances for Properties located north of Bringelly Road

The travel distances for properties located to the north of Bringelly Road are shown below in Table 1.

Table 1 – Properties located to the north of Bringelly Road

Property number	Traffic Travelling North (km)		Traffic Travelling South (km)	
	Distance to the intersection of Solway Road using the existing The Northern Road	Distance to the intersection of Solway Road using the new The Northern Road	Distance to the new intersection of Belmore Road using the existing The Northern Road	Distance to the new intersection of Belmore Road using the new The Northern Road
7	0.43	1.61	1.48	1.61
8	0.48	1.46	1.33	1.46
9	0.61	1.41	1.29	1.43
10	0.67	1.16	1.33	1.48
42	0.91	1.57	1.33	1.58
43	0.37	1.79	1.66	1.66
44	0.26	1.79	1.66	1.79
45	0.17	1.88	1.74	1.87

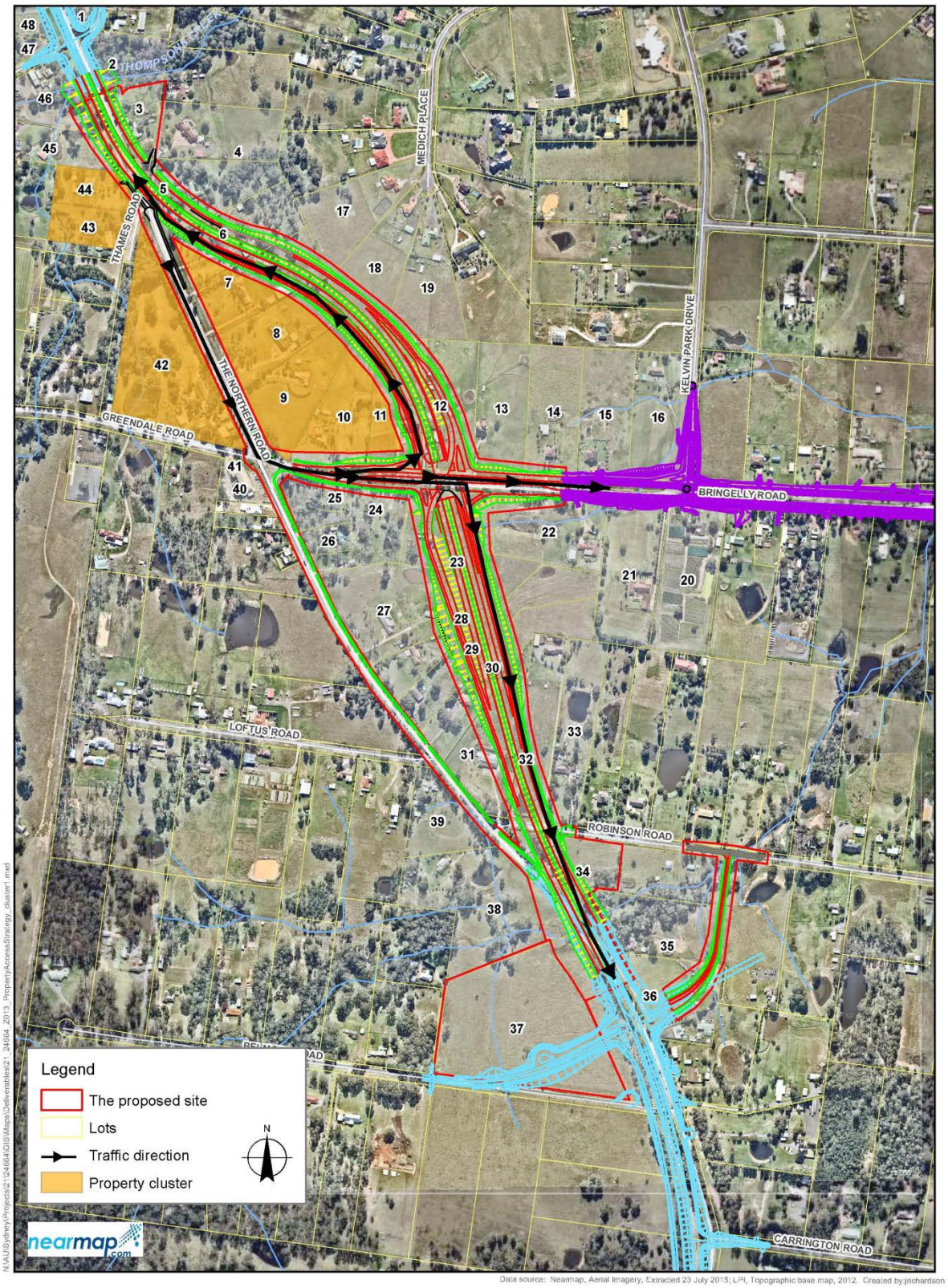

Figure 1 – Properties north of Bringelly Road

2.2 Properties south of Bringelly Road

The existing The Northern Road between Thames Road and Robinson Road will be converted into a cul-de-sac; hence there will be no direct access to the proposed The Northern Road. Residents will need to travel to the existing Greendale Road/The Northern Road intersection and travel along Bringelly Road for approximately 300 metres to the proposed Bringelly Road / The Northern Road interchange. Figure 2 shows the access strategy for the properties south of Bringelly Road, as described below.

