Shoalhaven City Council

14 January 2011

North Nowra to Bomaderry

Link Road Options Study

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Prepared for

Shoalhaven City Council

Prepared by

AECOM Australia Pty Ltd
Level 11, 44 Market Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8295 3600 F +61 2 9262 5060 www.aecom.com
ABN 20 093 846 925

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Prepared by Tanya Bacic/ Andy Yung/ Simon Kean

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1.0 Introduction

1.1 Objectives

AECOM (formerly Maunsell Australia) has been commissioned by Shoalhaven City Council (Council) to undertake the North Nowra to Bomaderry Link Road Traffic Modelling, Noise Assessment, Economics Evaluation and Options Analysis study. AECOM's acoustics team (formerly Bassett Acoustics) was commissioned to undertake the Noise Assessment.

As part of a strategy to improve the road network in the North Nowra area, particularly along Princes Highway and Illaroo Road, Council requires a comprehensive traffic modelling and options analysis study to be undertaken to investigate three proposed alignment options (as well as the 'do nothing' option) for a potential road link connecting North Nowra to Bomaderry. These include:

- Option 1: Pitt Street to Narang Road;
- Option 2: Illaroo Road to West Bunberra Street; and
- Option 3: West Cambewarra Road to Moss Vale Road.

The location of the three proposed Link Road alignment options are shown in **Figure 1.1**. The existing land use at the proposed Link Road option locations is predominantly rural open space.

Figure 1.1: North Nowra Link Road Options

Source: Shoalhaven City Council

Council had undertaken a forerunner study to derive possible traffic routes regime and provided an overarching assessment of possible road links to alleviate traffic congestion and satisfy the strategic planning objectives of the Nowra Bomaderry Structure Plan in the potential releasing of residential land consistent with wider planning strategies.

Council used TRACKS modelling programming for its initial assessment, a program endorsed and used by the RTA. This study used Paramics modelling which while assessing more specifically specific congestion times, the outcomes were verified by the TRACKS modelling. To guarantee validity, Council engaged Gabites Porter, which created the TRACKS modelling program to undertake an independent review of the Council TRACKS work, and to assess the validity of data used. The June 2010 Gabites Porter TRACKS Analysis Review Report is provided in Appendix F.

A three route link road option formed part of the scope of work within a defined study area which was determined by the Minister for Planning and published in the NSW Government Gazette in December 2006.

The options considered in the analysis were previously determined by Council and include the following:

Option 1 links Illaroo Road and Princes Highway between existing intersections at Pitt Street and Narang Road. At the western end of the link option, there are 10 residences on north side of Byron Avenue and 3 adjacent residences on Emerson Street. The route would pass approximately 30m to the closest residence on the north side of Byron Avenue and is approximately 120m to the furthest residence on the north side of Byron Avenue. At the eastern end the route passes approximately 30m from residences on Narang Road.

Option 2 links Illaroo Road and Princes Highway between a new intersection on Illaroo Road approximately 80m north of Falcon Crescent and the existing intersection at Bunberra Street. The route would pass approximately 60m north of residences on Falcon Crescent, Narrien Place, Wingello Close, Warren Avenue, 30m north of residences on Sutherland Drive and directly affect 3-4 residences on the Princes Highway (likely to be within 15m of adjacent residences on Princes Highway).

Option 3 links Illaroo Road and Moss Vale Road by extending West Cambewarra Road to the intersection of Moss Vale Road and Elvin Drive through the saleyards. The route passes approximately 25m south of residences on West Cambewarra Road.

In addition to these three options a variation to Options 1 and 3 was assessed to include traffic flows associated with the proposed Moss Vale to Illaroo Road Link. The purpose of this assessment (with and without the Moss Vale Link Road) is to determine whether there is any change to the isolated assessment when taking this proposed Nowra Bomaderry Structure Plan (NBSP) link into consideration.

Subsequent to the assessment of all the above options, the Paramics models have shown that the Shoalhaven Bridge Crossing is operating close to capacity with traffic queues forming along Princes Highway. To address this issue, a variation to Option 1 which includes measures to reduce delays across the Shoalhaven River Crossing has also been assessed.

The study has been undertaken for the base year (2005) and future year (2016) to determine the preferred Link Road option for submission as part of the North Nowra to Bomaderry Link Road Development Application.

The study considered the following tasks in detail:

- The advantages and disadvantages of the “Do Nothing” scenario and each proposed Link Road alignment option in terms of traffic, economic and noise analysis;
- Assessment of alternative option(s) that may assist in reducing future traffic volumes along Illaroo Road and Princes Highway based on the results of the traffic assessment; and
- Identification of a preferred alignment option for the North Nowra to Bomaderry Link Road.

The principal outcome of the study is the provision of a comprehensive technical report that identifies a preferred alignment option for the North Nowra to Bomaderry Link Road and quantifies the benefits of the North Nowra Link Road project to the local road network and to Princes Highway. The outcomes are supported by detailed traffic modelling, economic appraisal and environmental noise assessment.

The preparation of the study has involved extensive reviews by Council and RTA and progress of the study can be summarised as follows:

- Submission of Draft Link Road Options Study Report in October 2006;
- Meeting between Council, AECOM and RTA on Thursday 9th November 2006 to review the progress of the study;
- RTA comments on Draft report received Thursday 16th November 2006;
- Comments by SCC and RTA on Draft report forwarded to AECOM 28th November 2006;
- Submission of revised DRAFT Report of AECOM Dated February 2007;
- Comments by SCC on revised Draft report forwarded to AECOM 8th May 2007;
- Meeting between Council, AECOM and RTA 25th May 2007 to review outstanding issues;
- Revised draft report submitted by AECOM to SCC Friday 3rd August 2007; and
- Comments by SCC on revised draft report forwarded to AECOM 10th September 2007.

1.2 Key Issues Addressed

Whilst it has been accepted by Council and RTA that an alternative access road would be beneficial to the North Nowra area, there is insufficient technical data in the previous studies to substantiate the construction of a new Link Road. The key issues addressed by this study include:

- Provision of sufficient technical data on the impacts of the “Do Nothing” option;
- Provision of sufficient technical data to justify a new road construction that impacts the middle, southern or northern boundary of the Regional Conservation Park and adjacent bushland;
- Provision of sufficient technical data demonstrating the benefits to Princes Highway and the broader transport network as a result of constructing a Link Road;
- Examination of whether a Link Road independently would be sufficient to meet growing traffic levels in the longer term; and
- Examination of whether other feasible alternatives exist that could mitigate traffic volumes on Illaroo Road and Princes Highway, and whether those alternatives are sufficient independently or whether the Link Road would also be required.

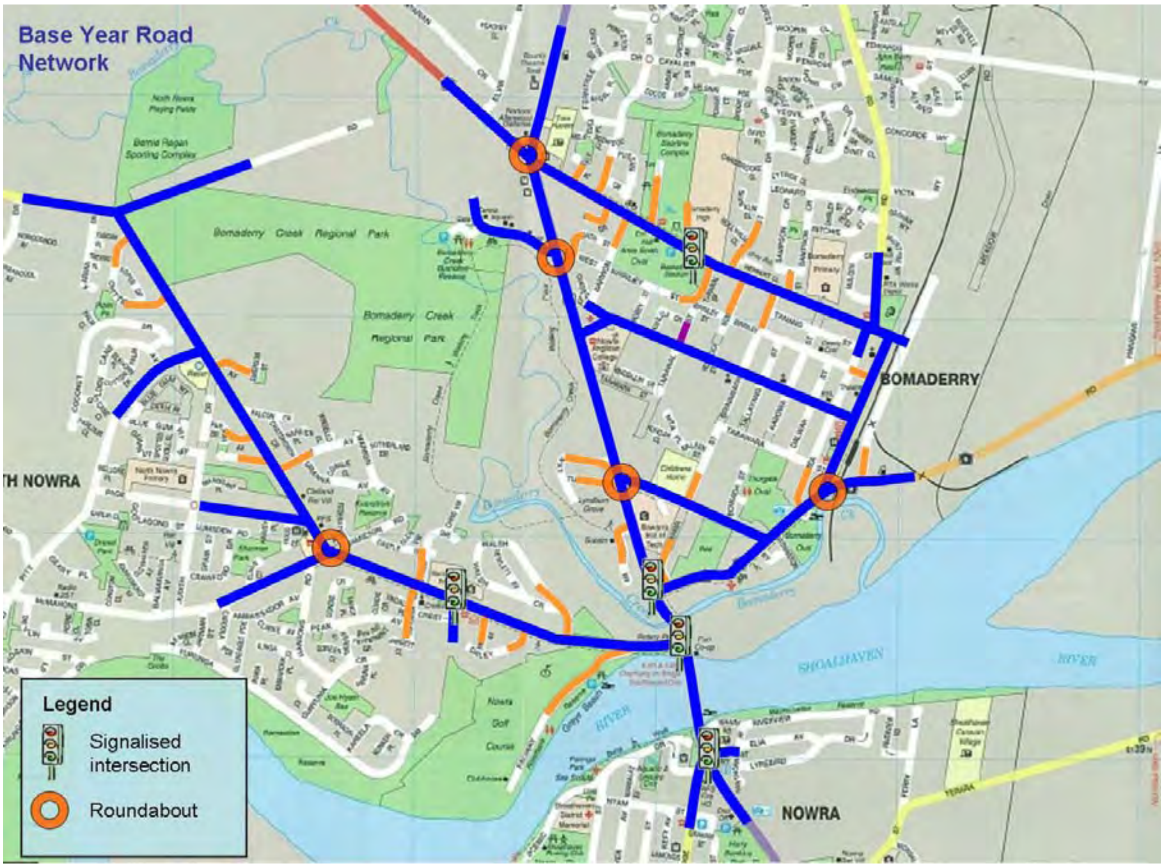
1.3 Study Area

The North Nowra to Bomaderry study area is defined in **Figure 1.2**. The road network for this project is bounded by Cambewarra Road / Moss Vale Road to the north, Meroo Street to the east, Bolong Road to the south and Illaroo Road to the west. Princes Highway has been modelled between Cambewarra Road and Bridge Road and is the major north-south arterial delineating North Nowra and Bomaderry.

The primary intersections that have been assessed are highlighted in **Figure 1.2** and include:

- Princes Highway / Illaroo Road;
- Princes Highway / Bolong Road;
- Princes Highway / Beinda Road;
- Princes Highway / Narang Road;
- Princes Highway / Cambewarra Road;
- Princes Highway / West Bunberra Street;
- West Bunberra Street / Meroo Street;
- Bolong Road / Meroo Street;
- Bolong Road / Beinda Road;
- Illaroo Road / McMahons Road;
- Illaroo Road / Page Avenue;
- Illaroo Road / Pitt Street; and
- Illaroo Road / West Cambewarra Road.

Figure 1.2: North Nowra to Bomaderry Study Area



Source: AECOM, October 2006

1.4 Report Structure

This report has been structured in to the following sections:

- **Chapter 2 Background** provides a background, discussing the context of the study and the traffic issues within North Nowra – Bomaderry;
- **Chapter 3 Paramics Traffic Modelling** discusses the development process of the base (2005) and future year "Do Nothing" and future year Link Road Options Paramics models. This section also summarises the future year model observations;
- **Chapter 4 Traffic Model Outputs** discusses the model outputs from Paramics and SIDRA, including network performance measures, turn flows, Link Road flows, travel times and intersection performance measures;
- **Chapter 5 Accident Analysis** summarises detailed analysis of accidents that occurred in the study area, which will assist in defining cost savings due to road network improvements in the economic appraisal;
- **Chapter 6 Economic Appraisal** outlines the methodology, assumptions and results of an economic appraisal of the proposed Link Road alignments;
- **Chapter 7 Noise Assessment** outlines the methodology, assumptions and results of the noise assessment for the proposed Link Road alignments; and
- **Chapter 8 Conclusion** provides a summary of the study and a discussion of the conclusions drawn from the traffic modelling, economic appraisal and noise assessment.

2.0 Background

Council has been investigating the concept of a North Nowra to Bomaderry Link Road for several years. Numerous studies have been undertaken to date that qualitatively support the construction of an alternative access road to mitigate the impacts of increasing traffic volumes along Illaroo Road and through the intersection with Princes Highway (shown in **Figure 2.1**).

Along with the increasingly high traffic volumes carried by Princes Highway, numerous intersections with the Nowra-Bomaderry local road network now rank as major accident blackspots. Between 1998 and 2003, there were 1056 reported road crashes within Nowra-Bomaderry, resulting in a total of 669 casualties and 12 fatalities. These statistics indicate road safety issues within the Nowra-Bomaderry road network, and that a review of existing traffic patterns, historical accident blackspots and proposed network improvements is necessary to address the observed road safety deficiencies.

The Draft Nowra Bomaderry Structure Plan (NBSP) Background Report (December 2005) identified a need for general safety improvements along Princes Highway. Council has raised concerns with the RTA's proposed interim road safety strategy, and has called for a review of access, safety and road capacity deficiencies.

Figure 2.1: Intersection with Illaroo Road and Princes Highway

Source: AECOM, January 2006 approximately 6:00 pm

Based on previous studies and local knowledge, the construction of an alternative access road would not only provide much needed additional network capacity along Illaroo Road and Princes Highway, north of the Shoalhaven River (particularly the section between Bolong Road and Illaroo Road), but would also result in improved road safety and environmental conditions. Council has also indicated that the construction of this link may potentially defer the need for infrastructure upgrade of Princes Highway for a number of years.

Council was previously (1992) granted development approval for the construction of a Link Road between Illaroo Road (at Pitt Street) and Narang Road. However, the development approval was appealed by the NSW National Parks and Wildlife Service (NPWS) on the basis that the application provided insufficient grounds to issue a licence to kill threatened and/or endangered species under section 120 of the NPWS Act, 1974.

The appeal process concluded that based on the evidence available at the time, a licence under the NPWS Act 1974 was not justified. The outcome of the hearing acknowledged that the need for a Link Road could be demonstrated and accepted by the court, however based on the evidence available the court was not satisfied that Council had adequately investigated alternative routes for the construction of the Link Road. Consequently, a licence was not justified at the time.

Ongoing consideration of the project continued, including the identification of a number of Link Road options supported by planning considerations and strategic traffic modelling, as part of Council's NBSP process. However, a comprehensive investigation of the alignment options and the benefits to Princes Highway and the wider road network has not been undertaken or accurately quantified.

As a result of progress on the Draft NBSP, Council appointed AECOM to carry out a detailed traffic investigation of the options for a North Nowra to Bomaderry Link Road. This report outlines the findings of those investigations.

3.0 Paramics Traffic Modelling

3.1 Introduction

Paramics is a micro-simulation software package that has been used to assess transport conditions of road networks, combining network geometry, traffic demand and intersection operations including detailed signal operations. Paramics models have been developed for the North Nowra to Bomaderry Link Road Study area to assess the traffic impacts of each Link Road option. The scenarios modelled forming part of this study (18 in total) are listed in **Table 3.1**.

Table 3.1: Nowra Paramics models developed

Year	Scenario	Modelled Period
2005 Base Year		
	Base (Existing)	AM, PM
2016 Future Year		
	Do Nothing (All growth as per NBSP)	AM, PM
	Do Nothing (No development growth in study area – however with 2% p.a. growth applicable to Princes Highway and Bolong Road through flows only)	AM, PM
	Link Road Option 1 (Pitt Street to Narang Road)	AM, PM
	Link Road Option 1 with River Crossing Relief (RCR) schemes	AM, PM
	Link Road Option 1 with link road between Illaroo Road and Moss Vale Road (as per NBSP proposed road network)	AM, PM
	Link Road Option 2 (Illaroo Road to Bunberra Street)	AM, PM
	Link Road Option 3 (West Cambewarra Road to Moss Vale Road at Elvin Drive)	AM, PM
	Link Road Option 3 with link road between Illaroo Road and Moss Vale Road (as per NBSP proposed road network)	AM, PM

Source: AECOM, October 2006

As highlighted in **Table 3.1**, Paramics models have been developed for the base year and future year during the morning (8 – 9 AM) and evening (3.30 – 4.30 PM) peak hour operations which represents the periods that the existing road network is most congested.

The base data has been derived from traffic surveys undertaken by Council on the following dates:

- Thurs 24th November 2005 and Thurs 25th May 2006 (traffic turning movements surveys);
- Thurs 22nd June 2006 and Thurs 29th June 2006 (pedestrian actuation surveys);
- Thurs 24th August 2006 (traffic queue surveys);
- Wed 8th & Thurs 9th March 2006, Wed 15th & Thurs 16th March 2006, Thurs 18th and Wed 24th May 2006, and Thurs 1st June 2006 (traffic travel time surveys); and
- Wed 19th January 2005 and Tuesday 31st March 1998 (traffic weave movement surveys).

Speed zone data was provided by Council and additional data has also been obtained from the RTA, including highway intersection layouts, signal phasing and SCATS data.

A site visit was also undertaken by AECOM to obtain sufficient road network data to ensure that the base case Paramics model network represents a true reflection of the existing road network features and constraints.

The time periods for assessment were agreed with both Council and the RTA prior to commencement of the traffic modelling.

The base models have been developed under existing road conditions. The future year models have been developed under the following conditions:

- Do nothing (existing geometry);
- Inclusion of the three proposed Link Road options between North Nowra and Bomaderry as shown in **Figure 1.1**;
- Inclusion of the Moss Vale and Illaroo Link Road for two of the proposed Link Road options (Options 1 and 3); and
- Inclusion of the proposed River Crossing relief (RCR) schemes for one of the proposed Link Road options (Option 1[1]).

The RCR option tested in Paramics includes the following schemes:

- Right turn ban from Princes Highway to Illaroo Road;
- Inclusion of an additional left turn approach lane from Illaroo Road to Princes Highway;
- Separation of Pleasant Way from Princes Highway / Bridge Road intersection;
- Variable speed zone on link road to reflect design criteria (Refer **Section 3.3.2** for details); and
- Inclusion of 40 kph school zone on the Princes Highway, Bomaderry.

The signal phases and timings have been updated as a result of the exclusion of particular traffic movements from these intersections.

The "Do Nothing" option for 2016 has been assessed under two different traffic demand scenarios. These include:

Scenario 1: Demand in line with the NBSP growth projections; and

Scenario 2: No growth with exception of a nominal 2% growth per annum on through traffic on Princes Highway and Bolong Road only (growth approximated following review of RTA data for the period 2000-2003).

The traffic demand used to assess each of the Link Road options in 2016 has been based on Scenario 1.

Scenario 2 is a lower growth scenario which has been used to assess the impact of increasing Princes Highway traffic volumes on the local road network, particularly Illaroo Road. This scenario is considered to assess whether a link road would benefit the local road network (particularly Illaroo Road) even if there were no additional growth in North Nowra or Bomaderry.

The Paramics model outputs have been used to assess intersection performance, undertake an economic appraisal of Link Road options and carry out noise assessments for each of the proposed alignment options. Details of the economic and noise assessments are set out in Chapters 6 and 7 respectively. The results of each of the assessments have been analysed and reviewed to assist in defining the preferred route option based on these considerations.

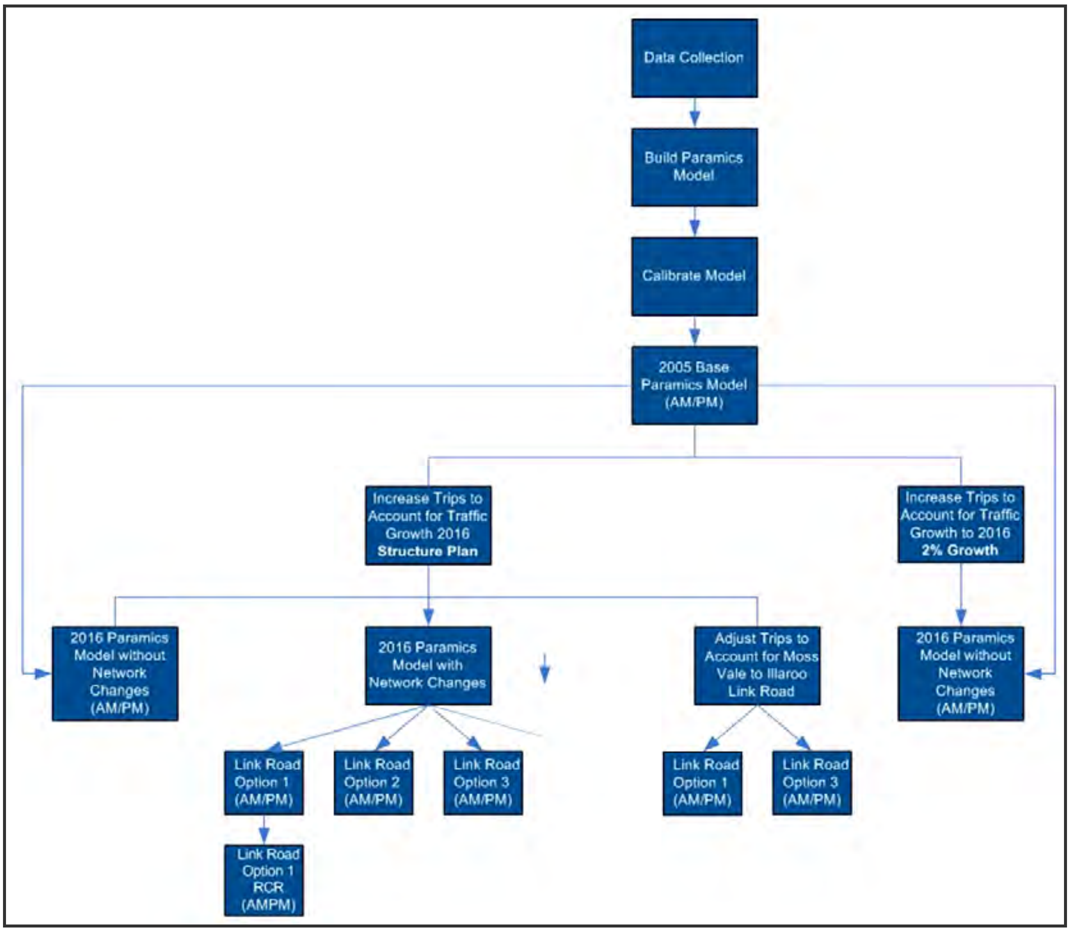
Due to the random release nature of Paramics models, each model run with identical random seed number but with slightly different network, flow or operation conditions will produce different results. Ten different seed values were used in the calibration of the models in accordance with RTA guidelines.

Sufficient model runs were observed to allow assessment of model stability and performance under application of different seed values, and optimum seed values were selected for the analysis (refer **Section 3.2.3**).

Figure 3.1 outlines the process that has been undertaken to develop the Paramics models.

[1] Option 1 is selected to model the RCR schemes on the basis that it is the preferred option following the initial round of Paramics Modelling and analysis in terms of traffic operations, economic performance, and noise impact assessments.

Figure 3.1: Nowra Paramics model development process



Source: AECOM, October 2006

3.2 Paramics Base Model Development

3.2.1 Development of Base Year (2005) Model

In order to provide a detailed assessment of the three proposed alignment options for a potential Link Road from North Nowra to Bomaderry, a detailed micro-simulation model has been developed to assess each of the options. The first stage in the process is to develop and calibrate an AM and PM peak base model. The methodology adopted for carrying out this task is described in the following sections.

3.2.1.1 Network Build

The extent of the Paramics micro-simulation model for the North Nowra to Bomaderry study area is as shown in **Figure 1.2** and includes Illaroo Road between West Cambewarra and Princes Highway, Princes Highway between Cambewarra Road and Bridge Road, Bolong Road between Princes Highway and Railway Street, Meroo Street and Meroo Road, Beinda Street, Bunberra Street and Cambewarra Road.

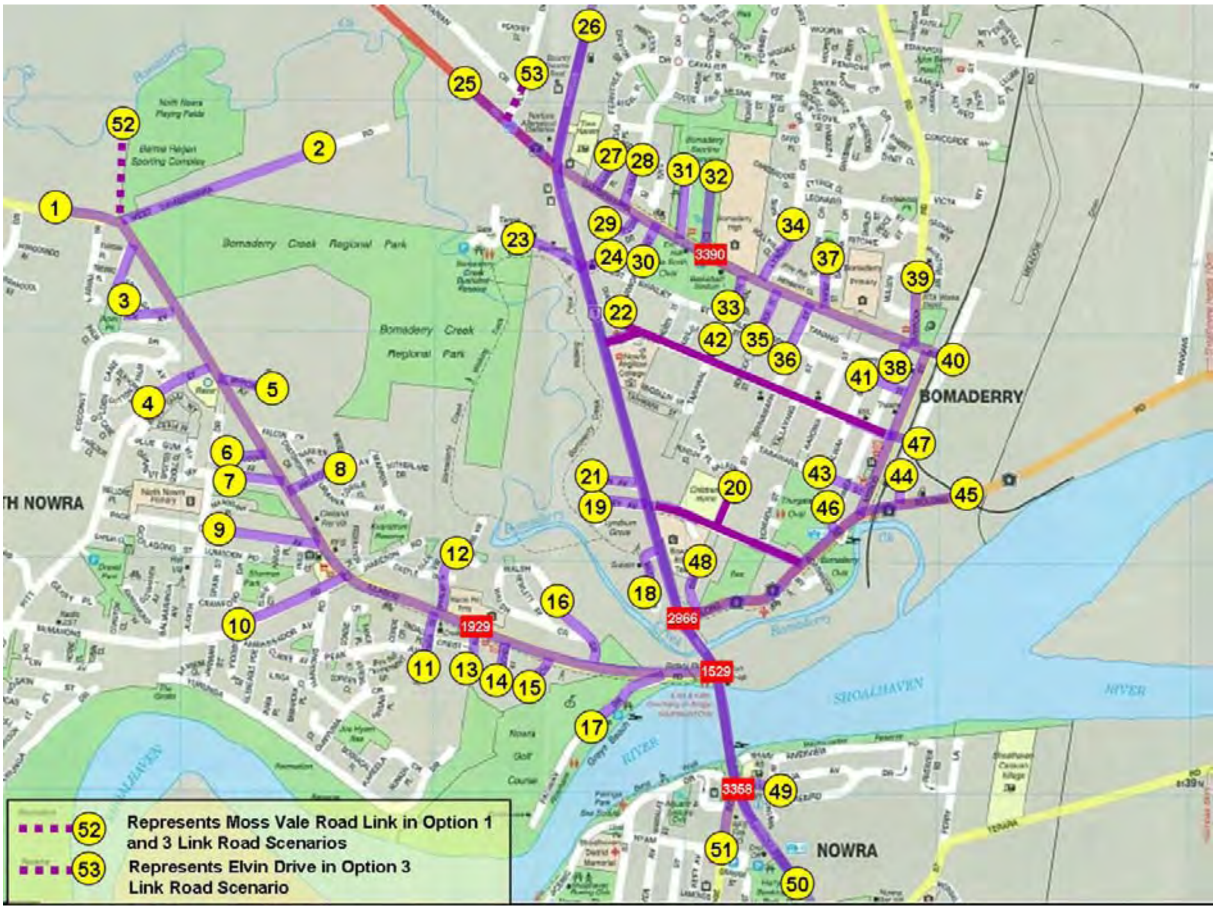
A site visit was carried out on 20 June 2006 to collect information on the layout and operation of the network. Data collected on site included:

- Posted speed limits;
- Intersection configuration;
- Location of on-street parking including peak period restrictions; and
- Bus stop locations.

Observation of the road network showed that congestion occurred during the peak periods at the intersection approaches of Bolong Road and Illaroo Road with Princes Highway and on the Shoalhaven River Bridge crossing.

The North Nowra to Bomaderry Paramics model consists of 51 zones, extending to 53 zones in some 2016 options, representing traffic feeders for all external zones (eight zones representing the major regional routes) and internal zones (forty three zones representing the minor residential streets). The model also includes four signalised intersections (TCS 1929, TCS 1529, TCS 2866 and TCS 3358) and one signalised pedestrian crossing (TCS 3390). The zone network and location of traffic signals are shown in **Figure 3.2**.

Figure 3.2: Zone and signalised intersection locations



Source: AECOM, October 2006

The model has been developed using version 5.1 of the Paramics software in-conjunction with Lane Choice plug-in version 2A (ceejazz 5.1/B33). The lane choice plug-in was used to control the lane usage groups of vehicles and to improve the performance of the modelled network. The RTA Paramics standard files for model configuration, road categories and vehicle classifications have also been used (including acceleration profiles, behaviour, categories, configuration and vehicles files).

The Paramics model was developed using aerial photographs supplied by Council. This was supplemented by on-site inspections of the network. The modelled road network includes details such as number of lanes on the carriageway; turning bays and speed zones. The geometry of the signalised junctions was coded using the aerial photographs, as well as signalised intersection diagrams supplied by RTA.

A number of priority (give way) intersections are included within the study area. To accurately model the wide lane widths on the approach to intersections and actual driver behaviour, priority intersections have been modelled with a small turn lane (approximately 10m in length). This ensures that through traffic at priority intersections is not delayed by one or two right turning vehicles.

3.2.1.2 Signal Coding

Signal phasing, green splits and inter-greens were coded based on IDM data extracted from RTA's SCATS system for the period 21-25 August 2006. A summary of this SCATS data is provided in **Tables A1** (AM peak) and **A2** (PM peak) of **Appendix A**. Signal offsets along Princes Highway were determined using Flexi Link data provided by RTA. The SCATS system used by RTA allows for adaptive phase lengths at intersections to improve the efficiency of individual junctions and corridors. In Paramics the signals default to a fixed time cycle. To accurately model the adaptive nature of traffic signals the average cycle and phase times were obtained from the SCATS IDM data and input into the model.

The inter-green period consists of a yellow period and an all-red period. The yellow period is used to warn drivers that the phase is terminating. The all-red period is to enable vehicles within the intersection to clear the controlled area. For all signalised intersections a four second yellow period was used with a two second all-red period.

3.2.1.3 Speed Zones

The road network speed zones are listed in **Table 3.2**. These speed zones have been input into the model.

Table 3.2: Speed Zones within North Nowra Study Area

Road	Speed Limit
Princes Highway	70 kph (except 40kph school zone)
Illaroo Road	60 kph (except 40kph school zone)
Bolong Road	60 kph
Moss Vale Road	60 kph
Bridge Road	50 kph
Bunberra Street	50 kph (except 40kph school zone)
Cambewarra Road	50 kph (except 40kph school zone)
Minor Roads / Residential Streets	50 kph

Source: AECOM, October 2006

Four 40kph school speed zones were also modelled adjacent to Illaroo Road Primary School, Bomaderry High School, Bomaderry Primary School and Nowra Anglican College. In the morning the school speed zone operates between 8 and 9:30 AM and coincides with the AM peak period (8 – 9 AM). During the afternoon the school speed zone operates between 2.30 – 4.00 PM. This time period extends half way into the PM peak period (3:30 – 4:30PM).

It was agreed with Council and RTA at the meeting held on 18 August 2006 that the 40 kph school zone period would be modelled throughout the PM peak hour for the following reasons:

- To simplify the modelling process;
- To ensure a worst case scenario is being modelled; and
- Both Princes Highway (school zone between 60m north and 300m south of West Bunberra Street) and Illaroo Road (school zone between Phillip Drive and Daley Crescent) would be similarly affected so one Link Road option would not be favoured over another.

The 40 kph zone was extended in the Option 1 RCR scenario to reflect the actual extent of the school zones at the following locations:

- Northbound carriageway of Princes Highway outside Nowra Anglican College between Narang Road and Beinda Street; and
- West Bunberra Street and Bunberra Street between West Bunberra Street and Robey Street.

The omission of the above school speed zones from the initial round of traffic modelling is not considered to have affected the outcome of the modelling and the selection of the preferred option.

3.2.1.4 Traffic Demand

The traffic demand matrix used in the model was derived using Paramics Estimator and refined with additional information provided by Council. The data provided by Council included:

- November 2005 AM (8-9AM) and PM (3.30-4.30PM) classified traffic counts with the exception of Princes Highway / Bridge Road and Illaroo Road / Crest Avenue intersections;
- May 2006 traffic counts (AM/PM) at Cambewarra Road / Coomea Street and Cambewarra Road / Meroo Street;
- Princes Highway / Bridge Road traffic counts were obtained from September 2003 classified counts (sourced by previous study) for both the AM and PM peak periods. A growth factor has been applied to these counts to reflect a November 2005 scenario;
- Illaroo Road / Crest Avenue traffic counts were sourced from April 2006 classified counts;
- Estimated cordon traffic flows at minor roads feeding onto the main road corridors; and
- Weaving data at Illaroo Road, Bridge Road and Bolong Road intersections with Princes Highway.

Paramics Estimator forms part of the Paramics suite and is a tool used to assist in the development of origin-destination (OD) matrices to match specific turn volumes, cordon flows and Link flows for input into Paramics Modeller. The demand matrices output from Paramics Estimator have been refined where necessary to more accurately represent the November 2005 turn flows provided by Council.

The AM and PM demand matrices have been developed to produce a one hour peak matrix, with a ramp up period covering 15 minutes. The 15 minute ramp up period is required to ensure that the peak hour matrix represents the busiest hour in both the morning and afternoon periods, not simply the busiest clock hour. The demand matrices have been separated into two matrices to represent cars and heavy vehicles. Heavy vehicle movements were estimated from the classified turn count data provided by Council. Heavy vehicle movements represented approximately 4% of all vehicle movements during the AM peak and 3% during the PM peak.

3.2.1.5 Bus Operations

Bus services were not modelled as there are a minimal number of buses operating within the study area during the peak periods. To represent the capacity of the carriageway taken up by buses (as well as on-street car parking) it was agreed with Council that all roads would be modelled as one lane in each direction, with the exception of additional lane capacity where provided at intersection approaches, and the following links:

- Princes Highway;
- Illaroo Road between Morschel Avenue and Princes Highway (which was modelled as two lanes in each direction); and
- Bolong Road between Princes Highway and approximately 70m east of Brinawarr Street.

3.2.1.6 Traffic Assignment

The traffic assignment method used for the base models is “All-or-nothing” (AON). This method was considered to be the most appropriate as a result of the limited route choice within the study area. The use of major and minor links was used to assist with route choice of familiar and unfamiliar vehicles. Dynamic Feedback assignment has been employed for the future year models to accurately account for the usage of the Link Road and rat-running that transpires as a result of the road network being more congested.

A 15 minute demand arrival profile was applied to the 1 hour 15 minute matrix. The shape of the profiles for both the AM and PM peak periods were based on the observed November 2005 count data.

3.2.2 Model Calibration

The model has been calibrated to ensure the simulation model accurately represents the observed traffic conditions and operations in the study area.

The principal data sources provided by Council to assist with model calibration include:

- Intersection counts collected in November 2005 for all major intersections;

- Cordon flows at each of the modelled zones;
- Weaving data at Illaroo Road and Bolong Road intersections with Princes Highway; and
- Travel time surveys collected in March 2006 along the following three main routes:
  1. Illaroo Road / Karama Drive intersection to Bridge Road (Hyam Street);
  2. Princes Highway (approximately 350m north of Cambewarra Road) to Princes Highway 320m south of Bridge Road; and
  3. Princes Highway / Cambewarra Road intersection to Bolong Road / Railway Street.

The process of model calibration using the data sources above is described in more detail below.

3.2.2.1 Intersection Counts, Cordon Flows and Weaving Data

The model calibration has been assessed against the criteria outlined in Volume 12 of the Design Manual for Roads and Bridges (DMRB) published by the Highways Agency (UK). The DMRB Calibration Guidelines used for this study is shown in **Figure 3.3**.

Figure 3.3: DMRB Calibration Guidelines

Criteria and Measures	Acceptability Guideline
Assigned Hourly flows * compared with observed flows	
1. Individual flows within 15% for flows 700 - 2,700 vph	)
2. Individual flows within 100 vph for flows < 700 vph	) > 85% of cases
3. Individual flows within 400 vph for flows > 2,700 vph	)
4. Total screenline flows (normally > 5 links) to be within 5%	All (or nearly all) screenlines
5. GEH statistic: i) individual flows : GEH < 5	> 85% of cases
ii) screenline (+) totals: GEH < 4	All (or nearly all) screenlines
Notes + Screenlines containing high flow routes such as Motorways should be presented both including and excluding such routes * links or turning movements (but see Paragraph 4.4.37).	
Modelled journey times compared with observed times	
6. Times within 15% (or 1 minute, if higher)	> 85% of routes

Source: DMRB Volume 12 Section 2 Part 1 Traffic Appraisal in Urban Areas, Table 4.2, May 1996.

The goodness of fit measure, as applied in the UK DMRB is a GEH statistic. This statistic is derived from a Chi-square distribution to assess how well two datasets are correlated. The strength of the GEH statistic is in the ability to incorporate both relative and absolute differences between the observed and modelled volumes. This statistic removes the discrepancies between small volumes with high relative differences and large volumes with large absolute differences. For the purposes of this modelling, the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows.

The comparison of the modelled and observed turning movements for all the major intersections, weaving movements and cordon flows during the AM and PM peak base Paramics models are presented in **Appendix B**.

For the PM peak base model the northbound traffic flow along Princes Highway between Cambewarra Road and Beinda Street is shown to be higher than the observed flows, with a GEH between 6 and 7. The demand on this section of Princes Highway was increased to ensure the throughput on the northern approach of the Princes Highway / Illaroo Road intersection corresponds with the high traffic count that was observed for the through movement. This approach was agreed with Council and RTA at the meeting held on 18 August 2006.

The estimated cordon flow to Zone 22 (Barwon Street) during the AM peak has also shown to have a GEH value greater than 7. The increase in modelled trips to this zone reflects the trips generated by residential streets feeding off Bunberra Street. The increase in trips matches the observed turn volumes at the intersections with Princes Highway and Meroo Street.

Given the match between the observed and modelled flows, and favourable comparisons between the observed and modelled behaviour, it is concluded that the Base AM and PM peak models are sufficiently well calibrated. This was confirmed by Council and RTA following a meeting on 18 August 2006 to review base model operations.

3.2.2.2 Travel Time

Travel time comparison was employed as a validation measure comparing the data outputs from the model with independent data not utilised for the model development process. Council undertook travel time surveys in March 2006 along the routes identified in **Table 3.3** to assist in the validation of base case Paramics models.

The UK DMRB states that modelled journey times compared with observed times should be within 15% (or 1 minute, if higher) for 85% of results (refer to **Figure 3.3**).

Table 3.3 and **Table 3.4** show that the average travel times output from the base AM and PM peak Paramics models respectively are lower than the Council surveyed travel times. The lower average travel times modelled by Paramics could be a result of the limited number of travel time surveys provided by Council. It is understood that Council carried out two to four runs along each route in each direction. This provides a general indication of travel time at select intervals within a peak period, however, it is considered to be insufficient to provide an accurate indication of the average travel time of all vehicles travelling along each route throughout the peak hour periods. It should also be highlighted that the travel time surveys undertaken by Council did not coincide with the intersection traffic count surveys. Seasonal variation in traffic demand could be another factor which is known to affect travel times throughout the network.

The Cost Benefit Analysis (COBA) Manual suggests that the number of journey times required to achieve a given accuracy within a 95% confidence level should be based on the Coefficient of Variation (CV) factor. The CV is defined as the ratio of the standard deviation to the mean of the observed journey times. The required number of journey time measurements specified by the COBA Manual is shown in **Figure 3.4**. The CV calculated for the surveyed travel times on Illaroo Road, Princes Highway and Bolong Road provided by Council is detailed in **Table 3.5** below. **Table 3.5** also shows the number of travel time survey runs that would need to be carried out to acquire an accuracy of +/-10 and +/-20 at the 95% confidence level.

Figure 3.4: COBA Required Number of Journey Time Measurements

Coefficient of Variation of observed journey times (CV)	Number of Journey Time Runs	
	Accuracy ±10%	Accuracy ±20%
5%	4	2
10%	7	2
15%	11	3
20%	18	5
30%	35	9
40%	64	16
50%	100	25

Source: Cost Benefit Analysis (COBA) Manual, Volume 13, Section 1, Part 5 Speeds on Links, Chapter 11 'Accuracy of Local Journey Time Measurements', May 2002.

Table 3.3: Comparison of the modelled and observed travel times during the AM peak

AM PEAK TRAVEL TIME SUMMARY	AVERAGE SURVEY	 ACTUAL	 % Difference
Bridge Road (Hyam Street(to Illaroo Road (Karama Drive)	0:05:13	0:04:11	20%
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	0:07:42	0:05:59	22%
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway 9twon Distance Signs, 350m north of C/L Cambewarra Road)	0:05:38	0:03:58	30%
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	0:05:48	0:04:13	27%
Cambewarra Road/Highway to Bolong Road/Railway Street	0:03:46	0:03:24	10%
Bolong Road/Railway Street to Cambewarra Road/Highway	0:04:09	0:03:12	23%
West Benberra Street/Highway to Bolong Road/Railway Street	0:02:41	0:02:07	21%
Bolong Road/Railway Street to West Bunberra Street/Highway	0:02:55	0:02:04	29%

Source: Shoalhaven Council Survey, March 2006

Table 3.4: Comparison of the modelled and observed travel times during the PM peak

PM PEAK TRAVEL TIME SUMMARY	AVERAGE SURVEY	 ACTUAL	 % Difference
Bridge Road (Hyam Street(to Illaroo Road (Karama Drive)	0:04:54	0:04:17	13%
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	0:07:07	0:05:55	17%
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway 9twon Distance Signs, 350m north of C/L Cambewarra Road)	0:04:34	0:03:57	14%
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	0:05:05	0:04:12	17%
Cambewarra Road/Highway to Bolong Road/Railway Street	0:04:10	0:03:35	14%
Bolong Road/Railway Street to Cambewarra Road/Highway	0:03:45	0:03:34	5%
West Benberra Street/Highway to Bolong Road/Railway Street	0:02:35	0:02:06	19%
Bolong Road/Railway Street to West Bunberra Street/Highway	0:02:40	0:02:02	24%

Source: Shoalhaven Council Survey, March 2006

Table 3.5: COBA Journey Time Measurement for Nowra

	Coefficient of Variation of observed journey times (CV)	Recommended Number of Journey Times	
		Accuracy +/-10%	Accuracy +/-20%
AM Peak			
Bridge Rd (Hyam St to Illaroo Road (Karama Drive) in both directions	18%	11-18	3-5
Princes Highway (320m south of Bridge Rd to 350m north of Cambewarra Rd) in both directions	22%	18-35	5-9
Journey time surveys in Bomaderry including Cambewarra Rd, Bunberra St and Bolong Road	23%	18-35	5-9
PM Peak			
Bridge Rd (Hyam St to Illaroo Road (Karama Drive) in both directions	11%	7-11	2-3
Princes Highway (320m south of Bridge Rd to 350m north of Cambewarra Rd) in both directions	13%	7-11	2-3
Journey time surveys in Bomaderry including Cambewarra Rd, Bunberra St and Bolong Road	20%	18	5

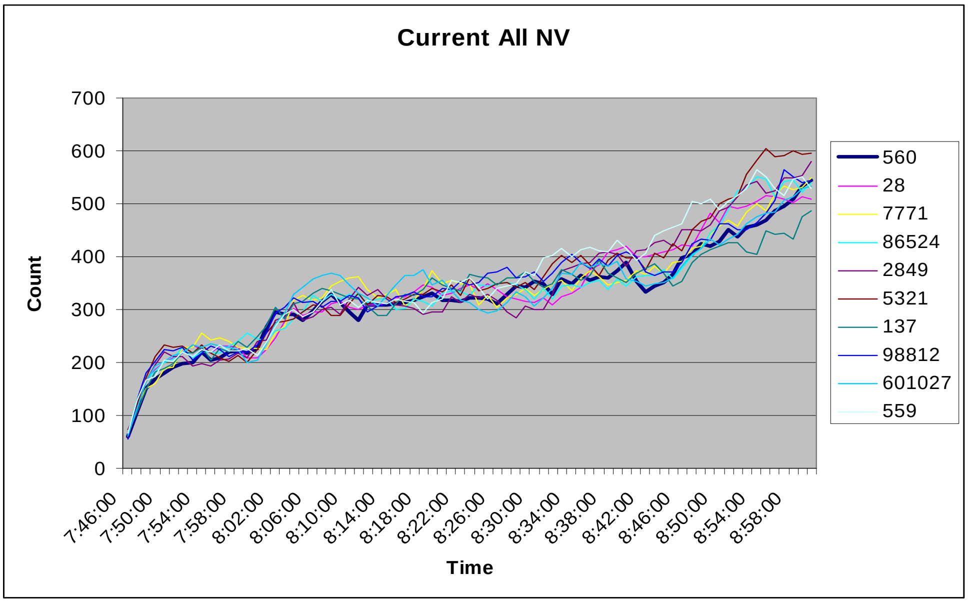
Source: AECOM, 2006

3.2.3 Seed Values

Seed values represent the different release patterns of traffic onto the network. The AM and PM peak models were run with ten standard RTA seed values to assess the stability of the models as shown in **Figure 3.5** and **Figure 3.6** respectively. **Figure 3.5** and **Figure 3.6** show that the number of vehicles on the network at any single point in time over the peak hour using different seed values. It indicates that the base models operate in a stable manner.

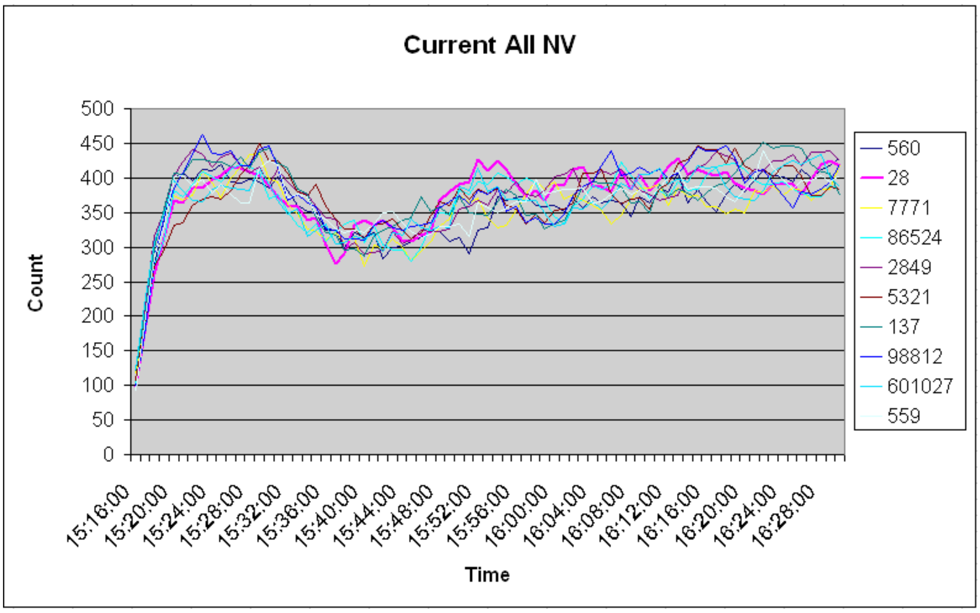
The average seed value selected to run in the AM peak model is 560 and for the PM peak is 28.

Figure 3.5: AM Peak - Current Number of Vehicles on the network over the modelled period for 10 seed runs



Source: AECOM

Figure 3.6: PM Peak - Current Number of Vehicles on the network over the modelled period for 10 seed runs



Source: AECOM

3.3 2016 Future Modelling

Having developed calibrated base AM and PM peak models that accurately reflect the traffic conditions in 2005, the base models were modified to represent the different future year Link Road options and demand conditions as highlighted in **Table 3.1**.

3.3.1 Future Demand Matrices

The 2016 models have been assessed under three different demand scenarios. These include:

- Traffic demands based on existing (2005) demands plus a nominal 2% growth per annum applied to Princes Highway and Bolong Road (through flows only) determined by approximating from RTA growth data for the period 2000-2003;
- Traffic demands determined from growth in line with the NBSP; and
- Traffic demands determined from growth in line with the NBSP including the Moss Vale to Illaroo Road link road connection in accordance with NBSP proposed road network.

The 2016 AM and PM demand matrices based on 2% growth per annum along Princes Highway and Bolong Road were developed by increasing the through trips along Princes Highway and Bolong Road in the base matrices. This resulted in approximately 450 and 500 additional trips on the road network during the AM and PM peak periods respectively. This scenario was only assessed for the existing network.

The 2016 AM and PM demand matrices based on the NBSP (with and without the Moss Vale to Illaroo Road Link) were developed by iteratively proportioning the base matrices to the cordon flows provided by Council for each of the external and internal zones set up in the model. The 2016 cordon flows were extracted from Council's daily TRACKS model.

The AM and PM flows extracted from the TRACKS models were initially based on the assumption of a peak to daily ratio of 10%, with directional ratios assumed to be the same as per 2005 surveyed directional ratios.

The TRACKS flows provided by Council showed significant traffic growth in North Nowra and Bomaderry with approximately 4300 to 4400 additional trips on the road network compared to the base models. The 2016 AM and PM models under the existing road geometry, showed that with this additional growth, the road network would become over saturated resulting in significant congestion and queuing on Princes Highway, Illaroo Road, Bolong Road and Bridge Road by the end of each peak hour.