2.2.1 Outbound traffic leaving from residential property

Residents leaving their property to travel north, south or east will be required to travel north towards the existing Greendale Road / The Northern Road intersection and turn right onto Bringelly Road. From here residents will travel along Bringelly Road to the new Bringelly Road / The Northern Road interchange and turn onto the proposed The Northern Road to travel north or south or continue straight through the interchange to travel east.

2.2.2 Inbound traffic returning to residential property

Residents returning to their property from the proposed The Northern Road will need to travel the reverse route of the travel directions described above in Section 2.2.1.

2.2.3 Travel distances for Properties located south of Bringelly Road

The travel distances for properties located to the north of Bringelly Road are shown below in Table 2.

Table 2- Properties located to the south of Bringelly Road

Property number	Traffic Travelling North (km)		Traffic Travelling South (km)	
	Distance to the intersection of Solway Road using the existing The Northern Road	Distance to the intersection of Solway Road using the new The Northern Road	Distance to the new intersection of Belmore Road using the existing The Northern Road	Distance to the new intersection of Belmore Road using the new The Northern Road
24	1.01	1.47	0.96	1.53
26	0.93	1.39	1.04	1.46
27	1.16	1.63	0.80	1.70
28	1.19	1.66	0.77	1.72
29	1.33	1.80	0.63	1.82
30	1.36	1.83	0.60	1.89
31	1.55	2.01	0.42	2.08
38	1.65	2.11	0.32	2.17
39	1.48	1.95	0.51	2.11

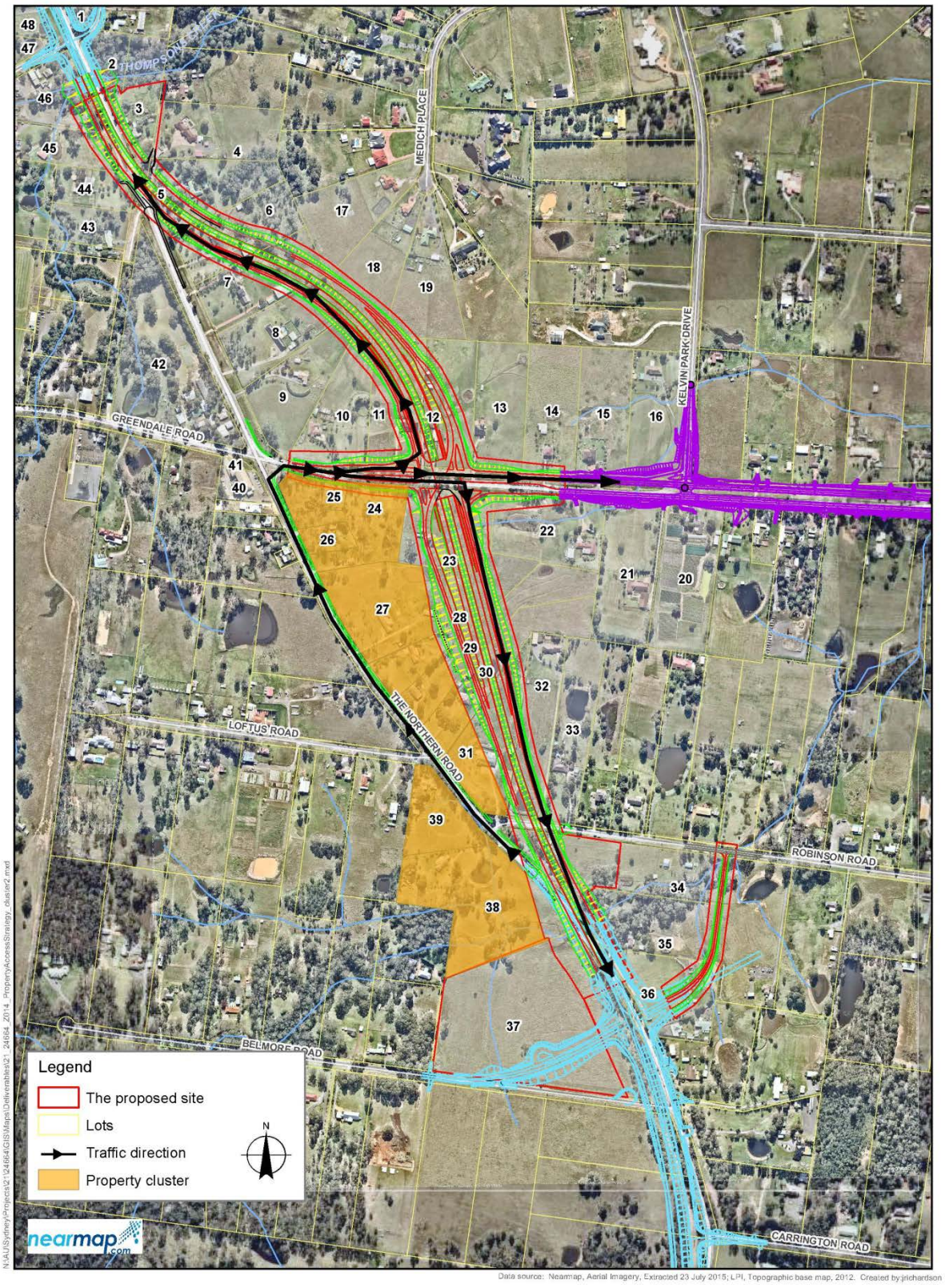

Figure 2 – Properties south of Bringelly Road

2.3 Properties along Bringelly Road

The existing Bringelly Road will be converted into a four lane dual carriageway road with a central median; hence access to properties along Bringelly Road will be altered to a left in and left out only. Figure 3 shows the access strategy for the properties affected along Bringelly Road, as described below.

2.3.1 Outbound traffic leaving from residential property on the northern side of Bringelly Road (Properties 13, 14, 15 and 16)

Residents leaving their property to travel north or south along The Northern Road will be required to first travel south along Jersey Road and turn right to travel west along Robinson Road to the new intersection with proposed The Northern Road / Belmore Road. From here residents will be able turn onto the proposed The Northern Road to travel north or south.

Access for residents travelling eastbound, along Bringelly Road, will not be altered by The Northern Road upgrade.

2.3.2 Inbound traffic returning to residential property on the northern side of Bringelly Road (Properties 13, 14, 15 and 16)

Residents returning to their property travelling from the east along Bringelly Road will follow the route as described above, making a loop between Jersey Road, Robinson Road and The Northern Road, before exiting back onto Bringelly Road.

Access for residents returning to their property will be similar to the existing conditions, when travelling from The Northern Road.

2.3.3 Outbound traffic leaving from residential property on the southern side of Bringelly Road (Properties 21 and 22)

Residents leaving their property to travel eastbound along Bringelly Road will be required to first travel west towards the intersection with the proposed Bringelly Road / Northern Road interchange and turn left to travel south along The Northern Road to the new intersection with Belmore Road. From here residents will turn left to travel east along Belmore Road and Robinson Road and again turn left to travel north along Jersey Road, before exiting back onto Bringelly Road to travel eastbound.

Access for residents travelling north or south along The Northern Road, will not be altered by The Northern Road upgrade.

2.3.4 Inbound traffic returning to residential property on the southern side of Bringelly Road (Properties 21 and 22)

Residents returning to their property from The Northern Road will be required to exit at Belmore Road intersection and travel the reverse direction as specified above; along Jersey Road until the intersection with Bringelly Road.

Access for residents returning to their property will be similar to the existing conditions, when returning from the east along Bringelly Road.

2.3.5 Travel distances for Properties located along Bringelly Road

The travel distances for properties located along Bringelly Road are shown below in Table 3.

Table 3 – Properties 13, 14, 15, 16, 21 and 22

Property number	Traffic Travelling North (km)		Traffic Travelling South (km)	
	Distance to the intersection of Solway Road using the existing The Northern Road	Distance to the intersection of Solway Road using the new The Northern Road	Distance to the new intersection of Belmore Road using the existing The Northern Road	Distance to the new intersection of Belmore Road using the new The Northern Road
13	1.18	5.03	1.56	3.04
14	1.29	4.92	1.68	2.92
15	1.37	4.83	1.77	2.83
16	1.62	1.50	2.02	1.43
21	1.51	1.41	1.89	1.31
22	1.34	1.24	1.73	1.15