AECOM advised Council and RTA that with this level of additional traffic on the network, and the resultant congestion, it would severely impact the accuracy of the Link Road options analysis. Council concurred and consequently reviewed the land use data in the NBSP, as well as the peak to daily ratios, and advised the following reductions to the original cordon flows provided by Council[2]:

- 15% reduction on actual growth rates between 2006 and 2016 - following Council's review of growth projections from 2001 to 2016 compared to actual growth achieved between 2001 and 2006;
- Reduction of AM peak to daily ratio from 10% to 8% (in accordance with surveyed peak/daily rates); and
- Reduction of PM peak to daily ratio from 10% to 9% (in accordance with surveyed peak/daily rates).

These adjustments to the 2016 AM and PM demand matrices resulted in a less congested network with approximately 2000 and 3000 additional trips on the road network during the AM and PM peak periods respectively.

[2] Email from Council dated 5 October 2006

The 2016 AM and PM demand matrices based on the revised structure plan assumptions have been used to assess each of the three proposed Link Road options. The demand matrix for Option 3 was adjusted however, to take into account the additional zone (zone 53) to model the Link Road connection on Moss Vale Road with Elvin Drive.

3.3.2 Speed of Link Road

The three proposed Link Road options were generally modelled as Local Collector roads with a 70 kph speed limit. It is understood from Council that different speed limits will apply to the Link Road options. These are described below:

- Option 1 (Pitt Street to Narang Road) – Total length 1810m. 150m at 60 kph west end, 1389m 80kph central, 271m 60 kph east end;
- Option 2 (Illaroo Road to Bunberra Street) – Total length 1820m. 150m 60 kph west end, 1520m 80kph central, 150m 60 kph east end; and
- Option 3 (West Cambewarra Road to Moss Vale Rd) – Total length 1730m. 60 kph full length of length of Link Road.

The Paramics modelling was agreed to be based on a 70 kph speed limit for each link road option except in the Option 1 RCR scenario where a variable speed limit on the link road has been modelled to test for the sensitivity of the link road with a variation in free flow speed.

Council advised that if variable speeds are to be modelled under each link road option, based on the assumption that no side road conflicts along the link road, traffic using link road Options 1 and 2 would experience 6% and 8% faster travel time than travelling on a consistent 70 kph speed limit. Traffic using both link road Options 3 and 4 would experience 14% slower travel time than travelling on a consistent 70 kph speed limit.

If this is the case, this could be significant in further separating the traffic demand and economic performance between the northern (Options 3 and 4) and southern Options (Options 1 and 2), where it could be expected that Options 1 and 2 could result in improved economic performance (based on improved travel times), and Options 3 and 4 could result in reduced economic performance (based on reduced travel times).

The base Options have all been modelled with consistent 70 kph free flow speed along the full length of each link. However, review of the results should consider the outcomes of Option 1 RCR.

The alignment of each Link Road option is shown in **Figure 1.1**.

3.3.3 Link Road Connections

The intersection connections (type and configuration) for each Link Road option have been determined based on the following:

- Council TRACKS model;
- Existing network geometry;
- SIDRA analysis; and
- Paramics observations.

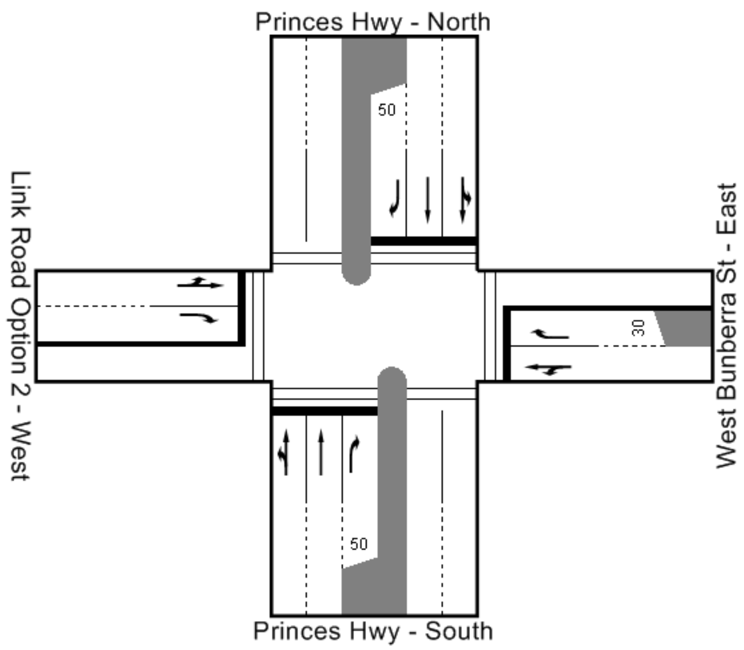
The connections with the proposed Link Road included in the model are:

- Link Road connections with Illaroo Road have been set up as one lane roundabouts;
- Link Road connections with the Princes Highway / Narang Road intersection (Options 1) connects with the existing alignment of Narang Road and correspondingly the existing roundabout on Princes Highway;
- The Link Road connection with the Princes Highway / West Bunberra Street intersection (Option 2) connects with the existing priority T-Junction intersection as a signalised cross intersection. The intersection configuration employed in the modelling is shown in **Figure 3.7**; and
- The Link Road connection with the West Cambewarra Road / Moss Vale Road intersection (Option 3) connects with Elvin Drive as a one lane roundabout.

The cycle time used corresponds with the coordinated cycle time utilised along Princes Highway. The settings for the signalised intersection proposed for Princes Highway / West Bunberra Street (Option 2) have been based on SIDRA analysis. Key issues include:

- Diamond overlap phasing was utilised for Princes Highway turn movements;
- Split phase approach was used for West Bunberra Street / Link Road Option 2 turn movements, as through vehicle movements were observed to be low compared to right turn movements; and
- A minimum green time of 17 seconds (19.5m carriageway and 1.2m/s pedestrian crossing speed) has been allowed for pedestrians to cross safely.

Figure 3.7: Option 2 Link Road Connection with Princes Highway and Bunberra Street



Source: AECOM

3.3.4 Signal Timing

Signal timings along Princes Highway have been adjusted to take into account the increase in traffic levels by 2016. The cycle time, signal phasing and green splits utilised were optimised initially using SIDRA and then fine tuned in Paramics to provide higher priority to Princes Highway through traffic movements. These modifications have been made to maintain traffic flow along Princes Highway as well as Illaroo Road and Bolong Road. A similar phase arrangement to that employed in the base models was used, however the cycle time in the future modelling has increased as shown in **Table 3.6**. The signal phase times have been revised to ensure the model operates effectively for each scenario being assessed.

Table 3.6: Nowra Paramics Model Coordinated Cycle Time along Princes Highway

Scenario	AM (Seconds)	PM (Seconds)
2005	122	126
2016 2% Growth	125	126
2016 Structure Plan	145	150

Source: AECOM

3.3.5 Traffic Assignment

The traffic assignment method used for the 2016 modelling has been discussed with RTA. It was agreed that "Dynamic Feedback" assignment with a feedback period of two minutes will be adopted for all future year modelling.

Dynamic feedback assignment assumes that drivers familiar with the road network will re-route if congestion is experienced on the road network and an alternative route with less delay is available. Dynamic feedback will accurately account for the usage of the Link Road and rat-running that occurs as a result of the road network being more congested.

A two-minute feedback period was chosen because it is an appropriate length of time that could allow vehicles to re-route if necessary given the size of the road network. A longer (>2 minutes) feedback periods would not provide enough opportunities for vehicles to re-route as it exceeds the travel time of some routes throughout the network. A shorter (<1 minute) feedback period would provide excessive re-routing opportunities and result in impractical travel behaviour within the network.

3.3.6 Model Observations (2016)

The Paramics models provide a visual representation of traffic conditions as they change and evolve throughout the modelled AM peak (8-9) and PM peak (3.30-4.30) periods. Through visual observation of the model it is possible to identify issues as they occur.

The general issues identified with regard to traffic in the North Nowra to Bomaderry study area in 2016 include:

- The proximity of the Princes Highway / Illaroo Road intersection with the Princes Highway / Bolong Road signalised intersection (providing limited storage space), causes significant congestion and acts as a 'throttle' to traffic travelling southbound along Princes Highway.
- Shoalhaven Bridge Crossing is also observed to be congested with traffic being throttled in a southbound direction along Princes Highway. Extensive queuing also occurs for traffic turning right from Illaroo Road, in particular during the AM peak where the number of right turn movements from Princes Highway onto Bridge Road has been forecast to increase by approximately 65% in 2016. It is observed that the level of queuing currently extends to obstruct the adjacent through lane hindering through vehicle movements occasionally during AM and PM peak hours in an average weekday flow conditions. The queuing condition worsens in 2016 such that the maximum queuing extends to north of the Shoalhaven River for most of the peak hour due to a significant increase in southbound traffic flow on the highway and the southbound right turn demand at Bridge Road.
- As a result of the congestion at the Princes Highway / Illaroo Road intersection and Shoalhaven River Bridge crossing, extensive queuing is observed to occur on Princes Highway extending beyond Beinda Street and in some instances up to Bunberra Street / Narang Road. To avoid the queues on Princes Highway some vehicles are observed to rat-run via Beinda Street and Bolong Road. Rat-running increases along these routes as demand to access Princes Highway increases as a result of the Link Road. This situation results in longer queues occurring on the highway compared to the "Do Nothing - NBSP" model, as well as along Bolong Road due to more green time being allocated to Princes Highway vehicle movements to account for the increase in traffic. The extent of queuing, however, has reduced on Illaroo Road as expected.
- Extensive queuing is observed on Illaroo Road under the scenario with 2% growth on the Princes Highway and Bolong Road through traffic only. Queues on Illaroo Road are observed to extend just beyond Pitt Street causing large delays for vehicles exiting the minor residential streets at priority intersections under the NBSP growth scenario. With the Link Road the queues are shown to reduce to between Crest Avenue and McMahons Road (to the extent of current observed queue conditions on Illaroo Road). This has consequently improved vehicle access onto Illaroo Road from the minor residential streets.
- At the Princes Highway / Bridge Road intersection extensive queuing on the southern and western approaches is observed to occur throughout the PM peak period with approximately 150 to 250 vehicles not being released onto the network from Bridge Road western approach (Zone 51) and Princes Highway southern approach (Zone 50). The impact of this queuing on these approaches has not been modelled as it extends beyond the study area. Queuing on the western approach (Bridge Street) has increased and extends into further zone 51 due to the significant (100%) forecast growth in traffic using Bridge Road to access the Princes Highway. Conditions are improved considerably under the 2016 PM Peak Option 1 RCR scenario with improved capacity for northbound flow on Princes Highway.

- Queuing is observed for Option 3 at Princes Highway / Cambewarra Road intersection by the end of the peak hour. This occurs as a result of the proximity of the Link Road connection for Option 3 with Moss Vale Road and Elvin Drive, as well as the increase of traffic generated from the Link Road. An increase in average vehicle delay of approximately 18 seconds during the AM peak and approximately 10 seconds during the PM peak occurs when compared to the other Link Road modelled options. The overall average vehicle delay experienced over the hour however, is still within acceptable limits (Level of Service B).

In 2016, the number of unreleased vehicles on the modelled road network during the AM and PM peak periods is presented in **Table 3.7**. **Table 3.7** highlights that during the AM peak period only a small number of vehicles are not being released. During the PM peak period a higher number of vehicles (up to 500 vehicles) are not being released onto the road network, however as discussed above, this is a result of the high traffic flows along Princes Highway in the northbound direction. The impact of this queuing has not been modelled as it extends beyond the study area.

Similarly, the 2016 DN2P options show variation in traffic flows compared to the base models. This is also a result of increased delays along the Princes Highway and Bolong Road that have affected the release of vehicles onto the Paramics model network.

The results indicate that Options 1 and 2 has the greatest ability to reduce unreleased vehicles onto the network in the more constrained PM Peak period.

Table 3.7: Unreleased vehicles on the road network

Scenario	Matrix	AM Peak		PM Peak	
		Number of Vehicles	Zone	Number of Vehicles	Zone
Do Nothing 2% Growth	1	14	16	0	0
	2	5	25	10	25
Do Nothing Structure Plan	1	113	8,9,12,50	336	50,51
	2	24	50	76	50,51
Option 1	1	50	50,45,44	162	50,51
	2	14	50,45	64	50,51
Option 1 RCR	1	8	50	145	50,51
	2	2	50	49	50,51
Option 1 MVRDLK	1	28	44,45	228	50,51
	2	2	45	95	50,51
Option 2	1	50	45,50	91	50,51
	2	21	39,45,50	80	50,51
Option 3	1	61	16,25,50	384	44,45,50,51
	2	8	25,50	92	45,50,51
Option 3 MVRDLK	1	39	25,44,45,50	284	50,51
	2	16	26,45,50	79	50,51

Note: Matrix 1 represents cars and Matrix 2 represents heavy vehicles

Source: AECOM, outputs from Paramics

4.0 Traffic Model Outputs

4.1 Introduction

The Paramics model outputs have been produced to support the traffic engineering, economic appraisal, and noise assessments for each of the three proposed Link Road options. The key outputs extracted from the Paramics models for these studies include:

- Network performance measures including Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT), Mean Speed and Number of Vehicles released on the network;
- Turn flows at the thirteen key intersections (listed below);
- Traffic flows at critical mid-block locations;
- Travel times along the three main routes along Princes Highway, Illaroo Road and Bolong Road; and
- Level of Service and average vehicle delay at the thirteen key intersections (listed below).

The thirteen key intersections forming part of the study area (and as highlighted in **Figure 1.2**) include:

- Node 2: Princes Highway / Illaroo Road (Signalised Intersection);
- Node 3: Princes Highway / Bolong Road (Signalised Intersection);
- Node 4: Princes Highway / Beinda Street (Roundabout);
- Node 5: Princes Highway / Bunberra Street (Priority Intersection);
- Node 6: Princes Highway / Narang Road (Roundabout);
- Node 7: Princes Highway / Cambewarra Road (Roundabout);
- Node 9: Illaroo Road / McMahons Road (Roundabout);
- Node 10: Illaroo Road / Page Avenue (Priority Intersection);
- Node 11: Illaroo Road / Pitt Street (Priority Intersection);
- Node 12: Illaroo Road / West Cambewarra Road (Priority Intersection);
- Node 13: Bolong Road / Beinda Street (Priority Intersection);
- Node 14: Bolong Road / Meroo Street (Roundabout); and
- Node 15: Meroo Street / Bunberra Street (Priority Intersection).

The following intersections have been included in the Paramics modelling, however detailed intersection analysis was not required as part of this study:

- Node 1: Princes Highway / Bridge Road (Signalised Intersection);
- Node 8: Illaroo Road / Crest Avenue (Signalised Intersection);
- Node 17: Cambewarra Road / Coomea Street (Priority Intersection); and
- Node 18: Cambewarra Road / Meroo Street (Priority Intersection).

4.2 Network Performance Measures

The network performance measures from the 2005 and 2016 Paramics models have been extracted to "benchmark" each "Do Nothing - NBSP" and proposed Link Road option and assist in the economic evaluation process (discussed in **Section 6**) and in identifying the preferred Link Road option.

The network performance outputs (as presented in **Table 4.1)** include:

- Vehicle Kilometres Travelled (VKT);
- Vehicle Hours Travelled (VHT);
- Mean Vehicle Speed; and
- Number of Vehicles.

Table 4.1: Network Performance Measures

Scenario	VKT	VHT	Mean Speed	Number of Vehicles
2005				
AM	14,424	357	40	6,264
PM	15,704	376	42	6,476
2016 AM				
Do Nothing 2% Growth	15,485	447	35	6,736
Do Nothing Structure Plan	17,153	709	24	7,793
Option 1	17,887	672	27	8,013
Option 1 RCR	17,723	614	29	7,852
Option 2	17,433	663	26	7,857
Option 3	18,089	705	26	8,147
Option 1 MVRDLK	17,839	599	30	7,987
Option 3 MVRDLK	17,645	672	26	7,933
2016 PM				
Do Nothing 2% Growth	16,387	403	41	6,685
Do Nothing Structure Plan	19,049	903	21	8,479
Option 1	19,687	854	23	8,727
Option 1 RCR	19,887	696	29	8,523
Option 2	19,626	832	24	8,747
Option 3	19,717	965	20	8,639
Option 1 MVRDLK	19,305	818	24	8,703
Option 3 MVRDLK	19,525	766	26	8,738

Source: AECOM, outputs from Paramics

Table 4.1 shows that VHT and VKT are lower for the link road Options 1 and 2 (southern link road options) and higher for link road Option 3 (northern link road option) during both the AM and PM peak periods. This trend is identified in Council's TRACKS modelling analysis, and is expected considering the centre of gravity of trip generation in North Nowra, and the high percentage (approximately 70%) of existing movements on Illaroo Road which have destinations south of the river.

VHT and VKT are key performance measures that authorities aim to minimise in network planning and this is an objective of the NSW State Government in their Action for 2010 vision. Apart from the economic benefits of improved travel efficiencies, minimisation of VHT and VKT results in less vehicle emissions (less pollution levels) and therefore provides considerable benefit to the environment and the community.

The network performance measures demonstrate that Option 1 with Moss Vale Road Link and Option 1 RCR scenarios result in the lowest VHT value and highest mean speed – an overall indicator of relative level of service out of all the options in the AM Peak. Option 1 RCR scenario results in the lowest VHT and highest mean speed out of all the options in the PM Peak. Option 2 also results in the lowest VKT in both AM and PM peaks.

4.3 Turn Flows

The turn flows at each of the thirteen key intersections have been extracted from the models for each of the different scenarios.

The 2005 base AM and PM modelled turn flows are presented in **Appendix B**. The turn flows extracted for the 2016 AM and PM models are presented in **Appendix C** and **Appendix D** respectively, including:

- Do nothing 2% growth along Princes Highway and Bolong Road through traffic only;
- Do nothing NBSP;
- Link Road Option 1 with and without Moss Vale to Illaroo Road Link;
- Link Road Option 1 RCR;
- Link Road Option 2; and
- Link Road Option 3 with and without Moss Vale to Illaroo Link Road.

These turn flows have been used to carry out detailed intersection analysis using SIDRA (discussed in **Section 4.7**) and noise assessment (discussed in **Section 7.0**) for each of the Link Road options modelled.

The base AM and PM peak modelled flows have been calibrated against the observed November 2005 turn flows provided by Council. This data also provided indicative 2016 turn flows at each of the key intersections with and without the Moss Vale to Illaroo Road Link based on the 2016 TRACKS model which has been reviewed in June 2010for its validity by Gabites Porter, the author of the TRACKS program. It should be noted that these turn flows have been included on the diagrams presented in **Appendix C** and **Appendix D** for reference only and do not take into consideration the reductions applied to the 2016 traffic flows as discussed in **Section 3.3.1**.

4.4 Link Flows

Link flows at key mid-block locations around the study area have been extracted from the models for each of the different scenarios. The link flow comparison between all 2016 AM and PM models is also presented in **Appendix C** and **Appendix D** respectively.

As would be expected, there is a general increase on Princes Highway and Bolong Road when comparing the Base Case and the 2016 2% growth scenario.

During 2016 AM peak, the model flows show that there is a 15% to 30% reduction in traffic on Illaroo Road between McMahons Road and Princes Highway with the construction of the Link Road when compared to the 2016 NBSP scenario without the existence of the Link Road. A similar reduction of traffic is also observed in the 2016 PM peak with the construction of the Link Road.

Beinda Street, Bunberra Street, and Cambewarra Road all experience an increase in traffic as a result of development envisaged under the NBSP (up to 150 vph during the peak hour or 1500-1800 vpd). Further increases in traffic are likely to occur on these roads as a result of the construction of a link road irrespective of options (up to 103 vph during the peak hour or 1000-1300 vpd), when traffic re-routes between North Nowra and Bomaderry.

Traffic growth on these local roads could be expected to reach up to 3000 vpd with increased demands according to NBSP and changed traffic patterns as a result of the North Nowra to Bomaderry Link Road.

Option 1 has the least impacts on traffic flow on local roads as it does not have a direct connection into an existing east-west local/collector road.

The number of vehicles using each of the proposed Link Road options in the Paramics models is summarised in **Table 4.2** below.

Table 4.2: Number of vehicles using the Link Road for each Scenario

Scenario	Link Total (vph)	Link (vph) -> Out of North Nowra	Link (vph) -> In to North Nowra
2005			
AM			
PM			
2016 AM			
Do Nothing 2% Growth			
Do Nothing Structure Plan			
Option 1	536	412	124
Option 1 RCR	611	402	209
Option 2	480	371	109
Option 3	450	348	102
Option 1 MVRDLK	472	352	120
Option 3 MVRDLK	420	278	142
2016 PM			
Do Nothing 2% Growth			
Do Nothing Structure Plan			
Option 1	499	291	208
Option 1 RCR	519	315	204
Option 2	460	267	193
Option 3	478	278	200
Option 1 MVRDLK	389	227	162
Option 3 MVRDLK	385	181	204

Source: AECOM, outputs from Paramics

Forecasts indicate that approximately 400 to 600 vehicles will use the Link Road during the AM or PM peak hour under each of the different scenarios tested. There is generally less traffic on the Link Road during the PM peak when compared with the AM peak in each scenario. This is due to less delays being experienced by vehicles returning to North Nowra using the current northbound left-turn slip lane at Illaroo Road intersection. It is also due to the fact that AM peak period is more concentrated whereas the traffic is spread over a longer period during the PM peak period.

The Link Road attracts the highest level of traffic under the Option 1 RCR scenario. This occurs as vehicle delays travelling into and out of Nowra on the Princes Highway is reduced by improved performance at the intersections of Illaroo Road and Bridge Street with Princes Highway as well as improved travel times due to the variable speed limit on the Link Road.

There are significant traffic increase with Link Option 1 RCR, in comparison to base Option 1. Modelling Results indicate Link Option 1 RCR results in traffic increases of 17% and 12% during AM and PM hours, respectively, following a 6% increase in travel time allowable along the link road in the RCR scenario.

Whilst Option 1 RCR demonstrates a positive relationship between travel speed and travel demand on the link road, in the constrained peak period models, the increased travel demand can not be attributed only to increased speed allowed on the link road, although the findings are significant.

Option 1 RCR generally improved flow conditions along the Princes Highway, but this was more notable in the PM Peak period, with increased capacity for northbound traffic attributed to the banned right turn into Illaroo Road.

Option 1 was selected by Council, RTA and AECOM for further assessment based on favourable traffic, economic and noise outputs. Additional modelling works were undertaken (river crossing relief or "RCR" scenario) to determine the effectiveness of the "do minor" works to the north and south of the Shoalhaven river bridges. This was considered necessary due to the constrained model conditions identified during the initial phases of modelling.

The modelling (of Option 1 RCR) scenario showed considerable relief to Princes Highway operations, particularly in the PM Peak.

The benefits are highlighted in **Table 4.6** and **Table 4.7** which show a reduction to average delays at the critical Highway intersections (Bolong Road and Illaroo Road) for Option 1. Further reductions to average delay result when Option 1 is modelled in conjunction with the Moss Vale Link Road and RCR scenario.

Table 4.6 and **Table 4.7** also demonstrate the effect of the Moss Vale Link Road and RCR scenario in terms of offsetting any adverse impacts of the link road on SH1 / Bolong Road intersection.

4.5 Travel Times

Travel times were extracted from each of the 2005 and 2016 Paramics models for the following key routes, shown in **Figure 4.1**:

Route 1: Bridge Road (Zone 51) to Illaroo Road (Zone 1);

Route 2: Illaroo Road (Zone 1) to Bridge Road (Zone 51);

Route 3: Princes Highway South (Zone 50) to Princes Highway North (Zone 26);

Route 4: Princes Highway North (Zone 26) to Princes Highway South (Zone 50);

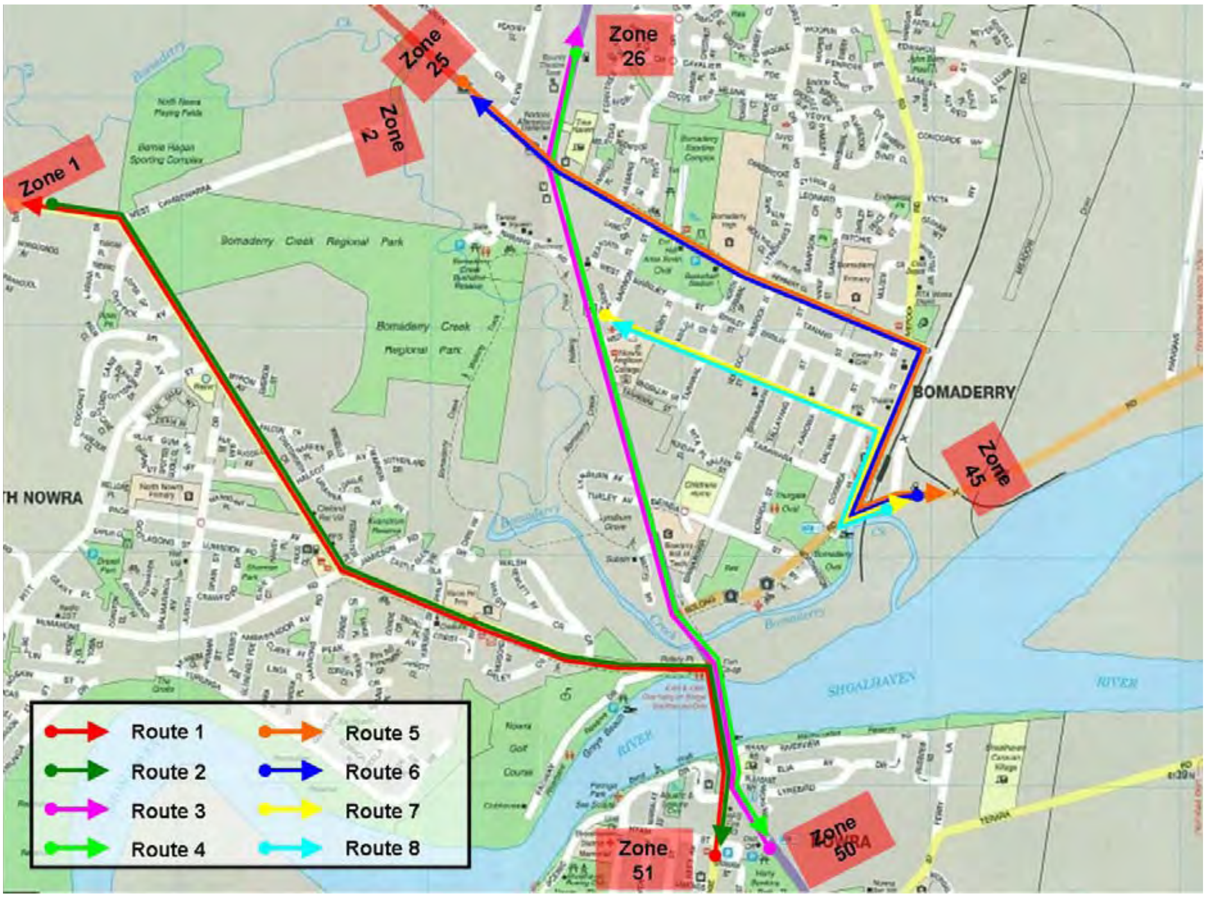
Route 5: Moss Vale Road (Zone 25) to Bolong Road (Zone 45);

Route 6: Bolong Road (Zone 45) to Moss Vale Road (Zone 25);

Route 7: West Bunberra Street (Zone 22) to Bolong Road (Zone 45); and

Route 8: Bolong Road (Zone 45) to West Bunberra Street (Zone 22).

Figure 4.1: Key Travel Time Routes



Source: AECOM, October 2006

A comparison of the travel times output from the Paramics models for each of the different scenarios analysed is shown in **Table 4.3** and **Table 4.4** respectively. The network travel times in **Table 4.3** and **Table 4.4** are minimum, maximum and average values of a single model for all trips made between a particular origin-destination within the peak hour.

4.5.1.1 AM Peak

The 2016 “Do Nothing” 2% p.a. growth in through traffic along Princes Highway and Bolong Road model results show an increase in average travel time of up to 2 minutes for vehicles travelling along Route 2. The increase in travel time along Illaroo Road eastbound is a result of more green time allocated to the major arm, Princes Highway through movements, to accommodate the traffic growth along Princes Highway (to the detriment of Illaroo Road vehicle movements).

Table 4.3.1 highlights that in 2016 based on the NBSP and existing road network a significant increase in travel time compared to existing conditions (base 2005) will occur for vehicles travelling along the following routes:

- Illaroo Road to Bridge Road (Route 2) has an increase in travel time of up to 10 minutes;
- Princes Highway through traffic in both the northbound and southbound direction (Route 3 and Route 4) has an increase in travel time of up to 4 to 5 minutes; and
- Moss Vale Road to Bolong Road (Route 5) has the least increase in travel time of up to 2 minutes.

This is in line with the extensive queuing observed along Illaroo Road and Princes Highway in the 2016 AM peak “Do Nothing - NBSP” Paramics model.

It should also be noted that the RCR option does not provide any significant travel time savings in the AM peak, but more significant travel time savings occur in the PM peak.

Table 4.3.2 highlights that the construction of a Link Road will reduce the average travel time along Illaroo Road by approximately 2 to 3 minutes in 2016 (based on the NBSP). Each Link Road option has a similar average travel time along Illaroo Road between 9 to 10 minutes.

The average travel time on Princes Highway along the northbound carriageway is similar to the “Do nothing - NBSP” option. It is higher in the southbound direction by up to 1 to 2 minutes. This is in line with the observations of the Paramics models, which showed queuing on Illaroo Road reduced as a result of vehicles utilising the Link Road.

It was noted during model observations that capacity constraints at the Princes Highway / Illaroo Road intersection and Shoalhaven Bridge Crossing (discussed in **Section 3.3.6**) resulted in slightly longer queues on the southbound carriageway. Travel times and average intersection delays reduce with the RCR scenario but more notably for the northbound carriageway.

The travel time benefits of the MVRDLK do not appear to be significant when compared to the equivalent Link Road options modelled without the MVRDLK although there are notable traffic operational benefits of the MVRDLK at critical Princes Highway intersections.

There are generally time savings on Cambewarra Road in the eastbound direction with the construction of the link road (compared with the 2016 DN-NBSP scenario). However, the travel time is higher by 1 to 3 minutes in the westbound direction travelling towards the Princes Highway in all link road scenarios, due to longer delays experienced on the Princes Highway.

The travel time on both directions of West Bunberra Road remains constant (within 1 minute) in all link road scenarios (compared with the 2016 DN-NBSP scenario), except in the westbound direction under Option 3 with MVRDLK which increased by almost 2 minutes.

Of **Tables 4.3.1** to **4.3.3** (AM), Option 1 MVRDLK had the lowest value of VHT indicating better overall performance compared to other Link options.

Table 4.3.2 indicates that values of VHT increase as location of the Link Road option moves to the north. This is a similar trend found with Council’s TRACKS analysis.

Table 4.3 AM Peak – Travel Time Comparisons

Table 4.3.1

AM		Survey			Base 2005			2016 DN2P			2016 DN-NBSP		
TRAVEL TIME SUMMARY	ROUTE	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Bridge Road (Hyam Street) to Illaroo Road (Karama Drive)	1	0:04:35	0:06:32	0:05:13	0:04:01	0:04:25	0:04:11	0:04:02	0:04:23	0:04:11	0:04:17	0:04:19	0:04:18
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	2	0:06:26	0:10:20	0:07:42	0:04:21	0:09:29	0:05:59	0:04:54	0:12:20	0:07:42	0:05:32	0:20:07	0:11:52
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road)	3	0:04:39	0:07:25	0:05:38	0:03:06	0:05:10	0:03:58	0:03:00	0:05:35	0:03:55	0:03:27	0:09:23	0:05:38
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	4	0:04:09	0:07:00	0:05:48	0:03:15	0:05:55	0:04:13	0:03:18	0:06:40	0:04:43	0:03:19	0:11:25	0:05:54
Cambewarra Road/Highway to Bolong Road/Railway Street	5	0:03:36	0:03:55	0:03:46	0:03:15	0:03:51	0:03:24	0:03:16	0:03:38	0:03:27	0:03:27	0:05:11	0:04:10
Bolong Road/Railway Street to Cambewarra Road/Highway	6	0:04:09	0:04:09	0:04:09	0:03:02	0:03:20	0:03:12	0:03:12	0:03:19	0:03:15	0:03:03	0:03:37	0:03:18
West Bunberra Street/Highway to Bolong Road/Railway Street	7	0:02:34	0:02:48	0:02:41	0:01:56	0:02:21	0:02:07	0:02:00	0:02:20	0:02:09	0:02:01	0:02:12	0:02:06
Bolong Road/Railway Street to West Bunberra Street/Highway	8	0:02:53	0:02:53	0:02:55	0:02:00	0:02:13	0:02:04	0:01:57	0:02:09	0:02:03	0:01:58	0:02:18	0:02:06
Average Network VHT			N/A			357			447			709	

Table 4.3.2

Without Moss Vale Link Road		2016 Option 1			2016 Option 1 RCR			2016 Option 2			2016 Option 3		
TRAVEL TIME SUMMARY	ROUTE	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Bridge Road (Hyam Street) to Illaroo Road (Karama Drive)	1	0:04:18	0:04:41	0:04:28	0:03:52	0:04:52	0:04:17	0:04:11	0:04:31	0:04:18	0:04:03	0:04:53	0:04:21
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	2	0:04:19	0:18:21	0:09:24	0:04:44	0:14:51	0:08:43	0:04:50	0:14:52	0:09:48	0:04:23	0:17:47	0:09:56
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road)	3	0:03:32	0:08:25	0:05:11	0:03:57	0:06:59	0:05:20	0:03:32	0:11:42	0:05:22	0:03:21	0:06:54	0:04:56
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	4	0:03:19	0:14:16	0:06:42	0:03:21	0:15:09	0:06:15	0:03:22	0:12:32	0:07:13	0:03:23	0:14:07	0:06:48
Cambewarra Road/Highway to Bolong Road/Railway Street	5	0:03:16	0:03:59	0:03:33	0:03:21	0:04:09	0:03:42	0:03:20	0:04:26	0:03:58	0:03:40	0:04:06	0:03:50
Bolong Road/Railway Street to Cambewarra Road/Highway	6	0:03:20	0:05:27	0:04:00	0:03:56	0:04:14	0:04:03	0:03:34	0:05:14	0:04:15	0:03:15	0:03:56	0:03:35
West Bunberra Street/Highway to Bolong Road/Railway Street	7	0:02:01	0:02:31	0:02:10	0:02:01	0:02:18	0:02:10	0:01:55	0:02:08	0:02:02	0:02:08	0:02:20	0:02:11
Bolong Road/Railway Street to West Bunberra Street/Highway	8	0:02:00	0:03:52	0:02:31	0:02:03	0:02:15	0:02:09	0:02:10	0:02:22	0:02:14	0:02:02	0:03:56	0:02:34
Average Network VHT			672			614			663			705	

Table 4.3.3

With Moss Vale Link Road		2016 Option 1 MVRDLK			2016 Option 3 MVRDLK		
TRAVEL TIME SUMMARY	ROUTE	Min	Max	Average	Min	Max	Average
Bridge Road (Hyam Street) to Illaroo Road (Karama Drive)	1	0:04:12	0:04:26	0:04:19	0:04:19	0:05:27	0:04:51
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	2	0:05:42	0:13:34	0:08:27	0:04:29	0:16:39	0:09:29
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road)	3	0:03:41	0:06:25	0:04:58	0:03:37	0:06:39	0:04:55
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	4	0:03:14	0:11:24	0:05:49	0:03:20	0:14:05	0:07:24
Cambewarra Road/Highway to Bolong Road/Railway Street	5	0:05:19	0:05:19	0:05:19	0:04:00	0:04:00	0:04:00
Bolong Road/Railway Street to Cambewarra Road/Highway	6	0:03:09	0:04:09	0:03:36	0:03:21	0:12:40	0:05:52
West Bunberra Street/Highway to Bolong Road/Railway Street	7	0:02:08	0:02:25	0:02:13	0:02:13	0:02:13	0:02:13
Bolong Road/Railway Street to West Bunberra Street/Highway	8	0:01:58	0:02:26	0:02:11	0:02:02	0:04:55	0:03:28
Average Network VHT			599			672	

Table 4.4 PM Peak – Travel Time Comparisons

Table 4.4.1

PM		Survey			Base 2005			2016 DN2P			2016 DN-NBSP		
TRAVEL TIME SUMMARY	**ROUTE**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Bridge Road (Hyam Street) to Illaroo Road (Karama Drive)	1	0:04:39	0:05:10	0:04:54	0:04:01	0:04:43	0:04:17	0:03:57	0:04:55	0:04:21	0:04:47	0:17:52	0:07:58
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	2	0:06:19	0:08:04	0:07:07	0:04:30	0:07:49	0:05:55	0:05:02	0:07:41	0:05:48	0:07:11	0:20:27	0:12:32
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road)	3	0:04:07	0:05:19	0:04:34	0:03:09	0:05:06	0:03:57	0:03:09	0:05:29	0:04:10	0:05:42	0:27:38	0:08:52
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	4	0:04:10	0:06:11	0:05:05	0:03:17	0:05:43	0:04:12	0:03:15	0:05:36	0:04:10	0:04:16	0:13:19	0:06:14
Cambewarra Road/Highway to Bolong Road/Railway Street	5	0:03:44	0:04:36	0:04:10	0:03:35	0:03:35	0:03:35	0:03:18	0:03:48	0:03:33	0:03:37	0:04:24	0:04:00
Bolong Road/Railway Street to Cambewarra Road/Highway	6	0:03:43	0:03:43	0:03:45	0:03:34	0:03:34	0:03:34	0:03:12	0:03:42	0:03:27	0:03:26	0:03:26	0:03:26
West Bunberra Street/Highway to Bolong Road/Railway Street	7	0:02:29	0:02:42	0:02:35	0:02:02	0:02:12	0:02:06	0:02:13	0:02:17	0:02:15	0:02:02	0:02:16	0:02:08
Bolong Road/Railway Street to West Bunberra Street/Highway	8	0:02:40	0:02:40	0:02:40	0:01:59	0:02:11	0:02:02	0:01:56	0:02:12	0:02:04	0:01:57	0:02:20	0:02:09
Average Network VHT			N/A			376			403			903	

Table 4.4.2

Without Moss Vale Link Road		2016 Option 1			2016 Option 1 RCR			2016 Option 2			2016 Option 3		
TRAVEL TIME SUMMARY	**ROUTE**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Bridge Road (Hyam Street) to Illaroo Road (Karama Drive)	1	0:04:21	0:17:23	0:05:47	0:04:03	0:08:49	0:05:02	0:04:17	0:07:31	0:04:50	0:04:39	0:11:02	0:06:43
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	2	0:08:11	0:15:47	0:11:18	0:06:12	0:11:58	0:09:03	0:06:58	0:14:43	0:11:41	0:07:04	0:16:12	0:11:12
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road)	3	0:04:51	0:28:32	0:08:35	0:04:37	0:42:00	0:09:13	0:05:13	0:20:31	0:08:40	0:05:11	0:20:13	0:08:38
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	4	0:05:16	0:12:56	0:07:49	0:03:29	0:08:31	0:05:06	0:05:36	0:13:28	0:08:06	0:04:08	0:22:20	0:09:17
Cambewarra Road/Highway to Bolong Road/Railway Street	5	0:03:51	0:03:51	0:03:51	0:04:04	0:04:04	0:04:04	0:03:54	0:03:54	0:03:54	0:03:19	0:03:19	0:03:19
Bolong Road/Railway Street to Cambewarra Road/Highway	6	0:04:46	0:04:46	0:04:46	0:04:18	0:04:18	0:04:18	0:04:33	0:04:47	0:04:39	0:03:12	0:03:12	0:03:12
West Bunberra Street/Highway to Bolong Road/Railway Street	7	0:02:10	0:02:42	0:02:22	0:01:59	0:02:11	0:02:05	0:02:08	0:02:27	0:02:13	0:03:28	0:03:41	0:03:34
Bolong Road/Railway Street to West Bunberra Street/Highway	8	0:01:59	0:03:00	0:02:19	0:02:02	0:02:11	0:02:05	0:02:03	0:04:12	0:02:36	0:02:03	0:09:19	0:03:35
Average Network VHT			854			696			832			965	

Table 4.4.3

With Moss Vale Link Road		2016 Option 1 MVRDLK			2016 Option 3 MVRDLK		
TRAVEL TIME SUMMARY	**ROUTE**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Bridge Road (Hyam Street) to Illaroo Road (Karama Drive)	1	0:04:41	0:17:46	0:07:16	0:04:25	0:15:17	0:06:59
Illaroo Road (Karama Drive) to Bridge Road (Hyam Street)	2	0:06:15	0:12:57	0:09:34	0:07:38	0:13:32	0:09:11
Princes Highway (Speed Camera, 320m south of Bridge Road) > Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road)	3	0:04:54	0:35:35	0:08:49	0:04:34	0:34:15	0:08:03
Princes Highway (Town Distance Sign, 350m north of C/L Cambewarra Road) > Princes Highway (Speed Camera, 320m south of Bridge Road)	4	0:03:58	0:09:41	0:06:58	0:03:57	0:09:51	0:06:35
Cambewarra Road/Highway to Bolong Road/Railway Street	5	0:03:26	0:03:42	0:03:34	0:03:38	0:03:38	0:03:38
Bolong Road/Railway Street to Cambewarra Road/Highway	6	0:03:21	0:03:55	0:03:38	0:03:12	0:03:12	0:03:12
West Bunberra Street/Highway to Bolong Road/Railway Street	7	0:02:13	0:02:20	0:02:16	0:01:59	0:02:41	0:02:20
Bolong Road/Railway Street to West Bunberra Street/Highway	8	0:01:56	0:02:32	0:02:12	0:02:01	0:02:34	0:02:12
Average Network VHT			818			766	

4.5.1.2 PM Peak

The 2016 “Do Nothing” 2% p.a. growth of through traffic along Princes Highway and Bolong Road model showed no significant increase in travel time compared to the base model.

Table 4.4.1 highlights that in 2016 based on the NBSP and existing road network a significant increase in travel time compared to existing conditions (base 2005) will occur for vehicles travelling along the following routes:

- Illaroo Road to Bridge Road (Route 2) has an increase in travel time of up to 12 minutes;
- Bridge Road to Illaroo Road (Route 1) has an increase in travel time of up to 13 minutes;
- Princes Highway through traffic in the southbound direction (Route 4) has an increase in travel time of up to 7 minutes; and
- Princes Highway through traffic in the northbound direction (Route 3) has an increase in travel time of up to 22 minutes.

It should also be noted that that the RCR option has provided significant travel time savings for Routes 2 (Illaroo Road) and 4 (Princes Highway)..

Table 4.4.2 highlights that the construction of a Link Road will reduce the average travel time along Illaroo Road by approximately 1 to 2 minutes in both the eastbound and westbound direction, however it is higher on Princes Highway in a southbound direction by up to 1 to 2 minutes. The reasons for the decrease in travel time along Illaroo Road and increase in travel time on Princes Highway are similar to those discussed above for the AM peak. Once again, the increases of travel time on the highway can be offset by incorporation of the MVRDLK and RCR options.

Table 4.4.3 shows the travel time benefits with the inclusion of the MVRDLK for both Option 1 and 3. These include:

- Decrease in travel time of up to 2 minutes for vehicles travelling along Route 2 (Illaroo Road); and
- Decrease in travel time of up to 2 minutes for vehicles travelling along Route 4 (Princes Highway).

The reason for the decrease in travel time along these routes with the MVRDLK is primarily due to the reduction in traffic demand along Illaroo Road in the eastbound direction, in particular from Page Avenue and McMahons Road, where the right turn movements onto Illaroo Road are reduced by approximately 34% and 48% respectively. This reduction in trips makes Illaroo Road in the eastbound direction more accessible, compared to the Link Road options, thereby reducing the amount of traffic using the Link Road and Princes Highway in the southbound direction.

The travel time on both directions of Cambewarra remains constant (within 1 minute) in all link road scenarios (compared with the 2016 DN-NBSP scenario), except in the westbound direction under Option 3 which increased by almost 5 minutes. This is due to the extensive queuing on the Princes Highway in the southbound direction (increase of 4 minutes on southbound Princes Highway).

The pattern of travel time at Cambewarra Road applies to West Bunberra Road as travel time increases in Option 3 due to increase in delays along the Princes Highway.

Of **Tables 4.4.1** to **4.4.3** (PM), Option 1 RCR had the lowest value of VHT indicating better overall performance compared to the other Link options.

Table 4.4.2 indicates that values of VHT increase relative to the location of the Link Road option, with higher values of VHT observed the further north the Link Road. This is a similar trend found with the TRACKS analysis.

In general terms, it is expected that the development of a Link Road will improve the overall level of accessibility to the North Nowra area, particularly for local trips between Bomaderry and North Nowra as well more strategic trips travelling between North Nowra and regions to the north and east. By using the Link Road, these trips will be provided with the opportunity to avoid the congestion on Illaroo Road, and at the Illaroo Road/Princes Highway intersection This will reduce travel times for these trips on the network, as well as remove these trips from Illaroo Road, and Illaroo Road/Princes Highway intersection.

4.6 Level of Service

SIDRA intersection analysis (as discussed in **Section 4.7**) was carried out on the thirteen key intersections for each of the different scenarios modelled to compare in detail the performance and operation of each intersection.

SIDRA analyses intersections in isolation and in situations where significant congestion occurs upstream and downstream of an intersection, SIDRA can often underestimate the junction performance. Based on the initial SIDRA results and observations from the Paramics modelling, in particular along Princes Highway, Illaroo Road and Bolong Road, it was concluded that SIDRA was not accurately measuring intersection performance.

To ensure that vehicle throughput, as well as the queuing observed upstream and downstream to/from each intersection was accurately being modelled, the main performance indicators (listed below) were extracted from Paramics to provide a more accurate comparison between the different scenarios. These include:

- Average delay – length of time (in seconds) the average vehicle waits at the intersection; and
- Level of service – a measure of the overall performance of the intersection (**Table 4.5**).

Table 4.5: Performance Criteria for Intersections

Level of Service	Average Delay / Vehicle (secs/veh)	Traffic Signals, Roundabouts	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 accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity; requires other control mode
F	>70	Roundabouts require other control mode	At capacity; requires other control mode

Source: Guide to Traffic Generation Developments, RTA, October 2002.

Table 4.6 and **Table 4.7** summarises the performance of the thirteen intersections modelled in Paramics for the AM (8-9AM) and PM (3.30-4.30PM) peak periods respectively in 2005 and 2016 for each of the scenarios modelled.

The RTA recommended performance standard during the weekday peak hour is Level of Service (LOS) C or better[3]. The intersections that operate at an unsatisfactory Level of Service (that is, Level of Service D or worse) have been highlighted in **Table 4.6** and **Table 4.7** where orange represents a LOS D, pink represents a LOS E and red represents a LOS F.

[3] RTA Guide to Traffic Generating Developments, Version 2.2 October 2002

Table 4.6: AM Peak - Summary of Intersection Performance

Table 4.6.1

AM Peak		Base 2005			2016 DN2P			2016 DN-NBSP		
Intersection		LoS	AvD	Num Veh	LoS	AvD	Num Veh	LoS	AvD	Num Veh
Illaroo Rd	McMahons Rd	A	2	1,138	A	3	1,233	B	18	1,518
Illaroo Rd	Page Ave	A	1	724	A	1	784	D	50	902
Illaroo Rd	Pitt St	A	1	504	A	1	537	A	2	694
Illaroo Rd	West Cambewarra	A	0	356	A	0	390	A	0	435
Princes Hwy	Illaroo Rd	C	34	4,523	E	62	4,774	F	122	5,176
Princes Hwy	Bolong Rd	B	23	3,361	C	29	3,687	E	65	3,918
Princes Hwy	Beinda St	A	2	2,256	A	3	2,557	A	7	2,559
Princes Hwy	West Bunberra St	A	2	2,065	A	2	2,349	A	1	2,347
Princes Hwy	Narang Rd	A	3	1,837	A	3	2,107	A	3	2,241
Princes Hwy	Cambewarra Rd	A	6	2,163	A	8	2,434	A	7	2,602
Bolong Rd	Beinda St	A	2	1,310	A	3	1,430	A	7	1,887
Bolong Rd	Meroo Rd	A	2	1,448	A	5	1,541	A	8	1,889
Meroo Rd	West Bunberra St	A	1	766	A	1	738	A	1	935

Table 4.6.2

Without Moss Vale Link Road		2016 Option 1			2016 Option 1 RCR			2016 Option 2			2016 Option 3		
Intersection		LoS	AvD	Num Veh	LoS	AvD	Num Veh	LoS	AvD	Num Veh	LoS	AvD	Num Veh
Illaroo Rd	McMahons Rd	A	4	1,424	A	3	1,436	A	4	1,421	A	3	1,434
Illaroo Rd	Page Ave	A	1	1,024	A	1	1,133	A	1	1,014	A	1	1,014
Illaroo Rd	Pitt St	A	2	933	A	2	1,026	A	0	641	A	1	678
Illaroo Rd	West Cambewarra	A	1	401	A	1	407	A	1	389	A	1	654
Princes Hwy	Illaroo Rd	F	96	4,981	F	88	4,767	F	97	4,853	F	103	5,009
Princes Hwy	Bolong Rd	F	88	3,749	F	77	3,567	F	81	3,633	F	82	3,805
Princes Hwy	Beinda St	C	33	2,484	B	16	2,395	B	15	2,361	C	31	2,444
Princes Hwy	West Bunberra St	A	2	2,437	A	2	2,389	C	39	2,567	A	1	2,390
Princes Hwy	Narang Rd	A	4	2,589	A	4	2,584	A	4	2,263	A	3	2,292
Princes Hwy	Cambewarra Rd	A	8	2,676	A	8	2,646	A	8	2,659	B	26	2,812
Bolong Rd	Beinda St	B	18	1,824	B	22	1,824	A	10	1,760	A	12	1,881
Bolong Rd	Meroo Rd	A	14	1,904	A	10	1,880	A	10	1,859	A	12	1,994
Meroo Rd	West Bunberra St	A	1	988	A	1	1,027	A	3	1,122	A	1	1,029
Illaroo Rd	Link Rd Option 2							A	2	785			
Moss Vale	Link Rd Option 3										B	22	1,360

Table 4.6.3

With the Moss Vale link road		2016 Option 1 MVRDLK			2016 Option 3 MVRDLK		
		LoS	AvD	Num Veh	LoS	AvD	Num Veh
Illaroo Rd	McMahons Rd	A	3	1,264	A	3	1,133
Illaroo Rd	Page Ave	A	1	1,003	A	1	886
Illaroo Rd	Pitt St	A	2	991	A	1	674
Illaroo Rd	West Cambewarra	A	1	629	A	2	710
Princes Hwy	Illaroo Rd	F	78	4,892	F	98	4,903
Princes Hwy	Bolong Rd	E	66	3,767	F	90	3,790
Princes Hwy	Beinda St	B	24	2,575	B	19	2,481
Princes Hwy	West Bunberra St	A	2	2,531	A	1	2,339
Princes Hwy	Narang Rd	A	4	2,635	A	3	2,214
Princes Hwy	Cambewarra Rd	A	10	2,789	B	20	2,805
Bolong Rd	Beinda St	A	10	1,702	B	18	1,887
Bolong Rd	Meroo Rd	A	13	1,864	B	22	1,936
Meroo Rd	West Bunberra St	A	1	1,007	A	6	984
Moss Vale	Link Rd Option 3				A	6	1,369

Table 4.7: PM Peak - Summary of Intersection Performance

Table 4.6.1

PM Peak Intersection		Base 2005			2016 DN2P			2016 DN-NBSP		
		LoS	AvD	Num Veh	LoS	AvD	Num Veh	LoS	AvD	Num Veh
Illaroo Rd	McMahons Rd	A	4	1,410	A	4	1,597	A	6	1,840
Illaroo Rd	Page Ave	A	1	862	A	1	1,191	A	2	1,274
Illaroo Rd	Pitt St	A	1	534	A	2	962	A	1	700
Illaroo Rd	West Cambewarra	A	1	399	A	1	423	A	1	432
Princes Hwy	Illaroo Rd	B	25	5,013	F	94	5,635	F	131	5,784
Princes Hwy	Bolong Rd	B	26	3,820	F	82	4,321	D	43	4,483
Princes Hwy	Beinda St	A	2	2,331	B	25	2,568	A	3	2,689
Princes Hwy	West Bunberra St	A	2	2,170	A	1	2,457	A	1	2,425
Princes Hwy	Narang Rd	A	3	1,916	A	4	2,645	A	3	2,333
Princes Hwy	Cambewarra Rd	A	6	2,236	A	13	2,973	A	13	2,766
Bolong Rd	Beinda St	A	3	1,588	A	9	2,200	A	10	2,224
Bolong Rd	Meroo Rd	A	6	1,669	B	17	2,263	A	12	2,184
Meroo Rd	West Bunberra St	A	1	879	A	3	1,156	A	1	1,094

Table 4.6.2

Without Moss Vale Link Road Intersection		2016 Option 1			2016 Option 1 RCR			2016 Option 2			2016 Option 3		
		LoS	AvD	Num Veh	LoS	AvD	Num Veh	LoS	AvD	Num Veh	LoS	AvD	Num Veh
Illaroo Rd	McMahons Rd	A	4	1,597	A	4	1,693	A	5	1,612	A	4	1,576
Illaroo Rd	Page Ave	A	1	1,191	A	1	1,310	A	1	1,219	A	1	1,172
Illaroo Rd	Pitt St	A	2	962	A	2	1,082	A	1	683	A	1	789
Illaroo Rd	West Cambewarra	A	1	423	A	1	445	A	1	391	A	1	726
Princes Hwy	Illaroo Rd	F	94	5,635	D	50	5,686	F	79	5,688	F	113	5,547
Princes Hwy	Bolong Rd	F	82	4,321	C	40	4,264	E	70	4,308	F	94	4,280
Princes Hwy	Beinda St	B	25	2,568	A	4	2,707	A	9	2,614	C	36	2,578
Princes Hwy	West Bunberra St	A	1	2,457	A	2	2,456	D	44	2,724	A	1	2,480
Princes Hwy	Narang Rd	A	4	2,645	A	4	2,653	A	5	2,385	A	3	2,385
Princes Hwy	Cambewarra Rd	A	13	2,973	A	8	2,852	A	13	2,878	B	25	3,100
Bolong Rd	Beinda St	A	9	2,200	A	8	2,218	A	14	2,118	B	27	2,130
Bolong Rd	Meroo Rd	B	17	2,263	A	12	2,179	B	21	2,210	C	30	2,132
Meroo Rd	West Bunberra St	A	3	1,156	A	1	1,053	A	1	1,230	A	2	1,145
Illaroo Rd	Link Rd Option 2							A	2	781			
Moss Vale	Link Rd Option 3										A	3	1,403

Table 4.6.3

With the Moss Vale link road		2016 Option 1 MVRDLK			2016 Option 3 MVRDLK		
		LoS	AvD	Num Veh	LoS	AvD	Num Veh
Illaroo Rd	McMahons Rd	A	4	1,395	A	3	1,355
Illaroo Rd	Page Ave	A	1	1,126	A	1	1,043
Illaroo Rd	Pitt St	A	2	944	A	1	651
Illaroo Rd	West Cambewarra	A	1	689	A	1	817
Princes Hwy	Illaroo Rd	F	75	5,630	F	71	5,671
Princes Hwy	Bolong Rd	D	56	4,383	D	43	4,503
Princes Hwy	Beinda St	A	3	2,677	A	3	2,707
Princes Hwy	West Bunberra St	A	1	2,505	A	1	2,500
Princes Hwy	Narang Rd	A	3	2,613	A	3	2,404
Princes Hwy	Cambewarra Rd	A	10	3,021	B	17	3,259
Bolong Rd	Beinda St	A	6	2,130	A	6	2,142
Bolong Rd	Meroo Rd	A	12	2,143	A	12	2,152
Meroo Rd	West Bunberra St	A	1	1,074	A	1	1,068
Moss Vale	Link Rd Option 3				A	3	1,598

4.6.1 Base 2005

Table 4.6.1 and **Table 4.7.1** indicate that under existing conditions (2005) the road network (and associated key intersections) during the AM and PM peak periods operates at a C or better.

4.6.2 2016 ‘Do Nothing’ 2% Growth on through traffic along Princes Highway and Bolong Road

The 2016 “Do Nothing” models based on 2% growth in through traffic along Princes Highway and Bolong Road during the AM and PM peak periods show a decrease in compared to the base models at the following intersections:

4.6.2.1 AM Peak

- Princes Highway / Illaroo Road (C to E); and
- Princes Highway / Bolong Road (B to C).

4.6.2.2 PM Peak

- Princes Highway / Illaroo Road (B to F);
- Princes Highway / Bolong Road (B to F);
- Princes Highway / Beinda Street (A to B); and
- Bolong Road / Meroo Street (A to B).

The decrease in observed during the PM peak can be attributed to a similar cycle time being used to the 2005 PM peak base model. The intersection performance may be improved (in particular at Princes Highway intersections with Bolong Road and Illaroo Road) if the cycle time is increased.

The decrease in Level of Service at Princes Highway / Illaroo Road and Princes Highway / Bolong Road intersections highlight the need for intersection improvements to be introduced with background traffic growth alone, and not including additional growth in Nowra as a result of developments to 2016 assumed in the Nowra Bomaderry Structure Plan (NBSP).

4.6.3 2016 ‘Do Nothing’ – growth as per Nowra Bomaderry Structure Plan (NBSP)

The 2016 “Do Nothing” models (based on growth as per NBSP) during the AM and PM peak periods shows a decrease in Level of Service compared to the base models in the following locations:

4.6.3.1 AM Peak

- Illaroo Road and Page Avenue (A to D);
- Illaroo Road and McMahons Road (A to B);
- Princes Highway and Illaroo Road (C to F); and
- Princes Highway and Bolong Road (B to E).

4.6.3.2 PM Peak

- Princes Highway and Illaroo Road (B to F); and
- Princes Highway and Bolong Road (B to D).

Extensive queuing was observed in the AM peak Paramics model at the intersection of Princes Highway / Illaroo Road. The queues on Illaroo Road (western approach) extended up to Pitt Street (approximately 2km) and on Princes Highway (northern approach) up to West Bunberra Street by the end of the peak hour (approximately 800m).

The queues generated on Illaroo Road affected the operation of the minor roads connecting to Illaroo Road. For example, the Illaroo Road / Page Avenue intersection experienced an increase in average vehicle delay from 1 second (A) to 50 seconds (D) and Illaroo Road / McMahons Road intersection experienced an increase from 2 seconds (A) to 18 seconds (B).

4.6.4 2016 Link Road Option 1

The 2016 Link Road "Option 1" models during the AM and PM peak periods show an increase and/or decrease in Level of Service compared to the 2016 NBSP models in the following locations:

4.6.4.1 AM Peak

- Illaroo Road / Page Avenue (D to A);
- Illaroo Road / McMahons Road (B to A);
- Princes Highway / Bolong Road (E to F);
- Princes Highway / Beinda Street (A to C); and
- Bolong Road / Beinda Street (A to B).

4.6.4.2 PM Peak

- Princes Highway / Bolong Road (D to F);
- Princes Highway / Beinda Street (A to B); and
- Bolong Road / Meroo Street (A to B).

The improvement in Level of Service during the AM peak at Page Avenue and McMahons Road intersections with Illaroo Road indicates that Illaroo Road will become less congested with the construction of a Link Road and the flow of traffic will improve from residential roads onto Illaroo Road. This benefit is experienced under each of the Link Road scenarios that have been modelled to a varying degree.

The Princes Highway / Bolong Road intersection has decreased to a F during both the AM and PM peak periods. This is due to the additional traffic accessing Princes Highway southbound from the Link Road.

To accommodate this traffic, additional green time was allocated to Princes Highway through movements (to the detriment of Bolong Road movements). This modification in signal timing resulted in an increase in queue length on Bolong Road (eastern approach) which also impacted the performance of some of the minor roads feeding off Bolong Road, such as the Bolong Road / Beinda Street intersection (during the AM peak) and the Bolong Road / Meroo Street intersection (during the PM peak).

The increase in traffic and congestion on Princes Highway southbound carriageway has also affected the operation of the Princes Highway / Beinda Street intersection during both the AM and PM peak. Queues on Princes Highway have been observed to extend past Beinda Street (from Bolong Road) allowing fewer opportunities for vehicles to turn left from Beinda Street onto Princes Highway. This results in increased queues and vehicle delays on the eastern approach.

The Link Road has increased traffic on Princes Highway and as a result of congestion encouraged vehicles to rat-run along Beinda Street and then Bolong Road. This route allows vehicles to avoid the long queues / delays experienced on Princes Highway at the Bolong Road intersection (northern approach) but has resulted in a decrease in Level of Service at the Bolong Road / Beinda Street intersection during the AM peak.

Rat-running along Beinda Street and Bolong Road is evident in existing conditions to a lesser extent than in the 2016 scenarios with the link road. An increase in these movements in future is likely to contribute to deterioration in safety at intersection Beinda Street / Bolong Road.

4.6.5 2016 Link Road Option 1 RCR

The 2016 Link Road "Option 1 RCR" models during the AM and PM peak periods show an increase and/or decrease in Level of Service compared to the 2016 NBSP models in the following locations:

4.6.5.1 AM Peak

- Illaroo Road / Page Avenue (D to A);
- Illaroo Road / McMahons Road (B to A);
- Princes Highway / Bolong Road (E to F);
- Princes Highway / Beinda Street (A to B); and
- Bolong Road / Beinda Street (A to B).

4.6.5.2 PM Peak

- Princes Highway / Illaroo Road (F to D); and
- Princes Highway / Bolong Road (D to C);

The significant improvement in during the PM peak at Illaroo Road and Bolong Road intersections with Princes Highway indicates that the RCR adjustments to the network have proven to be effective in relieving congestion along the Princes Highway across the Shoalhaven River Crossing.

4.6.6 2016 Link Road Option 2

The 2016 Link Road "Option 2" models during the AM and PM peak periods show an increase and/or decrease in Level of Service compared to the 2016 NBSP models in the following locations:

4.6.6.1 AM Peak

- Illaroo Road / Page Avenue (D to A);
- Illaroo Road / McMahons Road (B to A);
- Princes Highway / Bolong Road (E to F);
- Princes Highway / Beinda Street (A to B); and
- Princes Highway / Bunberra Street (A to C).

4.6.6.2 PM Peak

- Princes Highway / Bolong Road (D to E);
- Princes Highway / Bunberra Street (A to D); and
- Bolong Road / Meroo Street (A to B).

The increase and/or decrease in Level of Service during both the AM and PM peak periods for Option 2 are similar to that observed for Option 1 with the exception of the Princes Highway / West Bunberra Street intersection.

In this option, the Princes Highway / West Bunberra Street intersection has been upgraded to a signalised cross intersection formed by the Link Road connection with Princes Highway on the western approach. The performance of this intersection was optimised and allows for pedestrian crossings on all approaches, high through movements along Princes Highway and high right turn movements from West Bunberra Street and Link Road Option 2 onto Princes Highway.

4.6.7 2016 Link Road Option 3

The 2016 Link Road "Option 3" models during the AM and PM peak periods show an increase and/or decrease in Level of Service compared to the 2016 NBSP models in the following locations:

4.6.7.1 AM Peak

- Illaroo Road / Page Avenue (D to A);
- Illaroo Road / McMahons Road (B to A);
- Princes Highway / Bolong Road (E to F);
- Princes Highway / Beinda Street (A to C); and
- Princes Highway / Cambewarra Road (A to B).

4.6.7.2 PM Peak

- Princes Highway / Bolong Road (D to F);
- Princes Highway / Beinda Street (A to C);
- Princes Highway / Cambewarra Road (A to B);
- Bolong Road / Meroo Street (A to C); and
- Bolong Road / Beinda Street (A to B).

The increase and/or decrease in Level of Service during both the AM and PM peak periods for Option 3 are similar to that observed for Option 1 with the exception of the Princes Highway / Cambewarra Road intersection. The increase in average vehicle delay at this intersection is due to the ce proximity of the proposed Link Road connection for Option 3 with Moss Vale Road and Elvin Drive, as well as the additional traffic generated from the Link Road on the western approach.

4.6.8 2016 Link Road Option 1 MVRDLK

The 2016 Link Road “Option 1 MVRDLK” models during the AM and PM peak periods shows an increase and/or decrease in Level of Service compared to the 2016 NBSP models in the following locations:

- Illaroo Road / Page Avenue (D to A);
- Illaroo Road / McMahons Road (B to A); and
- Princes Highway / Beinda Street (A to B).

The intersections identified above all experience an improvement in Level of Service as a result of the Moss Vale Link Road being introduced. No change in Level of Service during the PM peak was observed.

When compared to Option 1: **Table 4.6** and **Table 4.7** indicate that the introduction of the MVRDLK has the following observed impacts:

4.6.8.1 AM Peak

- Improved (from F>E) at Princes Highway / Bolong Road;
- Improved (from C>B) at Princes Highway / Beinda St; and
- Improved (from B>A) at Bolong / Beinda St.

4.6.8.2 PM Peak

- Improved (from F>D) at princes Highway / Bolong Road;
- Improved (from B>A) at Princes Highway / Beinda St; and
- Improved (from B>A) at Bolong / Meroo St.

4.6.9 2016 Link Road Option 3 MVRDLK

The 2016 Link Road “Option 3 MVRDLK” models during the AM and PM peak periods shows an increase and/or decrease in Level of Service compared to the 2016 NBSP models in the following locations:

4.6.9.1 AM Peak

- Illaroo Road / Page Avenue (D to A);
- Illaroo Road / McMahons Road (B to A);
- Princes Highway / Bolong Road (E to F);
- Princes Highway / Beinda Street (A to B);
- Princes Highway / Cambewarra Road (A to B)
- Bolong Road / Beinda Street (A to B); and
- Bolong Road / Meroo Street (A to B).

4.6.9.2 PM Peak

- Princes Highway / Cambewarra Road (A to B)

This option displays similar results to previous Link Road scenarios. Levels of Service at intersections along Illaroo Road improve as more traffic is diverted to the Link Road(s). The additional traffic using Princes Highway causes intersection performance to decrease as less opportunity exists for traffic on minor arms to access Princes Highway.

4.6.10 Princes Highway and Illaroo Road Intersection

The models show improvement in overall intersection performance at Princes Highway and Illaroo Road as a result of construction of the Link Road(s). In some instances the performance level was found to be marginally worse, for example at Princes Highway and Bolong Road. This is primarily due to the limited capacity on the northern approach of Princes Highway / Illaroo Road intersection, as well as the downstream congestion occurring on Shoalhaven River Bridge Crossing. This results in extensive queuing on Bolong Road.

Even though the Princes Highway / Illaroo Road intersection was observed to operate at a Level of Service F for all scenarios modelled in 2016 it should be noted that the overall average vehicle delay did improve considerably with the construction of the Link Road. The average delay for each link road scenario at this intersection has been compared with the "Do Nothing – NBSP". This is shown in **Table 4.6** and **Table 4.7** and listed below:

4.6.10.1 AM Peak

- Approximately 21 second reduction in average delay without the MVRDLK;
- Approximately 34 second reduction in average delay with RCR scheme; and
- Approximately 34 second reduction in average delay with the MVRDLK.

4.6.10.2 PM Peak

- Approximately 33 second reduction in average delay without the MVRDLK;
- Approximately 61 second reduction in average delay with RCR scheme; and
- Approximately 58 second reduction in average delay with the MVRDLK.

4.6.11 Princes Highway and Bolong Road Intersection

The models show a general worsening in overall intersection performance at Princes Highway and Bolong Road as a result of construction of the Link Road(s). There are no instances where the performance level was improved. This is due to extensive queuing along Bolong Road, and also on the northern approach of the Princes Highway / Bolong Road intersection.

Table 4.6 and **Table 4.7** identify that the adverse conditions at the Princes Highway / Bolong Road can be offset by addition of MVRDLK (AM and PM peak improvements) and RCR option (AM and PM peak improvements) in conjunction with Option 1, to the extent of reducing average delays back to equivalent "no link road" conditions. In conjunction with Option 3, the MVRDLK improved conditions in the PM peak, but increased delays in the AM peak. Reductions (when compared to Do Nothing – growth as per NBSP) are noted as follows:

4.6.11.1 AM Peak

- Approximately 23 second increase in average delay for Option 1 without the MVRDLK;
- Approximately 17 second increase in average delay for Option 3 without the MVRDLK;
- Approximately 16 second increase in average delay for Option 2 without the MVRDLK;
- Approximately 1 second increase in average delay for Option 1 with the MVRDLK (a reduction of 22 seconds with the MVRDLK and equivalent to the level of average delays without any link roads);
- Approximately 25 second increase in average delay for Option 3 with the MVRDLK (a further increase of 8 seconds in average delays with the MVRDLK);
- Approximately 13 second increase in average delay for Options 1 and 3 with the MVRDLK; and
- Approximately 12 second increase in average delay with Option 1 RCR scheme (a reduction of 11 seconds from Option 1 without the MVRDLK).

4.6.11.2 PM Peak

- Approximately 39 second increase in average delay for Option 1 without the MVRDLK;
- Approximately 51 second increase in average delay for Option 3 without the MVRDLK;
- Approximately 27 second increase in average delay for Option 2 without the MVRDLK;
- Approximately 13 second increase in average delay for Option 1 with the MVRDLK (a reduction of 26 seconds with the MVRDLK);

- No increase in average delay for Option 3 with the MVRDLK (a reduction of 51 seconds in average delays with the MVRDLK and equivalent to the level of average delays without any link roads);
- Approximately 7 second increase in average delay for Options 1 and 3 with the MVRDLK; and
- Approximately 3 second reduction in average delay with Option 1 RCR scheme (a reduction of 16 seconds from Option 1 without the MVRDLK and 3 seconds lower than without any link roads).

4.7 SIDRA Intersection Analysis

In addition to Paramics, the thirteen key intersections within the study area have been modelled for the years 2005 and 2016 with the aid of SIDRA/3.0 software.

SIDRA analysis has been undertaken and the results are presented in **Appendix E.** Due to the level of congestion in the network, these results are not considered to be an accurate measure of intersection performance and no further analysis of SIDRA results has been undertaken at this stage.

A summary of the intersection control for the eastern and western end of each link road option is given in **Table 4.8**. This includes AECOM's assessment of required intersection treatments at each end of the Link Road options. Further details on the layout for each intersection is provided in **Appendix E.**

Table 4.8: Intersection Controls

	Option 1		Option 2		Option 3	
Year/Option	**Princes Hwy / Narang Rd**	**Illaroo Rd / Pitt St**	**Princes Hwy / Bunberra St**	**Illaroo Rd / Link Rd**	**Illaroo Rd / West Cambewarra**	**West Cambewarra / Moss Vale**
2005	Roundabout	Priority intersection	Priority intersection	-	Priority intersection	-
2016 DN2P	Roundabout	Priority intersection	Priority intersection	-	Priority intersection	-
2016 DN-NBSP	Roundabout	Priority intersection	Priority intersection	-	Priority intersection	-
2016 Opt 1	Roundabout	Roundabout	Priority intersection	-	Priority intersection	-
2016 Opt 1 MVRDLK	Roundabout	Roundabout	Priority intersection	-	Roundabout	-
2016 Opt 2	Roundabout	Priority intersection	Signalised intersection	Roundabout	Priority intersection	-
2016 Opt 3	Roundabout	Priority intersection	Priority intersection	-	Roundabout	Roundabout
2016 Opt 3 MVRDLK	Roundabout	Priority intersection	Priority intersection	-	Roundabout	Roundabout

4.7.1 Option 1

The existing intersection layout of the Princes Highway and Narang Rd consists of a non-mountable roundabout including:

- 2 through lanes on Princes Highway (both approaches);
- 2 approach lanes on Narang Rd west approach (left and through/right); and
- 1 approach lane with all movements on the West Birriley St east approach.

This roundabout layout remains unchanged throughout the future years and options with satisfactory operations.

The existing intersection layout of Illaroo Rd and Pitt St consists of:

- 1 approach lane on Illaroo Rd (north leg);
- 2 approach lanes on Illaroo Rd (south leg) including a short left turn lane; and
- 2 approach lanes on Pitt Street (west leg) including a short left turn lane.

In 2016 Option 1 and 2016 Option 1 MVRDLK the intersection requires the following layout:

- Single lane roundabout.

The existing intersection layouts and required layouts are included in **Appendix E**.

4.7.2 Option 2

The existing intersection layout of the Princes Highway and Bunberra St consists of:

- 2 through lanes and a right turn lane of 50m on the Princes Highway south leg;
- A marked left turn lane and a marked short right turn lane of 30m on West Bunberra St east; and
- 2 through lanes on the Princes Highway north leg.

In 2016 Option 2 the intersection requires traffic signals to be installed with the following layout:

- A shared through and left turn lane, a through lane and a right turn lane of 50m on the Princes Highway north and south legs. After 2016, it is likely that the right turn lane (south leg) will require extension;
- A shared through and left and a right turn lane of 30m on the West Bunberra St east approach; and
- A shared through and left and a separate right turn lane on the Link Rd Option 2 west approach.

There is no current intersection on Illaroo Road at the proposed Illaroo Road / Link Road Option 2 junction.

In 2016 Option 2, the intersection Illaroo Road / Link Option 2 requires the following layout:

- Single lane roundabout.

The existing intersection layouts and required layouts are included in **Appendix E**.

4.7.3 Option 3

The existing intersection layout of Illaroo Rd and West Cambewarra Rd consists of:

- Single lane approach on Illaroo Rd east leg;
- Single lane approach on Illaroo Rd west leg; and
- Single lane approach on West Cambewarra Rd east leg.

In 2016 Option 3, the required intersection layout includes:

- Single lane roundabout.

In 2016 Option 3 MVRDLK and Option 1 MVRDLK the required intersection layout at Illaroo Rd and West Cambewarra Rd / MVRDLK junction consists of:

- Single lane roundabout.

The layout required for the intersection of Moss Vale Rd and West Cambewarra Rd (intersection of Moss Vale Road with Link Option 3) includes:

- Single lane roundabout.

4.8 Future Network Improvements

The Paramics results highlight that by 2016 the Princes Highway (including intersections with Bolong Road, Illaroo Road and Bridge Road) will constrain the road network in the study area.

These intersections are predicted to be saturated and operate at a Level of Service E or worse under each scenario modelled in 2016 resulting in large vehicle delays and extensive queuing. Observation of the Paramics models indicates that the link capacity of Shoalhaven River Bridge Crossing, in particular in the southbound direction, as well as the Princes Highway / Bridge Road intersection will also affect the overall performance of the road network in this area.

Whilst this is not a study for the Princes Highway, the modelling has indicated that to improve the performance of the road network, and accommodate the increasing growth to the extent proposed in the NBSP from 10 years onwards, it is considered that further strategic road infrastructure improvements will be required to relieve the congestion along Princes Highway and adjoining roads, particularly the highway section between Bolong Road and Bridge Road. This will be in addition to the proposed North Nowra to Bomaderry Link Road, which has been shown to provide overall network benefits.

Of the North Nowra to Bomaderry Link Road options, Option 1 has been shown to have the greater ability to reduce overall VHT on the network. The modelling has also shown that the benefits of Option 1 can be further enhanced (further improvements to network operations) by the construction of the MVRDLK and RCR option.

In general terms, minor improvements to intersections along Princes Highway, such as the provision of additional turning bays, restricting under utilised turn movements and/or removing non-critical pedestrian crossing signals, will improve traffic operations in the short term (0 – 10 years) but will be insufficient to accommodate forecast growth in traffic in the medium to long term. However improvements gained from these measures are only expected to result in a marginal improvement in network performance compared to forecast traffic growth from 10 years onwards.

The Gabites Porter / Council's TRACKS analysis has also shown the benefits of the MVRDLK as well as providing an indication that additional network connections (between the expanding North Nowra and future Western Bypass corridor) will be necessary to limit the amount of traffic growth from North Nowra congesting the Princes Highway corridor.

The TRACKS analysis indicates that to accommodate the growth assumptions of the NBSP - all of these works (North Nowra to Bomaderry Link Road, MVRDLK, and connections between North Nowra to West Bypass – i.e. in accordance with the NBSP proposed road network) will all be necessary to contain traffic volumes on Illaroo Road to current 2005 levels.

A summary of TRACKS analysis is contained in **Appendix F**.

5.0 Accident Analysis

5.1 Introduction

Traffic accident data was provided by the RTA for the Shoalhaven Local Government Area (LGA) as part of the North Nowra to Bomaderry Link Road Study. The accident data provided is for the period between July 2000 and June 2005. This data is the latest available at the start of the study.

The data provided has been converted to calendar years for the purposes of increased clarity in the interpretation of trends and changes within this timeframe. In instances where data has been provided for six month periods, the data has been annualised to represent the calendar year. This approach has only been used for analysing accident trends between calendar years. For reference, accident data for year 2000 and 2005 has been marked with a different colour (grey) in **Figure 5.1** to **Figure 5.5** since the accident data for these two years has been adjusted by a factor of two to represent the number of accidents occurred in those calendar years.

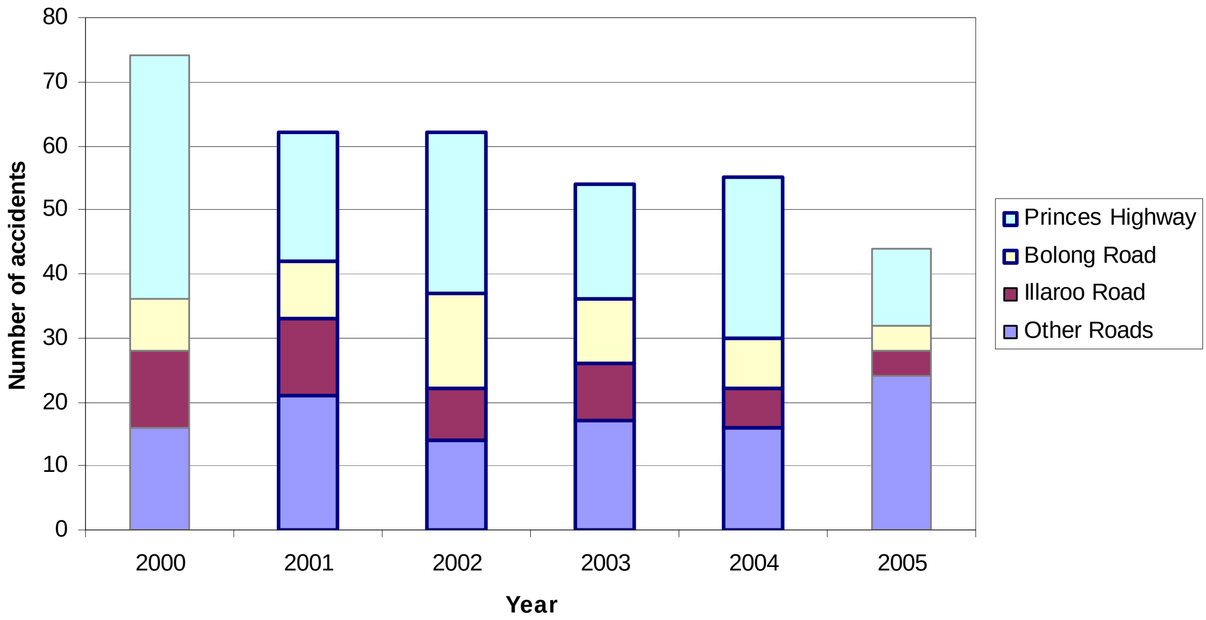
Figure 5.6 shows the location of the accidents and the extent of the accident analysis.

5.2 Recent Accident Trends

The dataset contains 2974 recorded road accidents between 2000 and 2005 within the LGA. Of these, 291 accidents occurred within the study area. All accidents have been classified as either fatal, injury or non-injury accidents.

The number of recorded accidents within the study area for each year is displayed in **Figure 5.1**. The figure also shows a breakdown of accidents occurring on the Princes Highway, Illaroo Road, Bolong Road and all other roads within the study area.

Figure 5.1: Annualised Number of Accidents within the Study Area (2000-2005)

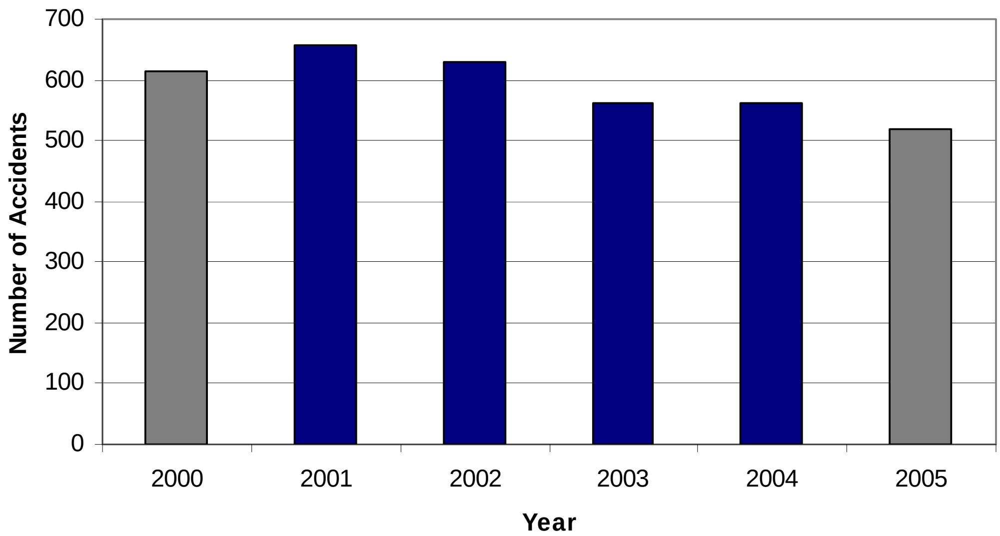


Source: AECOM calculations based on NSW RTA data, 2006

The data identifies that between 44 and 74 accidents took place each year, which equates to an average of approximately 60 accidents each year occurs within the study area. The data also confirms the trend of declining numbers of accidents within the study area as well as along the Princes Highway, Illaroo Road and Bolong Road per annum. However, there is an increase in the number of accidents occurring on ‘other roads’ within the study area per annum.

In comparison to the study area, data for the LGA, shown in **Figure 5.2**, reveals a similar decline in the number of traffic accidents between 2000 and 2005. Data for the LGA shows the most traffic accidents took place in 2001, with the least accidents occurring in 2005.

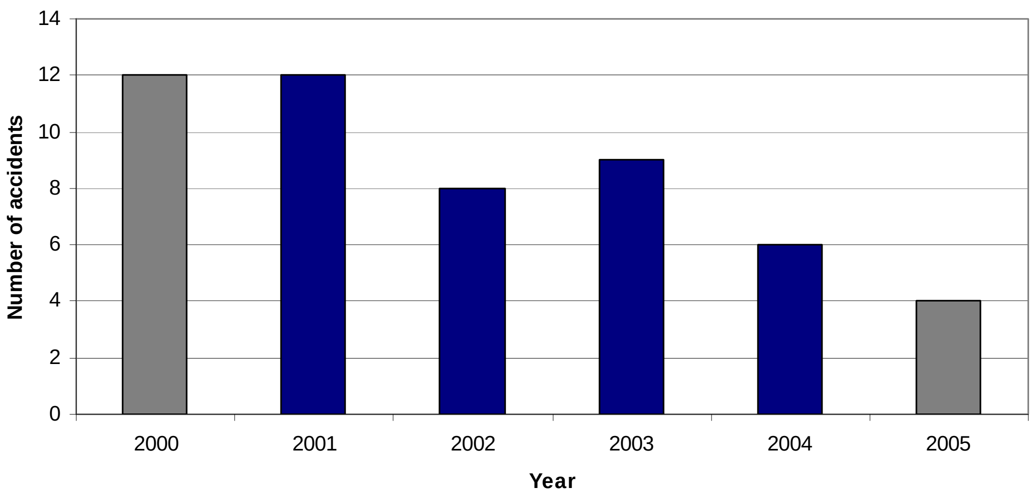
Figure 5.2: Annualised Number of Accidents in Shoalhaven LGA (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

During the same time period, a total of 43 accidents occurred on Illaroo Road, within the study area. The highest number of accidents that occurred on Illaroo Road was 12 in 2000 and 2001. It has reduced to 4 in 2005. The trend of the number of accidents recorded on Illaroo Road for each year is displayed in **Figure 5.3**.

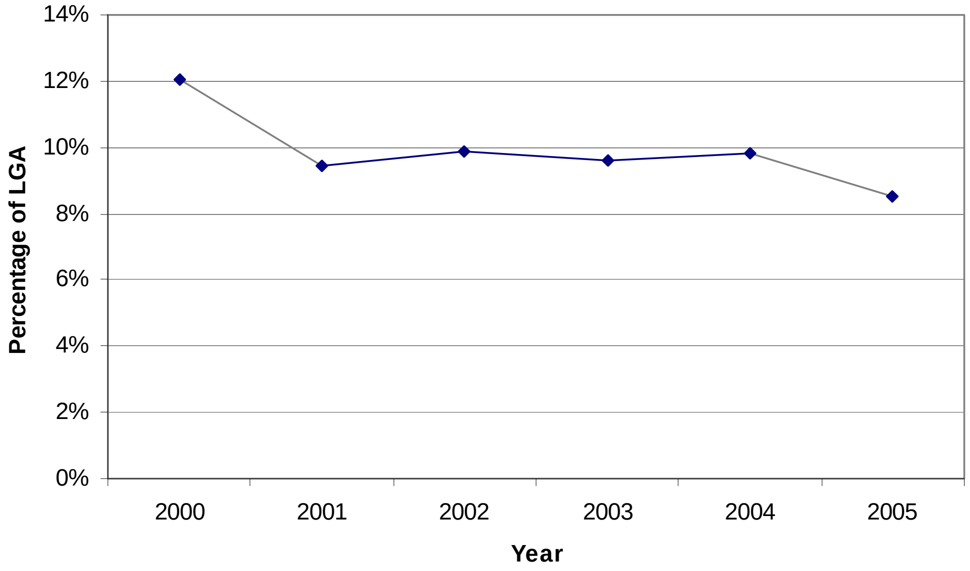
Figure 5.3: Annualised Number of Accidents on Illaroo Road (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.4 shows the trend of the traffic accidents within the study area relative to the entire Shoalhaven LGA. The data indicates that there is a decrease in the number of accidents taking place within the study area over time, having fallen from approximately 12% of the Shoalhaven LGA in 2000 to nearly 8% in 2005.

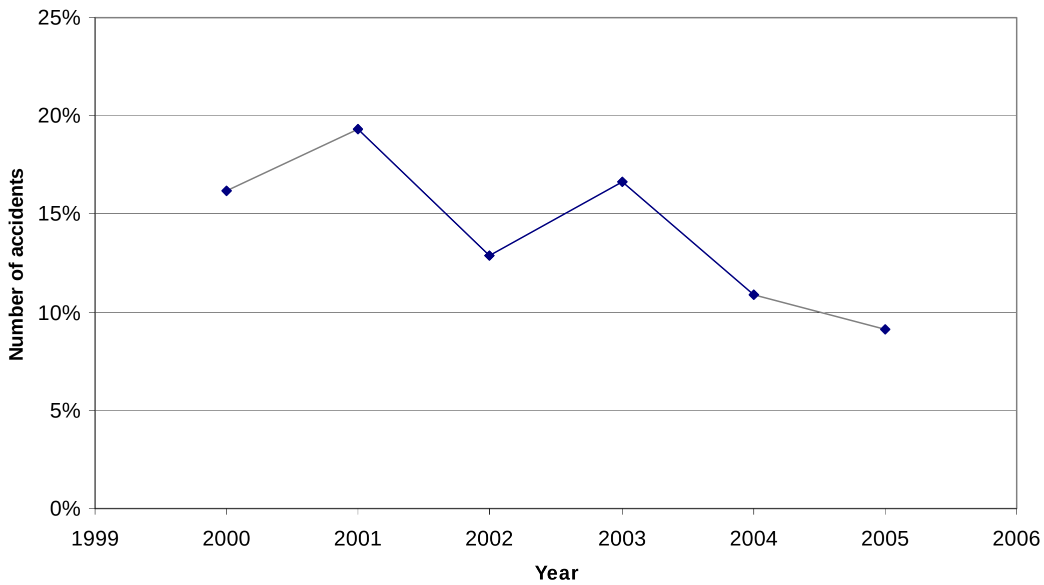
Figure 5.4: Accident Data in the Study Area as a Proportion of the Shoalhaven LGA (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.5 shows the trend of the traffic accidents that occurred on Illaroo Road relative to the study area. The data indicates that there is a decrease in the number of accidents taking place in Illaroo Road over time, having fallen from approximately 19% of the study area in 2001 to 8% in 2005. However, in 2001 and 2003 there is an increase in the percentage of accidents that occurred on Illaroo Road relative to the study area.

Figure 5.5: Accident Data on Illaroo Road as a Proportion of the Study Area (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

5.3 Accident Classification

Between 2000 and 2005 there were 291 traffic accidents within the study area. These are shown in **Figure 5.6**.

Figure 5.6: Location of Traffic Accidents within and in the vicinity of the study area between 2000 and 2005

Source: Shoalhaven Council, 2007

As outlined in **Table 5.1** there were three fatal accidents (1%), 135 accidents (46%) that involved only an injury and 153 accidents (52%) that were free of injury. These figures are relatively consistent with the data on traffic accidents within the entire Shoalhaven LGA between 2000 and 2005. As shown in **Table 5.2**, the recorded traffic accidents within the council area over this time were 61 accidents (2%) that involved a fatality, 1279 accidents (43%) that involved only an injury and 1634 accidents (55%) that did not involve any injury. As shown in **Table 5.3**, the total number of accidents that occurred on Illaroo Road is 43 accidents. None of these involved fatalities, 49% involved an injury and 51% did not involve any injury.

Table 5.1: Accident Classification within the Study area (2000-2005)

	Fatal	Injury	Non-injury	Grand Total
Study area	3	135	153	291
Percentage	1%	46%	52%	100%

Source: AECOM calculations based on NSW RTA data, 2006

Table 5.2: Accident Classification in the Shoalhaven LGA (2000-2005)

	Fatal	Injury	Non-injury	Grand Total
Shoalhaven LGA	61	1279	1634	2974
Percentage	2%	43%	55%	100%

Source: AECOM calculations based on NSW RTA data, 2006

Table 5.3: Accident Classification on the Illaroo Road (2000-2005)

	Fatal	Injury	Non-injury	Grand Total
Illaroo Road	0	21	22	43
Percentage	0%	49%	51%	100%

Source: AECOM calculations based on NSW RTA data, 2006

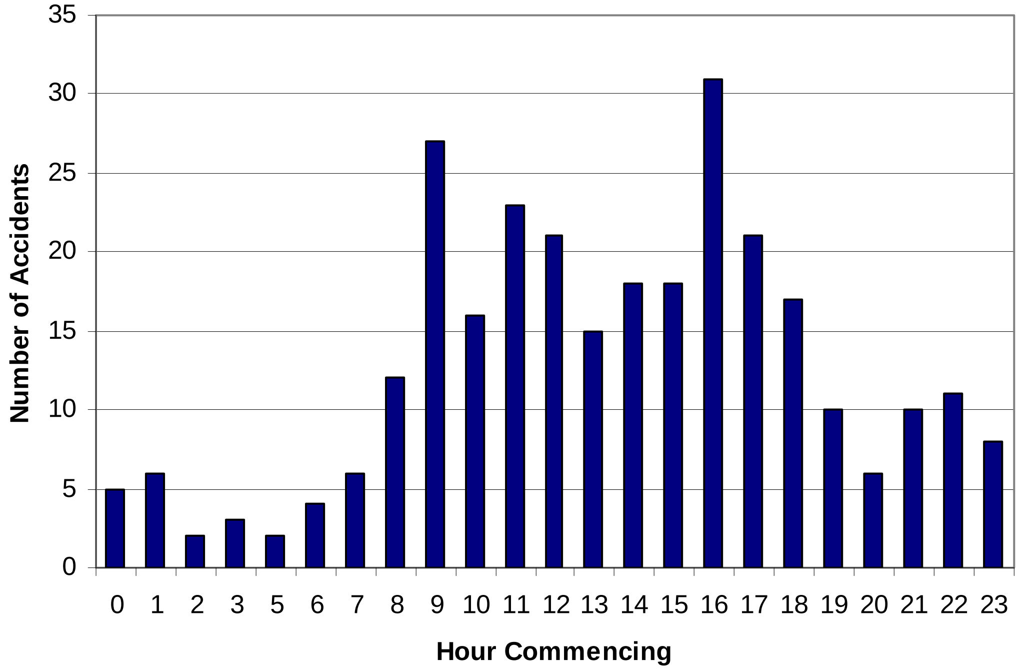
5.4 Accidents by Time of Day

A review by time of day of the traffic accident has been undertaken to identify the peaks and troughs of accidents within the study area between 2000 and 2005. It should be noted that the definition of peak used in the accident analysis differs from the definition of the peak period used for traffic modelling. The peak period in this analysis is defined as between 7am and 10am in the morning and 4pm and 7pm in the evening, in contrast to the one-hour peak period used in the traffic modelling process.

The data shown in **Figure 5.7** indicates that the busiest hour for traffic accidents occurs in the peak hour between 4-5 PM. The second busiest hour throughout the day is between 9 -10AM. The traffic accident data for the study area also identifies that business hours between 10AM and 4PM also experience a high number of accidents for each hour. For each hour there are approximately 50% to 75% the volume of accidents that occur during the PM peak hour.

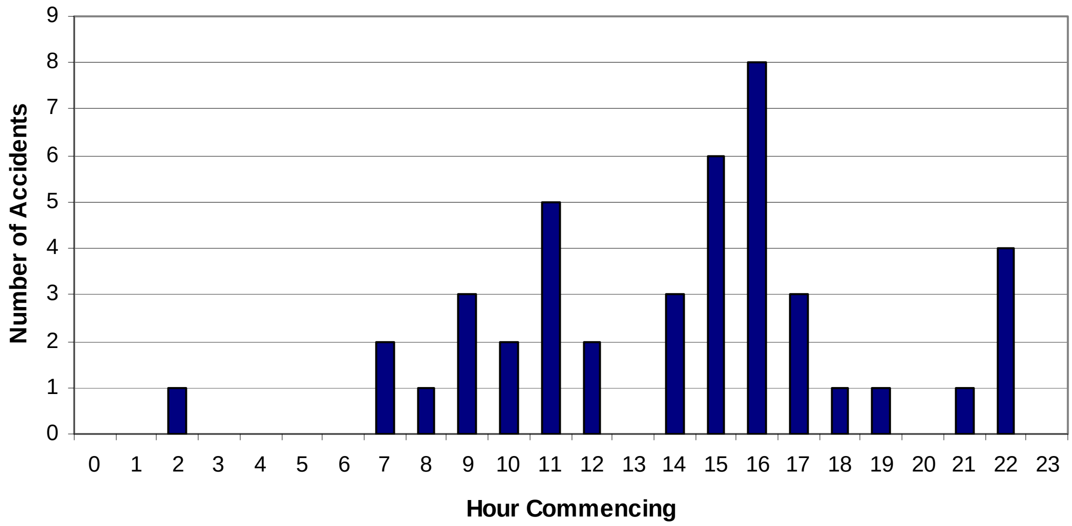
The data shown in **Figure 5.8** indicates that the busiest hour for traffic accidents on Illaroo Road occurs in the peak hour between 4-5 PM (same as the study area). The second busiest hour throughout the day is between 3-4PM.

Figure 5.7: Time of Day of Traffic Accidents within the Study Area (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.8: Time of day period for Accidents on Illaroo Road within Study Area (2000-2005)

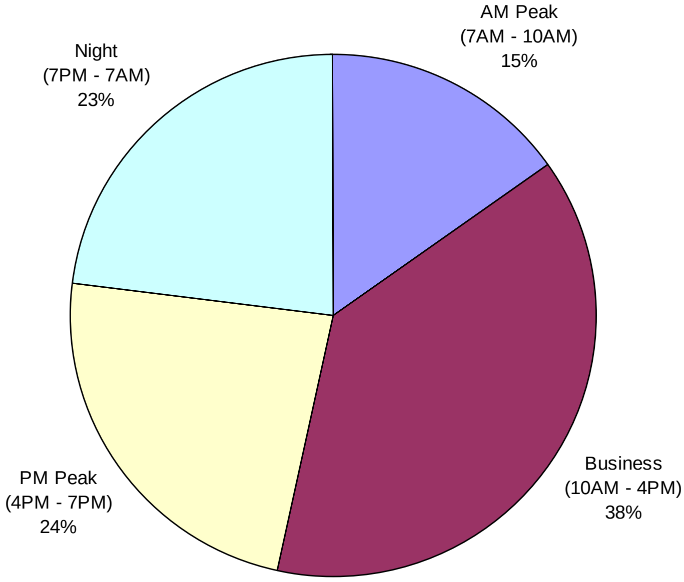


Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.9 shows the busiest time of day for accidents is during business hours between 10AM to 4PM. This period of the day accounts for 38% of traffic accidents within the study area. The PM peak period from 4PM until 7PM is the time of day that 24% of accidents occurred. A further 25% of all accidents took place in the night period between 7PM and 7AM. Only 15% of accidents occurred in the AM peak period from 7AM until 10AM. Thus, approximately 62% of recorded accidents took place between 10AM and 7PM.