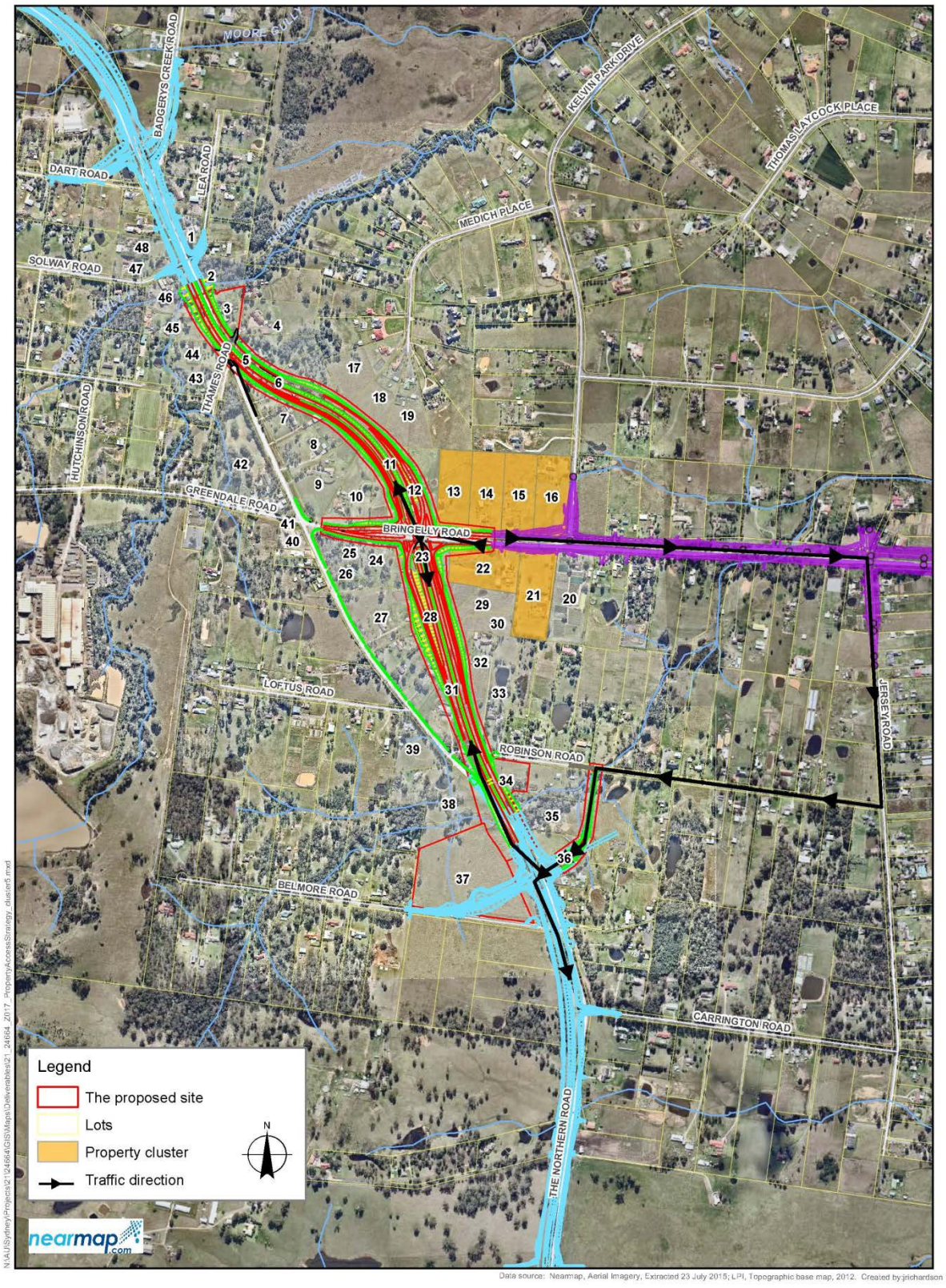

Figure 3 – Properties 13, 14, 15, 16, 21 and 22

2.4 Properties 32 and 33

Residents of Properties 32 and 33 will have a new access into the existing Robinson Road and intersection of Belmore Road / The Northern Road. Figure 4 shows the access strategy for properties 32 and 33, as described below.

2.4.1 Outbound traffic leaving from residential property

Access for residents travelling north or south along The Northern Road will be facilitated through the proposed Belmore Road / The Northern Road intersection, where residents will turn right or left to travel along The Northern Road.

2.4.2 Inbound traffic returning to residential property

Access for residents returning to their property from travel along The Northern Road will be required to turn into Robinson Road via the new intersection with Belmore Road / The Northern Road. From here residents can return to their properties along Robinson Road.

2.4.3 Travel distances for Properties 32 and 33

The travel distances for properties 32 and 33 are summarised in Table 4 below.

Table 4 – Properties 32 and 33

Property number	Traffic travelling north (km)		Traffic travelling south (km)	
	Distance to the intersection of Solway Road using the existing The Northern Road	Distance to the intersection of Solway Road using the new The Northern Road	Distance to the new intersection of Belmore Road using the existing The Northern Road	Distance to the new intersection of Belmore Road using the new The Northern Road
32	1.64	2.64	0.52	0.63
33	1.71	2.61	0.57	0.60