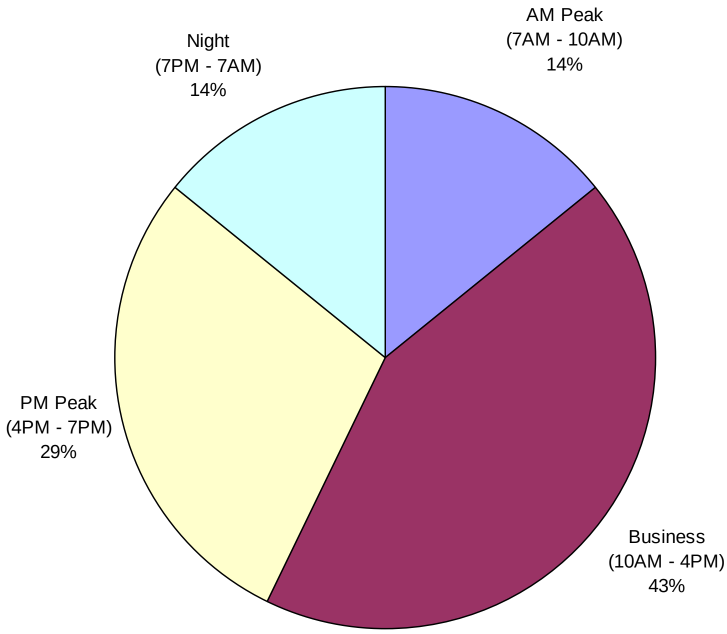
Figure 5.10 shows the busiest time of day for accidents on Illaroo Road is during business hours between 10AM to 4PM. This period of the day accounts for 43% of traffic accidents on Illaroo Road. The PM peak period from 4PM until 7PM is the time of day that 29% of accidents occurred. A further 14% of all accidents took place in the night period between 7PM and 7AM and another 14% of accidents occurred in the AM peak period from 7AM until 10AM. Thus, approximately 72% of recorded accidents took place between 10AM and 7PM.

Figure 5.9: Time of day period for Accidents within Study Area (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.10: Time of day period for Accidents on Illaroo Road (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

5.5 Climatic Influences on Road Accidents

Weather can often be a significant cause or factor in the occurrence of a traffic accident. The observed traffic accidents within the study area between 2000 and 2005, as shown in **Table 5.4**, indicate that the weather was categorised as "fine" for 216 of the 291 incidents. Weather is not considered to be a contributing factor for 74% of recorded traffic accidents. However, for the remaining 26% of traffic accidents, weather is considered to be a contributing factor in the cause of traffic accidents within the study area. The data in **Table 5.4** identifies that fog or mist is attributable to one fatality. Overcast conditions were observed during 35 accidents, of which 16 accidents resulted in an injury. Rain was observed for 39 accidents within the study area between 2000 and 2005, fourteen of which involved an injury.

Table 5.4: Weather during Traffic Accidents within the Study Area (2000-2005)

	Fatal	Injury	Non-injury	Total
Fine	2	105	109	216
Fog or mist	1	-	-	1
Overcast	-	16	19	35
Raining	-	14	25	39
Total	3	135	153	291

Source: AECOM calculations based on NSW RTA data, 2006

Table 5.5 shows the weather categories for accidents that occurred on Illaroo Road. The table shows that the majority (70%) of all crashes occurred in fine weather. Out of these, there were 50% injury accidents and 50% non-injury accidents. Overcast weather and rain contributed to 3 injury crashes respectively.

Table 5.5: Weather during Traffic Accidents on Illaroo Road (2000-2005)

	Fatal	Injury	Non-injury	Total
Fine	-	15	15	30
Fog or mist	-	-	-	-
Overcast	-	3	3	6
Raining	-	3	4	7
Total	-	21	22	43

Source: AECOM calculations based on NSW RTA data, 2006

5.6 Traffic Control Mechanisms and Road Traffic Accidents

The proximity of various traffic control devices such as signposting and signals can also be identified in regard to the traffic accidents that were recorded in the study area. A total of 165 accidents of the 291 recorded in the study area, including all three accidents involving fatalities, took place at locations where there were no traffic control devices in operation. As seen in **Table 5.6**, 55 accidents occurred at signalised intersections of which one is fatal and 21 of them involve injuries. A further 47 accidents occurred at locations where priority is designated by give way signs with an additional 16 accidents occurring at sites utilising stop signs. Another eight accidents were recorded at a number of other traffic control mechanisms including railway crossings and involvement of the Police.

Table 5.7 shows the traffic control mechanisms at the site of traffic accidents on Illaroo Road. The majority of all accidents (58%) and of the injury accidents (57%) occurred where there were no traffic controls. 43% of all accidents and 40% of the injury crashes occurred at controlled locations/intersections. Only one accident was recorded at another type of traffic control mechanism.

Table 5.6: Traffic Control Mechanism at the Site of Traffic Accidents within the Study Area (2000-2005)

	Fatal	Injury	Non-injury	Total
Traffic Signals	1	21	33	55
Give Way sign	-	23	24	47
Stop sign	-	7	9	16
No traffic controls	2	83	80	165
Other	-	1	7	8
Total	3	135	153	291

Source: AECOM calculations based on NSW RTA data, 2006

Table 5.7: Traffic Control Mechanism at the Site of Traffic Accidents on Illaroo Road (2000-2005)

	Fatal	Injury	Non-injury	Total
Traffic Signals	-	4	2	6
Give Way sign	-	4	5	9
Stop sign	-	1	1	2
No traffic controls	-	12	13	25
Other	-	-	1	1
Total	-	21	22	43

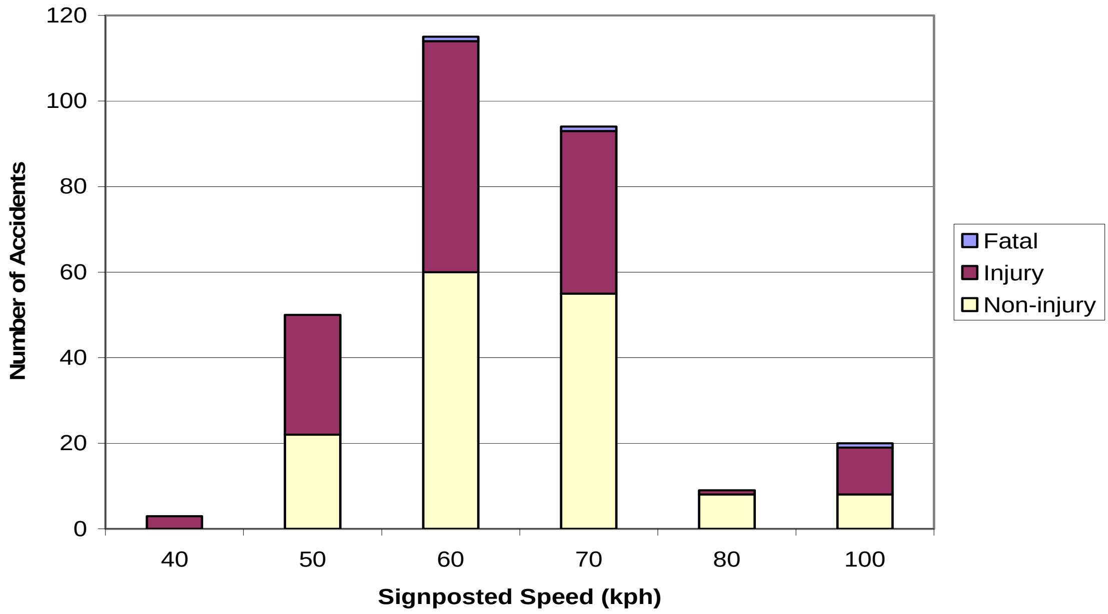
Source: AECOM calculations based on NSW RTA data, 2006

It is significant that approximately 60% of all accidents along Illaroo Road have occurred where no traffic controls exist. Reduction in traffic volumes on Illaroo Road by implementation of the proposed Nowra Bomaderry Structure Plan road link (including North Nowra Link Road) could be significant in reducing the number of accidents on Illaroo Road where no traffic controls exist, and may defer the need for upgrading Illaroo Road intersections.

Further analysis of the signposted speeds, as indicated by **Figure 5.11**, has identified that many of the recorded accidents take place within areas that are signposted as 60 kph zones. Accidents that occur within areas with this signposted speed account for 115 of the 291 incidents, including one of the fatalities. A further 94 accidents took place within zones that were signposted with speeds of 70 kph with 50 accidents occurring in 50 kph zones. Only one of the three fatalities have occurred within 100 kph speed zones, while three accidents relating to injuries occurred within zones that were signposted as 40 kph speed zones. There were 20 accidents that were recorded within the highest speed zone within the study area with a maximum speed of 100 kph.

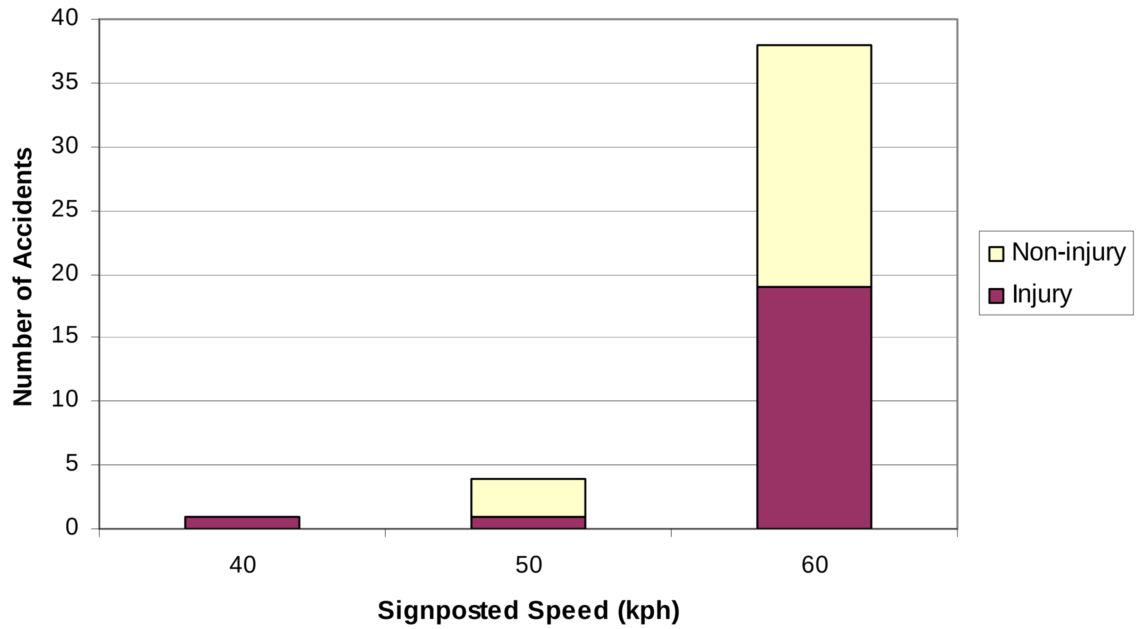
Figure 5.12 shows the signposted speeds at accident locations on Illaroo Road. Most of the recorded accidents take place within areas that are signposted as 60 kph zones. Accidents that occur within areas with this signposted speed account for 38 of the 43 incidents, including 19 injury crashes. A further 4 accidents take place in 50 kph zones and only one accident took place where the speed was signed 40 kph.

Figure 5.11: Signposted Speeds at Accident Locations in Study Area (2000-2005)



Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.12: Signposted Speeds at Accident Locations on Illaroo Road (2000-2005)

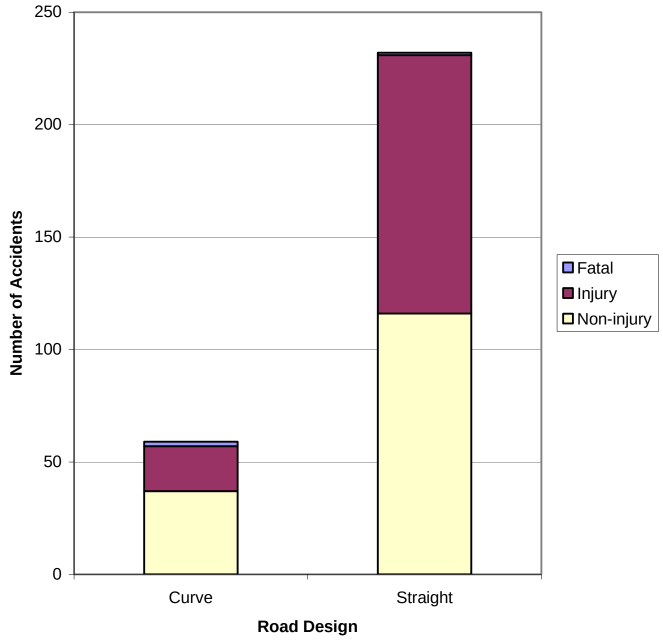


Source: AECOM calculations based on NSW RTA data, 2006

The observations of recorded traffic accidents within the study area between 2000 and 2005 also identify the road alignment where the accident took place. This data is categorised as accidents either occurring on a straight or on a curve in the road. Analysis of this data, as displayed in **Figure 5.13**, indicates that 59 accidents occurred on road locations where the alignment was on a curve, while the remaining 232 occurrences were on straight road segments. Of the 59 accidents that were reported on curved road segments, two accidents resulted in fatalities plus a further twenty accidents resulted in an injury.

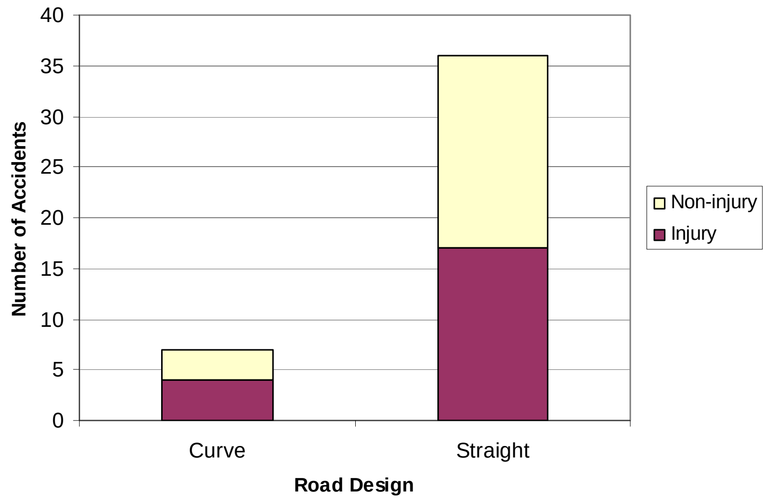
Accidents that occurred on different road alignments along Illaroo Road are displayed in **Figure 5.14**. The figures show that 36 of the 43 accidents on Illaroo Road occurred where the alignment of the road was straight. Of these, 17 accidents were injury crashes. 7 accidents occurred on curved sections of Illaroo Road, of which 4 were injury crashes.

Figure 5.13: Alignment Location of Accidents in Study Area, 2000-2005



Source: AECOM calculations based on NSW RTA data, 2006

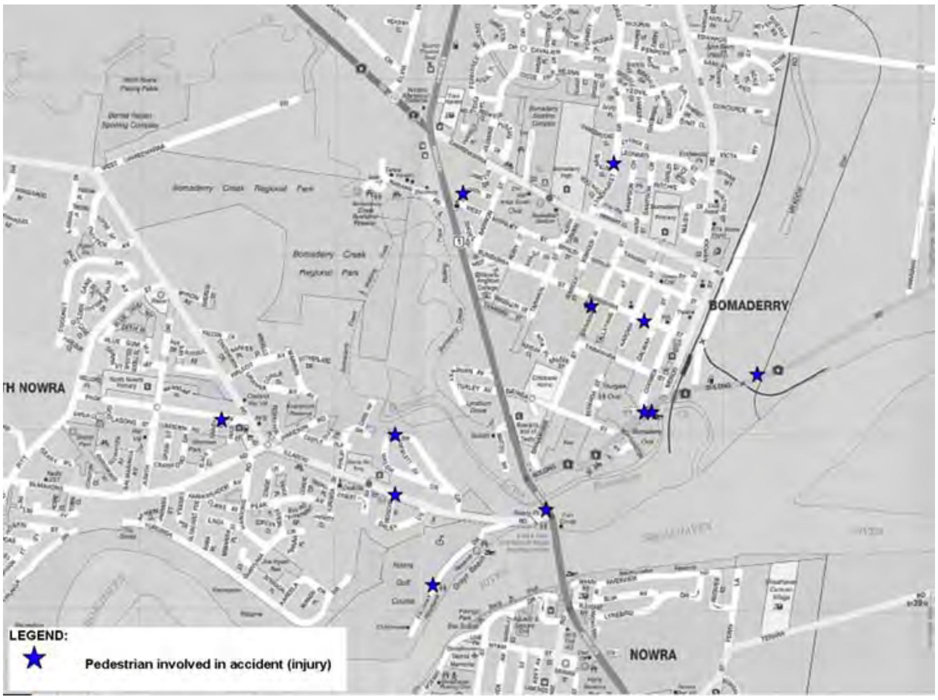
Figure 5.14: Alignment Location of Accidents in Study Area, 2000-2005



Source: AECOM calculations based on NSW RTA data, 2006

Pedestrians were involved in twelve traffic accidents within the study area between 2000 and 2005. All twelve accidents resulted in injuries with none of these accidents resulting in a fatality. The approximate locations of all accidents involving pedestrians are shown in **Figure 5.15**.

Figure 5.15: Approximate Location of Accidents Involving Pedestrians, 2000-2005



Source: AECOM based on NSW RTA data, 2006

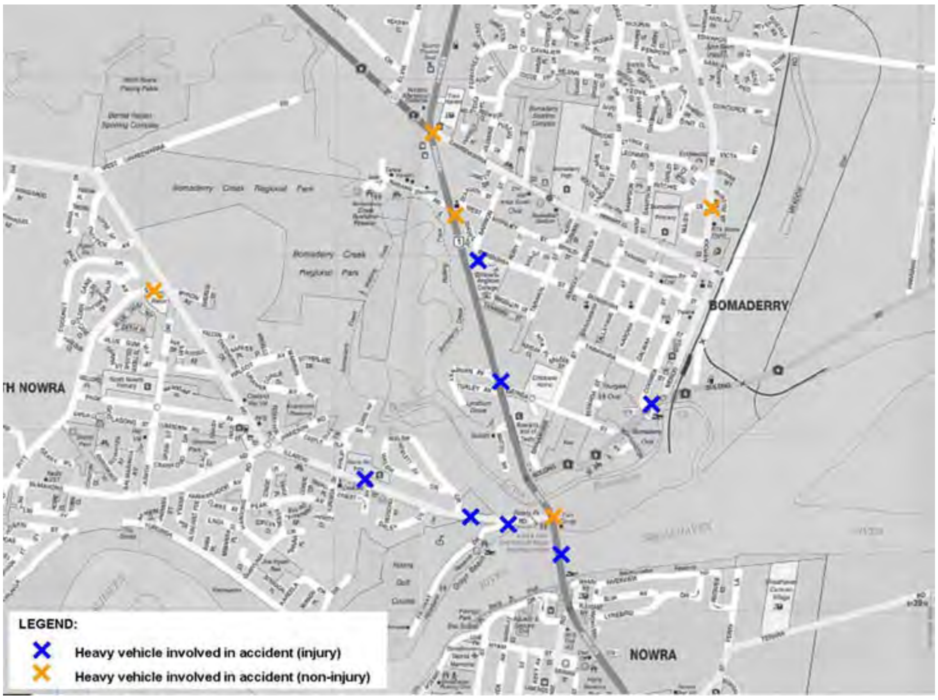
Heavy vehicles were involved in twelve accidents within the study area during the period between 2000 and 2005. This data, as displayed in **Table 5.8**, identifies that no fatal accidents involved heavy vehicles. A further seven accidents with heavy vehicles resulted in injuries, with a further five accidents not resulting in an injury. The approximate locations of all accidents involving Heavy vehicles are shown in **Figure 5.16**.

Table 5.8: Heavy Vehicle Involvement at Traffic Accident Sites within Study Area (2000-2005)

	No	Yes	Grand Total
Fatal	3	0	3
Injury	128	7	135
Non-injury	148	5	153
Total	278	12	291

Source: AECOM calculations based on NSW RTA data, 2006

Figure 5.16: Approximate Location of Accidents Involving Heavy Vehicles, 2000-2005



Source: AECOM based on NSW RTA data, 2006

5.7 Implications on Accident Levels with Link Road

The introduction of a link road between North Nowra and Bomaderry does have potential to improve traffic conditions in the area and could result in the reduction of traffic and transport related accidents in the area, particularly on Illaroo Road.

The link road would be designed to meet current construction and safety standards, providing a higher standard route for traffic between North Nowra and Bomaderry.

The diversion of traffic from Illaroo Road on to the Link Road could improve accident statistics along Illaroo Road as a higher order alternative route will be available with improved capacity for movements into / out of North Nowra, and the link road is also expected to be an attractive traffic route. Based on the Paramics modelling undertaken, Option 1 RCR is the option likely to attract the highest level of traffic (highest level of diversion of traffic from Illaroo Road).

Quantifying the likely rate for reduction of accidents or change in accident types as a result of a new link road is difficult to determine at this stage, as is the need to introduce future road safety upgrades on Illaroo Road. However, it can be confirmed that if the link road is not constructed to relieve traffic conditions on Illaroo Road, road safety is likely to deteriorate as a result of traffic growth and a decrease of environmental and/or amenity related issues.

It is significant that approximately 60% of all accidents along Illaroo Road have occurred where no traffic controls exist. Reduction in traffic volumes on Illaroo Road by implementation of the proposed Nowra Bomaderry Structure Plan road link (including North Nowra Link Road) could be significant in reducing the number of accidents on Illaroo Road where no traffic controls exist, and may defer the need for upgrading Illaroo Road intersections.

6.0 Economic Appraisal

6.1 Introduction

To determine whether a project delivers value for money to the community, an economic appraisal is undertaken to determine the magnitude of benefits generated relative to the expenditure required to develop the project. This section of the report presents the methodology, assumptions and results of an economic appraisal of possible North Nowra to Bomaderry Link Road alignments.

6.2 Objectives, Options and Scope

The objective of this economic appraisal is to assess whether the development of one of the alignment options would be more beneficial for the community and road users against a "do-minimum" base case. A discussion on each of the Nowra Link Road options was presented in **Section 1**.

This economic appraisal uses a cost-benefit framework to assess the desirability of each development option. The appraisal focuses on the benefits and costs accrued by road users, which include vehicle operating cost savings, travel time savings, accident cost savings, construction costs and maintenance costs. Benefits arising from each option are based on net decreases in road user costs relative to the base case.

6.3 Quantitative Assessment of Costs and Benefits

Modelling for the economic appraisal has initially been carried out according to NSW Government Guidelines. These guidelines are provided by two documents: the *RTA Economic Analysis Manual*[4], Version 2, 1999 and the NSW Government's *Guidelines for Economic Appraisals (TPP 97-2)*[5], which addresses issues that are not explicitly covered by the *RTA Economic Analysis Manual*.

Urban-based economic parameters from the *RTA Economic Analysis Manual* provide unit rates for the quantification of road user benefits in this appraisal. The *RTA Economic Analysis Manual* notes that an urban road is located within urban areas designated by the Australian Bureau of Statistics. The 2004 Australian Standard Geographical Classification (ASGC), published by the ABS, classifies areas with a population greater than 40,000 as urban areas. The Shoalhaven metropolitan area, incorporating Nowra town centre, the study area and catchment, is classified as an urban area by the ASGC and it is therefore considered appropriate to use urban-based economic parameters as opposed to rural-based economic parameters for this appraisal.

In May 2006, the RTA issued revised economic parameter estimates, expressed in December 2005 dollars. These parameters have been updated to January 2007 dollars for this appraisal.

6.3.1 Key Economic Parameters

Key parameters used in this economic appraisal are discussed as follows:

Discount rate: A 7% per annum real discount rate is adopted in the evaluation to calculate present values. This study also undertakes sensitivity tests at the discount rate of 4% and 10% and identifies the 'break even' discount rate.

[4] RTA, *Economic Analysis Manual*, Version 2, prepared by the Economic Services and Support Branch, July 1999.
[5] NSW Treasury, *NSW Government - Guidelines for Economic Appraisal*, TPP97-2, June 1997

Price Year: All costs and benefits in the evaluation are presented in January 2007 prices.

Where required, parameter values contained within the *RTA Economic Analysis Manual* were converted from December 2005 dollars to January 2007 dollars.

For accident and value of time parameters, a (nominal) increase of 3.1% per annum was applied to January 2007. This rate corresponds to the average annual growth in the average weekly earnings (AWE)[6] between May 1996 and May 2006. Post January 2007, in order to express values in January 2007 dollars, both sets of parameters were then increased at a (real) rate of 0.8% per annum which reflects the expected real increase in AWE over time. This assumption assumes continuing nominal AWE growth of 3.1% per annum and average RPI of 2.3% per annum.

All other parameters were inflated at a rate of 2.3% per annum to January 2007, which corresponds to the average annual growth in the Consumer Price Index[7] between June 1996 and June 2006.

Evaluation horizon: An evaluation horizon of 30 years from the conclusion of construction has been adopted for this study. All construction has been assumed to be completed by 2014.

The Treasury Guidelines do not pre-specify the evaluation horizon. It does suggest a horizon of 20 years, but notes that individual projects may have a longer or shorter life. It concludes by noting that there is no single appropriate horizon, but due to the difficulties in forecasting cash flows beyond 30 years, 30 years should be considered as a maximum horizon. Given the long-life nature of road assets, an investment horizon of 30 years has been adopted for this appraisal.

6.3.2 Key Traffic Parameters

Traffic modelling, the outputs of which are presented in **Section 4.0**, was undertaken for the AM and PM peak periods for 2016. The level of traffic modelling undertaken requires assumptions to be made to project model outputs to convert to daily and annual equivalents for all years in the evaluation horizon.

6.3.2.1 Definition of Time Periods

For the purposes of this appraisal, annual vehicle kilometres and vehicle hours have been disaggregated into three distinct periods: peak, business and off-peak. This was undertaken so that economic parameters could vary in value according to time-of-day.

It should be noted that the definition of peak used in this appraisal differs from the definition of the peak period used for modelling. The peak period in this appraisal is defined as between 7am and 10am in the morning and 4pm and 7pm in the evening, in contrast to the one-hour peak period used in the traffic modelling process.

The business period is defined as the time between the two peak periods i.e. 10am to 4pm. The off-peak period encompasses all other times i.e. 7pm to 7am.

6.3.2.2 Peak Expansion Factors

Historic data from a permanent count site located on Princes Highway was used to create proxy expansion factors. Site 07.051V, which is located on the Shoalhaven River crossing, was selected. An analysis of the hourly weekday traffic profile during 2003 found that traffic is distributed as shown in **Table 6.1**.

[6] ABS (2006): Total Earnings, All Persons, NSW (Trend) (Cat. No. 6302.11a)
[7] ABS (2006): Sydney Consumer Price Index (Original) (Cat. No. 6401.0)

Table 6.1: Distribution of Traffic by Time of Day on Princes Highway (Site 07.051V)

Time Period	Time Period	Proportion of Weekday Traffic
"Model" Peak	8am – 9am & 3:30pm – 4:30pm[8]	16.8%
Peak	7am – 10am & 4pm – 7pm	41.9%
Business	10am – 4pm	43.8%
Off Peak	7pm – 7am	14.2%

Source: RTA (2004)[9]

The calculated temporal distribution of traffic implies the following set of expansion factors that were used to convert model VKT and VHT forecasts to daily VKT and VHT forecasts:

- Model to Peak Period: 2.50 (41.9/16.8);
- Peak to Business Period: 1.05 (43.8/41.9); and
- Peak to Off-Peak Period: 0.34 (14.2/41.9).

6.3.2.3 Annualisation Factors

An additional expansion factor is required to convert daily forecasts to annual forecasts. This requires consideration of how weekend, public holiday and school holiday traffic compare to typical weekday traffic flows, and also how the modelled traffic demands compare with annual average traffic demands.

Average weekday traffic, average weekend traffic and average daily traffic statistics for the Princes Highway site are shown in **Table 6.2**.

Table 6.2: Annual Average Daily Traffic Statistics on Princes Highway (Site 07.051V)

Indicator	Northbound	Southbound	Average
AAWT	24,088	24,819	24,454
AAWE	19,394	18,697	19,046
AADT	22,747	23,070	22,909
Annualisation factor - Factor to Convert AAWT to AADT (x 365 days)			342

Source: RTA (2004)

The ratio of AAWT and AADT imply an annualisation factor of 342. This assessment (using ratio of average weekday to average daily) is important because the future traffic demands for the study have been derived with the assistance of the TRACKS models (which have been validated as average weekday traffic models). However the calculated ratio has been determined from Princes Highway survey data and not data for the wider study area.

Importantly, what this ratio does not take into consideration, is how the modelled traffic demands (that have been validated based on more recent traffic surveys undertaken on Thursday 24th November 2005) compare with the AAWT used in the above ratio, and how the modelled traffic demands compare with the AADT. A review of how the modelled traffic demands compare with AADT would provide a more accurate calculation of annualisation factor (however still specific to Princes Highway).

Council has not been able to obtain annual hourly flow data for 2005, however 2004 data has been provided by the RTA. Compared to the day of traffic surveys obtained for validation of Paramics models (Thursday 24th November 2005) - the equivalent day in 2004 is Thursday 25th November 2004.

The ratio of AAWT and AADT in **Table 6.2** imply an annualisation factor of 342. According to Council, the ratio of actual recorded traffic demands to AADT implies an annualisation factor of 265 – 293. These values have been calculated from available annual data for Princes Highway at Shoalhaven River crossing (RTA permanent count

[8] Data collected between 3pm and 4pm were used as a proxy for the 3:30pm to 4:30pm period.
[9] RTA, *Traffic Volume Data for Southern Region 2003*, prepared by the Traffic Management Branch, Traffic and Transport Directorate, June 2004

station site 07.051V). There are no other permanent count stations in the study area, and accordingly no data for estimating the same ratios on local roads.

Whilst the above calculated values may be appropriate for Princes Highway (having been calculated from annual Princes Highway traffic data), the factors would not be appropriate to apply across the study area, as it would not be expected that local roads would experience the same level of seasonal variation as occurs on the Princes Highway.

As there is no available annual traffic data for local roads, a conservative annualisation factor of 320 has been adopted. To ensure the study has adequately considered the implications of other values for annualisation factor - the impact of lower and higher annualisation factors of 260 and 340 has been considered in the sensitivity analysis.

The annualisation factor on Princes Highway at the Bridge over the Shoalhaven River reflects the high level of seasonal variation in traffic demand throughout the year, relative to the calculated average daily conditions for the year.

Other routes in the local network, including the Link Road options, would not be used by the majority of additional seasonal traffic, and therefore would not be subject to such a high level of sensitivity.

Consequently, it is considered that a factor of 320 better represents the impacts of the Link Road between North Nowra and Bomaderry, rather than a calculated factor that may be more appropriate for use on only the Princes Highway through the study area.

Application of a higher annualisation factor is likely to overvalue the economic impacts of the Link Road, where as application of a lower annualisation factor is likely to undervalue the economic impacts of the Link Road.

For this reason a conservative annualisation factor of 320 is considered to represent a more appropriate value than the calculated figure for regular traffic operations throughout the year on Princes Highway, with lower and higher values tested for sensitivity of the results.

6.3.2.4 Vehicle Composition

Shoalhaven Council undertook a traffic composition survey on May 25, 2006 on Illaroo Road. The results from the survey have been used to prepare a set of assumptions on vehicle composition which have been applied in the economic appraisal. Additional assumptions have been made with respect to the proportion of new cars and business cars and to reflect the traffic categories adopted in the Paramics micro-simulation modelling.

Vehicle composition estimates used in the economic analysis are shown in **Table 6.3**. It should be noted that the estimates shown in the table are daily averages, which have a higher proportion of heavy vehicles compared to the peak period (3-4 percent heavies). This difference is explained by the higher proportion of light commuter vehicles in the peak period, compared to other times of the day. Given the need to estimate annual benefits for the economic appraisal, it was considered more accurate to use daily averages rather than peak hour vehicle proportions.

Table 6.3: Assumed Vehicle Splits (Average Daily Composition)

Vehicle Type	Assumed Value
Private car (new)	4.0%
Private car (used)	73.0%
Business car	10.0%
Total: Light Vehicles	**87.0%**
Light commercial	7.0%
Rigid truck	4.0%
Articulated truck	1.0%
Bus	1.0%
Total: Heavy Vehicles	**13.0%**

Source: AECOM assumptions based on Shoalhaven Council data.

6.3.2.5 Vehicle Kilometres Travelled (VKT) Forecasts

Network VKT forecasts applied in the economic appraisal are based on output from the Paramics model. One-hour morning and afternoon peak period VKT forecasts for 2016 were produced for the base case and all seven development sub-options. These forecasts were aggregated, 'normalised' (explained later) and expanded to provide an annualised VKT figure for 2016.

Peak period VKT forecasts vary between 36,000 and 38,000 km per weekday between options, which are shown in **Table 6.4**. These indicate the similarity of traffic movements between the options.

Table 6.4: Model VKT Forecasts (2016)

Period	Base Case (Structure Plan)	Option 1	Option 1 (MVRDLK)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Model (AM)	17,153	17,887	17,839	17,723	17,433	18,089	17,645
Model (PM)	19,049	19,687	19,305	19,887	19,626	19,717	19,525
Total	**36,202**	**37,574**	**37,144**	**37,610**	**37,059**	**37,806**	**37,170**

Source: AECOM calculations

It is worth noting that the level of VKTs under each of the development options is higher than under the base case. Whilst this is possible, this increases the complexity of evaluating relative benefits. Possible reasons for this phenomenon include rerouting to avoid congestion and induced traffic. The benefit of rerouting is essentially a trade-off between travel time and vehicle operating costs and is easily captured within a conventional cost-benefit analysis.

On the other hand, induced traffic will result in higher network vehicle kilometres and hence higher aggregate vehicle operating costs. The evaluation of benefits accruing as a result of induced traffic is usually evaluated using 'rule of half' based calculations. However, to properly quantify these benefits, a detailed understanding of the change in generalised costs between individual origin-destination pairs is required. Given the residual differences between the VKT estimates, it was not considered appropriate to pursue this more detailed analysis since it would only likely have a marginal impact on the overall appraised result. In addition, it is unlikely to change the relative outcome between different schemes.

Under all development options, the number of vehicles on the network is projected to be higher than the base case. **Table 6.5** shows the number of vehicles under each of the development options is not significantly higher than under the base case.

However, to ensure consistency in evaluating the relative benefits of each option and the base case, VKT forecasts have been normalised. VKT forecasts shown in **Table 6.6** have been normalised by:

1. Calculating the ratio between projected vehicles under each option and the base case; and
2. Multiplying forecast VKTs by the corresponding ratio.

The results of the normalisation process are shown as **Table 6.6**.

Table 6.5: Model Vehicle Projections (2016)

Variable	Base Case (Structure Plan)	Option 1	Option 1 (MVRDLK)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Model (AM)	7,793	8,013	7,987	7,852	7,857	8,147	7,933
Model (PM)	8,479	8,727	8,703	8,523	8,747	8,639	8,738
Total	*16,272*	*16,740*	*16,690*	*16,375*	*16,604*	*16,786*	*16,671*
Ratio	100.0%	102.9%	102.6%	100.6%	102.0%	103.2%	102.5%

Source: AECOM calculations

Table 6.6: Normalised Model VKT Projections (2016)

Variable	Base Case (Structure Plan)	Option 1	Option 1 (MVRDLK)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Model	36,202	37,574	37,144	37,610	37,059	37,806	37,170
Ratio	100.0%	102.9%	102.6%	100.6%	102.0%	103.2%	102.5%
Normalised	36,202	36,524	36,124	37,373	36,318	36,648	36,280

Source: AECOM calculations

The normalised forecasts, using the previously mentioned expansion factors, were converted to daily network VKTs, disaggregated by peak, business and off-peak periods. An annualisation factor of 320 was then applied to convert the disaggregated daily VKT to annual VKT for 2016.

As a final step, a growth scenario was established to project network VKTs for all years within the evaluation horizon. It has been assumed that for the five years from opening (2014) to 2019, network VKTs would continue to increase by 2% per annum. Subsequent to 2019, network VKTs have been assumed to remain constant to the end of the evaluation period.

6.3.2.6 Vehicle Hours Travelled Forecasts

VHT forecasts in the economic appraisal are also based on output from the Paramics model. VHT outputs from model runs for 2016 has been produced and were aggregated, 'normalised' and expanded to provide annualised VHT forecasts for 2016.

Model VHT forecasts are shown in **Table 6.7** and normalised VHT forecasts are shown in **Table 6.8**.

Table 6.7: Model VHT Forecasts (2016)

Variable	Base Case (Structure Plan)	Option 1	Option 1 (MVRDL K)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDL K)
Model (AM)	709	672	599	614	663	705	672
Model (PM)	903	854	818	696	832	965	766
Total	1,612	1,526	1,417	1,310	1,495	1,670	1,438

Source: AECOM calculations

Table 6.8: Normalised Model VHT Projections (2016)

Variable	Base Case (Structure Plan)	Option 1	Option 1 (MVRDL K)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDL K)
Model	1,612	1,526	1,417	1,310	1,495	1,670	1,438
Ratio	100.0%	102.9%	102.6%	100.6%	102.0%	103.2%	102.5%
Normalised	1,612	1,483	1,382	1,302	1,465	1,619	1,404

Source: AECOM calculations

For the base case, the normalised vehicle hour forecasts, using the previously mentioned expansion factors, were converted to daily network hours, which were disaggregated by peak, business and off-peak period. An annualisation factor of 320 was then applied to convert the disaggregated daily vehicle hour forecasts to an annual vehicle hour forecast for 2016.

As traffic modelling has only been undertaken during peak periods, the extent of travel time savings is not known outside of the peak periods. Given this uncertainty, it has been assumed (worst case) that no travel time savings will be attainable outside the peak period.

Hence, for all development options, VHT forecasts for the business and off-peak periods were set to be equivalent to the corresponding base case VHT forecasts.

By undertaking this process, the benefits of the Link Road with regard to both lower vehicle kilometres travelled and lower vehicle hours travelled are represented within the economic appraisal.

It is worth noting that the relative benefits between options and taking no action (Do Nothing) for the off peak periods is less significant than the benefits attributed to the peak periods. This is simply a response to the higher volume of traffic that utilises the road network during the peak periods.

Note that the economic benefits attributed with the Link Road in regard to travel time savings are determined by VHT forecasts incorporating all movements across the network modelled, including regional traffic on Princes Highway. The benefits of the Link Road have not been estimated simply by deriving the reduced journey times on Illaroo Road.

The precise travel time savings outside the peak period or as part of the shoulder peak cannot be accurately represented within the economic analysis without extending the Paramics modelling period.

The nature of the traffic operations ensure that there are numerous quantitative parameters whose significance varies by time of day. Such factors not only include the different traffic compositions and trip making patterns that occur in the peak period and off peak periods, but also include the traffic signal operations. As SCATS is adaptive to the relative demands of approaches to intersections, changing demands are reflected with variation in cycle times and phase times. Consequently, a detailed review of travel time savings between options outside the peak periods would require further detailed Paramics modelling to represent the various capacity restraints in the network during business hours.

It is noted that the TRACKS analysis has incorporated network benefit analysis based on a 24 Hour average weekday model at 2006, 2016, and 2036. Higher benefits have been calculated by the TRACKS models (compared to the Paramics models) and this is likely to be as a result of TRACKS calculated benefits over a 24 Hour period as opposed to the 2 Hour peak period calculated benefits (i.e. AM + PM) with the business and off peak periods set to 2005 estimates with no growth, as reflected in this economic assessment.

Appendix F contains a summary comparison of the Gabites Porter TRACKS model outcomes which can be compared with the AECOM Paramics Model outcomes.

6.3.3 Key Road User Costs

Annual user benefits have been estimated as the sum of:

- Vehicle operating cost savings;
- Travel time savings; and
- Accident cost savings.

These benefits are based on the relative differences in VKT and VHT forecasts under the base case and all development options. The parameter values used to value vehicle operating costs, travel-time savings and accidents are based upon parameter estimates presented within Appendix B of the *RTA Economic Analysis Manual.* The derivation of each stream of benefits is discussed as follows:

6.3.3.1 Vehicle Operating Costs

Vehicle operating costs are incurred by road users when they drive their vehicle, and include costs associated with owning, maintaining and operating a vehicle. These costs include:

- Fuel and oil;
- Depreciation;
- Maintenance; and
- Wear on tyres and brakes.

The RTA Guidelines use the AustRoads (2006)[10] vehicle operating cost models to estimate the resource cost associated with motor vehicle use. AustRoads have developed an urban stop-start model and a freeway model. Given the urbanised nature of the road network within the study area, with stop-start driving, the urban stop start model is the more appropriate of the two models. This model takes the following form:

Equation 6.1: Urban Stop-Start Vehicle Operating Cost Model

$$\overbrace{VOC}^{\text{Vehicle operating cost per kilometre}} = \overbrace{A}^{\text{Model parameter}} + \frac{\overbrace{B}^{\text{Model parameter}}}{\underbrace{V}_{\text{Speed (in km/h)}}}$$

The parameters *A* and *B* are estimated for a number of different vehicle classes whilst *V* is derived by taking the quotient of vehicle kilometres travelled and vehicle hours travelled. These parameters are provided by both AustRoads and within the *RTA Economic Analysis Manual* and are shown in **Table 6.9**. The network speed assumptions, which are based on modelled output, are summarised by options in **Table 6.10**. It should be noted that these values are slightly different to the model output values summarised in **Table 4.1**. This is because the figures quoted in **Table 6.10**, represent the average 'peak' speed for both the AM and PM peak periods and have also undergone the normalisation process described in **Section 6.3.2.6**.

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[10] AustRoads, *Austroads Technical Report: Update to RUC Unit of Values to June 2005*, AP-T70/06, September 2006.

Table 6.9: Vehicle Operating Cost Model Parameters

Vehicle Type	A	B
Cars		
Private (new)	28.64	97.13
Private (used)	25.28	95.69
Business	23.77	94.23
Commercial Vehicles		
Light Commercial	31.97	258.02
Rigid Truck	69.3	476.2
Articulated Truck	128.44	1154.37
Buses	106.17	1126.02

Source: Table 4, RTA (2006)[11]

Table 6.10: Vehicle Speed Assumptions by Scenario – Peak Period (km/h)

Option	All vehicles
Base Case (Structure Plan)	22.5
Option 1	24.6
Option 1 (MVRDLK)	26.2
Option 1 RCR	28.7
Option 2	24.8
Option 3	22.6
Option 3 (MVRDLK)	25.8

Source: AECOM

These parameters, along with average network speed, are substituted into **Equation 6.1** to derive a vehicle operating cost rate for each vehicle type. Weighted average vehicle operating cost rates for light vehicles and heavy vehicles were then derived by weighting individual vehicle operating cost units by the assumed vehicle compositions shown in **Table 6.3**.

The unit vehicle operating cost rates are then multiplied by projected annual vehicle kilometres to estimate the annual vehicle operating costs for do nothing and project options.

6.3.3.2 Travel Time Costs

The cost associated with travel time requires a conversion of travel time into monetary terms. However, evaluating travel time costs requires careful consideration of the following factors:

- Vehicle type;
- Vehicle composition;
- Vehicle occupants;
- Presence of freight; and
- Temporal changes in value of time.

Network vehicle hours are generally lower than the network person hours as some vehicles have more than one occupant. Rather than converting forecast VHT to person hours, the base value of time rates has been adjusted

[11] RTA, *Updates to Appendix B – Economic Analysis Manual and Appendix C – RTA Road Cost Index*, May 2006

from person hours to vehicle hours. As a first step, vehicle occupation rates (shown as **Table 6.11**) were multiplied by the appropriate value of time rate, expressed in person hours (shown as **Table 6.12**), to derive value of time rates expressed in vehicle hours (shown as **Table 6.13**).

Table 6.11: Vehicle Occupation Rates

Period	Light Vehicles		Heavy Vehicles	
	Private Cars	Business Cars	Light Trucks	Heavy Trucks
Peak	1.12	1.20	1.30	1.00
Business	1.50	1.40	1.30	1.00
Off-peak	1.97	1.40	1.30	1.00

Source: Table 8, RTA (2006)

Table 6.12: Value of Time Unit Costs ($/Person Hours)

Period	Light Vehicles		Heavy Vehicles	
	Private Cars	Business Cars	Light Trucks	Heavy Trucks
Peak	$11.05	$35.34	$21.65	$22.93
Business	$11.05	$35.34	$21.65	$22.93
Off-peak	$11.05	$11.05	$11.05	$22.93

Source: Table 9, RTA (2006). Values are in December 2005 dollars.

Table 6.13: Value of Time Unit Costs ($/Vehicle Hours) Excluding Freight

Period	Light Vehicles		Heavy Vehicles	
	Private Cars	Business Cars	Light Trucks	Heavy Trucks
Peak	$12.38	$42.41	$28.15	$22.93
Business	$16.58	$49.48	$28.15	$22.93
Off-peak	$21.77	$15.47	$14.37	$22.93

Source: AECOM calculations. Values are in December 2005 dollars.

An additional allowance for the value of time associated with freight has been included. **Table 6.14** shows value of time unit cost rates inclusive of the value of freight.

Table 6.14: Value of Time Unit Costs ($/Vehicle Hours) Including Freight

Period	Light Vehicles		Heavy Vehicles	
	Private Cars	Business Cars	Light Trucks	Heavy Trucks
Peak	$12.38	$42.41	$29.30	$42.73
Business	$16.58	$49.48	$29.30	$42.73
Other	$21.77	$15.47	$14.37	$42.73

Source: AECOM calculations. Values are in December 2005 dollars.

Accounting for the vehicle composition, a weighted average value of time rate of $18.76 per vehicle hour for light vehicles and $35.31 per vehicle hour for heavy vehicles were derived (December 2005 dollars). These rates are increased in real terms within the evaluation horizon. Intrinsically, value of time is correlated with average weekly earnings. As earnings generally increase faster than inflation, it is necessary to apply a real increase to all value of time unit rates. This is assumed to be 0.8% per annum.

Finally, the monetary cost associated with travel time was derived by multiplying network travel times by the appropriate value of time unit cost rate.

6.3.4 Externality Costs

Accident cost unit rates have been estimated based on historic accident data for the study area and published accident cost rates published in the *RTA Economic Analysis Manual*. Accident cost unit rates make an allowance for the following costs:

- Human costs including ambulance, hospital and medical costs;
- Vehicle costs including repairs and towing; and
- General costs including travel delays, police and property.

Accident cost unit rates by type of accident are shown in **Table 6.15**. These rates have been increased by the change in nominal average weekly earnings to January 2007 (the end of December 2006), assumed to be 3.1% per annum, to bring the unit rates in line with the assumed price year.

Table 6.15: Accident Cost Unit Rates per Crash

Price Date	Fatal	Injury	Non-Injury
December 2005 rates	$1,833,943	$129,717	$6,995
December 2006 rates	$1,890,877	$133,744	$7,212

PDO – Property Damage Only

Source: Table 12, RTA (2006) and ABS Cat. No. 6302.11a.

Accident rates have been derived using historic accident data within the study area. Accident data between July 2000 and June 2005 in North Nowra and Bomaderry has been aggregated and averaged. Accident data by year and accident type is shown as **Table 6.16**.

Table 6.16: Historic Crash Data in North Nowra/Bomaderry (July 2000 – June 2005)

Period	Fatal	Injury	Non-Injury	Total
July 2000 – December 2000		10	14	24
January 2001 – December 2001	1	21	19	41
January 2002 – December 2002	1	29	21	51
January 2003 – December 2003		26	17	43
January 2004 – December 2004	1	23	29	53
January 2005 – June 2005		11	13	24
Total	**3**	**120**	**113**	**236**
Annual Average	**0.6**	**24.0**	**22.6**	**47.2**

Source: AECOM calculations based on RTA Crash Analysis Unit data.

The calculated average annual accident rates were then converted into a per (million) vehicle kilometre rate by dividing by the vehicle kilometres travelled within the study area. In 2005, annual VKTs within the study area were estimated to be 57,442,879km and are based on:

1. A modelled 2005 VKT estimate of 30,128 km;
2. An model to daily expansion factor of 5.96; and
3. A daily to annual expansion factor of 320.

Combining accident rates, accident cost rates and network VKTs, an accident cost unit rate of $0.0785 per kilometre was derived. The derivation of this rate is shown in **Table 6.17**.

Table 6.17: Accident Cost Unit Rate Derivation

Indicator	Fatal	Injury	PDO	Total
Annual average crashes	0.6	24.0	22.6	47.2
Network VKT (2005)	57,442,879km			
Accident rate per MVKT	0.01045	0.41781	0.39343	0.82169
Accident cost per crash	$1,890,877	$133,744	$7,212	
Accident cost rate per km	$0.0198	$0.0559	$0.0028	$0.0785

Source: AECOM calculations. All values in December 2006 dollars.

Future accident cost unit rates have been indexed with movements in real average weekly earnings, assumed to be 0.8% per annum. Annual accident costs for each option were estimated by multiplying the level of annual vehicle kilometres travelled by the accident cost unit rate.

6.3.5 Road Costs

6.3.5.1 Construction Costs and Timing

Concept construction costs for the options have been estimated by Shoalhaven Council and included in the economic appraisal. For planning purposes, it has been assumed that the nominal construction cost is spread across a three-year period between 2011 and 2013. The first million dollars is assumed to be spent in 2011 with the balance allocated equally between 2012 and 2013.

Construction cost estimates provided by Shoalhaven Council include allowances for the following expenses:

- New road;
- New bridges;
- Intersection improvements;
- Land acquisition;
- Survey, design and investigation;
- Project management;
- Services; and

Clearing, fencing and security.

Table 6.18 shows the assumed breakdown of construction costs by year. A contingency premium of 30 per cent has been incorporated into these estimates.

Table 6.18 Construction Cost Profile (2007 prices)

Option	2011	2012	2013	Total
Base Case (Structure Plan)	Nil	Nil	Nil	Nil
Option 1	$1,000,000	$5,112,180	$5,112,180	$11,224,359
Option 1 (MVRDLK)	$1,000,000	$12,837,598	$12,837,598	$26,675,197
Option 1 RCR	$1,000,000	$7,112,180	$7,112,180	$15,224,359
Option 2	$1,000,000	$8,786,466	$8,786,466	$18,572,932
Option 3	$1,000,000	$5,414,808	$5,414,808	$11,829,617
Option 3 (MVRDLK)	$1,000,000	$13,140,227	$13,140,227	$27,280,454

Source: AECOM calculations based on data provided by Shoalhaven Council

Note: Option 1RCR includes an additional $4 million for slip lane enhancements and property acquisition.

6.3.5.2 Maintenance Costs

Additional maintenance costs arising from the development of each Link Road have been estimated. Data provided by Shoalhaven Council suggests that each additional kilometre of road costs $26,200 per annum to maintain whilst annual bridge maintenance is 1.3 percent of its original construction cost. Based on construction costs and maintenance cost unit rates provided by Council, **Table 6.19** shows the assumed (additional) maintenance costs by each development option.

Table 6.19: Annual Maintenance Costs (2007 prices)

Option	Road Length (km)	Bridge Cost	Annual Maintenance Costs		
			Road	Bridge	Total
Base Case (Structure Plan)	Nil	Nil	Nil	Nil	Nil
Option 1	1.71	$5,795,016	$44,802	$72,438	$117,240
Option 1 (MVRDLK)	3.45	$11,269,926	$90,390	$140,874	$231,264
Option 1 RCR	1.71	$5,795,016	$54,527	$72,438	$126,965
Option 2	1.82	$7,964,007	$47,684	$99,550	$147,234
Option 3	1.73	$3,824,710	$45,326	$47,809	$93,135
Option 3 (MVRDLK)	3.47	$9,299,620	$90,914	$116,245	$207,159

Source: AECOM calculations based on data provided by Shoalhaven Council

Note: Option 1 RCR includes an additional $9,725 per annum to account for slip lane and traffic signals annual maintenance costs.

6.4 Results

6.4.1 Economic Indicators

The discounted cash flows from the base case and each of the development options were subsequently used in the calculation of economic indicators. Four economic indicators were calculated as outputs of the economic appraisal to evaluate the relative attractiveness for each of the development options against the base case. A brief description of each indicator is provided as follows:

Net Present Value (NPV): measures the absolute difference between total discounted benefits and costs. Cash flows are discounted at the prescribed discount rate of seven per cent, reflecting the notion that future benefits and costs have less value compared to current benefits and costs. A project with a NPV greater than zero would be considered desirable, with the project having the highest modelled NPV being the most desirable.

The NPV of each development option was calculated by taking the difference of the present value of costs incurred under the base case and Option *j* as illustrated in **Equation 6.2**:

Equation 6.2: Net Present Value

$$NPV_j = PV(\text{Costs})_{base} - PV(\text{Costs})_j$$
$$= \sum_{t=2011}^{t=2042} \frac{\text{Costs}_{t,base} - \text{Costs}_{t,j}}{(1+i)^{(t-2007)}}$$

Net Present Value per Dollar of Investment (NPVI): measures the return on a dollar of investment. The NPVI is calculated by dividing the net present value by the present value of investment (construction costs have been used as the proxy for investment). A project with a NPVI greater than zero would be considered desirable, with the project having the highest modelled NPVI being most desirable.

Equation 6.3: Net Present Value per Dollar of Investment

$$NPVI_j = \frac{NPV_j}{NPV(I_j)}$$
$$= \frac{NPV_j}{\sum_{t=2011}^{t=2042} \frac{I_{t,j}}{(1+i)^{(t-2007)}}}$$

Benefit Cost Ratio (BCR): measures the return received per dollar of costs. The BCR is calculated by dividing the present value of all benefits by the present value of all costs. A project with a BCR greater than one would be considered desirable, with the project having the highest BCR being most desirable.

The NPVI and BCR provide a scale in which to compare the relative attractiveness of different projects where the level of expenditure varies between projects.

Equation 6.4: Benefit-Cost Ratio

$$BCR_j = \frac{PV(\text{Road User Benefits})_j}{PV(\text{Construction and Net Maintenance Costs})_j}$$

Internal Rate of Return (IRR): the discount rate required to ensure that NPV is equal to zero. A project with an IRR greater than seven per cent (the project discount rate) would be considered desirable, with the project with the largest IRR being most desirable.

It is important to note that the above economic indicators, when interpreted individually, have various weaknesses. Hence, the Guidelines suggest a range of economic indicators to provide a broader set of evaluation criteria to enhance the probability that the best project is selected.

It should be noted that the appraisal is based on assumptions and hence calculated economic indicators may be sensitive to deviations from these assumptions. Furthermore, the economic appraisal is limited in considering road user costs and benefits. An analysis of other attributes to include wider community effects and impacts have not been included in the appraisal at this stage. A more detailed discussion of these attributes follow in **Section 6.6**.

6.4.2 Headline Results

Estimates for all four economic indicators have been calculated from the modelled cash flows between 2011 and 2042. Benefits arising from each development option have been derived by taking the difference in vehicle operating costs, travel time costs and accident costs incurred under the base case and each of the development options. The costs for each option have been based on the additional construction and maintenance costs incurred relative to the base case.

Project benefits have been derived by using estimates of Vehicle Kilometres (VKT) and Vehicle Hours Travelled (VHT) for each of the project options derived for 2016. It has been assumed that for the five years from opening (2014) to 2019, network VKT and VHT would continue to increase by 2% per annum. Subsequent to 2019, both VKT and VHT have been assumed to remain constant to the end of the evaluation period (2042).

Estimates of all four indicators for each of the development options are shown in **Table 6.20**. All indicators are based on a real discount rate of 7% per annum.

Table 6.20: Headline Economic Indicators (in thousands of $2007)

Indicator	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Benefits	$19,399	$38,101	$44,426	$23,638	-$3,786	$34,051
Costs	$8,199	$19,030	$10,852	$13,165	$8,405	$19,236
NPV	$11,200	$19,071	$33,574	$10,473	-$12,191	$14,815
BCR	2.366	2.002	4.09	1.796	-0.450	1.770
IRR	17.9%	15.5%	28.5%	13.8%	Undefined	13.6%
NPVI	1.534	1.105	3.400	0.870	-1.585	0.839

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices discounted at a real discount rate of seven percent per annum and discounted to a base year of 2007.

These results imply the following rankings:

Table 6.21: Headline Economic Indicators ($2007)

Indicator	Option 1	Option 1 (MVRDLK)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
NPV	4th	2nd	1st	5th	6th	3rd
BCR	2nd	3rd	1st	4th	6th	5th
IRR	2nd	3rd	1st	4th	Last	5th
NPVI	2nd	3rd	1st	4th	6th	5th

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices discounted at a real discount rate of seven percent per annum and discounted to a base year of 2007.

The economic indicators identify that **Option 1 RCR is the preferred option road alignment option.** In addition to this Option 1, Option 1 (MVRDLK), Option 2 and Option 3 (MVRDLK) are all economically justifiable and will return net positive benefits with the introduction of the scheme. Only Option 3 would return net negative results.

The benefits attributed to the Option1 RCR road alignment scheme are predominantly accounted for by cost savings introduced with the revised phase arrangements at key intersections on the Princes Highway.

It is the positive effects of the MVRDLK that results in Option 3 + MVRDLK returning reasonable benefit levels. Option 1 is viable alone, however it is considerably enhanced by the MVRDLK, and further enhanced by the RCR.

In general, the net present value criterion is the most appropriate criterion in evaluating one-off projects. However, where there is a budget constraint, it is desirable to maximise the return on investment, which is measured by BCR or NPVI. Thus Option 1 RCR is the preferred option.

6.4.2.1 Incremental Cost Benefit Analysis: Illaroo Road to Moss Vale Road Link

Further analysis of the economic appraisal results reveals that there is potential that the development of the Illaroo Road to Moss Vale Road Link could provide considerable benefits for road users. Incremental cost benefit analysis between Option 1 and Option 1 (MVRDLK) as well as between Option 3 and Option 3 (MVRDLK) show clear net benefits from the development of the Illaroo Road to Moss Vale Road Link.

The benefits and costs attributable to the Illaroo Road to Moss Vale Road Link can be derived by taking the difference of benefits and costs between the sub-options. From this point, incremental NPV and BCR estimates can be derived. For simplicity, only the incremental NPV and BCR results are reported, which are shown in **Table 6.22**.

Table 6.22: Incremental Cost Benefit Analysis ($2007): Illaroo Road - Moss Vale Road Link

Economic Indicator	Option 1	Option 1 (MVRDLK)	Option 3	Option 3 (MVRDLK)
Benefits	$19,399	$38,101	-$3,786	$34,051
Costs	$8,199	$19,030	$8,405	$19,236
Benefits attributable to MVRDLK	$18,702		$37,837	
Costs attributable to MVRDLK	$10,831		$10,831	
Incremental NPV	$7,871		$27,006	
Incremental BCR	1.73		3.49	

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices discounted at a real discount rate of seven percent per annum.

The incremental cost benefit analysis shows that the link is worthy of further consideration. For instance, if Option 1 were developed, the development of the Illaroo Road – Moss Vale Road Link is estimated to provide an additional $7.8 million in benefits, at a BCR of 1.73. Under both Options 1 and 3, net benefits increase with the development of the Illaroo Road – Moss Vale Road Link.

The incremental analysis, when compared with the isolated link road analysis, confirms that Option 1, and the Illaroo Road – Moss Vale Road link, provide benefits to the network, where as Option 3 does not.

The analysis shows that Council's NBSP proposed road network including Option 1 + MVRDLK would provide considerable benefits to the Nowra - Bomaderry road network if it was to accommodate growth as assumed in the NBSP.

6.4.2.2 Breakdown of Benefits

Travel time savings provide the primary justification for the development of a new east-west road link. With the exception of Option 3 (MVRDLK), the value of travel time savings provide almost all benefits or in some cases all the benefits.

In many cases, vehicle operating cost savings and accident cost savings are negative. This is as VKT forecasts under each of the development options are predicted to be higher than under the base case. As vehicle operating and accident costs are proportional to the level of VKTs, both costs are predicted to increase under each of the development options. Whilst at first glance this appears to result in a perverse increase in vehicle operating and accident costs, this may reflect a trade off between travelling longer distances to avoid congestion on the road network.

However, under Option 1 (MVRDLK), Option 2 and Option 3 (MVRDLK), the effect of increasing VKTs is negated by lower vehicle operating unit cost rates due to higher network speeds. According to Council, higher link speeds (compared to the link speeds modelled in Paramics for all options except Option 1 RCR) would be likely on Options 1 and 2, where as lower link speeds are likely on Options 3 without considerable offset from the existing West Cambewarra Road. The modelling of Option 1 RCR shows that higher link speeds are likely to contribute to increased economic benefits. The breakdown of benefits and costs attributable to each development option are shown in **Table 6.23**.

Table 6.23 Breakdown of Costs and Benefits by Option (in thousands of $2007)

Variable	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Construction costs	$7,303	$17,262	$9,881	$12,040	$7,693	$17,652
Maintenance costs	$896	$1,768	$971	$1,126	$712	$1,584
Total Costs	$8,199	$19,030	$10,852	$13,165	$8,405	$19,236
VOC savings	-$265	$2,091	$2,442	$839	-$2,094	$1,583
Travel time savings	$20,110	$36,026	$48,491	$22,959	-$1,072	$32,576
Accident savings	-$445	-$16	-$1,623	-$160	-$618	-$108
Total Benefits	$19,399	$38,101	$44,426	$23,638	-$3,785	$34,050
Net Present Value	$11,199	$19,071	$33,574	$10,473	-$12,191	$14,814

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices discounted at a real discount rate of seven percent per annum.

6.5 Sensitivity Analysis

Sensitivity analysis was conducted on key parameters used to underpin the model to test the robustness of inferences made in the previous section. Sensitivity tests were conducted on the following parameters:

- Discount rates (at four and ten percent);
- Construction cost contingency (at 10 percent and 50 percent);
- Earnings growth (no real earnings growth);
- Value of time (+/- 20 percent);
- Annualisation factor (260 days and 340 days);
- % Heavy Vehicles (7 percent and 20 percent); and
- Vehicle Operating Costs (+/- 20 percent).

The rankings between project options are robust to sensitivity tests undertaken. Of the sensitivity tests undertaken, the analysis is most sensitive to higher discount rates, a low annualisation factor and lower values of time. The other sensitivity tests have a lesser impact on affecting the magnitude of the economic returns for the project options. For the variation in the proportion of heavy vehicles, the analysis has only tested changes in the economic analysis model, and the alternative traffic flows and vehicle proportions have not been assessed in the Paramics model.

Specifically for Option 1, Option 1 + MVRDLK, and Option 1 + RCR, the NPV and BCR values are such that they would still be chosen over the base case and all other development options.

The results of the sensitivity analysis are shown in **Table 6.24** and **Table 6.25**.

Table 6.24: Sensitivity Analysis: Net Present Value (in thousands of $2007)

Variable	Option 1	Option 1 (MVRDLK)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Original values	**$11,200**	**$19,071**	**$33,574**	**$10,473**	**-$12,191**	**$14,815**
Low discount rate (4%)	$23,121	$41,791	$63,005	$24,304	-$16,880	$34,676
High discount rate (10%)	$5,298	$8,005	$18,551	$3,823	-$9,260	$5,286
Low contingency (10%)	$12,274	$21,592	$34,648	$12,229	-$11,089	$17,363
High contingency (50%)	$10,126	$16,551	$32,500	$8,717	-$13,293	$12,267
No real earnings growth	$8,420	$13,976	$26,953	$7,248	-$11,948	$10,221
Low value of time (-20%)	$7,178	$11,866	$23,876	$5,881	-$11,976	$8,299
High value of time (+20%)	$15,222	$26,277	$43,272	$15,065	-$12,405	$21,330
Low VOC (-20%)	$11,253	$18,653	$34,063	$10,305	-$11,772	$14,498
High VOC (+20%)	$11,147	$19,490	$33,086	$10,641	-$12,610	15,131
340 day annualisation	$12,532	$21,457	$36,785	$11,994	-$12,262	$16,972
260 day annualisation	$7,205	$11,914	$23,941	$5,912	-$11,978	$8,343
Low HGVs (7 percent)	$10,715	$18,105	$32,473	$9,876	-$12,085	13,953
High HGVs (20 percent)	$12,115	$20,931	$35,626	$11,616	-$12,421	16,470

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices discounted at a real discount rate of seven percent per annum.

Table 6.25: Sensitivity Analysis: Benefit Cost Ratio ($2007)

Variable	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Original values	**2.37**	**2.00**	**4.09**	**1.80**	**-0.45**	**1.77**
Low discount rate (4%)	3.25	2.76	5.67	2.49	-0.62	2.45
High discount rate (10%)	1.79	1.51	3.10	1.35	-0.34	1.34
Low contingency (10%)	2.72	2.31	4.54	2.07	-0.52	2.04
High contingency (50%)	2.09	1.77	3.72	1.58	-0.40	1.56
No real earnings growth	2.03	1.73	3.48	1.55	-0.42	1.53
Low value of time (-20%)	1.87	1.62	3.20	1.45	-0.42	1.43
High value of time (+20%)	2.86	2.38	4.99	2.14	-0.48	2.11
Low VOC (-20%)	2.37	1.98	4.14	1.78	-0.40	1.75
High VOC (+20%)	2.36	2.02	4.05	1.81	-0.50	1.79
340 day annualisation	2.53	2.13	4.39	1.91	-0.46	1.88
260 day annualisation	1.88	1.63	3.21	1.45	-0.43	1.43
Low HGVs (7 percent)	2.31	1.95	3.99	1.75	-0.44	1.73
High HGVs (20 percent)	2.48	2.10	4.28	1.88	-0.48	1.86

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows discounted at a real discount rate of seven percent per annum.

6.6 Qualitative Assessment

A range of factors has been identified that, at this stage, have not, or are not able to be quantified. The *NSW Guidelines for Economic Appraisals* and the *RTA Economic Analysis Manual* allow scope for the detailing of attributes that may impact on the economic viability in qualitative terms. The possible impact of the above mentioned attributes on the economic viability of a road link is described briefly as follows:

6.6.1.1 Deferral of Highway Investment

Council has suggested that the development of a new east-west road link has the potential to defer investment along the Princes Highway corridor. If this is the case, the deferral of construction expenditure on the Princes Highway is considered an economic benefit. Currently, it is not known to what extent a new road link can defer investment, and if investment were to occur, the size of the investment.

However, the value of deferred investment is not immaterial. For example, at a 7% discount rate, the present value of any investment can be reduced by 29% if construction can be deferred for five years. The present value of investment is further reduced if construction is deferred for a longer period.

6.6.1.2 Economic Development

A new road link has the potential to promote economic development through the provision of greater accessibility and mobility. The reduction in travel time associated with improved connectivity to regional road links provides the opportunity to consolidate and develop these areas to take advantage of improved access to key markets. The project may also assist in improving accessibility for visitors travelling to / from North Nowra and Bomaderry.

An additional benefit from construction spending on the development of a new road link is that it has the potential to generate economic activity within the region. However, the economic multiplier effects from expenditure on road construction generally would only have a short term impact.

6.6.1.3 Environmental Externalities

No attempt has been made to quantify, in monetary terms, the impact of any development option on the natural environment. An observation of the proposed route alignments appear to traverse through areas of bushland and recreation.

The development of any one of the options may result in a material degradation of the natural environment. However, this appraisal cannot make any accurate assertions as to the relative or absolute impacts on the natural environment resulting from each development option.

As part of a preliminary appraisal, environmental externalities resulting from future traffic levels have also been estimated. These are based on RTA values as described in the Economic Appraisal Manual and are summarised in **Table 6.26**. These unit values (based on 2005 values) have been increased by the retail price index factor to convert them to 2006 value equivalents and subsequently have been multiplied by the modelled vehicle kilometre estimates for each scenario to determine the environment externality impact of each alternative relative to the base case.

Table 6.26: Environmental Externality Values – Passenger Vehicles (cents per vehicle km)

Item	Value
Noise	0.79
Air pollution	2.37
Water pollution	0.35
Greenhouse	1.69
Nature and landscape	0.33

Source: RTA Economic Analysis Manual, Table 18.

Relative to the level of net road user benefits, the impact of environmental externalities in monetary terms is small. For completeness, the present value of the environmental externalities (including noise) over the evaluation horizon has been calculated for all options, relative to the base case, and is shown as follows:

Table 6.27: Environmental Externality Estimates ($2007)

Externality	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Noise	$39,396	$1,437	$143,527	$14,212	$54,688	$9,604
Air pollution	$118,189	$4,312	$430,581	$42,637	$164,065	$28,811
Water pollution	$17,454	$637	$63,588	$6,297	$24,229	$4,255
Greenhouse gases	$84,279	$3,075	$307,038	$30,404	$116,991	$20,544
Total	**$259,318**	**$9,461**	**$944,734**	**$93,550**	**$359,973**	**$63,213**

Source: AECOM calculations based on RTA (2006) parameters. Cash flows expressed on constant 2007 prices and have been discounted at a real discount rate of seven percent per annum. All values are in January 2007 dollars, and discounted to 2007.

Table 6.27 identifies that Option 1 + MVRDLK (i.e. in accordance with Council's NBSP proposed road network) has been shown to mitigate the impacts of growth by minimising environmental externalities to a much greater extent than any of the other options considered.

The impact of noise is discussed in further detail in **Section 7.0.**

6.6.1.4 Construction Impacts

The construction of a road link is likely to bring about short term negative impacts including the reduction of travel speeds, increasing the time required to travel between trip ends. Construction of road links also bring about the possibility of increased accident rates, noise, water quality and dust issues. However, as the new road links mainly involve the construction of a new road corridor, impacts on the existing road network may be limited to disruptions at the proposed intersections.

7.0 Noise Assessment

7.1 Introduction

AECOM (formerly Bassett Acoustics) was engaged by Shoalhaven City Council to assess the noise impacts of the proposed North Nowra to Bomaderry Link Road.

This noise assessment report includes:

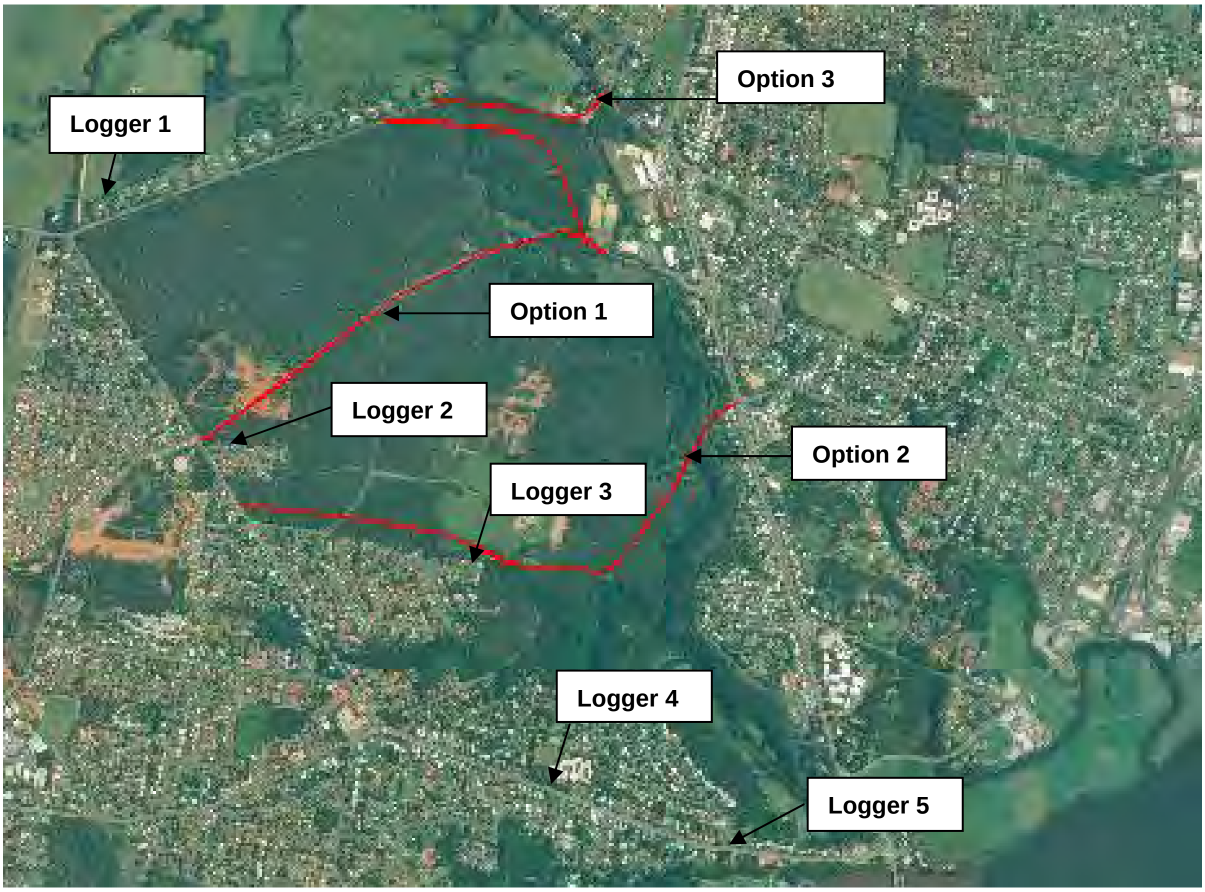
- A review of previous studies prepared by Council on the options analysis;
- A site level review of the road sections and proposed road alignments to ensure all sensitive land use and residential receivers are accounted for in the assessment process;
- Assessment of sleep disturbance due to the new proposed link road;
- Assessment of recreational areas;
- Monitoring of background noise levels at a number of indicative locations;
- Noise modelling of the predicted traffic conditions along each of the proposed road alignments;
- The effect of the proposed Link Road on noise levels along Illaroo Road and Princes Highway by assessing the change in traffic volumes on these roads; and
- Indicative noise mitigation measures.

Noise modelling was undertaken using SoundPLAN to model the existing noise environment (2006), the 2016 noise environment for the ‘Do Nothing 2016’ case without the Link Road and the noise environment in 2016 for each route option. The options were assessed at noise sensitive receivers against the NSW Department of Environment Climate Change and Water’s (DECCW) Environmental Criteria for Road Traffic Noise (ECRTN, 1999).

Noise logging was completed at the following locations as is indicated in **Figure 7.1**.

- Logger 1 3 West Cambewarra Road, North Nowra;
- Logger 2 9 Byron Avenue, North Nowra;
- Logger 3 11 Sutherland Drive, North Nowra;
- Logger 4 Illaroo Road Primary School, North Nowra; and
- Logger 5 45 Illaroo Road, North Nowra.

Figure 7.1: Noise Logger Locations



Source: AECOM

7.2 Ambient Noise Measurements

7.2.1 Unattended Noise Measurements

Four Infobyte noise loggers and one SVAN noise logger were used to continuously measure ambient noise levels at representative receivers on the surrounding road network. The loggers were located at 3 Cambewarra Road, 9 Byron Avenue, 11 Sutherland Drive, 45 Illaroo Road and Illaroo Road Primary School between 18 July 2006 and 26 July 2006. The logger at 45 Illaroo Road malfunctioned during this period requiring additional logging at this location between 26 July 2006 and 3 August 2006.

It should be noted that noise monitoring was not undertaken east of Bomaderry Creek as the road traffic flows, and hence road traffic noise levels, were not predicted to change as substantially as on nearby roads such as Illaroo Road, West Cambewarra Road and the Link Road and therefore these locations were used in preference to the Princes Highway. Five logger locations were considered adequate to calibrate the road traffic noise model accurately.

A noise logger measures the noise level over the sample period and then determines $L_{A,1}$, $L_{A,10}$, $L_{A,90}$, $L_{A,max}$ and $L_{A,eq}$ levels of the noise environment. The $L_{A,1}$, $L_{A,10}$ and $L_{A,90}$ levels are the levels exceeded for 1%, 10% and 90% of the sample period respectively. The $L_{A,max}$ is indicative of maximum noise levels due to individual noise events such as the pass by of a heavy vehicle. The $L_{A,90}$ is taken as the background noise level. The $L_{A,eq}$ level is the equivalent continuous sound level and has the same sound energy over the sample period as the actual noise environment with fluctuating sound levels. Refer to **Appendix G** for further explanation of acoustic parameters.

Table 7.1 below presents individual Rating Background Level (RBL's) and Road traffic noise levels for the assessment periods. Graphical representations of the logged noise levels are included in **Appendix H**. The major ambient noise sources in the area are road traffic noise, apart from at 11 Sutherland Drive which is located approximately 500 m from Illaroo Road. The noise levels at this location appear to be dominated by noise emissions associated with the residence.

Table 7.1: Existing Ambient Noise Levels, ($L_{A,90}$)

Logger	Location	RBL, $L_{A,90}$ dB(A)			ANL, $L_{Aeq\ 1\ hr}$ dB(A)	
		Day (0700 - 1800)	Evening (1800 - 2200)	Night (2200 - 0700)	Day (0700 - 2200)	Night (2200 - 0700)
1	3 West Cambewarra Road	34	34	33	49[2]	47[2]
2	9 Byron Avenue	37	33	29	50[2]	43[2]
3	11 Sutherland Drive[1]	34	47	43	52[2]	51[2]
4	Illaroo Road Public School	52	41	36	70[2]	64[2]
5	45 Illaroo Road	54	44	30	73	67

Note 1: The noise levels at this location appear to be dominated by night-time noise emissions from the property.
Note 2: Free field (no façade correction)
Source: Bassett Acoustics

7.2.2 Existing Road Traffic Noise in Parkland

Logging of existing traffic noise levels was not conducted in the woodland areas. In these types of areas, well away from traffic noise, measurements are often affected by extraneous noise from wildlife and wind induced noise in trees. For this reason the calibrated noise model has been used to identify the existing traffic noise contribution within the recreational areas rather than unattended logging. This is a widely used method of determining noise level contributions when logged data is affected by other noise sources. The noise model was calibrated for the existing traffic conditions during AECOM's (formerly Bassett Acoustics) previous assessment.

7.3 Noise Criteria

The NSW DECCW recommends that traffic noise impacts on potentially affected residences be assessed according to their published documentation Environmental Criteria for Road Traffic Noise (ECRTN), 1999. The ECRTN classifies roads according to the functional categories applied by the Road Traffic Authority (RTA). The RTA differentiates roads by a range of factors, including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options. ECRTN also recognises that in some cases there will be extra noise sensitivities, for example, places of worship and schools, where more stringent standards are expected.

The functional category for the proposed North Nowra - Bomaderry Link Road and surrounding network is 'collector road'. Under the ECRTN there are two development classifications and associated criteria that are applicable for this development. The classifications and criteria (day and night) that are applicable are summarised in **Table 7.2**. For the purposes of this assessment the 'existing' noise emissions were taken to be the estimated noise levels in 2016 for the 'Do Nothing 2016' option without a Link Road between Illaroo Road and Princes Highway. With exception of the Passive Recreation Areas these noise levels are taken to be at 1 m from the building façade.

Table 7.2: Summary of Relevant Criteria

Area under conside-ration	Type of Development	Criteria		
		Day (7am-10pm)	Night (10pm-7am)	Where criteria are already exceeded
New Link Road	New collector road	$L_{Aeq(1hr)}$ 60 dB(A)	$L_{Aeq(1hr)}$ 55 dB(A)	The new road should be designed so as not to increase existing noise levels by more than 0.5 dB. Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In some instances this may only be achievable through long term strategies, such as improved planning, design and construction of adjoining land use developments, reduced vehicle emission levels through new vehicle standards; greater use of public transport and alternative methods of freight haulage.
Surrounding Collector Roads	Redevelopment of existing collector road	$L_{Aeq(1hr)}$ 60 dB(A)	$L_{Aeq(1hr)}$ 55 dB(A)	The new road should be designed so as not to increase existing noise levels by more than 2 dB. Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In some instances this may only be achievable through long term strategies, such as improved planning, design and construction of adjoining land use developments, reduced vehicle emission levels through new vehicle standards; greater use of public transport and alternative methods of freight haulage.
Bush and Parkland	Passive Recreation Areas	$L_{Aeq(1hr)}$ 55 dB(A)		Where existing levels of traffic noise exceed the criteria, all feasible and reasonable noise control measures should be evaluated and applied. Where this has been done and the internal or external criteria (as appropriate) cannot be achieved, the proposed road or land use development should be designed so as not to increase existing road traffic noise levels by more than 0.5 dB(A) for new roads and 2 dB(A) for redeveloped roads or land use development with potential to create additional traffic.

Note: Criteria apply at 1 m from the façade that is most exposed to traffic noise

The RTA also has an Environmental Noise Management Manual (ENMM, 2001), which incorporates noise criteria from ECRTN with the addition of various assessment procedures and practice notes applicable to the RTA. ENMM Practice Note (i) sets out principles which can be applied in determining the most appropriate road development category, and hence the corresponding noise target criteria, in otherwise difficult-to-interpret situations, especially where there is a transition between the road categories, including minor and substantial realignments. This should be referred to once the preferred option has been identified to ensure that all reasonable and feasible mitigation has been included in the design.

Residents that experience little or no traffic noise are likely to be more affected by traffic noise on a new road alignment than those residents that experience some road traffic noise where noise from traffic on a realigned or upgraded road may make little or no change. This requires road sections to be categorised according to relevant DECCW classifications, rather than a single classification for the whole route.

ENMM also recognises the increased importance in relation to 'acute' traffic noise, where the RTA advise that for affected residents, noise control options are to be identified, irrespective of the change in noise levels predicted.

7.4 Project Specific Noise Criteria

The project specific noise criteria at representative locations for the North Nowra to Bomaderry Link Road are presented in **Table 7.3**. The criteria were established from the ambient noise measurements and the ECRTN noise criteria. Potential noise impacts at other receivers are discussed in **Section 7.7** and refer to figures in the attached appendices.

Table 7.3: Project Specific Noise Criteria

Location	$L_{Aeq\ (1hr)}$	
	Day	Night
3 West Cambewarra Road	60	55
9 Byron Avenue	60	55
11 Sutherland Drive	60	55
Illaroo Road Public School[1]	75	69
45 Illaroo Road[1]	75	69
Locations that may be impacted by additional noise from the new road and criteria are already exceeded in 2016[1] • Byron Avenue near Illaroo Road for Option 1 • Princess Highway near intersection for Option 2	Existing (2016) + 0.5	
Locations that may be impacted by additional noise on the existing road network due to the new road and criteria are already exceeded in 2016[1] • Princes Highway • Illaroo Road	Existing (2016) + 2	

Note 1: This assumes that all feasible and reasonable noise mitigation measures have been considered

7.5 Sleep Disturbance

The ENMM requires an investigation of sleep disturbance during an options assessment. The purpose of this is to assist in ranking the options but not the specification of noise mitigation. The DECCW's ECRTN provides a detailed discussion of the issues involved in sleep disturbance.

The following summary from the ECRTN provides recommendations for noise criteria to control maximum internal noise levels.

The following characteristics of a noise signal are identified as being strongly related to sleep disturbance:

- The peak level of the noise events, described by either $L_{A1,\ (1minute)}$ or L_{Amax};
- The emergence of noise events above the general ambient noise level, described by measures such as ($L_{Amax} - L_{Aeq}$) or ($L_{Amax} - L_{A90}$);
- The number of such noise events occurring during the sleeping period;

A comparison of the existing research on sleep arousal results in the following conclusions:

- Maximum internal noise levels below 55 dB(A) are unlikely to cause awakening reactions (this is equivalent to an external noise level of 65 dB(A) allowing for a 10 dB(A) noise reduction for windows open for natural ventilation);
- One or two noise events per night, with maximum internal noise levels of 70 dB(A), are not likely to affect health and well being significantly.

7.6 Noise Modelling

7.6.1 Methodology and Modelling Assumptions

7.6.1.1 SoundPLAN Parameters

Traffic noise levels at sensitive land uses and residences identified within the noise catchment area were calculated using the SoundPLAN modelling software package. SoundPLAN is used extensively worldwide, and takes a standards-based approach to modelling, where noise propagation calculations are carried out in accordance with accepted standards as used in various countries. SoundPLAN implements the 1988 version of the UK Calculation of Road Traffic Noise (CoRTN) prediction model.

The road surface for the Link Road was modelled as standard Dense Graded Asphalt. A correction of +2.5 dB(A) has been applied to the External Noise Level results to take into account façade effects. In addition a +1.5 dB(A) calibration factor was applied to calibrate the model with measured noise levels on Illaroo Road. Ground absorption on Illaroo Road and Princes Highway was set to 25% soft ground.

The modelling of noise levels at residences in the vicinity of Byron Avenue, Falcon Crescent, Halcot Avenue and Sutherland Drive included up to three rows of houses along Illaroo Road to provide representative levels of shielding in areas that are not currently significantly affected by road traffic noise but may be affected by the proposed routes.

The CoRTN algorithm predicts L_{A10} noise levels rather than L_{Aeq} noise levels as required by the ECRTN. The L_{A10} levels predicted using CoRTN were adjusted to L_{Aeq} noise levels by subtracting 3 dB(A). This is a typical correction commonly used in NSW for road modelling with the RTA.

7.6.1.2 Intersections

The introduction of a signalised intersection to a route that is predominantly free flowing has been shown by some studies to result in an increase in noise level close to the signal-controlled junction. A Japanese [1] study showed that the increase in noise level varied according to the specific traffic conditions of the road but on average was 2.4 dB(A) higher than an equivalent continuous traffic flow condition.

An American [2] study suggests that the installation of a roundabout causes slightly less noise than a signalised intersection. A noise increase of 1 to 2 dB(A) is suggested for a roundabout compared to the equivalent continuous traffic flow condition.

For this assessment 2.4 dB(A) has been added to the results for receivers near a new intersection to take into account the change from free flowing traffic conditions to a situation where traffic is required to pass through an intersection.

7.6.1.3 Time Period

The daytime period was modelled in SoundPLAN for this assessment as this appears to be the worst case in terms of exceeding the noise criteria based on the noise logging data. Factors that support this conclusion are:

- The logging data indicates that both the peak AM and PM traffic flow periods occur during the daytime period; and
- The ECRTN criteria are 5 dB(A) lower for the night-time period and the measured night-time noise levels are 7 dB(A) lower. This indicates that the most significant impact in terms of exceeding the ECRTN goals will occur during the daytime period.

7.6.1.4 Traffic Volumes

There are a significant number of road segments in this model due to the high number of intersections within the study area. Typical traffic flows are in the order of 450 to 500 vehicles per hour for the Link Road under consideration, 1,400 vehicles per hour on the northern section of Princes Highway, 4,200 vehicles per hour on the southern section of Princes Highway, 550 vehicles per hour on the northern section of Illaroo Road and 1,500 vehicles per hour on the southern section of Illaroo Road. Traffic volumes within the study area under different link road options can be found in **Appendix C**. The worst case traffic volumes during the daytime period were modelled. In most cases these were the PM traffic volumes.

Vehicle speeds have been modelled as indicated in **Table 3.2**.

Noise emission from traffic flows have been modelled for the Option under consideration, along the new road and significant roads on the surrounding road network. The major roads included in this assessment were:

- Illaroo Road;
- Princes Highway; and
- Link Road Under Consideration

The road traffic volumes and noise emission levels on surrounding roads were also calculated during the assessment. Note that the noise assessment of the surrounding road network was only included as a 'check' to ensure that all of the impacts had been captured and was beyond the scope of work of this study. Assessments for these roads are not calibrated and therefore can not be interpreted as being representative of the roads in their entirety. Impacts on these roads could potentially occur as it appears that the surrounding networks carry significant levels of traffic and may have existing noise levels close to the ECRTN criteria. Roads included for noise assessment for the "surrounding road network" include:

- McMahons Road;
- Pitt Street;
- Page Avenue;
- West Cambewarra Road;
- Moss Vale Road;
- Narang Road;
- Bunberra Street;
- Cambewarra Road;
- Meroo Street;
- Bolong Road; and
- Belinda Street.

7.7 Acoustic Assessment

7.7.1 General

The following tables present a range of noise levels at representative receivers that may be expected at residential buildings of single and double storey construction for each Option and the existing (2006) and 'Do Nothing 2016' scenario). Data is presented as a range due to differences in setback from the roads and differing degrees of shielding for individual residences on each road.

The daytime noise levels have been modelled for this study as the daytime criteria are the controlling criteria. Night-time noise levels are typically 7dB(A) less than the night-time criteria within this study area.

The predicted daytime noise level contours for the 'Do Nothing 2016' scenario are shown in **Appendix J** at individual residences and in recreational areas.

The noise level contours and the expected increase in noise levels at individual receivers for each of the route options can be identified in **Appendix K**. The noise contours in **Appendix K** also indicate where noise levels increase from the 'Do Nothing 2016' scenario by 0.5 and 2 dB(A) from the impact of 'new' and 'existing' roads respectively. Lots where the noise criterion of 60 dB(A) has been exceeded and the noise levels are increased by 0.5 and 2 dB(A) are denoted by red shaded areas. The 0.5 dB(A) increase is applicable where lots are adjacent to the proposed link road and 2 dB(A) increase is applicable where lots are adjacent to existing roads. The noise levels in recreation areas are illustrated in **Appendix L**. Approximate areas of land zoned in the Shoalhaven Local Environmental Plan 2009 Land Zoning Map – Sheets LZN_19 & LZN_20 as 'RE1 Public Recreation', 'E1 National Parks and Nature Reserves' or 'E2 Environmental Conservation' affected by road traffic noise (>55 dB(A)) are detailed in the following sections. The L_{Amax} noise levels from individual vehicle driveby that influences sleep disturbance are shown in **Appendix M** for each of the route options.

During the assessment against ECRTN criteria consideration was given to each individual residence along each route. The noise impacts are summarised within the tables below at representative locations.

The surrounding road network in the tables shows a summary of the range in noise levels at representative locations. This was to ensure that there were no significant changes in traffic noise levels outside of the study area.

It should be noted that the purpose of this report is to determine a ranking of route options based on road traffic noise impact.

7.7.2 Future 2016 – Do Nothing (No Link Road)

The daytime noise level contours for the ‘Do Nothing 2016’ scenario are shown in **Appendix J** at individual residences and in recreational areas. The noise levels in some locations along the Princes Highway and Illaroo Road currently exceed the 60 dB(A) daytime criterion. The noise levels in the bushland recreation areas are mostly below the 55 dB(A) criterion for ‘passive recreation’ areas. However this criterion is exceeded at distances less than 50 m from Illaroo Road and 380 m from Princes Highway.

The noise levels at representative locations are presented below in **Table 7.4.** It shows that there may be a significant increase in noise levels at these locations without the construction of a new Link Road between Illaroo Road and Princes Highway. The noise levels increase at a greater rate at logger location 3 due to increase traffic flows in this region as per the Structure Plan. This is attributed to developments in the area along Illaroo Road.

Table 7.4: Do Nothing Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq(1hr)}$	
	Existing (2006)	Do Nothing 2016
Byron Av	48 to 57	51 to 59
Narang Rd	61 to 65	66 to 71
Princes Hwy / Narang Rd intersection	64 to 73	70 to 78
Princes Hwy / West Bunberra St intersection	72 to 75	76 to 78
Illaroo Road / Pitt Street intersection, Option 1	55 to 69	57 to 71
Illaroo Road, new intersection, Option 2	63 to 66	66 to 69
Illaroo Road / West Cambewarra Rd intersection	63 to 64	66 to 67
Falcon Cr near Illaroo Road	49 to 57	52 to 60
Sutherland Dr	50 to 50	52 to 53
West Cambewarra Rd	48 to 55	50 to 55
Moss Vale Rd (up 500 m from Princes Highway)	54 to 66	58 to 69
Moss Vale Rd / Elvin Rd Intersection	54 to 59	58 to 62
Logger 1, 3 West Cambewarra Rd	53	53
Logger 2, 9 Byron Ave	53	56
Logger 3, 11 Sutherland Drive	50	53
Logger 4, Illaroo Rd Primary	73	74
Logger 5, 45 Illaroo Rd	74	75
Surrounding Road Network	48 to 76	50 to 78

7.7.3 Option 1 (Link Road – Pitt Street to Narang Road)

Figure 1 in **Appendix K** shows the predicted daytime noise levels for Option 1 and the expected increase in noise levels relative to the ‘Do Nothing 2016’ case. The number of residences where noise levels increase by more than 0.5 dB(A) is 621. Of these residences there are 46 where the noise levels increase by more than 2 dB(A).

The noise levels increase in the recreation area due to the proposed route is as illustrated in Figure 1 **Appendix L**. The criterion is exceeded for an area of approximately 57 ha within passive recreational areas. One lookout point and picnic area fall within the 55 dB(A) contour area, however the picnic area is approximately 50 m from the proposed route. Part of the Bomaderry Creek Walking Track and a very small part of Burnie's Walk are also located with the 55 dB(A) contour area. .

The noise contours in **Appendix M** indicate that there are 52 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by.

The noise levels at representative locations are presented below in **Table 7.5**. There are a significant number of properties where the existing (2006) and the predicted 'Do Nothing 2016' noise levels exceed the ECRTN noise goals. The Option 1 Link Road, other than for properties in the vicinity of Byron Avenue and Narang Road, is not expected to impact significantly on the surrounding road network.

The residents that would be most affected are those at the Illaroo Road end of Byron Avenue. These residents may experience noise levels that exceed the daytime ECRTN noise goal of 60 dB(A) in 2016 due to noise from Illaroo Road and be subjected to a greater than 0.5 dB(A) noise increase due to traffic on the proposed Option 1 Link Road.

The additional noise impacts at locations on the surrounding roads are not predicted to be significant.

There may be a slight reduction in noise level (relative to the 'Do Nothing 2016' scenario) of less than 1 dB(A) near 45 Illaroo Road and Illaroo Road Primary School with the Link Road (i.e. taking noise levels back to equivalent 2006 levels). However in practice a reduction of that order would be barely perceivable and would be within the margin of error of measurement.

Table 7.5 Option 1 Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq\ (1hr)}$			Noise Goals Exceeded[1]			
	Existing (2006)	Do Nothing 2016	Option 1	Do Nothing >60dB(A)	Option 1 >60dB(A)	Relative to Do Nothing >0.5dB(A)	Relative to Do Nothing >2dB(A)
Byron Av	49 to 58	51 to 59	53 to 62	No	Yes	Yes	N/A
Narang Rd	61 to 65	66 to 71	69 to 71	Yes	Yes	N/A	Yes
Princes Hwy / Narang Rd intersection	64 to 73	70 to 78	70 to 77	Yes	Yes	N/A	No
Upgraded Illaroo Road / Pitt Street intersection	55 to 69	57 to 71	60 to 73	Yes	Yes	N/A	No
Falcon Cr near Illaroo Rd	54 to 59	52 to 60	53 to 60	No	No	N/A	N/A
Sutherland Dr	50 to 50	52 to 53	52 to 52	No	No	N/A	N/A
West Cambewarra Rd	48 to 55	50 to 55	51 to 55	No	No	N/A	N/A
Moss Vale Rd (up 500 m from Princes Highway)	54 to 66	58 to 69	58 to 69	Yes	Yes	N/A	No
Moss Vale Rd and Elvin Rd Intersection	54 to 59	58 to 62	58 to 62	Yes	Yes	N/A	No
Logger 1, 3 West Cambewarra Rd	53	53	54	No	No	N/A	No
Logger 2, 9 Byron Ave	54	56	59	No	No	N/A	N/A
Logger 3, 11 Sutherland Dr	50	53	52	No	No	N/A	N/A
Logger 4, Illaroo Rd Primary	73	74	73	Yes	Yes	N/A	No
Logger 5, 45 Illaroo Rd	74	75	74	Yes	Yes	N/A	No
Surrounding Road Network	48 to 76	50 to 78	51 to 78	Yes	Yes	N/A	No

Note 1: Where target noise goals are exceeded for the 'Do Nothing' scenario the ECRTN 60 dB(A) criterion applies. Where the target noise levels exceed the 60 dB(A) criterion for the 'Do Nothing' case then the noise levels should not increase by more than +0.5 dB(A) due to the new road and +2 dB(A) due to traffic changes on the existing road network due to the development.

The level of mitigation required to meet the noise criteria at Byron Avenue is in the order of 0.5 to 2 dB(A). This may be achieved with a 2 m high berm or noise barrier or a low noise road surface.

However given that the level of noise mitigation required is relatively small this should be re-considered during the detailed design phase when the final road alignment and pavement elevation are known.

The noise levels increase near the upgraded intersection to a higher degree than at other locations due to noise associated with the stopping and starting of vehicles on the Link Road.

7.7.4 Option 2 (Link Road – Illaroo Road North of Falcon Cr to SH1 / West Bunberra Street)

The predicted daytime noise levels for Option 2 and the expected increase in noise levels relative to the 'Do Nothing 2016' case are shown in Figure 2 of **Appendix K**. The number of residences where noise levels increase by more than 0.5 dB(A) is 706. Of these residences there are 202 where the noise levels increase by more than 2 dB(A).

The noise levels in the recreation area increase due to the proposed route as is illustrated in Figure 2 **Appendix L**. The criterion is exceeded for an area of approximately 60 ha within passive recreational areas. No picnic area, lookout point or walking track within the regional park fall within the 55 dB(A) contour.

The noise contours in **Appendix M** indicate that there are 104 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by.

The noise levels at representative locations are presented below in **Table 7.6.** There are a significant number of properties where the existing (2006) and the predicted 'Do Nothing 2016' noise levels exceed the ECRTN noise goals. The Option 2 Link Road may impact on residences in the vicinity of Falcon Crescent, Sutherland Drive, a new intersection at Illaroo Road and at the intersection on Princes Highway at Bunberra Street.

Noise levels will increase at Sutherland Drive, Warren Avenue, Narrien Place by up to 8 dB(A), although criteria may only be exceeded by 1 dB(A). Based on the information provided to AECOM, it appears that the Option 2 Link Road passes through the corner of Lot 118 DP 751258 (Por 118) Jamieson Road. Noise levels are expected to exceed the 60 dB(A) criteria within the subdivision. If possible the alignment of Option 2 should be adjusted so that it does not pass closer than 70 m from the nearest residential property boundary. This is to avoid the need for a noise wall or berm. A lesser setback could be considered with an appropriate noise wall or berm. The noise levels Lot 118 DP 751258 (Por 118) Jamieson Road should be reviewed during detailed design once the final alignment and location of residences within the subdivision are known.