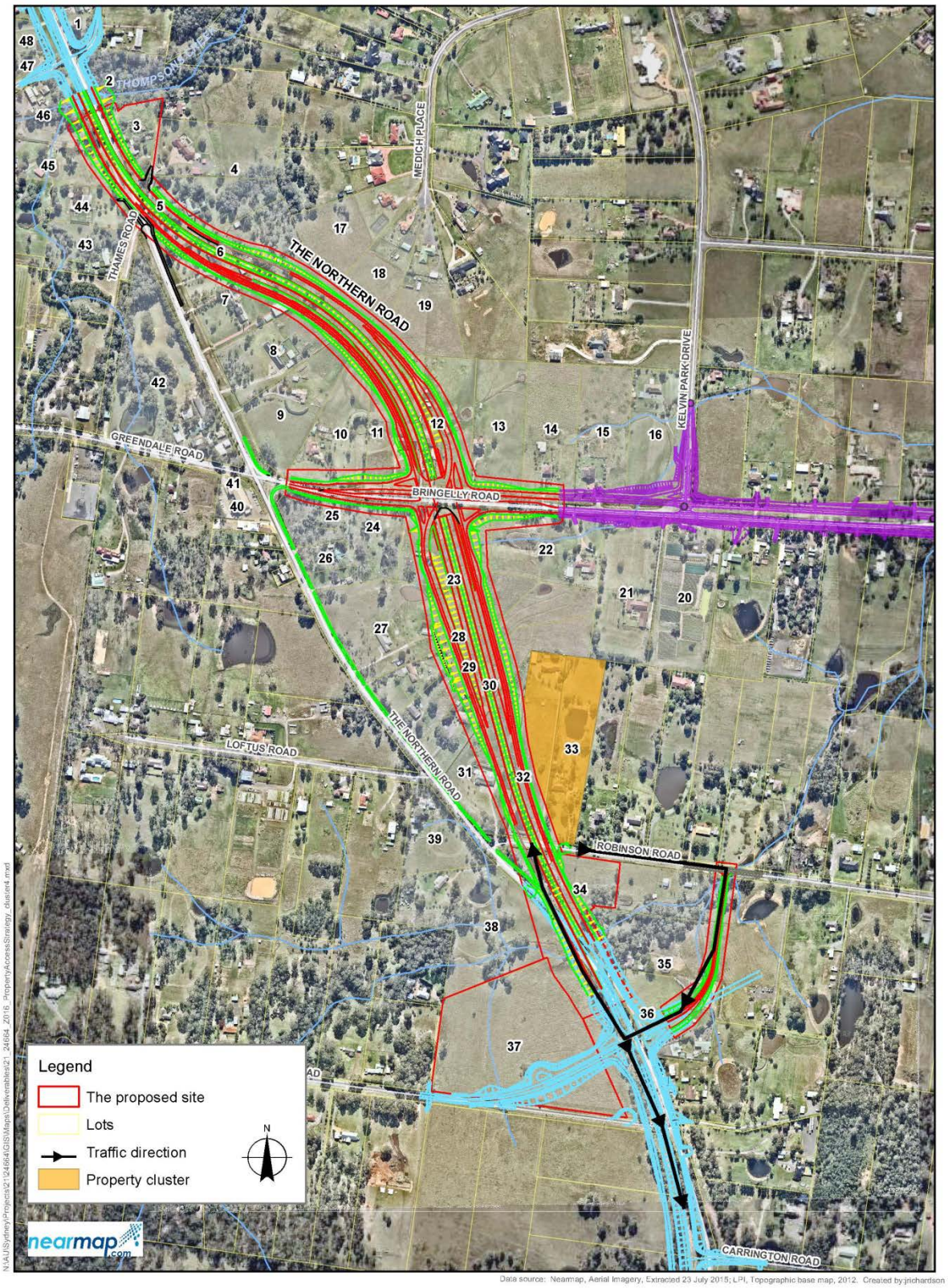

Figure 4 – Property 32 and 33

2.5 Properties 35 and 36

Residents of Properties 35 and 36 will be provided with a new access on the eastern extension of Belmore Road that will connect their property with the proposed road and Robinson Road. Figure 5 shows the access strategy for property 35 and 36, as described below.

2.5.1 Outbound traffic leaving from residential property

Access for residents travelling north or south along The Northern Road will be facilitated through the proposed Belmore Road / The Northern Road intersection, where residents will turn right or left to travel along The Northern Road.

2.5.2 Inbound traffic returning to residential property

Access for residents returning to their property from travel along The Northern Road will be required to turn into Belmore Road at the new intersection with The Northern Road. From here residents can return to their property via Robinson Road.

2.5.3 Travel distances for Properties 35 and 36;

The travel distances for Properties 35 and 36 are shown below in Table 5.

Table 5 – Properties 35 and 36

Property number	Traffic Travelling North (km)		Traffic Travelling South (km)	
	Distance to the intersection of Solway Road using the existing The Northern Road	Distance to the intersection of Solway Road using the new The Northern Road	Distance to the new intersection of Belmore Road using the existing The Northern Road	Distance to the new intersection of Belmore Road using the new The Northern Road
35	1.82	2.15	0.17	0.14
36	1.82	2.15	0.17	0.14