The noise levels, near the proposed new intersection at Illaroo Road (Illaroo Road and Falcon Street), already exceed the daytime ECRTN noise criteria of 60 dB(A) in 2016. This restricts the maximum increase under the ECRTN noise criteria to 2 dB(A) due to changes in traffic on the existing road network and 0.5 dB(A) due to noise emission from the new road and intersection. The expected increase due to additional traffic and the interruption to traffic flow on Illaroo Road exceeds these criteria. Mitigation other than property treatments may be impractical at these locations.

The increase in noise levels for receivers at the Princes Highway intersection from the new road may be reduced with a noise wall in the order of 2.5 m in height. This would need to be reviewed following confirmation of the final road layout and pavement levels. Subject to design, it is considered that this (provision of noise wall) would be effective in offsetting the adverse noise impacts of the Link Road Option 2 only on adjacent properties, and would not be effective in offsetting the predominant noise source – that is the adverse noise impacts associated with background traffic growth on Princes Highway.

As with Option 1 the additional noise impacts at locations on the surrounding road are not predicted to be significant. There may be a slight reduction in noise level (relative to the 'Do Nothing 2016' scenario) of less than 1 dB(A) near 45 Illaroo Road and Illaroo Road Primary School with the Link Road (i.e. taking noise levels back to equivalent 2006 levels). However in practice a reduction of that order would be barely perceivable and is within the margin of error of measurement.

Table 7.6: Option 2 Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq\ (1hr)}$			Noise Goals Exceeded[1]			
	Existing (2006)	Do Nothing 2016	Option 2	Do Nothing >60dB(A)	Option 2 >60dB(A)	Relative to Do Nothing >0.5dB(A)	Relative to Do Nothing >2dB(A)
Byron Av	49 to 58	51 to 59	52 to 59	No	No	N/A	N/A
Narang Rd	61 to 65	66 to 71	65 to 70	Yes	Yes	N/A	No
Princes Hwy / West Bunberra St intersection	72 to 73	76 to 77	77 to 78	Yes	Yes	N/A	No
New Illaroo Rd intersection	63 to 66	66 to 69	69 to 72	Yes	Yes	Yes	N/A
Falcon Cr near Illaroo Rd	54 to 59	52 to 60	57 to 62	No	Yes	Yes	Yes
Sutherland Dr	50 to 50	52 to 53	59 to 61	No	Yes	N/A	Yes
West Cambewarra Rd	48 to 55	50 to 55	50 to 55	No	No	N/A	N/A
Moss Vale Rd (up 500 m from Princes Highway)	54 to 66	58 to 69	58 to 70	Yes	Yes	N/A	No
Moss Vale Rd and Elvin Rd intersection	54 to 59	58 to 62	58 to 63	Yes	Yes	N/A	No
Logger 1, 3 West Cambewarra Rd	53	53	53	No	No	N/A	N/A
Logger 2, 9 Byron Ave	54	56	56	No	No	N/A	N/A
Logger 3, 11 Sutherland Dr	50	53	61	No	Yes	N/A	Yes
Logger 4, Illaroo Rd Primary	73	74	73	Yes	Yes	N/A	No
Logger 5, 45 Illaroo Rd	74	75	75	Yes	Yes	N/A	No
Surrounding Road Network	48 to 76	50 to 78	50 to 78	Yes	Yes	N/A	No

Note 1: Where target noise goals are exceeded for the 'Do Nothing' scenario the ECRTN 60 dB(A) criterion applies. Where the target noise levels exceed the 60 dB(A) criterion for the 'Do Nothing' case then the noise levels should not increase by more than +0.5 dB(A) due to the new road and +2 dB(A) due to traffic changes on the existing road network due to the development.

The noise levels increase near the new intersection to a higher degree than at other locations due to noise associated with the stopping and starting of vehicles on the link road.

7.7.5 Option 3 (Link Road - West Cambewarra Road to Moss Vale Rd at Elvin Drive)

The predicted daytime noise levels for Option 3 and the expected increase in noise levels relative to the 'Do Nothing 2016' case are shown in Figure 3 of **Appendix K**. The number of residences where noise levels increase by more than 0.5 dB(A) is 686. Of these residences there are 74 where the noise levels increase by more than 2 dB(A).

The noise levels in the recreation area increase due to the proposed route as is illustrated in Figure 3 **Appendix L**. The criterion is exceeded for an area of approximately 53 ha within passive recreational areas. No picnic area, lookout point or walking track within the regional park fall within the 55 dB(A) contour.

The noise contours in **Appendix M** indicate that there are 43 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by.

The noise levels at representative locations are presented below for Option 3 in **Table 7.7**. The table indicates that the ECRTN noise criteria may be exceeded by up to 6 dB(A) at residences along West Cambewarra Road and Moss Vale Road.

While it may be possible to construct noise walls that achieve 6 dB(A) of noise reduction it may not be feasible as these residences have access driveways to these roads. The access points would create gaps in the noise wall and significantly reduce the amount of noise reduction that may be obtained. A noise reduction of up to 2 dB(A) may be achieved through a change in road surface type from Dense Graded Asphalt to Open Graded Asphalt;

however this may not be sufficient reduction to meet the ECRTN noise goals. Another alternative would be to consider property treatments; however, these only reduce the internal noise levels and do not protect the amenity of outdoor areas.

Similar to considerations stated for Option 2, Option 3 may need to be offset from the existing Cambewarra Road alignment (by minimum of 70 m from nearest property boundary) in order to ensure noise impacts fall within acceptable limits. This may improve the design and mitigate the direct impacts of traffic growth as the existing Cambewarra Road could be retained as service road with a single access point back to Link Road.

However this would require considerable encroachment into the adjacent Regional Park in the order of some 80 m. It is noted that the dedication of the adjacent lands as Regional Park made an allowance of only 10m encroachment into the Regional Park, increasing the existing 20 m road reserve to 30 m to make adequate allowance for a higher standard (Link Road) construction. This would not be sufficient to attenuate noise impacts, and would mean direct impact of the Link Road on existing residences. A minimum additional 70 m encroachment into the adjacent Regional Park would be necessary to accommodate the Link Road within acceptable limits without a noise wall or berm.

The encroachment into the Regional Park could be reduced significantly if a berm or barrier was constructed between the Link Road and the existing West Cambewarra Road subject to appropriate road geometry of the road connection to West Cambewarra Road.

The difference (increase or decrease) in noise levels at locations on the surrounding road are not predicted to be significant and barely perceivable compared with the 'Do Nothing 2016' option.

Table 7.7: Option 3 Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq\ (1hr)}$			Noise Goals Exceeded[1]			
	Existing (2006)	Do Nothing 2016	Option 3	Do Nothing >60dB(A)	Option 3 >60dB(A)	Relative to Do Nothing >0.5dB(A)	Relative to Do Nothing >2dB(A)
Byron Av	49 to 58	51 to 59	51 to 59	No	No	N/A	N/A
Narang Rd	61 to 65	66 to 71	65 to 70	Yes	Yes	N/A	No
Princes Hwy / Narang Rd intersection	64 to 73	70 to 78	69 to 76	Yes	Yes	N/A	No
Falcon Cr near Illaroo Rd	54 to 59	52 to 60	51 to 59	No	No	N/A	N/A
Sutherland Dr	50 to 50	52 to 53	51 to 52	No	No	N/A	N/A
West Cambewarra Rd	48 to 55	50 to 55	60 to 66	No	Yes	N/A	N/A
Moss Vale Rd (up to 500 m from Princes Highway)	54 to 66	58 to 69	59 to 70	Yes	Yes	N/A	No
Moss Vale Rd / Elvin Rd / West Cambewarra Rd intersection	54 to 59	58 to 62	59 to 64	Yes	Yes	N/A	No
West Cambewarra Rd / Illaroo Road intersection	63 to 64	66 to 67	67 to 68	Yes	Yes	N/A	No
Logger 1, 3 West Cambewarra Rd	53	53	64	No	Yes	N/A	Yes
Logger 2, 9 Byron Ave	54	56	55	No	No	N/A	N/A
Logger 3, 11 Sutherland Dr	50	53	52	No	No	N/A	N/A
Logger 4, Illaroo Rd Primary	73	74	73	Yes	Yes	N/A	No
Logger 5, 45 Illaroo Rd	74	75	74	Yes	Yes	N/A	No
Surrounding Road Network	48 to 76	50 to 78	50 to 77	Yes	Yes	N/A	No

*Note 1: Where target noise goals are exceeded for the 'Do Nothing' scenario the ECRTN 60 dB(A) criterion applies. Where the target noise levels exceed the 60 dB(A) criterion for the 'Do Nothing' case then the noise levels should not increase by more than +0.5 dB(A) due to the new road and +2 dB(A) due to traffic changes on the existing road network due to the development***.**

7.7.6 Option 1 with Moss Vale Road link

The predicted daytime noise levels for Option 1 with Moss Vale Road Link (MVRDLK) and the expected increase in noise levels relative to the 'Do Nothing 2016' case are shown in Figure 4 of **Appendix K**. The number of residences where noise levels increase by more than 0.5 dB(A) is 655. Of these residences there are 80 where the noise levels increase by more than 2 dB(A).

The noise levels in the recreation area increase due to the proposed route as is illustrated in Figure 4 **Appendix L**. The criterion is exceeded for an area of approximately 64 ha within passive recreational areas. One lookout point and picnic area fall within the 55 dB(A) contour area, however the picnic area is approximately 50 m from the proposed route. Part of the Bomaderry Creek Walking Track and a very small part of Burnie's Walk are also located with the 55 dB(A) contour area. .

The noise contours in **Appendix M** indicate that there are 52 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by.

The noise levels at representative locations are presented below in **Table 7.8**. The values indicate that the addition of the Moss Vale Road Link does not provide any significant additional impact compared with Option 1 within the options study area. The mitigation measures discussed in Option 1 would be applicable to this scenario. Noise levels increase on Moss Vale Road and West Cambewarra Road due to the MVRDLK, primarily near the MVRDLK intersections. However the expected increase in noise levels is expected to be less than 2 dB(A). These should be considered further as part of a more detailed assessment of the MVRDLK.

Table 7.8: Option 1 + MVRDLK Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq\ (1hr)}$			Noise Goals Exceeded[1]			
	Existing (2006)	Do Nothing 2016	Option 1 +MVRDLK	Do Nothing >60dB(A)	Option 1 +MVRDLK >60dB(A)	Relative to Do Nothing >0.5dB(A)	Relative to Do Nothing >2dB(A)
Byron Av	49 to 58	51 to 59	53 to 62	No	No	Yes	N/A
Narang Rd	61 to 65	66 to 71	69 to 71	Yes	Yes	N/A	Yes
Princes Hwy / Narang Rd intersection	64 to 73	70 to 78	70 to 77	Yes	Yes	N/A	No
Upgraded Illaroo Road / Pitt Street intersection	55 to 69	57 to 71	60 to 73	Yes	Yes	N/A	No
Falcon Cr near Illaroo Rd	54 to 59	52 to 60	52 to 59	No	No	N/A	No
Sutherland Dr	50 to 50	52 to 53	51 to 52	No	No	N/A	No
West Cambewarra Rd	48 to 55	50 to 55	51 to 57	No	No	N/A	No
Moss Vale Rd (up 500 m from Princes Highway)	54 to 66	58 to 69	59 to 70	Yes	Yes	N/A	No
Moss Vale Rd and Elvin Rd Intersection	54 to 59	58 to 62	59 to 63	Yes	Yes	N/A	No
Logger 1, 3 West Cambewarra Rd	53	53	55	No	No	N/A	N/A
Logger 2, 9 Byron Ave	54	56	59	No	No	N/A	N/A
Logger 3, 11 Sutherland Dr	50	53	52	No	No	N/A	N/A
Logger 4, Illaroo Rd Primary	73	74	73	Yes	Yes	N/A	No
Logger 5, 45 Illaroo Rd	74	75	74	Yes	Yes	N/A	No
Surrounding Road Network	48 to 76	50 to 78	51 to 78	Yes	Yes	N/A	No

*Note 1: Where target noise goals are exceeded for the 'Do Nothing' scenario the ECRTN 60 dB(A) criterion applies. Where the target noise levels exceed the 60 dB(A) criterion for the 'Do Nothing' case then the noise levels should not increase by more than +0.5 dB(A) due to the new road and +2 dB(A) due to traffic changes on the existing road network due to the development***.**

7.7.7 Option 3 + MVRDLK

The predicted daytime noise levels for Option 3 with MVRDLK and the expected increase in noise levels relative to the 'Do Nothing 2016' case are shown in Figure 5 of **Appendix K**. The number of residences where noise levels increase by more than 0.5 dB(A) is 370. Of these residences there are 124 where the noise levels increase by more than 2 dB(A).

The noise levels in the recreation area increase due to the proposed route as is illustrated in Figure 5 **Appendix L**. The criterion is exceeded for an area of approximately 49 ha within passive recreational areas. No picnic area, lookout point or walking track within the regional park fall within the 55 dB(A) contour.

The noise contours in **Appendix M** indicate that there are 43 residences where the external L_{Amax} noise level may exceed 65 dB(A) due to a heavy vehicle drive by.

The noise levels at representative locations in **Table 7.9** indicate that the addition of the Moss Vale Road Link creates additional impacts for receivers near Elvin Road compared with Option 3. This is due to the combined impact of the new intersection associated with Option 3 and additional traffic flows associated with the MVRDLK. Property treatments may be required in this area. Further to this the mitigation measures discussed in Option 3 would be applicable to this scenario.

Noise levels increase on West Cambewarra Road due to the MVRDLK, primarily near the MVRDLK intersection. However the expected increase in noise levels is expected to be less than 2 dB(A). The impact of MVRDLK should be considered in greater detail in an additional assessment for the MVRDLK.

Table 7.9: Option 3 + MVRDLK Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq\ (1hr)}$			Noise Goals Exceeded[1]			
	Existing (2006)	Do Nothing 2016	Option 3 +MVRDLK	Do Nothing >60dB(A)	Option 3 +MVRDLK >60dB(A)	Relative to Do Nothing >0.5dB(A)	Relative to Do Nothing >2dB(A)
Byron Av	49 to 58	51 to 59	51 to 59	No	No	N/A	N/A
Narang Rd	61 to 65	66 to 71	65 to 70	Yes	Yes	N/A	No
Princes Hwy / Narang Rd intersection	64 to 73	70 to 78	69 to 77	Yes	Yes	N/A	No
Falcon Cr near Illaroo Rd	54 to 59	52 to 60	51 to 59	No	No	N/A	N/A
Sutherland Dr	50 to 50	52 to 53	51 to 52	No	No	N/A	N/A
West Cambewarra Rd	48 to 55	50 to 55	58 to 65	No	Yes	N/A	Yes
Moss Vale Rd (up 500 m from Princes Highway)	54 to 66	58 to 69	60 to 71	Yes	Yes	N/A	No
Moss Vale Rd / Elvin Rd / West Cambewarra Rd intersection	54 to 59	58 to 62	60 to 65	Yes	Yes	Yes	Yes
West Cambewarra Rd / Illaroo Road intersection	63 to 64	66 to 67	68 to 69	Yes	Yes	N/A	Yes
Logger 1, 3 West Cambewarra Rd	53	53	64	No	Yes	N/A	Yes
Logger 2, 9 Byron Ave	54	56	55	No	No	N/A	N/A
Logger 3, 11 Sutherland Dr	50	53	52	No	No	N/A	N/A
Logger 4, Illaroo Rd Primary	73	74	72	Yes	Yes	N/A	No
Logger 5, 45 Illaroo Rd	74	75	74	Yes	Yes	N/A	No
Surrounding Road Network	48 to 76	50 to 78	50 to 78	Yes	Yes	N/A	No

Note 1: Where target noise goals are exceeded for the 'Do Nothing' scenario the ECRTN 60 dB(A) criterion applies. Where the target noise levels exceed the 60 dB(A) criterion for the 'Do Nothing' case then the noise levels should not increase by more than +0.5 dB(A) due to the new road and +2 dB(A) due to traffic changes on the existing road network due to the development.

7.7.8 Option 1 River Crossing Relief

The Option 1 River Crossing Relief (RCR) scenario includes the following differences to Option 1:

- Right turn is banned from Princes Highway into Illaroo Road;
- Introduce third approach lane (left turn only) on Illaroo Road for approach to Princes Highway;
- Removal of Pleasant Way from Bridge Street / Princes Highway intersection;
- 40 km/hr school zone on Princes Highway between Narang Road to north of Beinda Street; and
- Adjust to variable speed limit on Link Road – 60 km/hr on 150 m of west end and 271 m of the eastern end, 80 km/hr on the rest of the Link Road (1389 m).

The predicted daytime noise levels for Option 1 RCR and the expected increase in noise levels relative to the 'Do Nothing 2016' case are shown in Figure 6 of **Appendix K**. The number of residences where noise levels increase is similar to Option 1.

The noise levels in the recreation area increase due to the proposed route as is illustrated in Figure 6 **Appendix L**. The criterion is exceeded for an area of approximately 59 ha within passive recreational areas. One lookout point and picnic area fall within the 55 dB(A) contour area, however the picnic area is approximately 50 m from the proposed route. Part of the Bomaderry Creek Walking Track and a very small part of Burnie's Walk are also located with the 55 dB(A) contour area. .

Table 7.10 indicates that these differences result in up to 1 dB(A) reduction in noise levels at Narang Road and a 0.5 dB(A) reduction in noise levels at Byron Avenue relative to Option 1. The mitigation discussed in Option 1 may still be required subject to the final road alignment and level. This should be reviewed during detail design.

While Option 1 RCR attracts higher traffic volumes, the noise levels do not increase significantly as the increase in emissions are partially offset by a noise reduction on the approaches to intersections due to a lowering of vehicle speeds (speed limit reduces to 60 km/hr approaching intersections) relative to Option 1 (speed limit maintained at 70 km/hr along Link Road).

Table 7.10: Option 1 RCR Daytime Noise Level Summary

Location	Noise Levels, $L_{Aeq\ (1hr)}$			Noise Goals Exceeded[1]			
	Existing (2006)	Do Nothing 2016	Option 1 RCR	Do Nothing >60dB(A)	Option 1 RCR >60dB(A)	Relative to Do Nothing >0.5dB(A)	Relative to Do Nothing >2dB(A)
Byron Av	49 to 58	51 to 59	54 to 63	No	No	Yes	N/A
Narang Rd	61 to 65	66 to 71	67 to 71	Yes	Yes	N/A	No
Princes Hwy / Narang Rd intersection	64 to 73	70 to 78	69 to 76	Yes	Yes	N/A	No
Upgraded Illaroo Road / Pitt Street intersection	55 to 69	57 to 71	61 to 73	Yes	Yes	N/A	No
Falcon Cr near Illaroo Rd	54 to 59	52 to 60	53 to 59	No	No	N/A	No
Sutherland Dr	50 to 50	52 to 53	52 to 53	No	No	N/A	No
West Cambewarra Rd	48 to 55	50 to 55	51 to 56	No	No	N/A	N/A
Moss Vale Rd (up 500 m from Princes Highway)	54 to 66	58 to 69	59 to 70	Yes	Yes	N/A	No
Moss Vale Rd and Elvin Rd Intersection	54 to 59	58 to 62	59 to 63	Yes	Yes	N/A	No
Logger 1, 3 West Cambewarra Rd	53	53	54	No	No	N/A	N/A
Logger 2, 9 Byron Ave	54	56	62	No	Yes	Yes	N/A
Logger 3, 11 Sutherland Dr	50	53	53	No	No	N/A	N/A
Logger 4, Illaroo Rd Primary	73	74	73	Yes	Yes	N/A	No
Logger 5, 45 Illaroo Rd	74	75	75	Yes	Yes	N/A	No
Surrounding Road Network	48 to 76	50 to 78	51 to 78	Yes	Yes	N/A	No

Note 1: Where target noise goals are exceeded for the 'Do Nothing' scenario the ECRTN 60 dB(A) criterion applies. Where the target noise levels exceed the 60 dB(A) criterion for the 'Do Nothing' case then the noise levels should not increase by more than +0.5 dB(A) due to the new road and +2 dB(A) due to traffic changes on the existing road network due to the development.

7.8 Summary of Noise Assessment

7.8.1 Noise Impacts

Based on the findings of this assessment the routing option that would create the least noise impact when assessed against the ECRTN guidelines is Option 1 RCR.

The benefits of this option, in terms of noise emissions, compared with the other alternatives are:

- It uses existing intersections and would not create significant additional noise emissions due to interruptions of traffic flow on Illaroo Road and Princes Highway;
- Residences along Bryon Avenue may be protected with a noise berm or wall without impacting on property access and urban design; and
- It attracts higher traffic flows without significant differences in noise levels as the increase in emissions are partially offset by a noise reduction (on approaches to intersections) due to a lowering of the vehicle speed relative to Option 1.

Option 1, Option 1 + MVRDLK and Option 1 RCR do not differ significantly from each other in terms of noise impact.

Table 7.11 provides a summary of the number of residential lots where additional noise mitigation measures are to be considered in order to fulfil the requirements of the ECRTN (assuming all reasonable and feasible noise mitigation methods have been applied to the road design).

Table 7.11: Residential Properties where Additional Noise Mitigations should be considered

Option	Residential Properties adjacent to New Link Road	Residential Properties adjacent to Existing Roads	Total Residential Properties
Option 1	3 (1 & 2 Byron Street)	0	3
Option 2	3	11	14
Option 3	19	8	27
Option 1 + MVRDLK	2	0	2
Option 3 + MVRDLK	19	9	28
Option 1 + RCR	3	0	3

The properties in Table 7.11 have been identified as having road traffic noise levels exceeding the criteria and also having increased noise levels compared with the 'Do Nothing 2016' scenario (>0.5 or 2 dB(A) increase depending on whether they are adjacent to the proposed link road or an existing road). It is noted that Options 1, Option 1 + MVRDLK and Option 1 + RCR affect the least number of residential properties and compliance with the ECRTN will be most easily achieved.

Option 2 has the following disadvantages compared with Option 1:

- It creates an additional interruption to traffic flow with an associated increase in noise emission on Illaroo Road;
- There is a larger increase in noise levels for residents in the vicinity of Sutherland Drive and the eastern end of Halcot Avenue than for residents affected by Option 1 near Byron Avenue. This is because the residents near Byron Avenue already experience higher levels of traffic noise;
- The noise levels increase by more than 2 dB(A) for four times as many residents compared with Option 1; and
- There are potentially twice the number of residents affected by sleep disturbance compared with Option 1.

The disadvantages of Options 3 compared with Option 1:

- The noise levels along West Cambewarra Road and Moss Vale Road would increase significantly beyond ECRTN noise criteria and be difficult to mitigate;
- Property treatments may be required, these only reduce internal noise levels and do not protect the amenity of outdoor areas;

- They are likely to require a substantial encroachment into the adjacent Regional Park in the order of some minimum 80 m to accommodate the link road within acceptable limits; and
- The noise levels increase by more than 2 dB(A) for more residents than for Option 1.

The advantages of Options 3 compared with Option 1:

- The encroachment into the Regional Park could be reduced significantly if a berm is constructed between the new road and West Cambewarra Road to mitigate noise levels to residences. This would be subject to appropriate road geometry of the road connection to West Cambewarra Road.

The noise emissions associated with Option 1 + MVRDLK do not differ significantly from Option 1 except for a slight increase in noise levels near the intersections at each end of MVRDLK.

The noise emissions associated with Option 3 + MVRDLK are significantly worse for receivers near Elvin Road due to the combined impact of the Option 3 intersection with Moss Vale Road and changed traffic flows associated with the MVRDLK.

Neither of the options provide a significant reduction in road traffic noise levels relative to the year 2016 'Do Nothing – NBSP' case.

With Link Road Options 1 and 2, there may be a slight reduction in noise level (relative to the year 2016 'Do Nothing - NBSP' case) of less than 1 dB(A) near 45 Illaroo Road and Illaroo Road Primary School with the Link Road (i.e. taking noise levels back to equivalent 2006 levels). However in practice - reduction of that order would be barely perceptible and is within the margin of error of measurement. These reductions were not noted with Option 3.

Additional noise modelling should be undertaken following finalisation of road layout and pavement heights to confirm the mitigation and measures required. The modelling should also take into consideration the shielding by buildings and structures.

7.8.2 Possible Noise Mitigation Measures

Option 1 - The level of mitigation required to meet the noise criteria at Byron Avenue is in the order of 0.5 to 2 dB(A). This may be achieved with a 2 m high berm or noise barrier or the use of a low noise road surface for the new road (e.g. Open Graded Asphalt).

Option 2 – Noise mitigation measures for residential properties located near the proposed new intersection at Illaroo Road (Illaroo Road and Falcon Street) is likely to comprise individual property treatments, as other treatments are likely to be deemed unreasonable given the fact that there are less than 3 receivers located together. The increase in noise levels for receivers at the Princes Highway intersection from the new road may be reduced with a noise wall in the order of 2.5 m in height. This would need to be reviewed following confirmation of the final road layout and pavement levels. Subject to design, it is considered that this (provision of noise wall) would be effective in offsetting the adverse noise impacts of the Link Road Option 2 only on adjacent properties, and would not be effective in offsetting the predominant noise source – that is the adverse noise impacts associated with background traffic growth on Princes Highway, therefore property treatments should be considered for those properties facing the Princes Highway.

Option 3 - While it may be possible to construct noise walls that achieve the require noise mitigation of 6 dB(A) it may not be feasible as these residences have access driveways from West Cambewarra Road. The access points would create gaps in the noise wall and significantly reduce the amount of noise reduction that may be obtained. A noise reduction of up to 2 dB(A) may be achieved through a change in road surface type from Dense Graded Asphalt to Open Graded Asphalt; however this may not be sufficient reduction to meet the ECRTN noise goals.

Alternatively Option 3 could be offset from the existing Cambewarra Road alignment (by minimum of 70 m from nearest property boundary) in order to ensure noise impacts fall within acceptable limits. This may improve the design and mitigate the direct impacts of traffic growth as the existing West Cambewarra Road could be retained as service road with a single access point back to Link Road. However this would require considerable encroachment into the adjacent Regional Park in the order of some 80 m. It is noted that the dedication of the adjacent lands as Regional Park made an allowance of only 10 m encroachment into the Regional Park, increasing the existing 20 m road reserve to 30 m to make adequate allowance for a higher standard (Link Road) construction. This would not be sufficient to attenuate noise impacts, and would mean direct impact of the Link Road on existing residences. A minimum additional 70 m encroachment into the adjacent Regional Park would be necessary to accommodate the Link Road to meet the acceptable noise limits without a noise wall or berm.

The encroachment into the Regional Park could be reduced significantly if a berm or barrier was constructed between the Link Road and the existing West Cambewarra Road subject to appropriate road geometry of the road connection to West Cambewarra Road.

7.9 References

[1] Tsukui, K and Oshino, Y. *Basic Study of the Increase in Road Traffic Noise Caused by the Installation of Traffic Lights*. Japan Automobile Research Institute Journal, 23(10), 2001

[2] Nelson, P. M., *Transportation noise reference book*, Butterworths, London, 1987.

8.0 Conclusions and Recommendations

Shoalhaven City Council had undertaken a forerunner study to derive possible traffic routes regime and provided an overarching assessment of possible road links to alleviate traffic congestion and satisfy the strategic planning objectives of the Nowra Bomaderry Structure Plan in the potential releasing of residential land consistent with wider planning strategies.

Council used TRACKS modelling programming for its initial assessment, a program endorsed and used by the RTA*. This study used Paramics modelling which while assessing more specifically specific congestion times, the outcomes were verified by the TRACKS modelling. To guarantee validity, Council engaged Gabites Porter, which created the TRACKS modelling program to undertake an independent review of the Council TRACKS work, and to assess the validity of data used. The June 2010 Gabites Porter TRACKS Analysis Review Report is provided in **Appendix F**.

A three route link road option formed part of the scope of work within a defined study area which was determined by the Minister for Planning and published in the NSW Government Gazette in December 2006.

AECOM was subsequently commissioned by Shoalhaven Council in 2007 to undertake the North Nowra to Bomaderry Link Road Traffic Modelling, Economics Evaluation, Noise Assessment and Options Analysis study with the aim of investigating the technical merits of constructing a link road between North Nowra and Bomaderry, and (if justified in terms of providing sufficiently higher benefits in relation to cost) recommending a preferred alignment. Bassett Acoustics was commissioned to undertake the Noise Assessment.

The study has provided the following:

- Technical data on the impacts of the 'Do Nothing' (no link road) option;
- Technical data on the impacts of the new link road construction (based on two primary alignments and two separate alignment options for the West Cambewarra link road option);
- Technical data highlighting the benefits to Princes Highway and the broader transport network as a result of constructing a Link Road; and
- Examination of whether a Link Road independently would be sufficient to meet growing traffic levels in the longer term.

8.1 Paramics Modelling

Paramics micro-simulation software has been used to assess transport conditions in the North Nowra to Bomaderry study area. The model has taken into account road network geometry, traffic demand and intersection operations including detailed signal operations.

A total of 18 models have been developed for both the AM (8-9) and PM peak (3.30-4.30) periods. These time periods are currently identified as the critical peak periods in the network within the study area.

The models have been utilised to assess the traffic impacts of each of the "Do Nothing" and Link Road options. The future year assessments have been carried out for the year 2016 with land use growth projections from Council's Nowra / Bomaderry Structure Plan.

The preliminary modelling had determined that minor improvements (river crossing relief) in conjunction with the addition of a North Nowra to Bomaderry Link Road, would be necessary to improve capacity in the short term (0 – 10 years). However, substantial capacity improvements would be required beyond 2016 on the Princes Highway (particularly the section Bolong Road to Bridge Road) including upgrading of lane capacity on the Shoalhaven river bridges.

Observation of model operations has revealed similar trends for each of the future year (2016) Link Road options. The main observations include:

- The proximity of the Princes Highway / Illaroo Road intersection with the Princes Highway / Bolong Road signalised intersection (providing limited storage space), causes significant congestion and acts as a 'throttle' to traffic travelling southbound along Princes Highway.
- Shoalhaven Bridge Crossing is also observed to be congested with traffic being 'throttled' in a southbound direction along Princes Highway. Extensive queuing also occurs for traffic turning right from Illaroo Road, in particular during the AM peak where the number of right turn movements from Princes Highway onto Bridge

Road has been forecast to increase by approximately 65% in 2016. It is observed that the level of queuing currently extends to obstruct the adjacent through lane hindering through vehicle movements occasionally during AM and PM peak hours. The queuing condition worsens in 2016 such that the maximum queuing extends to north of the Shoalhaven River for most of the peak hour due to a significant increase in southbound traffic flow on the highway and the southbound right turn demand at Bridge Road.

- As a result of the congestion at the Princes Highway / Illaroo Road intersection and Shoalhaven River Bridge crossing, extensive queuing is observed to occur on Princes Highway extending beyond Beinda Street. To avoid the queues on Princes Highway some vehicles are observed to rat-run via Beinda Street and Bolong Road. Rat-running increases along these routes as demand to access Princes Highway increases as a result of the Link Road.
- Extensive queuing is observed on Illaroo Road under the scenario with 2% growth on the Princes Highway and Bolong Road through traffic only. Queues on Illaroo Road are observed to extend just beyond Pitt Street causing large delays for vehicles exiting the minor residential streets at priority intersections under the NBSP growth scenario. With the Link Road the queues are shown to reduce to between Crest Avenue and McMahons Road (to the extent of current observed queue conditions on Illaroo Road). This has consequently improved vehicle access onto Illaroo Road from the minor residential streets.
- At the Princes Highway / Bridge Road intersection extensive queuing on the southern and western approaches is observed to occur throughout the PM peak period. The impact of this queuing on these approaches has not been modelled as it extends beyond the study area. Queuing on the western approach (Bridge Street) has increased due to the significant forecast growth in traffic using Bridge Road to access the Princes Highway. Conditions are improved considerably under the 2016 PM Peak Option 1 RCR scenario with improved capacity for northbound flow on Princes Highway.
- Queuing is observed for Option 3 at Princes Highway / Cambewarra Road intersection by the end of the peak hour. This occurs as a result of the proximity of the Link Road connection for Option 3 with Moss Vale Road and Elvin Drive, as well as the increase of traffic generated from the Link Road. An increase in average vehicle delay of approximately 18 seconds during the AM peak and approximately 10 seconds during the PM peak occurs when compared to the other Link Road modelled options. The overall average vehicle delay experienced over the hour however, is still within acceptable limits (Level of Service B).
- Beinda Street, Bunberra Street, and Cambewarra Road all experience an increase in traffic as a result of development envisaged under the NBSP. Further increases in traffic are likely to occur on these roads as a result of the construction of a Link Road irrespective of options, when traffic re-routes between North Nowra and Bomaderry. Traffic growth on these local roads could be expected to reach up to 3000 vpd with increased demands as a result of the NBSP, and traffic pattern changes as a result of the North Nowra to Bomaderry Link Road. It is considered that Option 1 has the least impacts on traffic flow on local roads as it does not have a direct connection into an existing east-west local/collector road.

The Paramics modelling highlights that the construction of a Link Road will improve the operation of the road network, except at the intersection of the Princes Highway / Bolong Road (If not offset by the provision of MVRDLK and RCR or similar relief treatment). The reasons for this are:

- Traffic flows, queuing and average delays on Illaroo Road at the Princes Highway intersection are significantly reduced. This is likely to reduce accident rates on Illaroo Road, offsetting the need for potential safety improvements, such as introducing additional signals at key intersections along Illaroo Road;
- The travel times for vehicles using Illaroo Road and travelling north on Princes Highway are improved;
- The travel times on Cambewarra Road and West Bunberra Road have generally not changed with the construction of the link road, except in the westbound direction where travel time has increased due to the delays along the southbound carriageway of the Princes Highway;
- The Level of Service at the Princes Highway / Illaroo Road intersection was maintained at F with and without the Link Road, however with the Link Road in place the average vehicle delay showed significant reductions; and
- All models show that there is a general worsening in overall intersection performance at Princes Highway and Bolong Road as a result of construction of the Link Road(s). This is due primarily to constraints of the Princes Highway from north of Bolong Road, across Shoalhaven River bridges to Bridge Road, resulting in extensive queuing along Bolong Road, and also on the northern approach of the Princes Highway / Bolong Road intersection. The modelling results also identify that the adverse conditions at Princes Highway /

Bolong Road can be offset by addition of MVRDLK (AM and PM peak improvements) and RCR option (AM and PM peak improvements) in conjunction with Option 1, to the extent of reducing average delays back to equivalent “no Link Road” conditions.

The model outputs highlight Option 1 as having the following benefits over the other options:

- Option 1 Link Road connection with the Princes Highway / Narang Road intersection is able to accommodate Link Road traffic without impacting on the operation of the existing roundabout. The Level of Service decreased at the Link Road connections with Princes Highway for both Option 2 (Princes Highway and Bunberra Street intersection) and Option 3 (Princes Highway and Cambewarra Road intersection);
- Option 1 Link Road is shown to be more favourable in terms of total vehicle numbers travelling along the Link Road during both the AM and PM peak periods;
- Option 1 showed reductions in average delay at intersection Princes Highway / Illaroo Road;
- Option 1 showed lower output values of VHT and total VKT when compared with Option 3, thereby offering economic and environmental benefits. Reducing values of VHT and total VKT are State Government objectives to minimise the economic and environmental consequence of growth. The Paramics modelling indicates that VHT and total VKT parameters increase the further the Link Road option is to the north. This is similar to the trend found in strategic analysis using Council’s TRACKS models which have subsequently been reviewed and endorsed by Gabites Porter (2010), the firm which created the TRACKS program.
- Option 1 is considered likely to have the least impacts on existing east-west streets in Bomaderry as the Option 1 Link Road does not connect directly into an existing east-west collector road (Beinda Street, West Bunberra Street or Cambewarra Road). The modelling has determined however that volumes of traffic will increase on these streets regardless of Link Road alignment due to growth envisaged under the NBSP, with additional increases as a result of the link road, as traffic patterns adjust to changes in the network.

Further sensitivity testing of road network improvements has been undertaken to address the major capacity constraints on the Princes Highway between Bolong Road and Bridge Road including Illaroo Road, and the impact that these will have on the performance of the Option 1 Link Road.

The model has been used to assess modifications to Bridge Road and Illaroo Road intersections with Princes Highway (referred to as “Option 1 RCR – river crossing relief” scenario) in an attempt to improve traffic movements / capacity across Shoalhaven River Bridge Crossing[12]. The modifications tested include:

- Right turn ban from Princes Highway to Illaroo Road;
- Inclusion of an additional left turn approach lane from Illaroo Road to Princes Highway;
- Separation of Pleasant Way from Princes Highway / Bridge Road intersection;
- Variable speed zone on Link Road to reflect design criteria (Refer **Section 3.3.2** for details); and
- Inclusion of 40 kph school zone on the Princes Highway, Bomaderry.

The results under ‘Option 1 RCR’ show an improvement in the Level of Service from F to D during the PM peak at the Princes Highway / Illaroo Road intersection and significant improvements to operations at Princes Highway / Bolong Road intersection. The assessment has shown both of these intersections can be further improved with the introduction of the Moss Vale Road – Illaroo Road Link.

Detailed intersection analysis shows that the addition of MVRDLK and RCR option (in conjunction with Option 1) act to offset the adverse impacts of the Link Road on the Princes Highway / Bolong Road intersection, to the extent of reducing average delays back to equivalent “no link road” conditions.

Option 1 RCR provides the most significant benefit in traffic and economic terms when compared to all other options tested.

In general terms, it is expected that the development of a Link Road will improve the overall level of accessibility to the North Nowra area, particularly for local trips between Bomaderry and North Nowra as well more strategic trips travelling between North Nowra and regions to the north and east. By using the Link Road, these trips will

[12] The additional ‘Do Minimum – River Crossing Relief’ testing was carried out following meeting held with RTA/Council on 9 November 2006

be provided with the opportunity to avoid the congestion on Illaroo Road, and at the Illaroo Road/Princes Highway intersection This will reduce travel times for these trips on the network, as well as remove these trips from Illaroo Road, and Illaroo Road/Princes Highway intersection.

To improve the performance of the road network to accommodate forecast growth proposed beyond 10 years, it is considered that further strategic road infrastructure improvements will be required to relieve congestion along Princes Highway and adjoining roads. This will be in addition to the need for the proposed North Nowra to Bomaderry Link Road.

8.2 Road Safety

Traffic accident data was provided by the RTA for the Shoalhaven Local Government Area (LGA) as part of the North Nowra to Bomaderry Link Road Study. The accident data provided is for the period between July 2000 and June 2005. This data is the latest available at the start of the study.

The dataset contains 2974 recorded road accidents between 2000 and 2005 within the LGA. Of these, 291 accidents occurred within the study area (as shown in **Figure 1.2**). All accidents have been classified as either fatal, injury or non-injury accidents. The data identifies that between 44 and 74 accidents took place each year between 2000 and 2005, which equates to an average of approximately 60 accidents each year occurs within the study area. The data also confirms the trend of declining numbers of accidents within the study area as well as along the Princes Highway, Illaroo Road and Bolong Road per annum.

During the same time period, a total of 43 accidents occurred on Illaroo Road, within the study area. The highest number of accidents (12) occurred on Illaroo Road was in 2000 and 2001 and it reduced to only 4 in 2005. It is significant that approximately 60% of all accidents along Illaroo Road have occurred where no traffic controls exist, and reduction in traffic volumes on Illaroo Road by implementation of the proposed Nowra Bomaderry Structure Plan road links (including North Nowra Link Road) could be significant in reducing the number of accidents on Illaroo Road where no traffic controls exist, and may defer the need for upgrading Illaroo Road intersections.

The diversion of traffic from Illaroo Road on to the Link Road could improve accident statistics along Illaroo Road as a higher order alternative route will be available with improved capacity for movements into / out of North Nowra, and the link road is also expected to be an attractive traffic route. Based on the Paramics modelling undertaken, Option 1 RCR is the option likely to attract the highest level of traffic (highest level of diversion of traffic from Illaroo Road).

Quantifying the likely rate for reduction of accidents or change in accident types as a result of a new link road is difficult to determine at this stage, as is the need to introduce future road safety upgrades on Illaroo Road. However, it can be confirmed that if the Link Road is not constructed to relieve traffic conditions on Illaroo Road, safety conditions are likely to deteriorate as a result of continual traffic growth and deterioration of environmental and/or amenity related issues.

8.3 Economics Appraisal

The economic appraisal has been based on the assessment of each Link Road option against four economic indicators. The appraisal evaluates the relative attractiveness for each of the options against the base case. Guidelines suggest that a range of economic indicators are used in the appraisal to enhance the probability that the best project is selected. The key indicators used in the appraisal include:

- Net Present Value;
- Net Present Value Per Dollar of Investment;
- Benefit Cost Ratio; and
- Internal Rate of Return.

Estimates of all four indicators for each of the development options are shown in **Table 8.1**. All indicators are based on a real discount rate of 7% per annum.

Table 8.1: Headline Economic Indicators (in thousands of $2007)

Indicator	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Benefits	$19,399	$38,101	$44,426	$23,638	-$3,786	$34,051
Costs	$8,199	$19,030	$10,852	$13,165	$8,405	$19,236
NPV	$11,200	$19,071	$33,574	$10,473	-$12,191	$14,815
BCR	2.366	2.002	4.090	1.796	-0.450	1.770
IRR	17.9%	15.5%	28.5%	13.8%	Undefined	13.6%
NPVI	1.534	1.105	3.400	0.870	-1.585	0.839

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices and discounted at a real discount rate of seven percent per annum and discounted to a base year of 2007.

The results of the appraisal imply the following rankings:

Table 8.2: Headline Economic Indicators ($2007)

Indicator	Option 1	Option 1 (MVRDLK)	Option 1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
NPV	4th	2nd	1st	5th	7th	3rd
BCR	2nd	3rd	1st	4th	7th	5th
IRR	2nd	3rd	1st	4th	Last	5th
NPVI	2nd	3rd	1st	4th	7th	5th

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows expressed in constant 2007 prices and discounted at a real discount rate of seven percent per annum and discounted to a base year of 2007.

Of all the options considered, Option 1, Option 2 and Option 3 (MVRDLK) are economically justifiable and the economic viability indicators clearly select Option 1 with RCR treatment as the preferred option. The incremental analysis undertaken to asses the benefits of MVRDLK suggests that Option 3 (MVRDLK) is only economically viable as a result of the MVRDLK, that is that Option 3 is not economically viable in isolation.

Sensitivity analysis was also conducted on key parameters used to underpin the model to test the robustness of the results shown in the **Table 8.2** above. The results of this analysis are shown in **Table 8.3**. The sensitivity tests confirm the rankings between options are robust and Option 1 (RCR) would still be chosen over the base case and all other development options.

Table 8.3: Sensitivity Analysis: Benefit Cost Ratio ($2007)

Variable	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
Original values	**2.37**	**2.00**	**4.09**	**1.80**	**-0.45**	**1.77**
Low discount rate (4%)	3.25	2.76	5.67	2.49	-0.62	2.45
High discount rate (10%)	1.79	1.51	3.10	1.35	-0.34	1.34
Low contingency (10%)	2.72	2.31	4.54	2.07	-0.52	2.04
High contingency (50%)	2.09	1.77	3.72	1.58	-0.40	1.56

Variable	Option 1	Option 1 (MVRDLK)	Option1 RCR	Option 2	Option 3	Option 3 (MVRDLK)
No real earnings growth	2.03	1.73	3.48	1.55	-0.42	1.53
Low value of time (-20%)	1.87	1.62	3.20	1.45	-0.42	1.43
High value of time (+20%)	2.86	2.38	4.99	2.14	-0.48	2.11
Low VOC (-20%)	2.37	1.98	4.14	1.78	-0.40	1.75
High VOC (+20%)	2.36	2.02	4.05	1.81	-0.50	1.79
260 day annualisation	2.53	2.13	4.39	1.91	-0.46	1.88
340 day annualisation	1.88	1.63	3.21	1.45	-0.43	1.43
Low HGVs (7 percent)	2.31	1.95	3.99	1.75	-0.44	1.73
High HGVs (20 percent)	2.48	2.10	4.28	1.88	-0.48	1.86

Source: AECOM calculations. All monetary values rounded to nearest thousand dollars. All cash flows discounted at a real discount rate of seven percent per annum.

In straight comparison between link road options, Option 1 would be recommended when considering which option provides the greatest transport economic benefits in relation to cost.

It is also significant that Option 1 RCR attracts the highest level of traffic to the link road, and more than doubles the BCR of Option 1.

As indicated above, further analysis of the economic appraisal results reveals that there is potential for the development of the Illaroo Road to Moss Vale Road Link to provide considerable additional benefits for road users.

Incremental cost benefit analysis between Option 1 and Option 1 (MVRDLK) as well as between Option 3 and Option 3 (MVRDLK) show clear net benefits from the development of the Illaroo Road to Moss Vale Road Link. The incremental analysis, when compared with the isolated link road analysis, confirms that Option 1, and the Illaroo Road – Moss Vale Road link, provides benefits to the network, where as Option 3 does not. The analysis shows that Council's NBSP proposed road network including Option 1 + MVRDLK would provide considerable benefits to the North Nowra Bomaderry road network if it is to accommodate growth as assumed in the NBSP.

The TRACKS analysis has also shown the benefits of the MVRDLK as well as providing an indication that additional network connections (between the expanding North Nowra and future Western Bypass corridor) will be necessary to limit the amount of traffic growth from North Nowra congesting the Princes Highway corridor.

The TRACKS analysis indicates that to accommodate the growth assumptions of the NBSP - all of these works (North Nowra to Bomaderry Link Road, MVRDLK, and connections between North Nowra to West Bypass in accordance with the NBSP proposed road network) will be necessary to contain traffic volumes on Illaroo Road to 2005 levels which are verified by the RTA and Gabites Porter to be valid for currency at the date of production of this analysis, and consistent with the NBSP.

Appendix F contains a summary comparison of the Gabites Porter TRACKS model outcomes.

8.4 Noise Assessment

Based on the findings of this assessment the routing option that would create the least noise impact when assessed against the ECRTN guidelines is Option 1 RCR.

The benefits of this option, in terms of noise emissions, compared with the other alternatives are:

- It uses existing intersections and would not create significant additional noise emissions due to interruptions of traffic flow on Illaroo Road and Princes Highway;
- Residences along Bryon Avenue may be protected with a noise berm or wall without impacting on property access and urban design; and
- It attracts higher traffic flows without significant differences in noise levels as the increase in emissions are partially offset by a noise reduction (on approaches to intersections) due to a lowering of the vehicle speed relative to Option 1.

Option 1, Option 1 + MVRDLK and Option 1 RCR do not differ significantly from each other in terms of noise impact.

Table 8.4 provides a summary of the number of residential lots where additional noise mitigation measures are to be considered in order to fulfil the requirements of the ECRTN (assuming all reasonable and feasible noise mitigation methods have been applied to the road design).

Table 8.4: Residential Properties where Additional Noise Mitigations should be considered

Option	Residential Properties adjacent to New Link Road	Residential Properties adjacent to Existing Roads	Total Residential Properties
Option 1	3 (1 & 2 Byron Street)	0	3
Option 2	3	11	14
Option 3	19	8	27
Option 1 + MVRDLK	2	0	2
Option 3 + MVRDLK	19	9	28
Option 1 + RCR	3	0	3

These properties have been identified as having road traffic noise levels exceeding the criteria and also having increased noise levels compared with the 'Do nothing 2016' scenario (>0.5 or 2 dB(A) increase depending on whether they are adjacent to the proposed link road or an existing road). It is noted that Options 1, Option 1 + MVRDLK and Option 1 + RCR affect the least number of residential properties and compliance with the ECRTN will be most easily achieved.

Option 2 has the following disadvantages compared with Option 1:

- It creates an additional interruption to traffic flow with an associated increase in noise emission on Illaroo Road;
- There is a larger increase in noise levels for residents in the vicinity of Sutherland Drive and the eastern end of Halcot Avenue than for residents affected by Option 1 near Byron Avenue. This is because the residents near Byron Avenue already experience higher levels of traffic noise;
- The noise levels increase by more than 2 dB(A) for four times as many residents compared with Option 1; and
- There are potentially twice the number of residents affected by sleep disturbance compared with Option 1.

The disadvantages of Options 3 compared with Option 1:

- The noise levels along West Cambewarra Road and Moss Vale Road would increase significantly beyond ECRTN noise criteria and be difficult to mitigate;
- Property treatments may be required, these only reduce internal noise levels and do not protect the amenity of outdoor areas;
- They are likely to require a substantial encroachment into the adjacent Regional Park in the order of some minimum 80 m to accommodate the link road within acceptable limits; and
- The noise levels increase by more than 2 dB(A) for more residents than for Option 1.

The advantages of Options 3 compared with Option 1:

- The encroachment into the Regional Park could be reduced significantly if a berm is constructed between the new road and West Cambewarra Road to mitigate noise levels to residences. This would be subject to appropriate road geometry of the road connection to West Cambewarra Road.

The noise emissions associated with Option 1 + MVRDLK do not differ significantly from Option 1 except for a slight increase in noise levels near the intersections at each end of MVRDLK.

The noise emissions associated with Option 3 + MVRDLK are significantly worse for receivers near Elvin Road due to the combined impact of the Option 3 intersection with Moss Vale Road and changed traffic flows associated with the MVRDLK.

Neither of the options provide a significant reduction in road traffic noise levels relative to the year 2016 'Do Nothing - NBSP' case.

With Link Road Options 1 and 2, there may be a slight reduction in noise level (relative to the year 2016 'Do Nothing - NBSP' case) of less than 1 dB(A) near 45 Illaroo Road and Illaroo Road Primary School with the Link Road (i.e. taking noise levels back to equivalent 2006 levels). However in practice - reduction of that order would be barely perceptible and is within the margin of error of measurement. These reductions were not noted with Option 3.

Additional noise modelling should be undertaken following finalisation of road layout and pavement heights to confirm the mitigation and measures required. The modelling should also take into consideration the shielding by buildings and structures.

8.5 Summary

This study has identified the merits of constructing a Link Road between North Nowra and Bomaderry, and has determined that the construction of the Link Road is economically viable, subject to route alignment.

The Paramics modelling results highlight Option 1 to be the preferred option when compared to the other Link Road options. This is consistent with the TRACKS modelling undertaken by Council which also highlighted Option 1 as the preferred option.

Option 1 RCR provides the most significant benefits to the operation of the Princes Highway as well as attracting the highest volume of traffic on to the Link Road.

MVRDLK was found to provide additional network benefits to the operation of Princes Highway, as well as in mitigation of impacts of increased traffic from NBSP growth and changed travel patterns (arising irrespective of Link Road) on local Bomaderry Streets. It also provides substantial improvement to economic performance of the network, beyond the value of the base Link Road options.

The economic assessment shows that Link Roads with alignments as per Options 1 and 2 are all economically justifiable, and the economic viability indicators selecting Option 1 with RCR treatment as the preferred option.

Link Road Option 1, Option 1 MVRDLK, and Option 1 RCR are identified as having the least noise impact (compared to all other options) when assessed against the ECRTN guidelines.

It is noted that (from the Paramics modelling) both Option 1 (and 2) showed lower output values of VHT and total VKT when compared with Option 3, thereby offering economic and environmental benefits. Reducing values of VHT and total VKT are State Government objectives to minimise the economic and environmental consequence of growth. The Paramics modelling indicates that VHT and total VKT parameters increase the further the link road option is to the north. This trend is also observed in strategic analysis using the TRACKS models.

Option 2 results in the lowest VKT in both AM and PM peaks. However, the high costs associated with Option 2 reduce its viability which has been shown in the economic assessment, while Option 1 performed well against all traffic/transport criteria.

Appendix F provides a summary review of Council's TRACKS Analysis of the Link Road Options undertaken by Gabites Porter, Traffic and Transport Engineering and Planning consultancy.

Council's TRACKS analysis has incorporated network benefit analysis based on a 24 Hour average weekday model at 2006, 2016, and 2036. Higher benefits have been calculated by the TRACKS models (compared to the Paramics models) and this is likely to be as a result of TRACKS calculated benefits over a 24 Hour period as opposed to the 2 Hour peak period calculated benefits (i.e. AM + PM) with the business and off peak periods set to 2005 estimates (with no growth) as reflected in the economic assessment in this study and aligned to the Nowra Bomaderry Structure Plan.

The independent TRACKS analysis has also shown the benefits of the MVRDLK as well as providing an indication that additional network connections (between the expanding North Nowra and future Western Bypass corridor) will be necessary to limit the amount of traffic growth from North Nowra congesting the Princes Highway corridor.

The TRACKS analysis indicates, and is verified by Gabites Porter that to accommodate the growth assumptions of the NBSP - all of these works (North Nowra to Bomaderry Link Road, MVRDLK, and connections between North Nowra to West Bypass) – as per the NBSP proposed road network will be necessary to contain traffic volumes on Illaroo Road to 2005 database levels (which are appropriate for 2010 currency assessment criteria).

Appendix A

Signal Timing (Base 2005)

Table A1: AM Peak summary of SCATS IDM** data for the period 21-25 August 2006 (Base 2005)

AM Peak (Base 2005)

TCS 1529 Princess Highway and Illaroo Road

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%	
A	North & South through movements	69	56%	66	54%	65	54%	67	55%	68	57%	67
B	South through & right, West left	16	13%	17	14%	18	15%	17	14%	14	12%	17
C	West left & right turns	38	31%	39	32%	37	31%	38	31%	37	31%	38
Average Cycle Time		124	100%	122	100%	120	100%	121	100%	120	100%	122

TCS 2866 Princess Highway and Bolong Road

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE	Adjusted Cycle Time 1	Adjusted Cycle Time 2
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%			
A	North and South through only	86	69%	85	69%	81	67%	84	69%	82	68%	84	83	83
B	South right turn, East left turn only	38	30%	34	28%	36	30%	35	29%	36	30%	36	36	39
C	East right turn	1	1%	4	3%	4	3%	2	2%	2	2%	3	3	0
Average Cycle Time		125	100%	123	100%	121	100%	122	100%	121	100%	123	122	122

TCS 3358 Princess Highway and Bridge Road

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE	Adjusted Cycle Time 1	Adjusted Cycle Time 2
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%			
A	North & South through and left movements, West left turn	77	62%	74	60%	72	59%	72	60%	67	56%	72	73	73
B	West left turn, North all movements	22	18%	25	20%	27	22%	28	23%	32	27%	27	22	22
C	Pedestrian phase on west leg	0	0%	0	0%	0	0%	0	0%	0	0%	0	0	0
D	West left turn, North left & right turns, (pedestrian phase on south leg)	7.44	6%	7.44	6%	6.1	5%	3.6	3%	7.2	6%	6	11	11
E	West left, North right, East left and South right turns	17	14%	17	14%	17	14%	17	14%	13	11%	16	16	16
Average Cycle Time		124	100%	124	100%	122	100%	120	100%	120	100%	121	122	122

AVERAGE CYCLE TIME 122

TCS 1929 Illaroo Road and Crest Avenue

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%	
A	West through and right turn, East through and Left turn	70	81%	69	81%	66	80%	66	80%	70	81%	68
B	South left and right	16	19%	16	19%	17	20%	17	20%	17	19%	16
Average Cycle Time		86	100%	85	100%	83	100%	83	100%	87	100%	84

TCS 3390 Cambewarra Rd and Bomaderry High School*

Phase	Movements	AVERAGE
A	North and South through movements	121
B	Pedestrian movements	24
Average Cycle Time		145

* Phase times and cycle times calculated from survey of pedestrian actuated traffic signals undertaken by Shoalhaven Council on Thursday 29 June 2006.

** SCATS IDM - Sydney Co-ordinated Adaptive Traffic System Intersection Diagnostic Monitor.

Table A2 PM Peak summary of SCATS IDM data for the period 21-25 August 2006 (Base 2005)**

PM Peak (Base 2005)

TCS 1529 Princess Highway and Illaroo Road

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%	
A	North & South through movements	67	55%	67	54%	68	55%	70	55%	72	55%	69
B	South through & right, West left	23	19%	25	20%	24	19%	25	20%	26	20%	25
C	West left & right turns	32	26%	32	26%	32	26%	32	25%	33	25%	32
Average Cycle Time		122	100%	124	100%	124	100%	127	100%	130	100%	126

TCS 2866 Princess Highway and Bolong Road

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE	Adjusted Cycle Time 1
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%		
A	North and South through only	79	65%	83	67%	82	66%	83	65%	85	65%	82	82
B	South right turn, East left turn only	40	33%	38	31%	40	32%	42	33%	43	33%	41	44
C	East right turn	2	2%	2	2%	2	2%	3	2%	3	2%	3	0
Average Cycle Time		122	100%	124	100%	124	100%	127	100%	130	100%	126	126

TCS 3358 Princess Highway and Bridge Road

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE	Adjusted Cycle Time 1	Adjusted Cycle Time 2
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%			
A	North & South through and left movements, West left turn	81	66%	83	67%	80	64%	86	68%	90	69%	84	84	84
B	West left turn, North all movements	14	11%	16	13%	13	10%	17	13%	14	11%	15	15	11
C	Pedestrian phase on west leg	0	0%	0	0%	0	0%	0	0%	0	0%	0	0	0
D	West left turn, North left & right turns, (pedestrian phase on south leg)	6	5%	6	5%	4	3%	4	3%	3	2%	5	4	11
E	West left, North right, East left and South right turns	22	18%	19	15%	29	23%	20	16%	23	18%	23	23	20
Average Cycle Time		123	100%	124	100%	125	100%	127	100%	130	100%	127	126	126

AVERAGE CYCLE TIME 126

TCS 1929 Illaroo Road and Crest Avenue

Phase	Movements	Mon Aug 21		Tues Aug 22		Wed Aug 23		Thurs Aug 24		Fri Aug 25		AVERAGE
		Av	Av%	Av	Av%	Av	Av%	Av	Av%	Av	Av%	
A	West through and right turn, East through and Left turn	76	83%	62	79%	66	80%	68	80%			68
B	South left and right	15	17%	17	21%	17	20%	17	20%			17
Average Cycle Time		91	100%	79	100%	83	100%	85	100%			85

TCS 3390 Cambewarra Rd and Bomaderry High School*

Phase	Movements	AVERAGE
A	North and South through movements	129
B	Pedestrian movements	9
Average Cycle Time		138

* Phase times and cycle times calculated from survey of pedestrian actuated traffic signals undertaken by Shoalhaven Council on Thursday 29 June 2006.

** SCATS IDM - Sydney Co-ordinated Adaptive Traffic System Intersection Diagnostic Monitor.

Appendix B

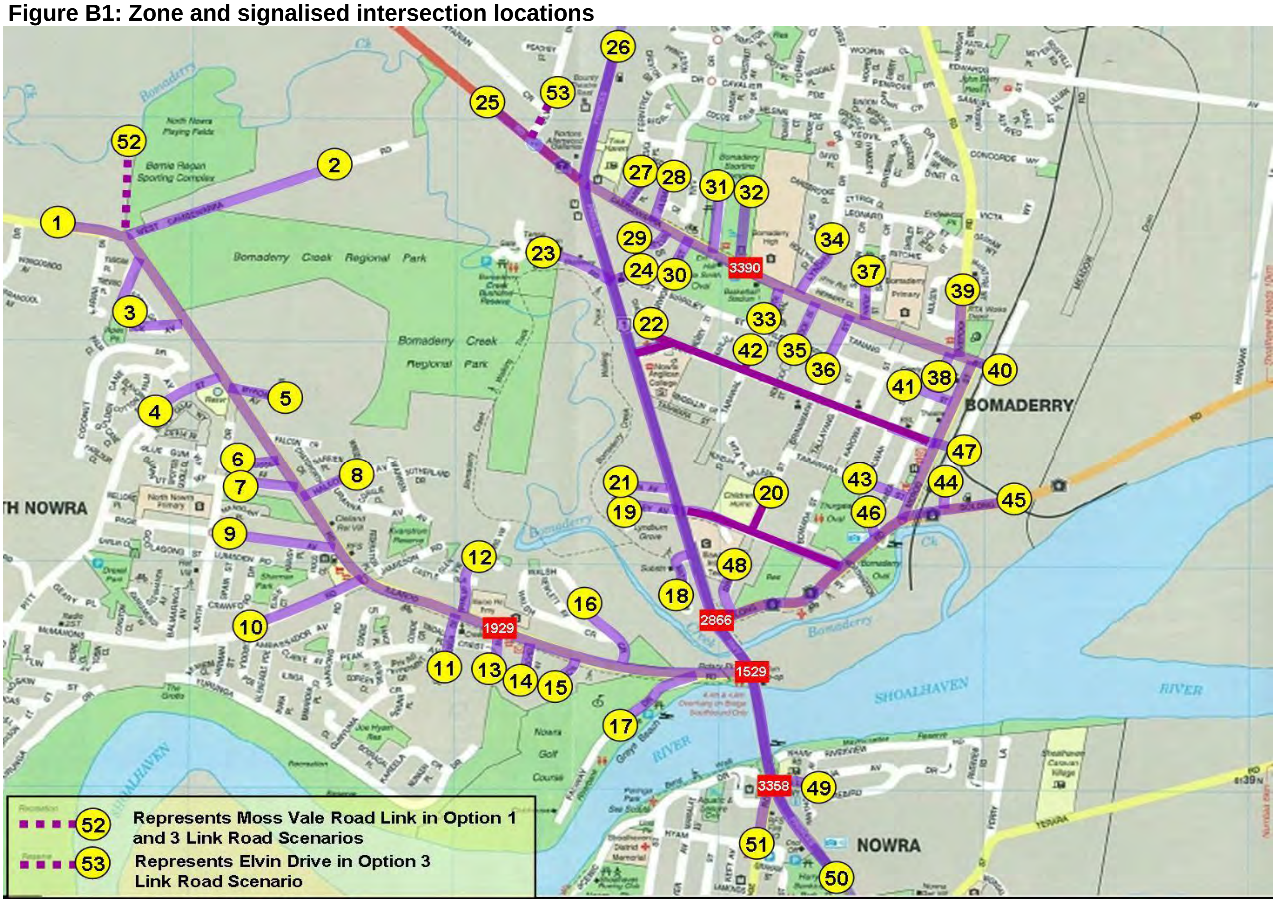
Paramics Model Outputs (2005)

2005 AM Peak Cordon Flows							
	To			From			
Zone	Observed	Modelled	GEH	Observed	Modelled	GEH	Comments
1	92.00	87.00	0.53	254.00	240.00	0.89	
2	2.00	6.00	2.00	9.00	21.00	3.10	
3	8.00	16.00	2.31	32.00	32.00	0.00	
4	55.00	58.00	0.40	109.00	92.00	1.70	
5	3.00	13.00	3.54	13.00	19.00	1.50	
6	6.00	11.00	1.71	28.00	27.00	0.19	
7	3.00	13.00	3.54	15.00	13.00	0.53	
8	14.00	9.00	1.47	55.00	63.00	1.04	
9	80.00	88.00	0.87	121.00	110.00	1.02	
10	223.00	200.00	1.58	332.00	298.00	1.92	
11	19.00	11.00	2.07	30.00	34.00	0.71	
12	75.00	65.00	1.20	134.00	129.00	0.44	
13	30.00	29.00	0.18	161.00	134.00	2.22	
14	7.00	14.00	2.16	9.00	11.00	0.63	
15	4.00	13.00	3.09	20.00	20.00	0.00	
16	73.00	127.00	5.40	125.00	133.00	0.70	Walsh Crescent
17	33.57	14.00	4.01	8.66	10.00	0.44	
18	10.00	7.00	1.03	22.00	26.00	0.82	
19	43.00	44.00	0.15	48.00	51.00	0.43	
20	99.00	159.00	5.28	89.00	94.00	0.52	Zone 20 was set up in the model to take into account the trips generated as a result of Binawarr Street as well as the TAFE access (internal road network) which accounts for the additional trips.
21	3.00	6.00	1.41	14.00	15.00	0.26	
22	46.36	114.00	7.55	70.06	81.00	1.26	Zone 22 and 42 was set up in the model to take into account the trips generated as a result of all residential streets along Bunberra Street to enable the turn volumes along Princess Highway and Meroo Road to be calibrated (internal road network) which accounts for the additional trips.
23	12.00	18.00	1.55	9.00	12.00	0.93	
24	48.00	37.00	1.69	48.00	43.00	0.74	
25	251.00	256.00	0.31	421.00	433.00	0.58	
26	341.00	420.00	4.05	604.00	696.00	3.61	
27	2.00	10.00	3.27	9.00	14.00	1.47	
28	47.00	48.00	0.15	190.00	188.00	0.15	
29	2.00	9.00	2.98	9.00	8.00	0.34	
30	63.00	63.00	0.00	60.00	37.00	3.30	
31	24.00	25.00	0.20	15.00	12.00	0.82	
32	293.00	231.00	3.83	240.00	244.00	0.26	
33	59.00	61.00	0.26	21.00	20.00	0.22	
34	192.00	158.00	2.57	82.00	105.00	2.38	
35	6.00	11.00	1.71	10.00	22.00	3.00	
36	47.00	49.00	0.29	33.00	37.00	0.68	
37	18.00	22.00	0.89	24.00	30.00	1.15	
38	74.00	78.00	0.46	45.00	49.00	0.58	
39	300.00	279.00	1.23	297.00	265.00	1.91	
40	103.00	106.00	0.29	112.00	121.00	0.83	

41	19.00	9.00	2.67	17.00	34.00	3.37	
42	100.00	115.00	1.45	100.00	60.00	4.47	No cordon flows were provided for zone 42 therefore we assumed a nominal amount of 100 trips to/from this zone. As stated for Zone 22 -> Zone 22 and 42 was set up in the model to take into account the trips generated as a result of all residential streets along Bunberra Street to enable the turn volumes along Princess Highway and Meroo Road to be calibrated (internal road network) which accounts for the additional trips.
43	76.00	46.00	3.84	38.00	71.00	4.47	
44	95.00	104.00	0.90	72.00	62.00	1.22	
45	308.00	251.00	3.41	506.00	431.00	3.47	
46	18.00	16.00	0.49	11.00	14.00	0.85	
47	47.00	39.00	1.22	1.00	2.00	0.82	
48	1.00	0.00	1.41	5.00	5.00	0.00	
49	34.00	44.00	1.60	23.00	33.00	1.89	
50	1686.00	1838	3.62	1157.00	1136.00	0.62	
51	760.00	817	2.03	460	433.00	1.28	

Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the above table - 94% of zonal flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)"

Figure B1: Zone and signalised intersection locations

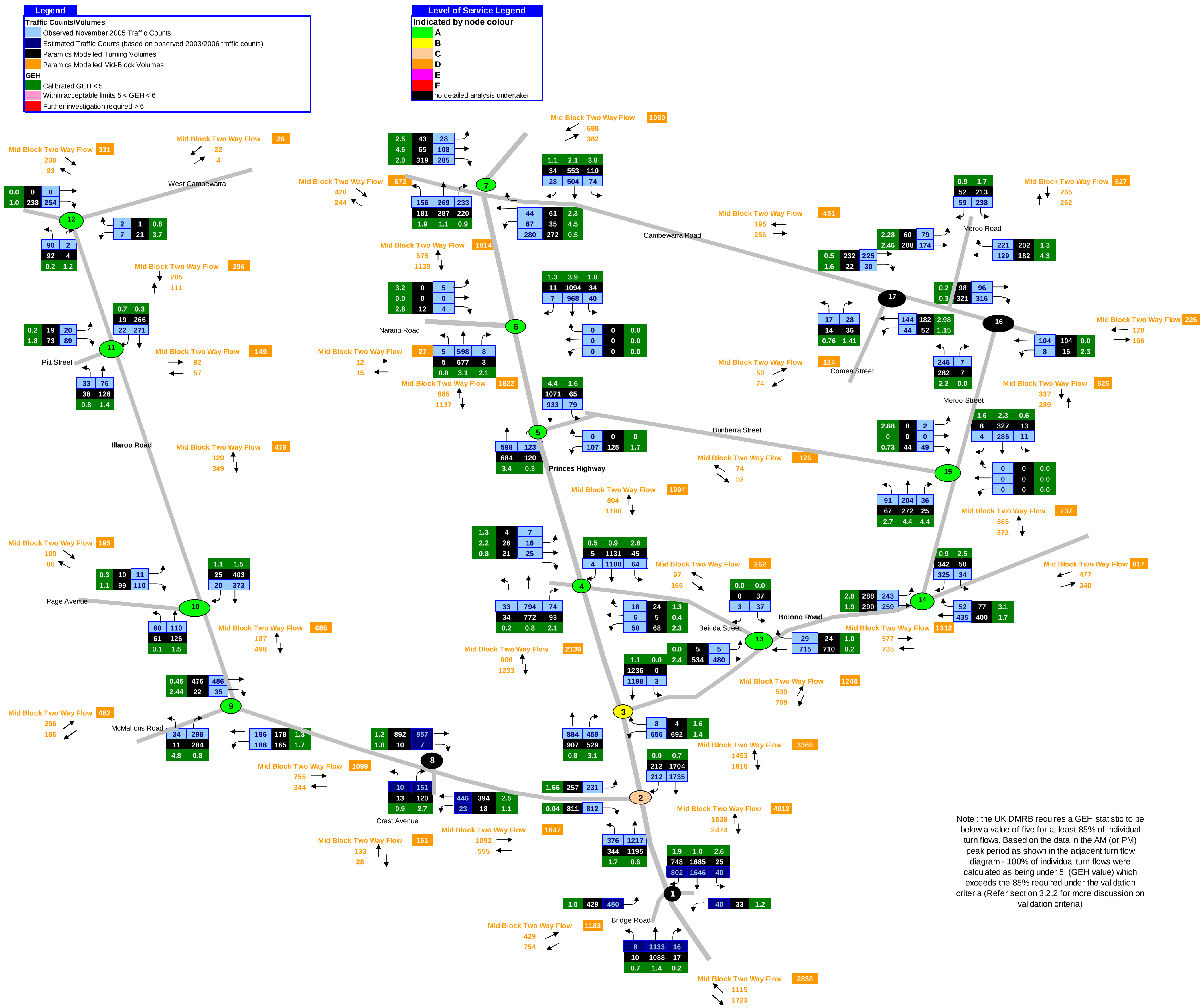


2005 PM Peak Cordon Flows							
	To			From			
Zone	Observed	Modelled	GEH	Observed	Modelled	GEH	Comments
1	209.00	212.00	0.21	160.00	148	0.97	
2	37.00	38.00	0.16	26.00	21	1.03	
3	21.00	34.00	2.48	14.00	8	1.81	
4	84.00	84.00	0.00	82.00	71	1.26	
5	9.00	12.00	0.93	6.00	11	1.71	
6	18.00	13.00	1.27	12.00	16	1.07	
7	10.00	10.00	0.00	7.00	11	1.33	
8	57.00	61.00	0.52	54.00	60	0.79	
9	106.00	105.00	0.10	123.00	128	0.45	
10	397.00	380.00	0.86	347.00	292	3.08	
11	67.00	52.00	1.94	27.00	34	1.27	
12	100.00	90.00	1.03	82.00	81	0.11	
13	21.00	23.00	0.43	49.00	50	0.14	
14	5.00	10.00	1.83	3.00	9	2.45	
15	14.00	14.00	0.00	9.00	12	0.93	
16	94.00	93.00	0.10	78.00	90	1.31	
17	19.49	20.00	0.11	23.82	23	0.17	
18	11.00	8.00	0.97	11.00	14	0.85	
19	23.00	39.00	2.87	24.00	22	0.42	
20	98.00	90.00	0.83	110.00	103	0.68	
21	9.00	7.00	0.71	6.00	10	1.41	
22	70.06	83.00	1.48	41.21	77	4.66	
23	21.00	27.00	1.22	13.00	16	0.79	
24	49.00	41.00	1.19	49.00	48	0.14	
25	343.00	350.00	0.38	301.00	340	2.18	
26	445.00	507.00	2.84	420.00	526	4.87	
27	6.00	9.00	1.10	4.00	15	3.57	
28	171.00	147.00	1.90	110.00	106	0.38	
29	6.00	4.00	0.89	4.00	13	3.09	
30	53.00	53.00	0.00	54.00	49	0.70	
31	38.00	35.00	0.50	40.00	29	1.87	
32	214.00	183.00	2.20	222.00	209	0.89	
33	31.00	26.00	0.94	36.00	32	0.69	
34	120.00	91.00	2.82	177.00	141	2.85	
35	16.00	13.00	0.79	8.00	10	0.67	
36	50.00	48.00	0.29	56.00	44	1.70	
37	32.00	31.00	0.18	25.00	25	0.00	
38	70.00	79.00	1.04	71.00	61	1.23	
39	319.00	292.00	1.54	367.00	362	0.26	
40	86.00	71.00	1.69	90.00	71	2.12	
41	16.00	11.00	1.36	17.00	18	0.24	

42	100.00	118.00	1.72	100.00	56	4.98	A nominal amount of 100 trips to / from zone 42 was determined to balance turn flows at either ends of Bunberra Street. Zone 42 was set up in the model to take into account the trips generated as a result of all residential streets along Bunberra Street to enable the turn volumes along Princess Highway and Meroo Road to be calibrated (internal road network) which accounts for the additional trips.
43	71.00	49.00	2.84	58.00	58	0.00	
44	75.00	74.00	0.12	88.00	76	1.33	
45	419.00	357.00	3.15	402.00	419	0.84	
46	22.00	10.00	3.00	24.00	40	2.83	
47	51.00	42.00	1.32	1.00	9	3.58	
48	3.00	5.00	1.00	2.00	6	2.00	
49	85.00	91.00	0.64	31.00	30	0.18	
50	1540.00	1563.00	0.58	1614.00	1574	1.00	
51	578.00	671.00	3.72	865.00	806	2.04	

Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the above table - 100% of zonal flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)"

Nowra Base 2005 AM Network



Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the AM (or PM) peak period as shown in the adjacent turn flow diagram - 100% of individual turn flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)

Nowra Base 2005 PM Network

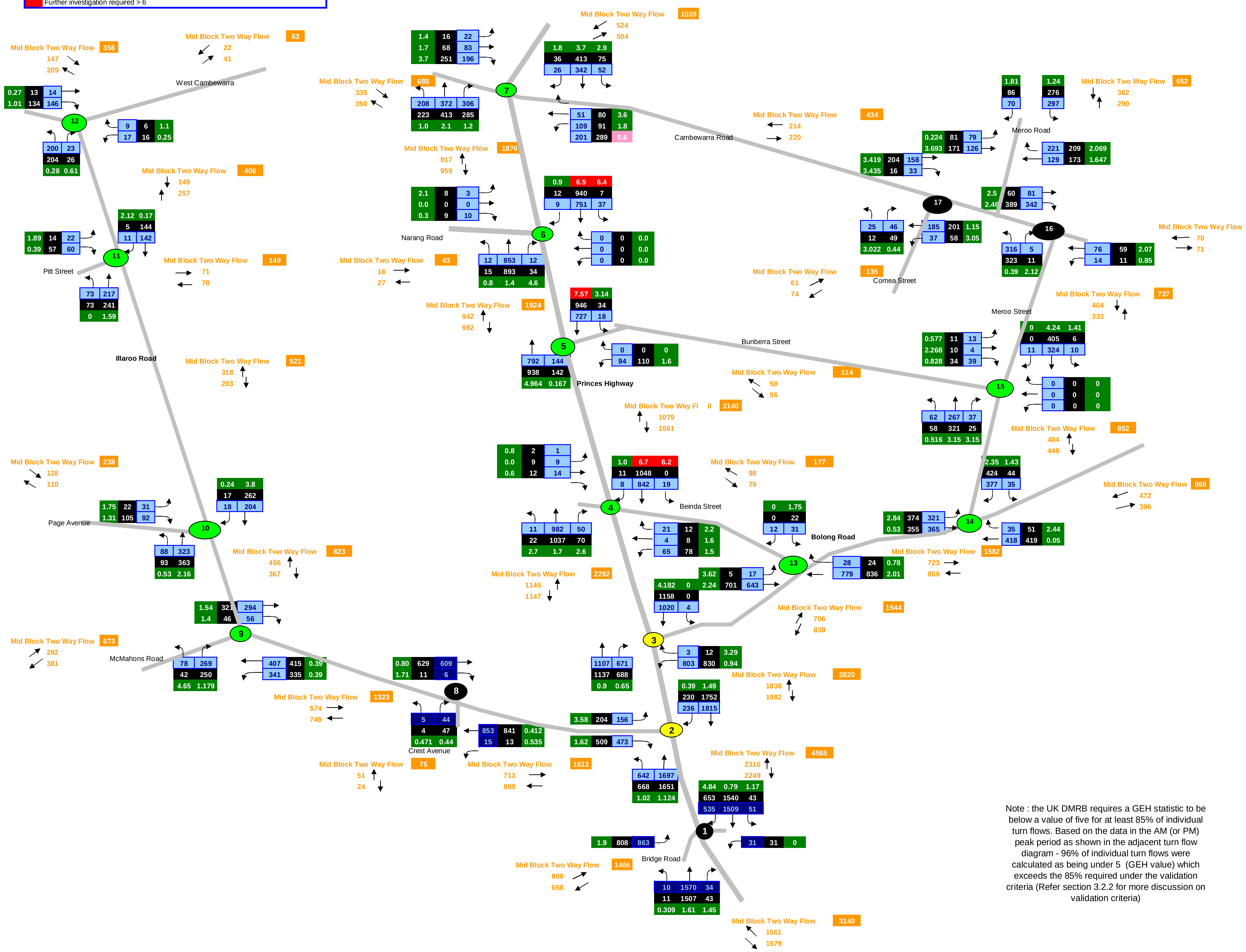
Legend

Traffic Counts/Volumes
- Observed November 2005 Traffic Counts
- Estimated Traffic Counts (based on observed 2003/2006 traffic counts)
- Paramics Modelled Turning Volumes
- Paramics Modelled Mid-Block Volumes

GEH
- Calibrated GEH < 5
- Within acceptable limits 5 < GEH < 6
- Further investigation required > 6

Level of Service Legend

Indicated by node colour
- A
- B
- C
- D
- E
- F
- No detailed analysis undertaken

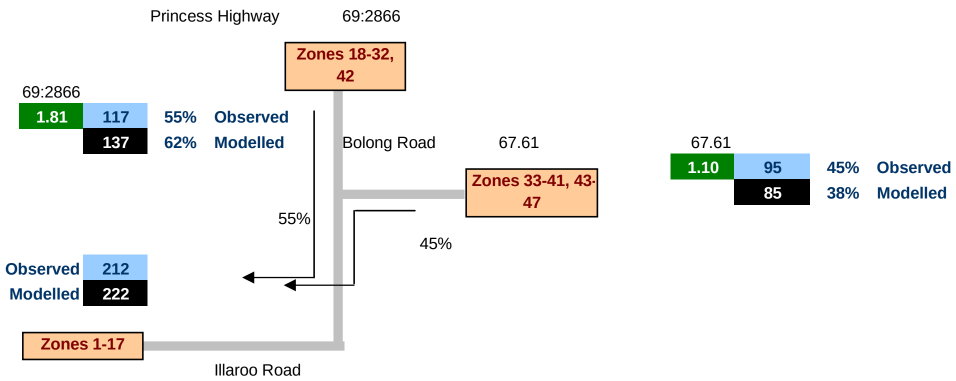


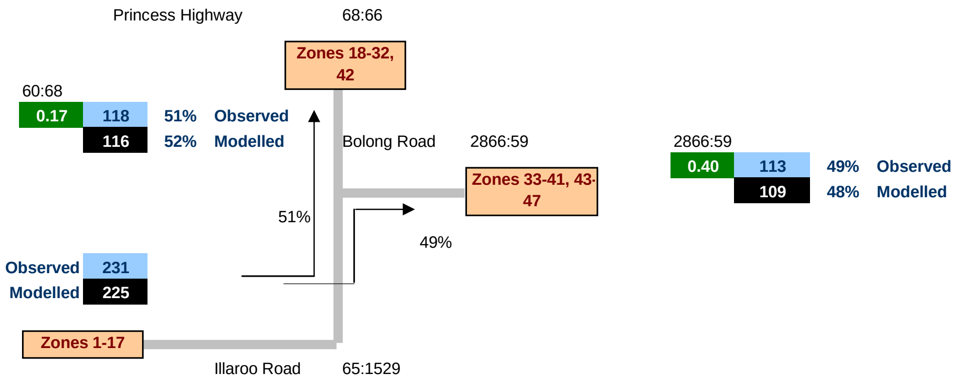
Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the AM (or PM) peak period as shown in the adjacent turn flow diagram - 96% of individual turn flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)

AM PEAK

Princess Highway / Bolong Road Weaving Movements

Legend	
Traffic Counts/Volumes	
(light blue)	Observed Traffic Flow
(black)	Modelled Traffic Flow
GEH	
(green)	Calibrated GEH < 5
(pink)	Within acceptable limits 5 < GEH < 6
(red)	Further investigation required > 6





PM PEAK

Princess Highway / Bolong Road Weaving Movements

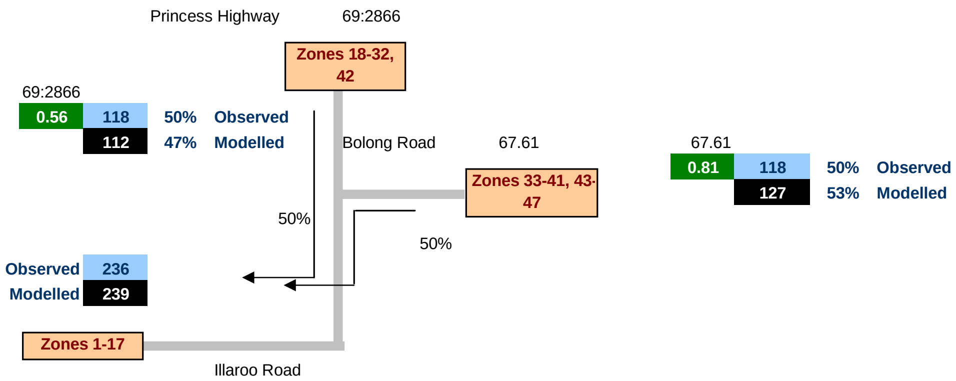
Legend

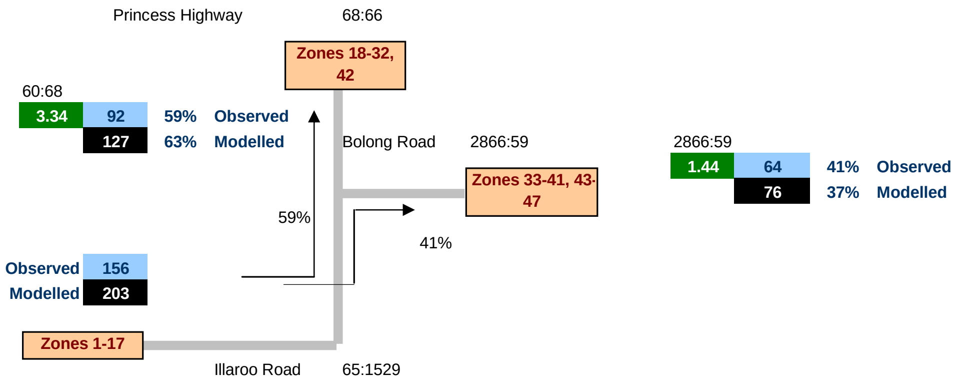
Traffic Counts/Volumes

- Observed Traffic Flow
- Modelled Traffic Flow

GEH

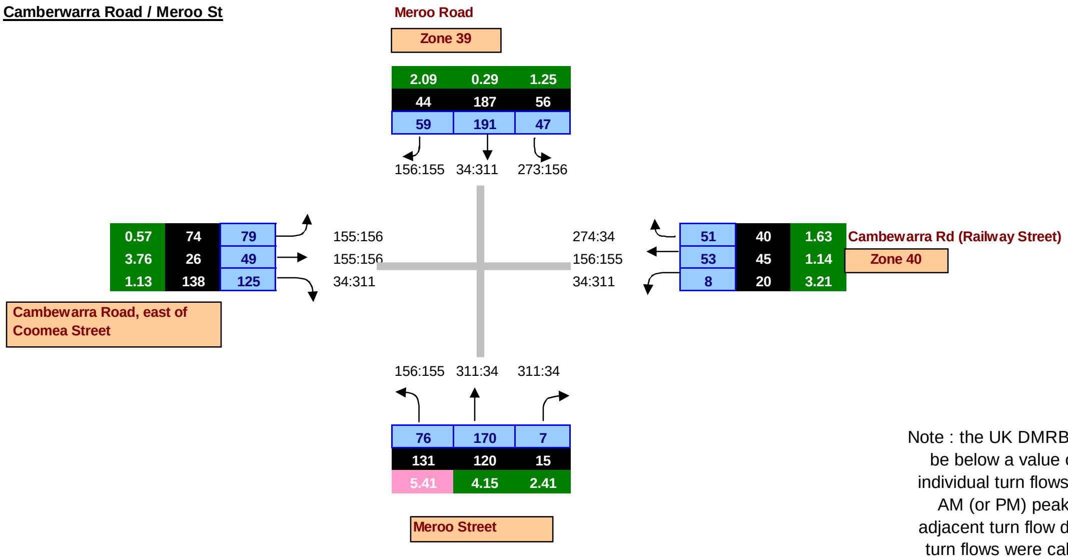
- Calibrated GEH < 5
- Within acceptable limits 5 < GEH < 6
- Further investigation required > 6





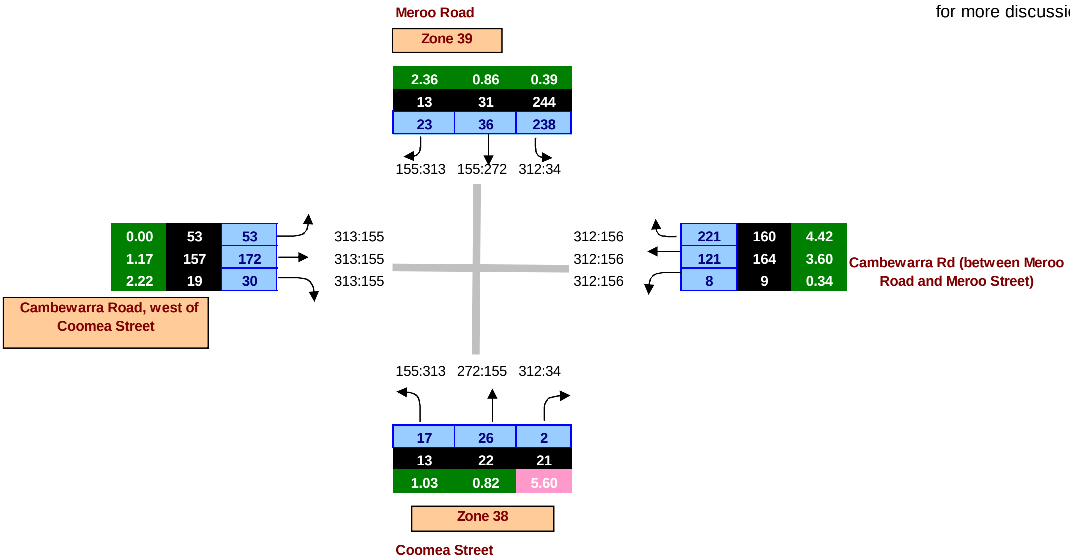
AM PEAK

Camberwarra Road / Meroo St



Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the AM (or PM) peak period as shown in the adjacent turn flow diagram - 92% of individual turn flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)

Camberwarra Road / Coomea Street



Legend

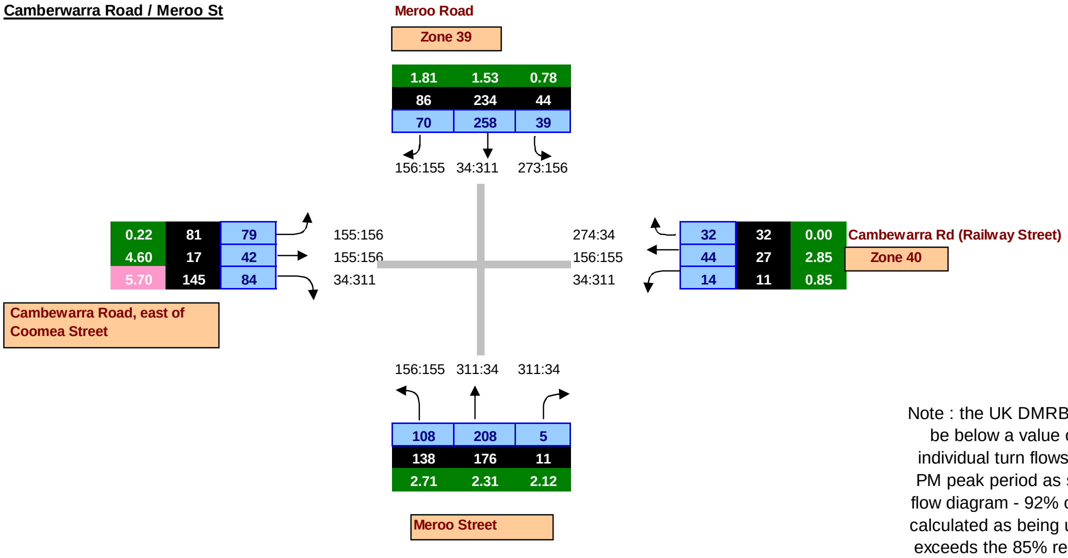
Traffic Counts/Volumes
- Observed Traffic Flow
- Modelled Traffic Flow

GEH
- Calibrated GEH < 5
- Within acceptable limits 5 < GEH < 6
- Further investigation required > 6

Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the AM (or PM) peak period as shown in the adjacent turn flow diagram - 92% of individual turn flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)

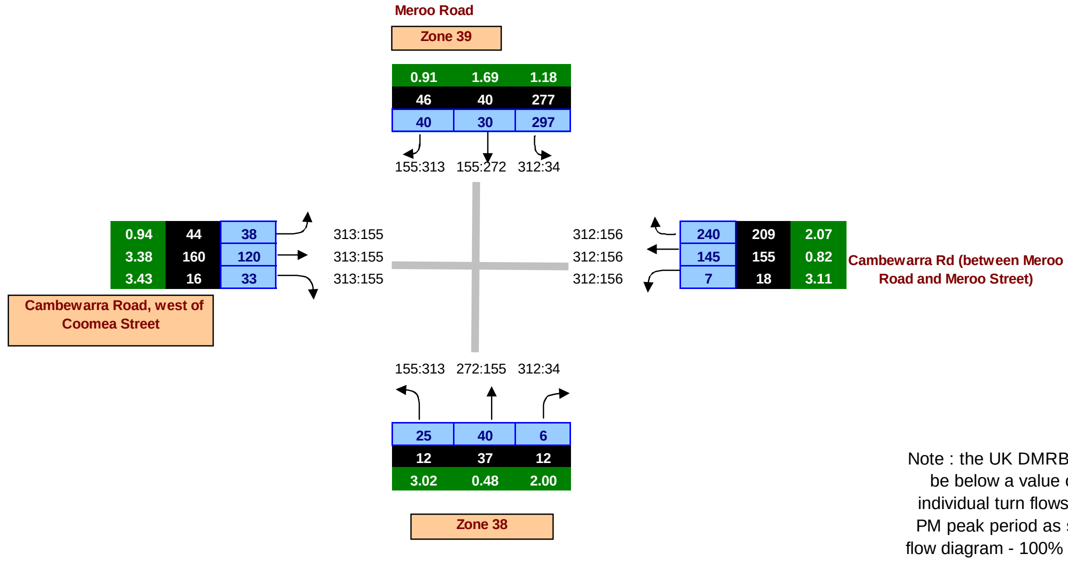
PM PEAK

Camberwarra Road / Meroo St



Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the PM peak period as shown in the adjacent turn flow diagram - 92% of individual turn flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)

Camberwarra Road / Coomea Street



Note : the UK DMRB requires a GEH statistic to be below a value of five for at least 85% of individual turn flows. Based on the data in the PM peak period as shown in the adjacent turn flow diagram - 100% of individual turn flows were calculated as being under 5 (GEH value) which exceeds the 85% required under the validation criteria (Refer section 3.2.2 for more discussion on validation criteria)

Legend

Traffic Counts/Volumes	
(light blue)	Observed Traffic Flow
(black)	Modelled Traffic Flow
GEH	
(green)	Calibrated GEH < 5
(pink)	Within acceptable limits 5 < GEH < 6
(red)	Further investigation required > 6

Appendix C

Paramics Model Outputs (2016 AM)

Nowra 2016 AM Do Nothing 2% p.a growth (on Highway and Bolong Through Flows only)

Legend

Traffic Counts/Volumes

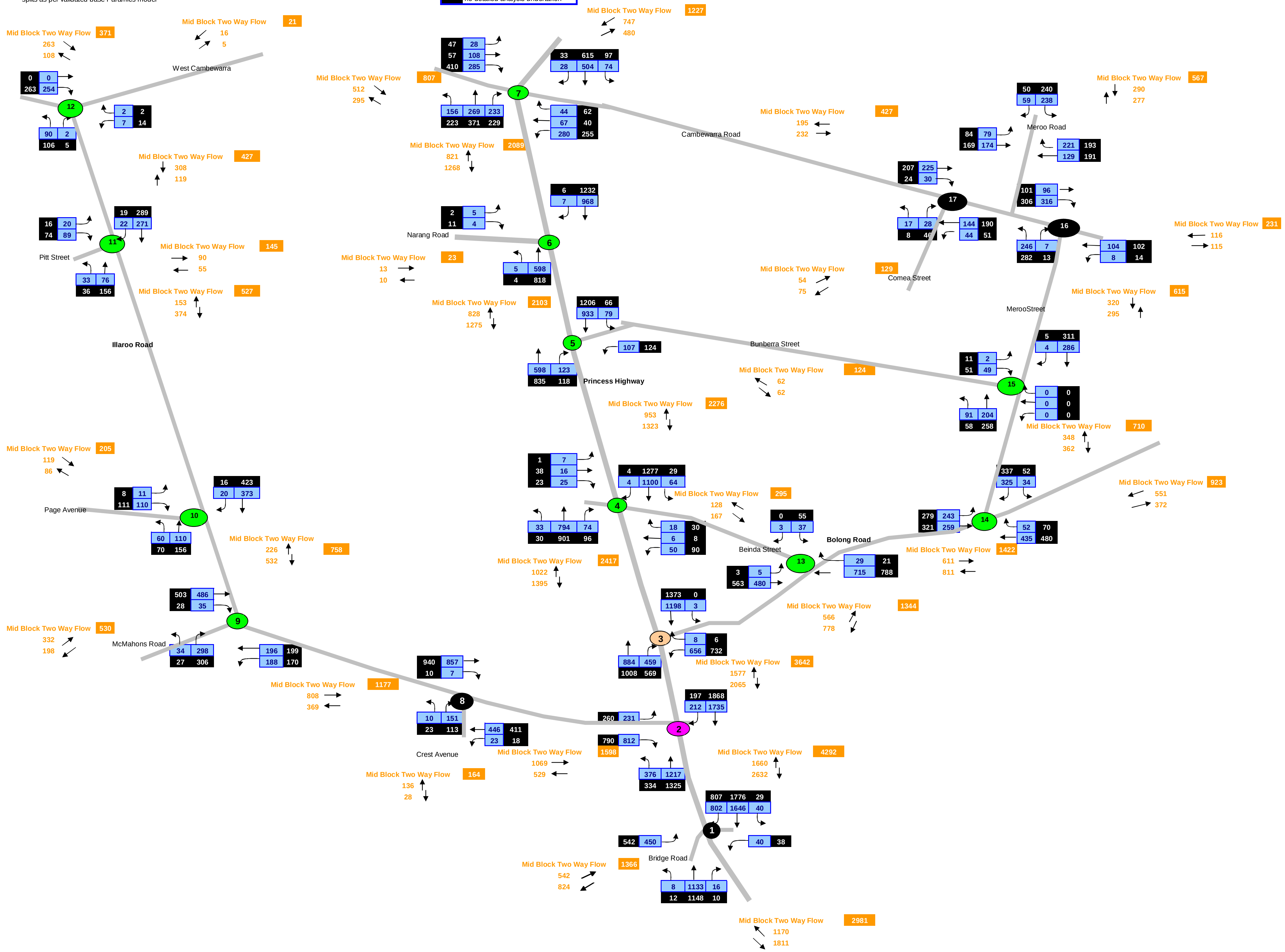
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