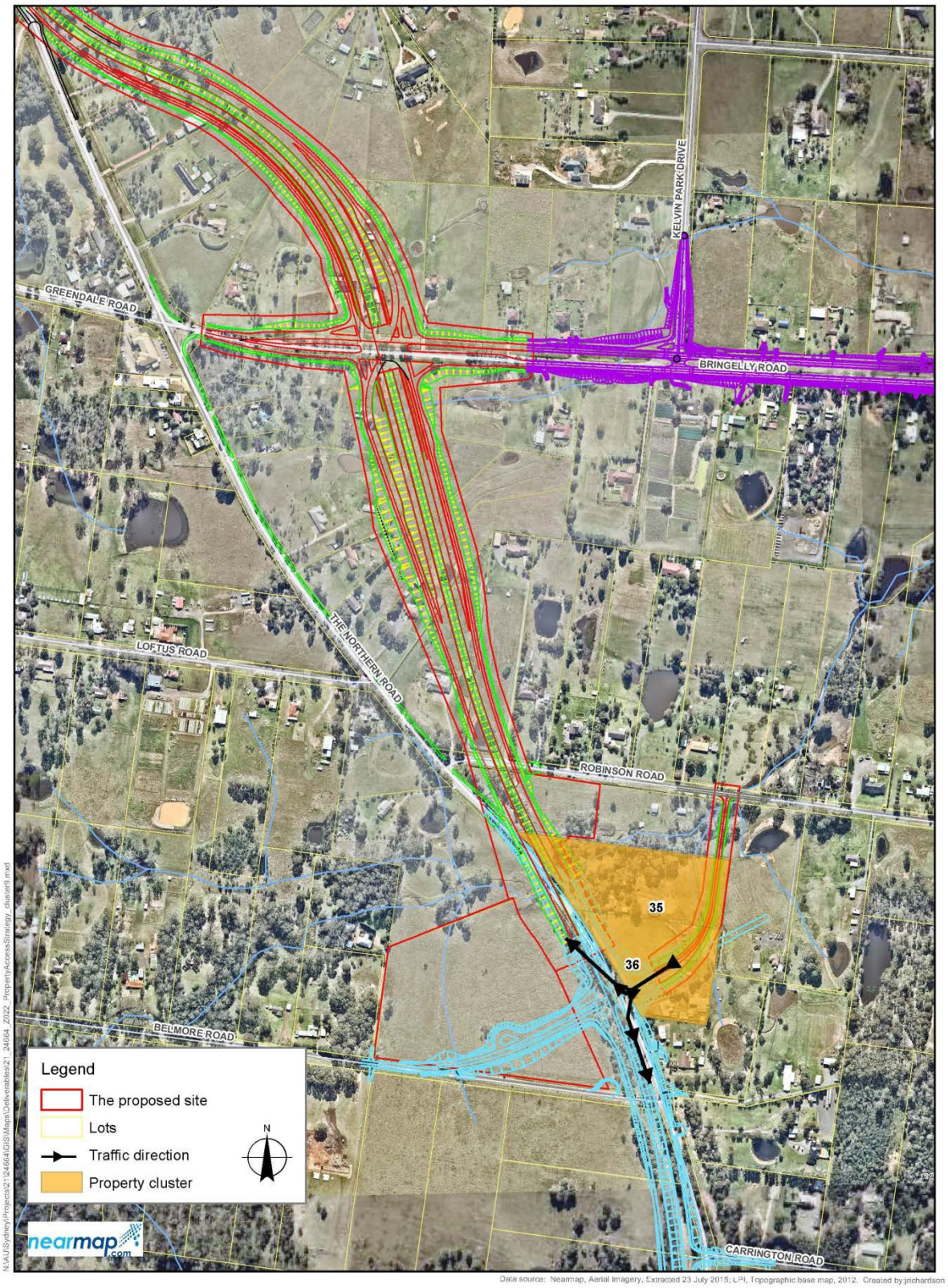

Figure 5 – Property 35 and 36

2.6 Properties along Lea Road and Property 4

The Northern Road will be upgraded to a four lane divided carriageway with a central median and therefore access to property 4 and those properties along Lea Road will be altered. Figure 6 shows the access strategy for property 4 and those properties along Lea Road, as described below.

2.6.1 Outbound traffic from residential property

Residents travelling northbound will initially have to travel south to be able to perform a U-turn. There are two options for vehicles to make a U-turn, either:

1. 1.0 km south of Lea Road at the proposed The Northern Road / Bringelly Road interchange. Vehicles would travel west along Bringelly Road towards the existing The Northern Road and turn right to make a U-turn around the proposed cul-de-sac and return to The Northern Road interchange to travel northbound.
2. 1.4 km south of Lea Road at the proposed intersection with Belmore Road. Vehicles would turn right at the intersection to make a permitted U-turn at the proposed U-turn facility and return onto The Northern Road to travel northbound.

Access for residents travelling southbound will not be altered by The Northern Road upgrade.

2.6.2 Inbound traffic to residential property

Residents returning to their property from the south will be required to travel along The Northern Road towards the intersection with Dart Road. From here residents can turn left at Dart Road to make a permitted U-turn at the proposed U-turn facility along Dart Road and return onto The Northern Road to travel southbound towards Lea Road.

Access for residents returning to their property from the north will not be altered by The Northern Road upgrade.

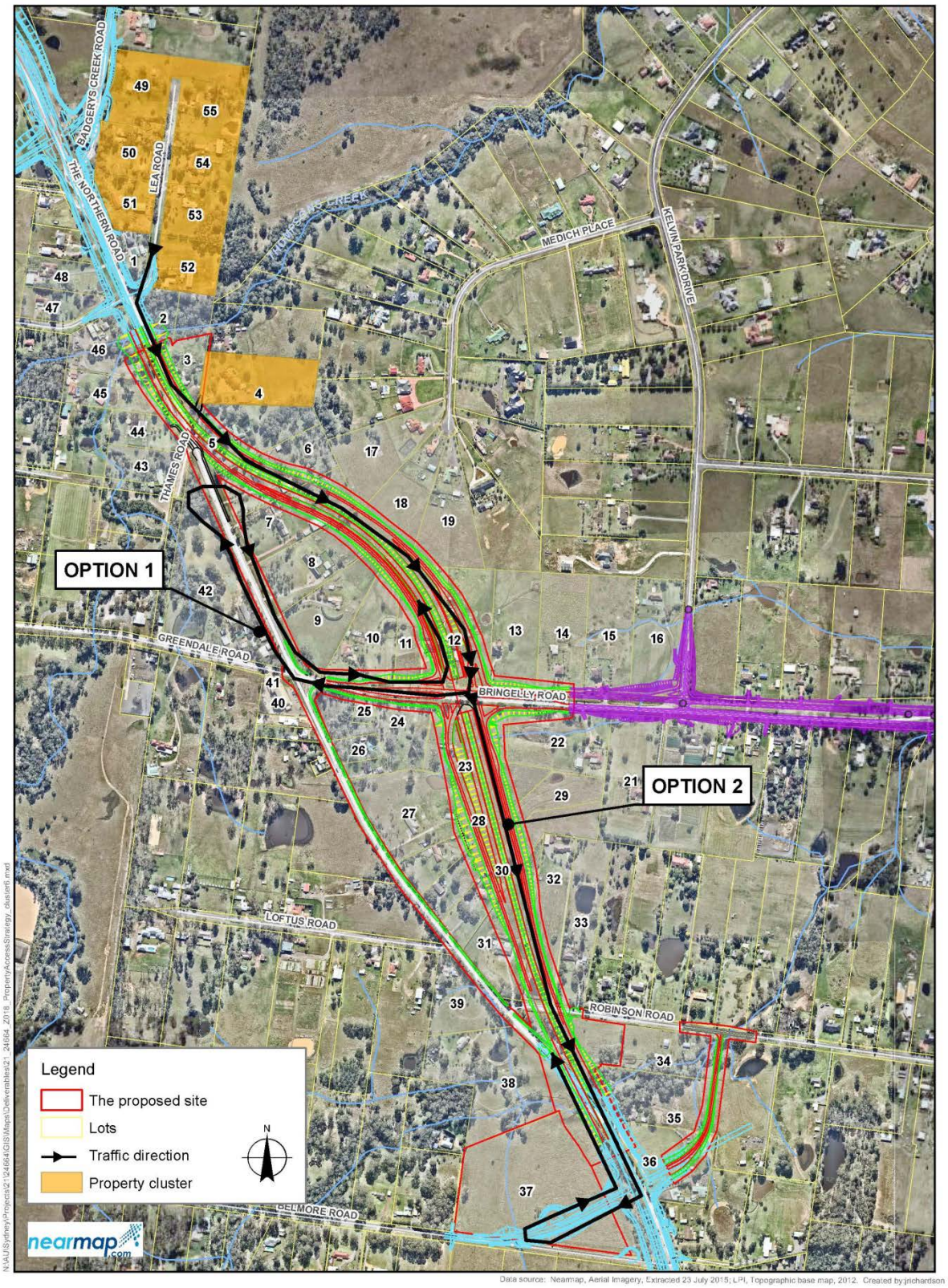

Figure 6 – Properties along Lea Road

2.7 Properties along Solway Road

The Northern Road will be upgraded to a four lane divided carriageway with a central median and therefore access to the properties along Solway Road will be altered. Figure 7 shows the access strategy for the properties along Solway Road, as described below.

2.7.1 Outbound traffic from residential property

Residents travelling southbound will initially have to travel north for 0.35 km along The Northern Road towards the new intersection with Dart Road. From here residents can turn left at Dart Road to make a permitted U-turn at the proposed U-turn facility along Dart Road and return onto The Northern Road to travel southbound.

Access for residents travelling northbound will not be altered by The Northern Road upgrade.

2.7.2 Inbound traffic to residential property

Residents returning to their property from the north will be required to travel along The Northern Road towards the intersection with Belmore Road. From here residents can turn right at Belmore Road to make a permitted U-turn at the proposed U-turn facility along Belmore Road and return onto The Northern Road to travel northbound towards Solway Road.

Access for residents returning to their property from the south will not be altered by The Northern Road upgrade.

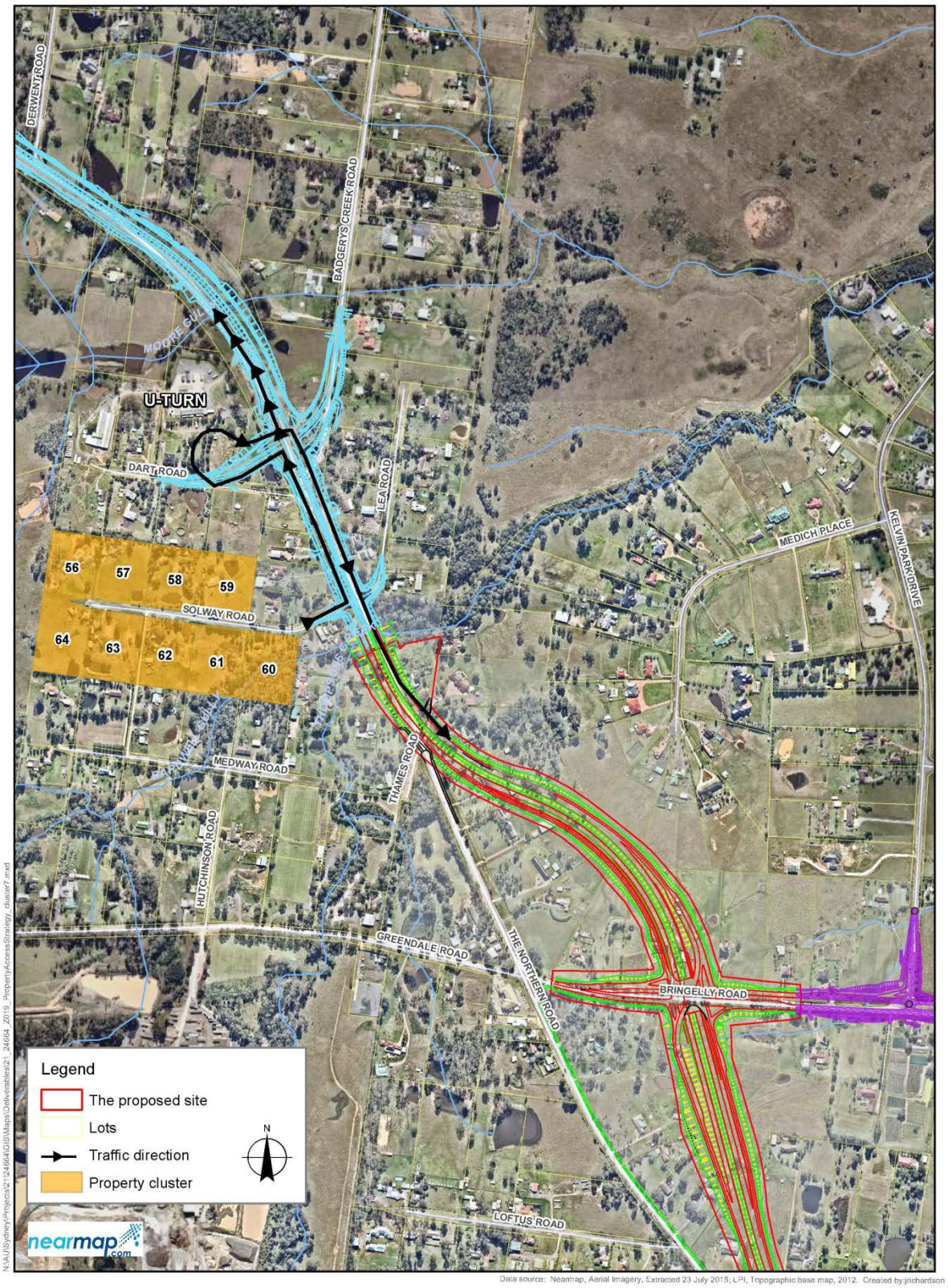

Figure 7 – Properties along Solway Road

2.8 Properties along Dart Road

The Northern Road will be upgraded to a four lane divided carriageway and will include the construction of a new intersection with Dart Road / Badgerys Creek Road / The Northern Road. Figure 8 below shows the access strategy for the properties along Dart Road.

2.8.1 Access to residential property

Residents accessing their properties along Dart Road will be facilitated through the intersection with The Northern Road upgrade. Residents will be required to turn at the proposed signalised intersection and continue in their direction of travel.

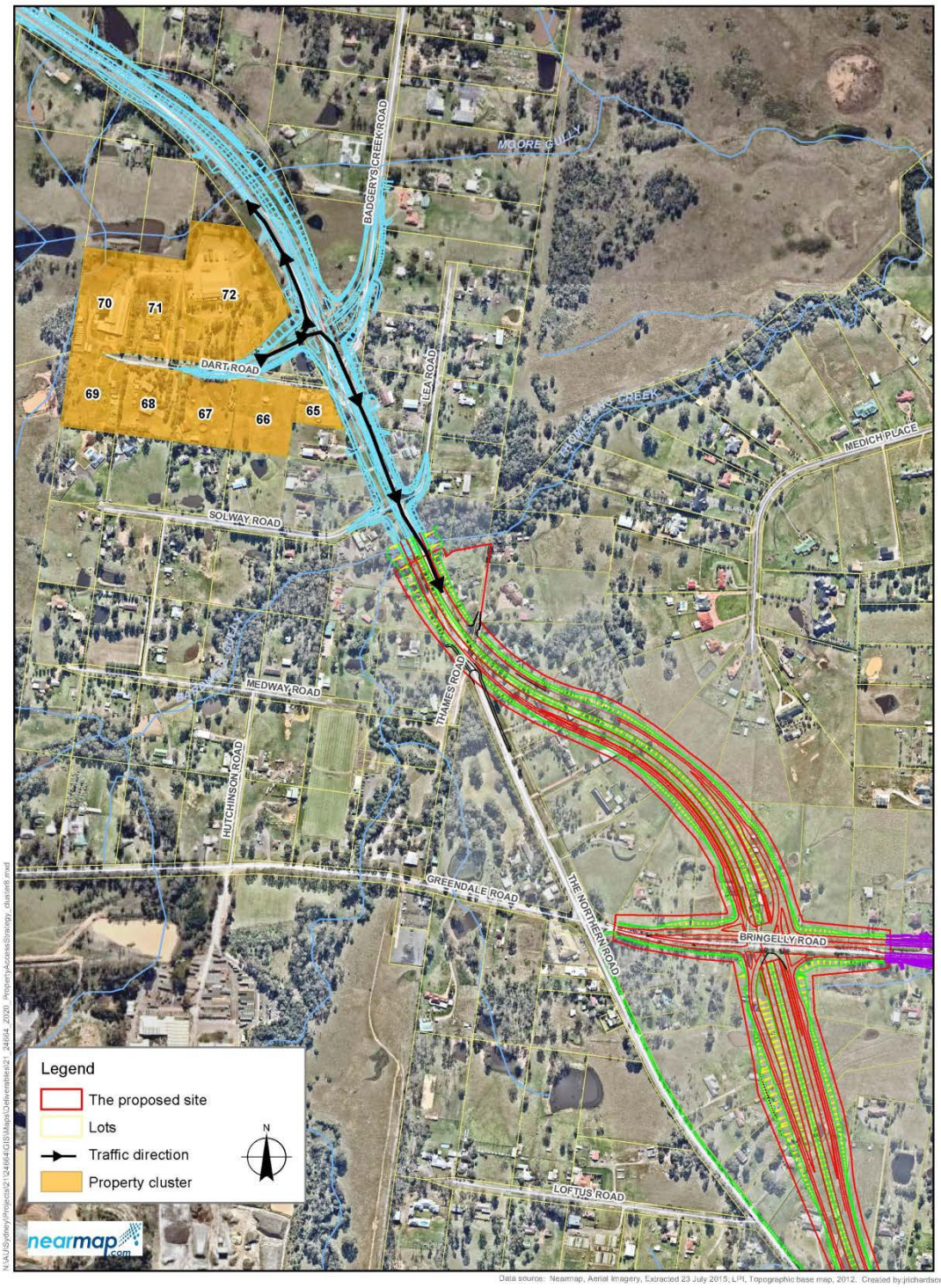

Figure 8 – Properties along Dart Road

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