Nowra 2016 AM Do Nothing Structure Plan

Legend

Traffic Counts/Volumes

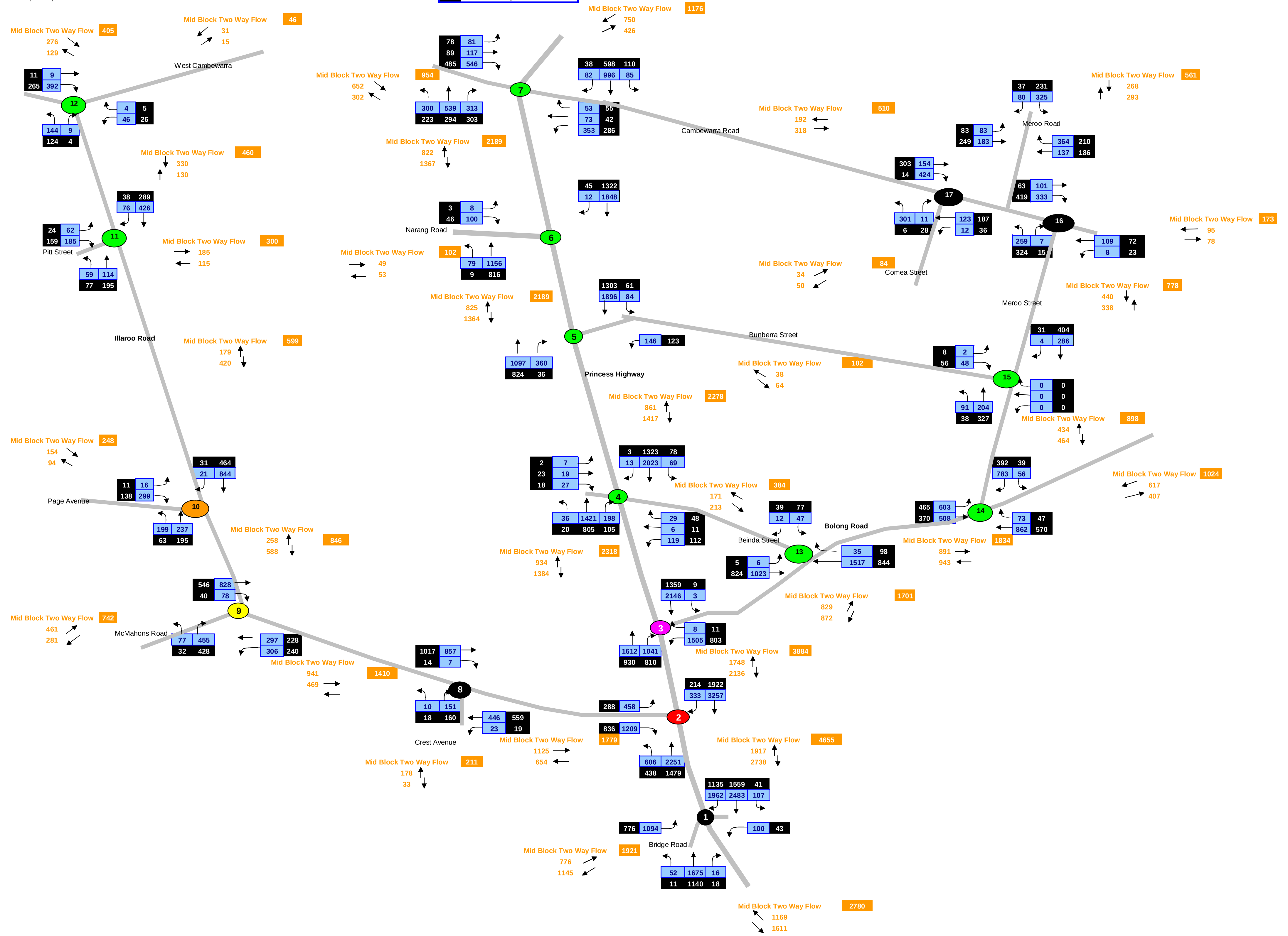
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



Nowra 2016 AM Peak Option 1 - Without Illaroo to Moss Vale Link Road

Legend

Traffic Counts/Volumes

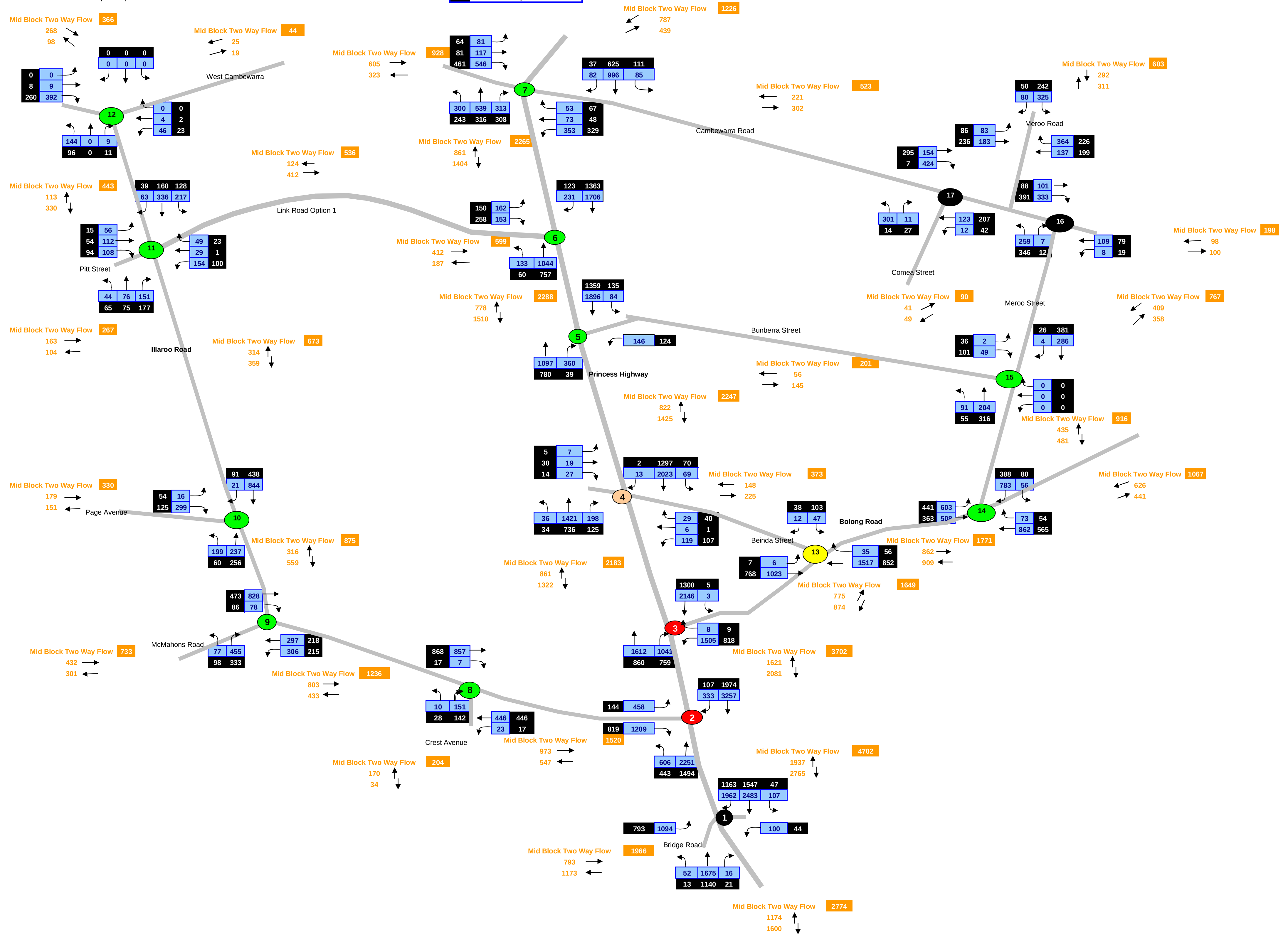
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



Nowra 2016 AM Peak Option 1 - With Illaroo to Moss Vale Link Road

Legend

Traffic Counts/Volumes

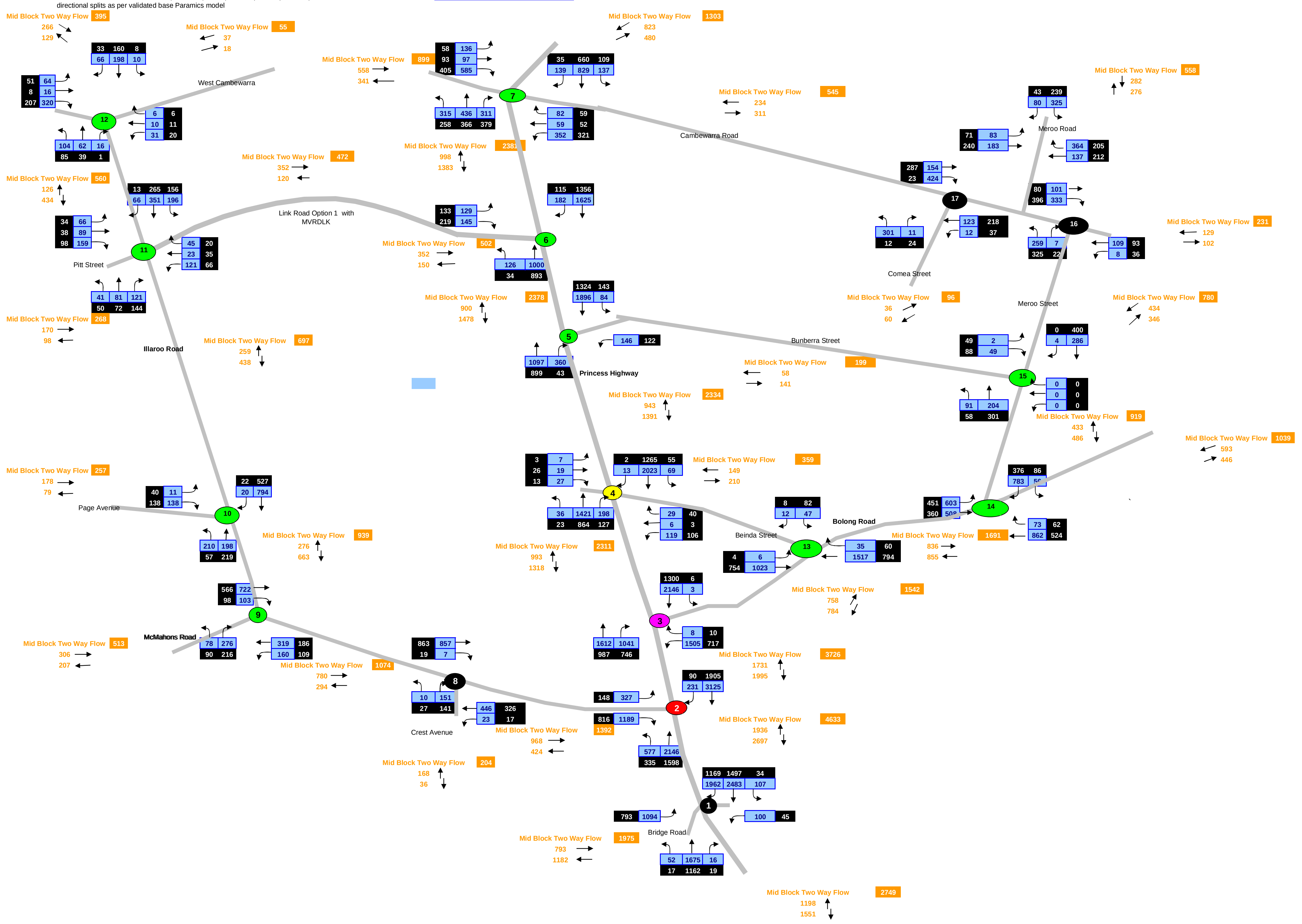
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model



Nowra 2016 AM Peak Option 1 - with River Crossing Relief (RCR)

Legend

Traffic Counts/Volumes

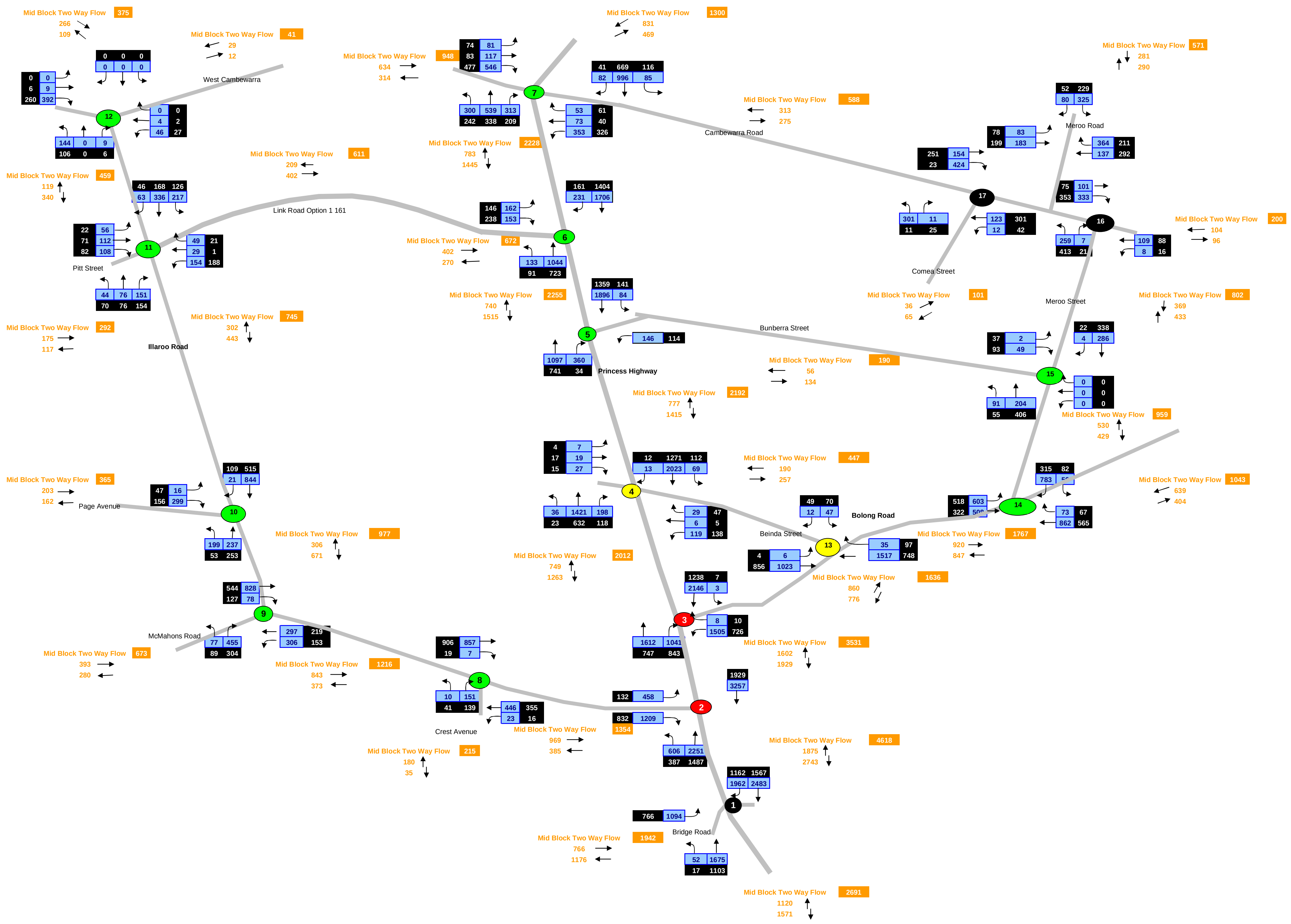
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



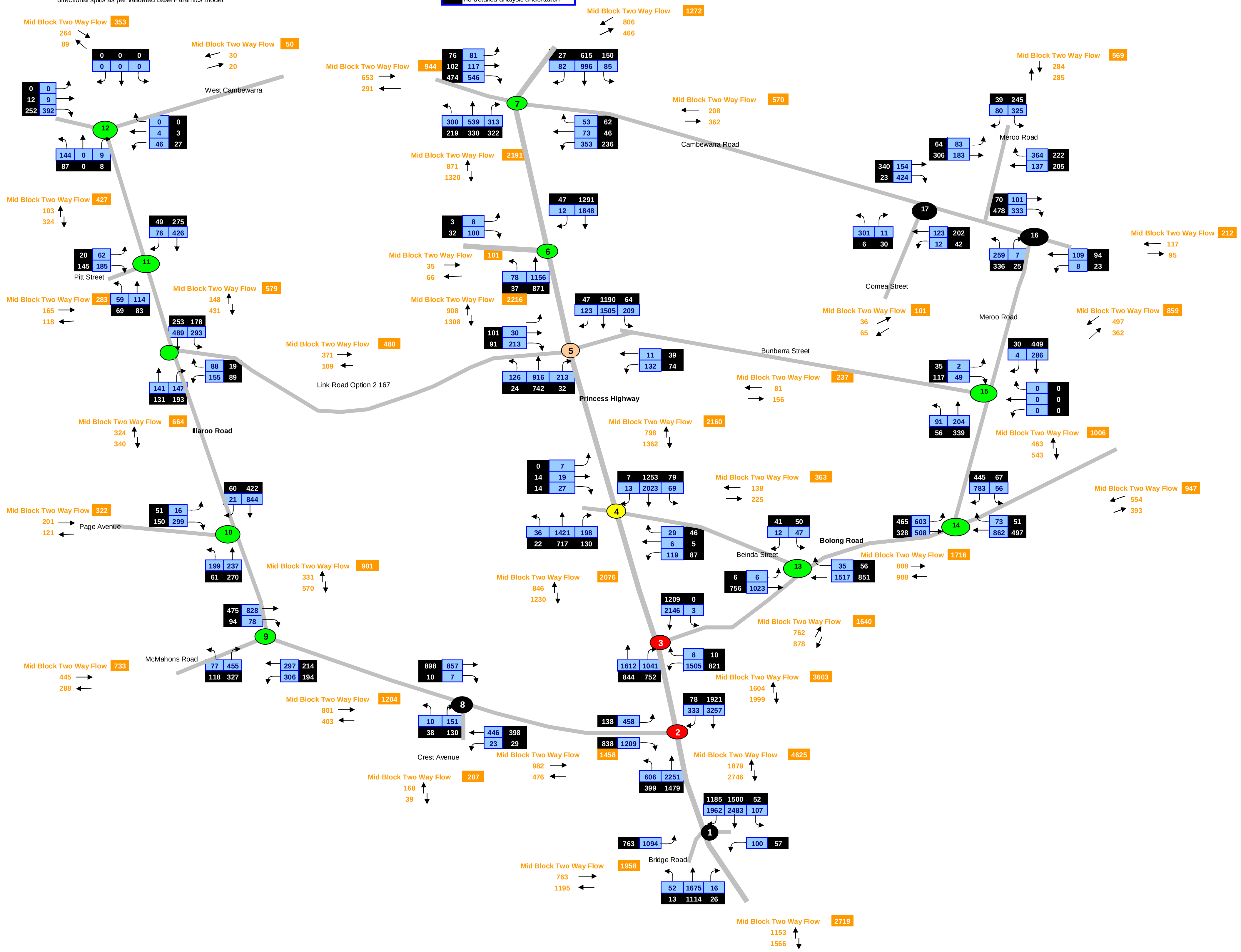
Nowra 2016 AM Peak Option 2

Legend

Traffic Counts/Volumes
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend
Indicated by node colour
- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



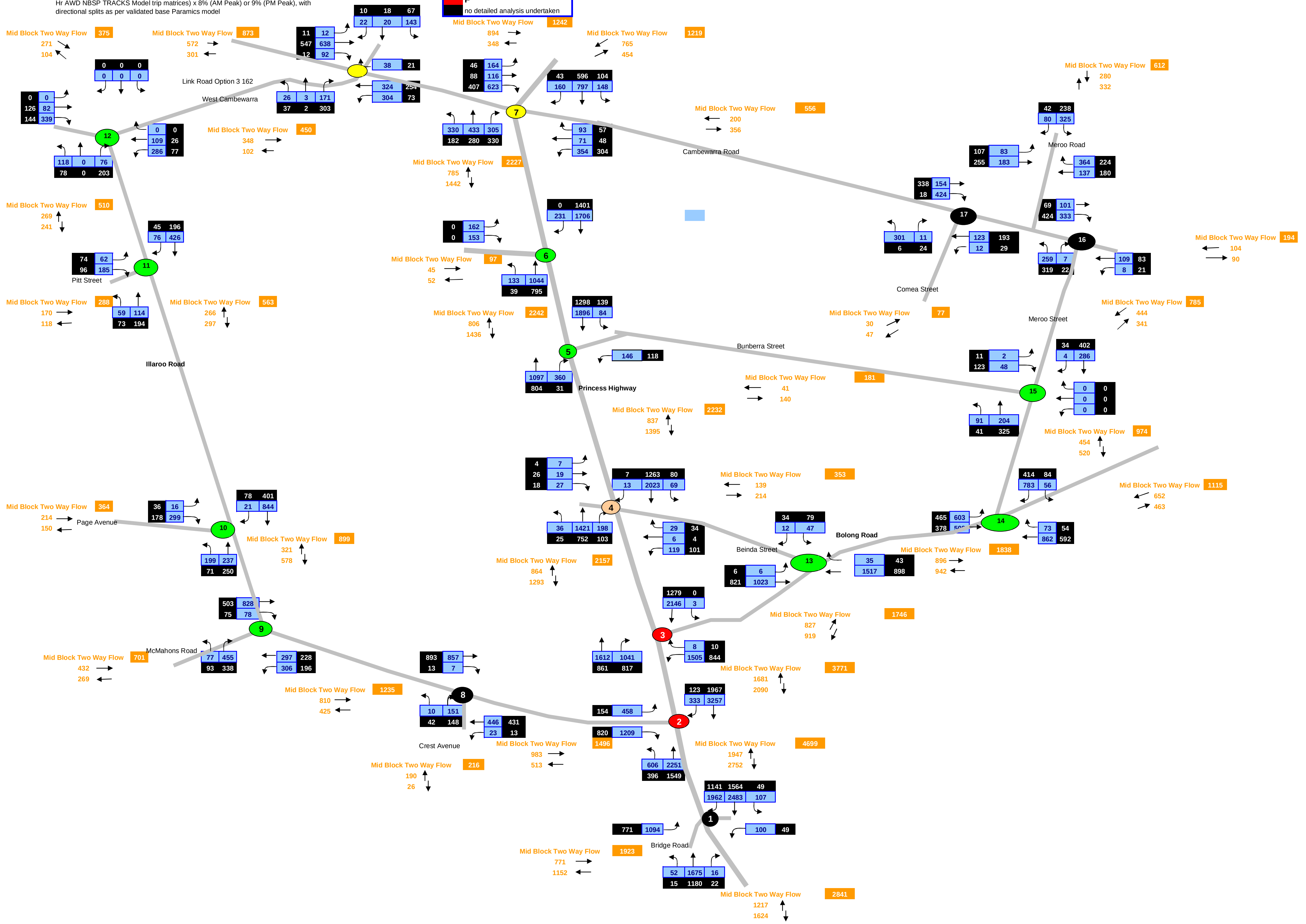
Nowra 2016 AM Peak Option 3 - Without Illaroo to Moss Vale Link Road

Legend

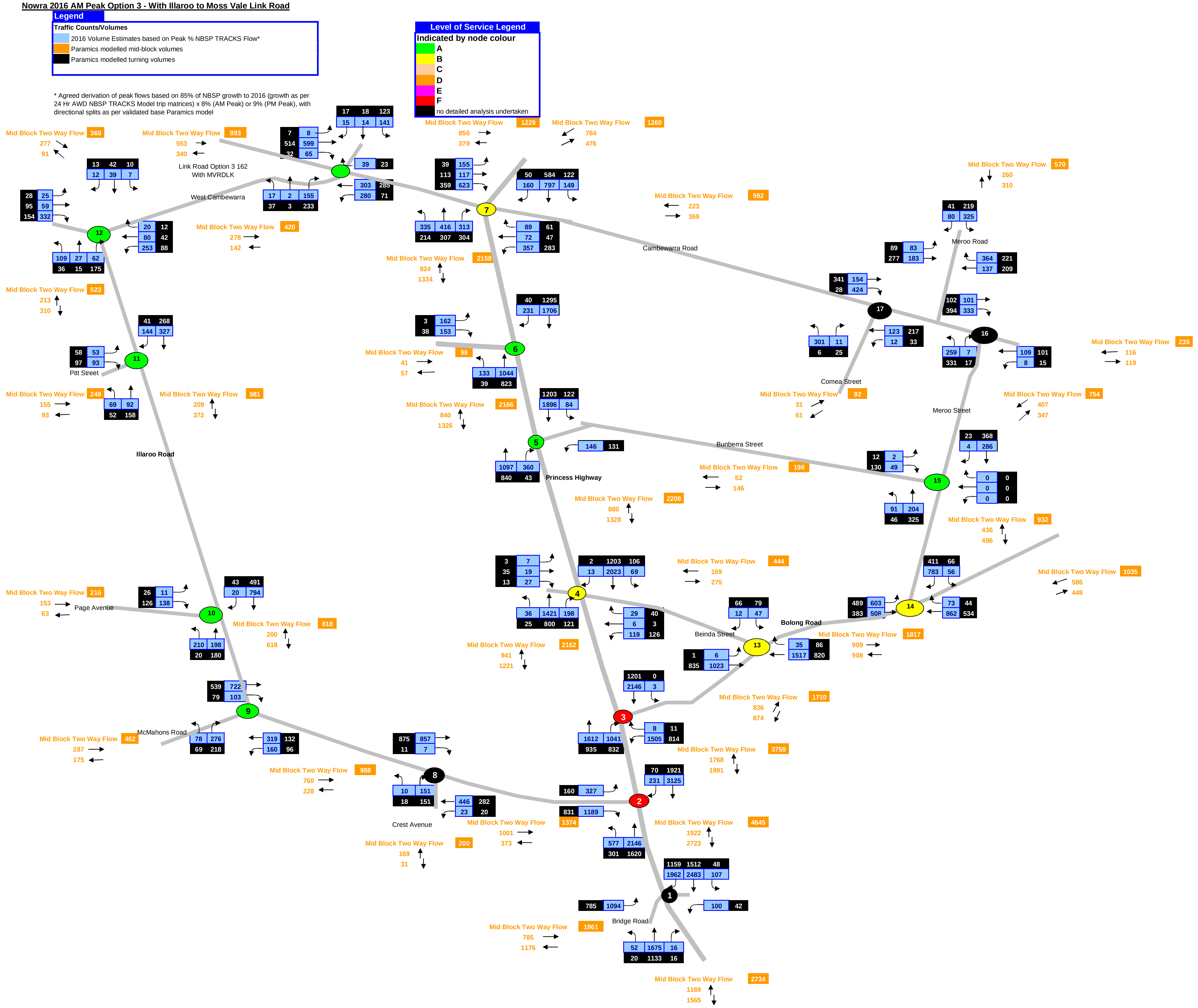
Traffic Counts/Volumes
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

Level of Service Legend
Indicated by node colour
- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model



Nowra 2016 AM Peak Option 3 - With Illaroo to Moss Vale Link Road



Nowra 2016 AM Link Flow Comparison

	2016 DN2P			2016 DNSP			2016 Option 1			2016 Option 1 RCR			2016 Option 1 MVRDLK			2016 Option 2			2016 Option 3			2016 Option 3 MVRDLK		
Stubb Roads	To node	From node	**Total Flow**	To node	From node	**Total Flow**	To node	From node	**Total Flow**	To node	From node	**Total Flow**	To node	From node	**Total Flow**	To node	From node	**Total Flow**	To node	From node	**Total Flow**	To node	From node	**Total Flow**
West Cambewarra	16	5	**21**	31	15	**46**	25	19	**44**	29	12	**41**	37	18	**55**	30	20	**50**	102	348	**450**	142	278	**420**
Illaroo Road (west of West Cambewarra)	263	108	**371**	276	129	**405**	268	98	**366**	266	109	**375**	266	129	**395**	264	89	**353**	271	104	**375**	277	91	**368**
Pitt Street	90	55	**145**	185	115	**300**	163	104	**267**	175	117	**292**	170	98	**268**	165	118	**283**	170	118	**288**	155	93	**248**
Page Avenue	119	86	**205**	154	94	**248**	179	151	**330**	203	162	**365**	178	79	**257**	201	121	**322**	214	150	**364**	153	63	**216**
McMahons Road	332	198	**530**	461	281	**742**	432	301	**733**	393	280	**673**	306	207	**513**	445	288	**733**	432	269	**701**	287	175	**462**
Crest Avenue	136	28	**164**	178	33	**211**	170	34	**204**	180	35	**215**	168	36	**204**	168	39	**207**	190	26	**216**	169	31	**200**
Bridge Road	542	824	**1366**	776	1145	**1921**	793	1173	**1966**	766	1176	**1942**	793	1182	**1975**	763	1195	**1958**	771	1152	**1923**	785	1176	**1961**
SH1 (south)	1170	1811	**2981**	1169	1611	**2780**	1174	1600	**2774**	1120	1571	**2691**	1198	1551	**2749**	1153	1566	**2719**	1217	1624	**2841**	1169	1565	**2734**
Bolong Road (east)	551	372	**923**	617	407	**1024**	626	441	**1067**	639	404	**1043**	593	446	**1039**	554	393	**947**	652	463	**1115**	586	449	**1035**
Railway (east of Meroo Street)	116	115	**231**	95	78	**173**	98	100	**198**	104	96	**200**	129	102	**231**	117	95	**212**	104	90	**194**	116	119	**235**
Meroo Road	290	277	**567**	268	293	**561**	292	311	**603**	281	290	**571**	282	276	**558**	284	285	**569**	280	332	**612**	260	310	**570**
Comea Street	54	75	**129**	34	50	**84**	41	49	**90**	36	65	**101**	36	60	**96**	36	65	**101**	30	47	**77**	31	61	**92**
SH1 (north)	747	480	**1227**	750	426	**1176**	787	439	**1226**	831	469	**1300**	823	480	**1303**	806	466	**1272**	765	454	**1219**	784	476	**1260**
Moss Vale Road	512	295	**807**	652	302	**954**	605	323	**928**	634	314	**948**	558	341	**899**	653	291	**944**						
Narang Road	13	10	**23**	49	53	**102**	412	187	**599**	402	270	**672**	352	150	**502**	35	66	**101**	45	52	**97**	41	57	**98**

Mid-block Locations	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**	To first road	From first road	**Total Flow**
Illaroo Road between West Cambewarra and Pitt	119	308	**427**	130	330	**460**	113	330	**443**	119	340	**459**	126	434	**560**	103	324	**427**	269	241	**510**	213	310	**523**
Illaroo Road between Pitt and Page	153	374	**527**	179	420	**599**	314	359	**673**	302	443	**745**	259	438	**697**				266	297	**563**	209	372	**581**
Illaroo Road between Page and McMahons	226	532	**758**	258	588	**846**	316	559	**875**	306	671	**977**	276	663	**939**	331	570	**901**	321	578	**899**	200	618	**818**
Illaroo Road between McMahons and Crest	369	808	**1177**	469	941	**1410**	433	803	**1236**	373	843	**1216**	294	780	**1074**	403	801	**1204**	425	810	**1235**	228	760	**988**
Illaroo Road between Crest and SH1	529	1069	**1598**	654	1125	**1779**	547	973	**1520**	385	969	**1354**	424	968	**1392**	476	982	**1458**	513	983	**1496**	373	1001	**1374**
SH1 between Bridge and Illaroo	2632	1660	**4292**	2738	1917	**4655**	2765	1937	**4702**	2743	1875	**4618**	2697	1936	**4633**	2746	1879	**4625**	2752	1947	**4699**	2723	1922	**4645**
SH1 between Illaroo and Bolong	2065	1577	**3642**	2136	1748	**3884**	2081	1621	**3702**	1929	1602	**3531**	1995	1731	**3726**	1999	1604	**3603**	2090	1681	**3771**	1991	1768	**3759**
SH1 between Bolong and Beinda	1395	1022	**2417**	1384	934	**2318**	1322	861	**2183**	1263	749	**2012**	1318	993	**2311**	1230	846	**2076**	1293	864	**2157**	1221	941	**2162**
SH1 between Beinda and Bunberra	1323	953	**2276**	1417	861	**2278**	1425	822	**2247**	1415	777	**2192**	1391	943	**2334**	1362	798	**2160**	1395	837	**2232**	1328	880	**2208**
SH1 between Bunberra and Narang	1275	828	**2103**	1364	825	**2189**	1510	778	**2288**	1515	740	**2255**	1478	900	**2378**	1308	908	**2216**	1436	806	**2242**	1326	840	**2166**
SH1 between Narang and Cambewarra	1268	821	**2089**	1367	822	**2189**	1404	861	**2265**	1445	783	**2228**	1383	998	**2381**	1320	871	**2191**	1442	785	**2227**	1334	824	**2158**
Bolong Road between SH1 and Beinda	778	566	**1344**	872	829	**1701**	874	775	**1649**	776	860	**1636**	784	758	**1542**	878	762	**1640**	919	827	**1746**	874	836	**1710**
Bolong Road between Beinda and Meroo	811	611	**1422**	943	891	**1834**	909	862	**1771**	847	920	**1767**	855	836	**1691**	908	808	**1716**	942	896	**1838**	908	909	**1817**
Meroo Street between Bolong and Bunberra	362	348	**710**	464	434	**898**	481	435	**916**	429	530	**959**	486	433	**919**	543	463	**1006**	520	454	**974**	496	436	**932**
Meroo Street between Bunberra and Cambewarra	320	295	**615**	440	338	**778**	409	358	**767**	369	433	**802**	434	346	**780**	497	362	**859**	444	341	**785**	407	347	**754**
Cambewarra Road between SH1 and Comea	195	232	**427**	192	318	**510**	221	302	**523**	313	275	**588**	234	311	**545**	208	362	**570**	200	356	**556**	223	369	**592**
Bunberra Street between SH1 and Meroo	62	62	**124**	38	64	**102**	56	145	**201**	56	134	**190**	58	141	**199**	81	156	**237**	41	140	**181**	52	146	**198**
Beinda Street between SH1 and Bolong	128	167	**295**	171	213	**384**	148	225	**373**	190	257	**447**	149	210	**359**	138	225	**363**	139	214	**353**	169	275	**444**
Option 1 Link Road between Illaroo and SH1							124	412	**536**	209	402	**611**	120	352	**472**									
Option 2 Link Road between Illaroo and SH1																109	371	**480**						
Illaroo Road between Pitt and Option 2 Link Road																148	431	**579**						
Illaroo Road between Option 2 Link Road and Page																324	340	**664**						
Option 3 Link Road between Illaroo and Moss Vale																			102	348	**450**	142	278	**420**
Moss Vale Road between SH1 and Option 3 Link Road																			894	348	**1242**	850	379	**1229**
Moss Vale Road west of Option 3 Link Road																			572	301	**873**	553	340	**893**
Option 4 Link Road between Illaroo and SH1																								

Appendix D

Paramics Model Outputs (2016 PM)

Nowra 2016 PM Do Nothing 2% growth p.a. (on Princes Highway and Bolong Road Through Flows only)

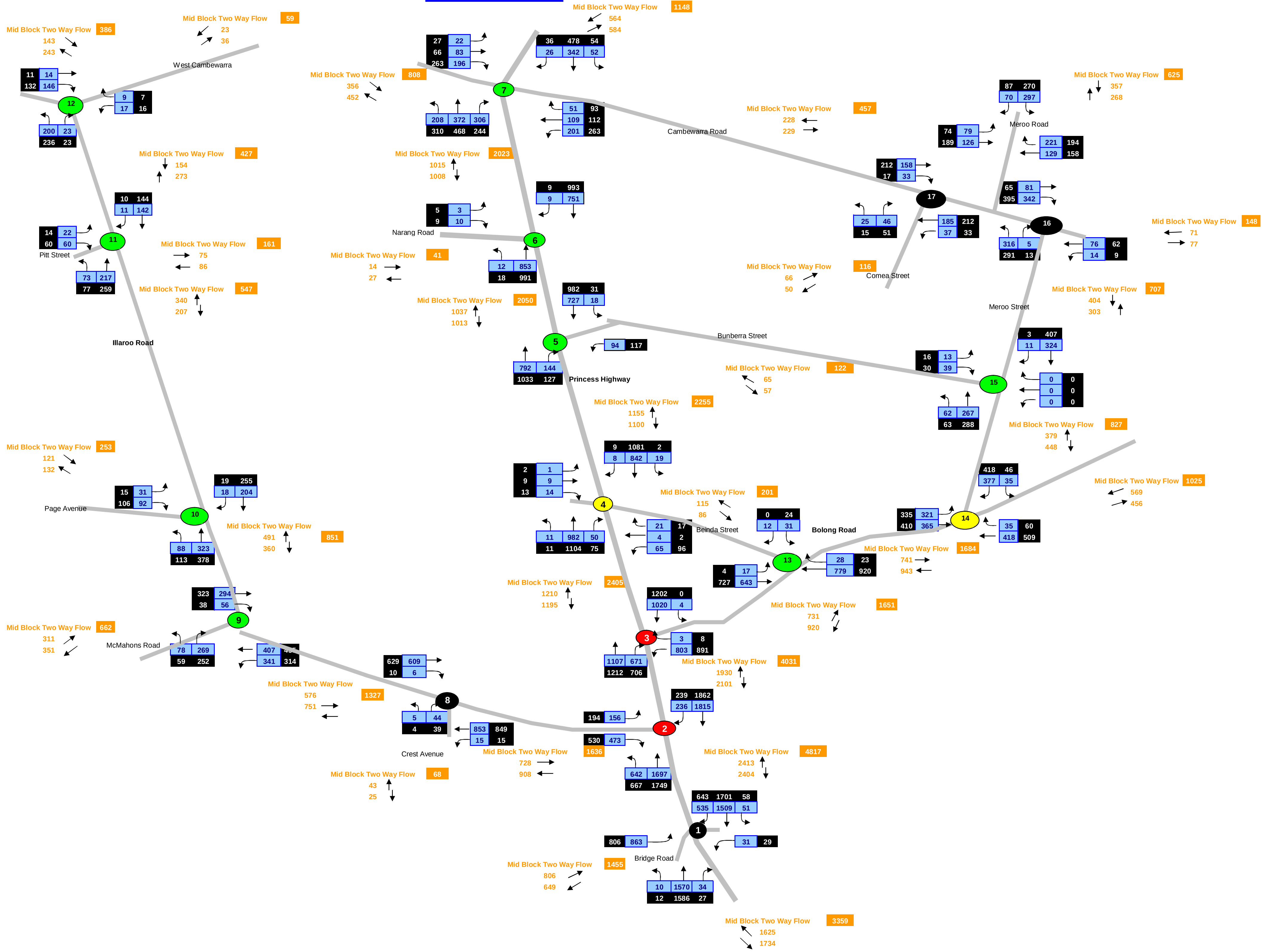
Legend

Traffic Counts/Volumes
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend

Indicated by node colour
- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



2/10/200712:37 PM

Turnflow 2016 DN2P PM 070111.xls

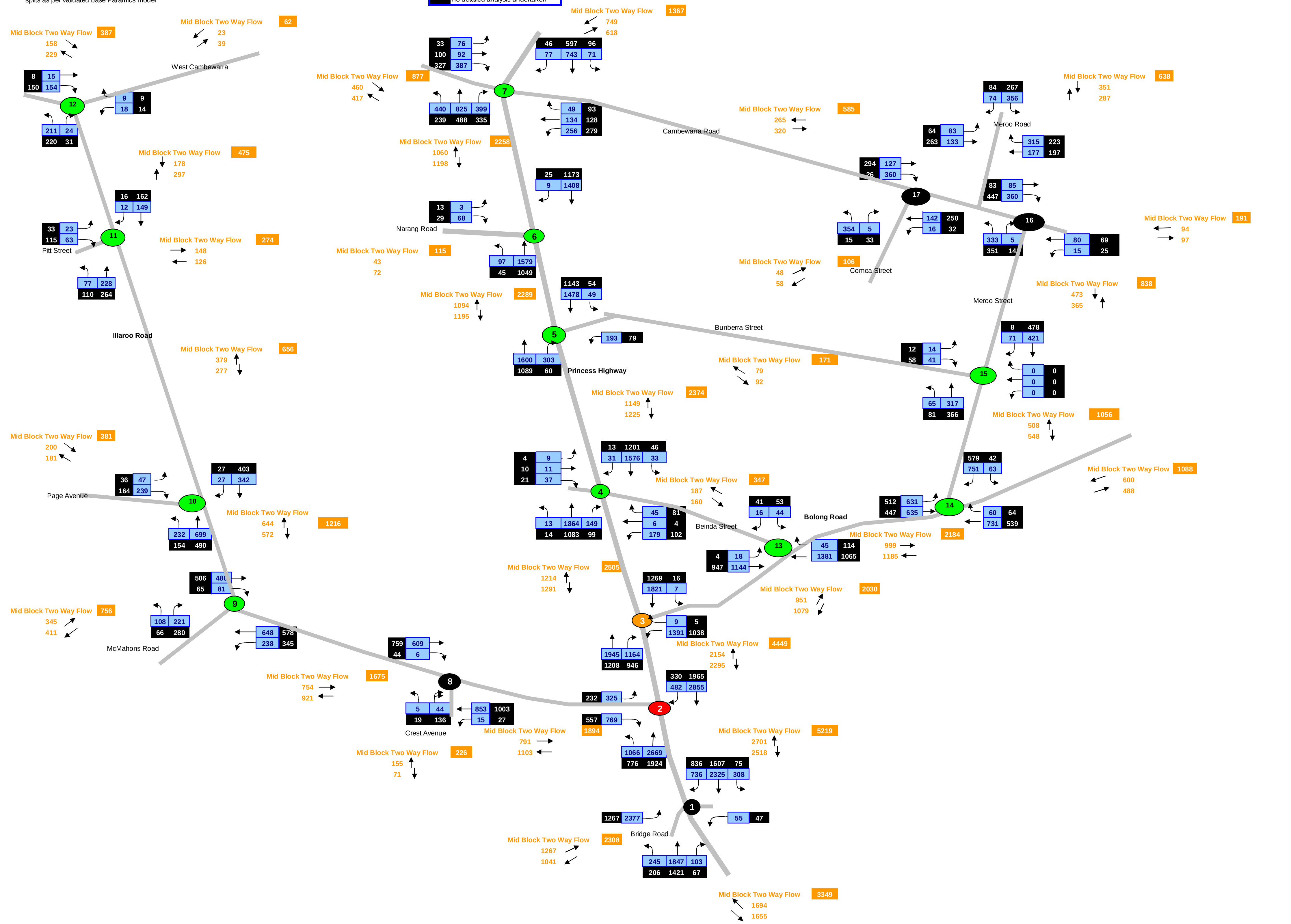
Nowra 2016 PM Do Nothing Structure Plan

Legend

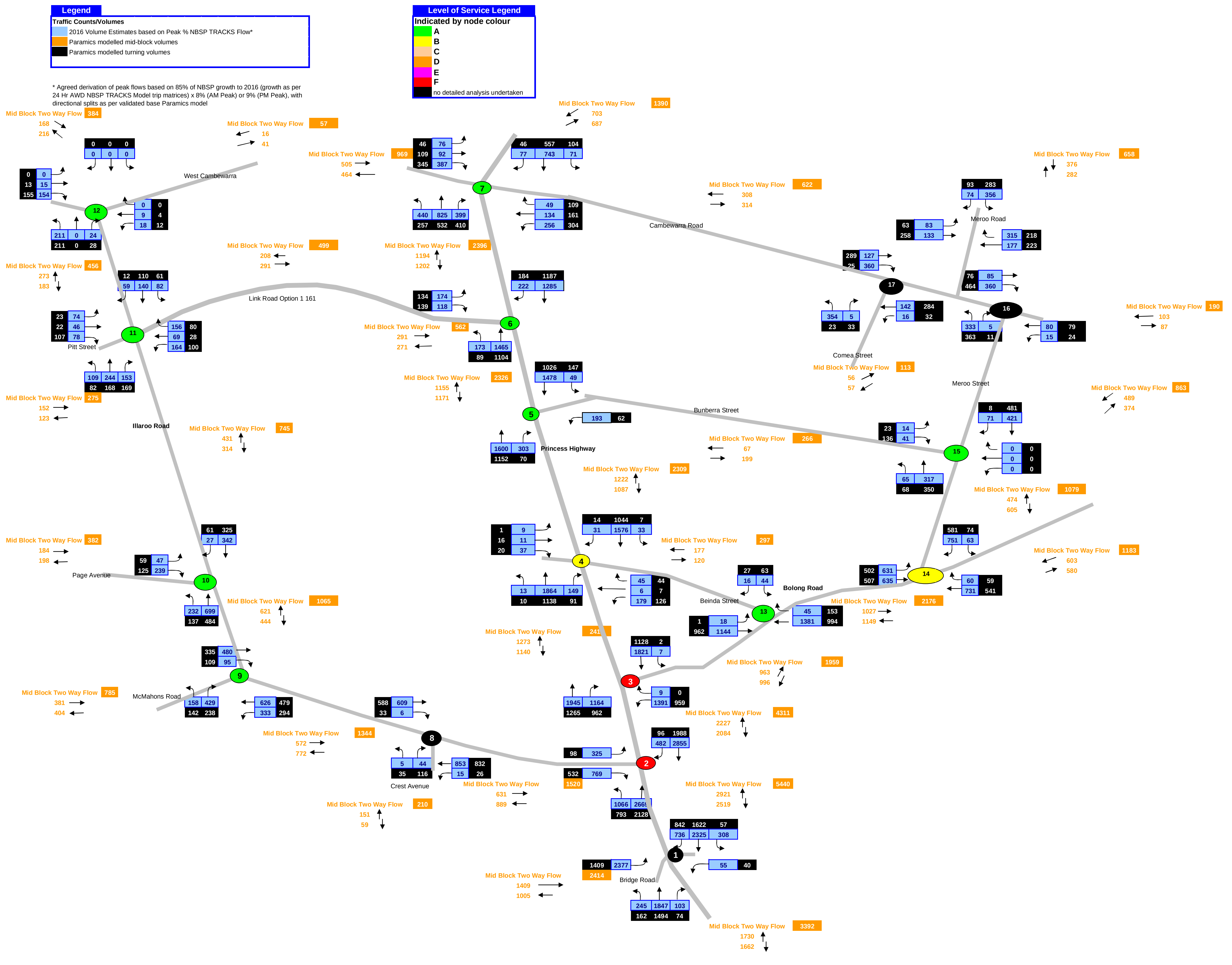
Traffic Counts/Volumes
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

Level of Service Legend
Indicated by node colour
- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model



Nowra 2016 PM Peak Option 1 - Without Illaroo to Moss Vale Link Road



Nowra 2016 PM Peak Option 1 - With Illaroo to Moss Vale Link Road

Legend

Traffic Counts/Volumes

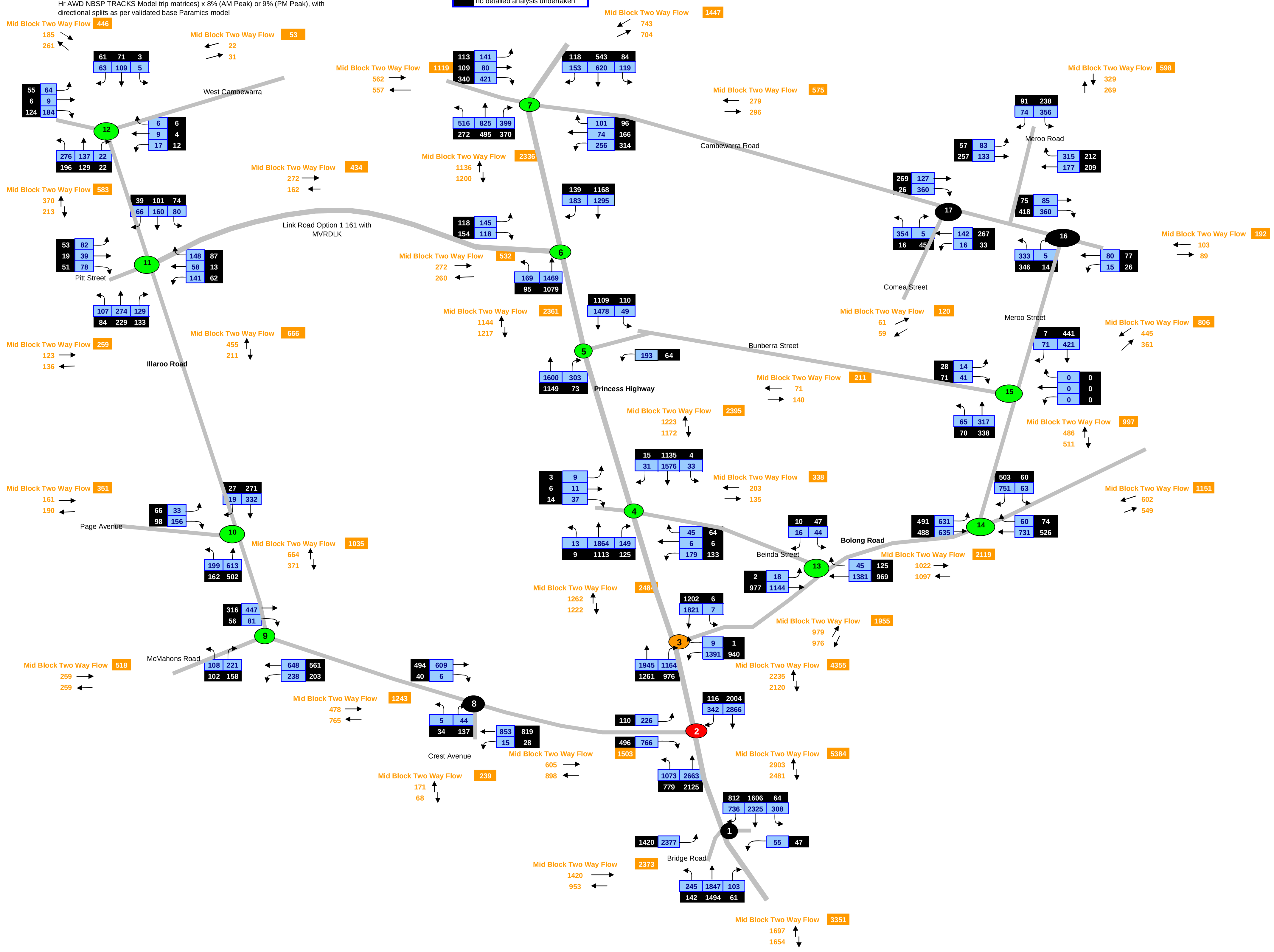
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model



Nowra 2016 PM Peak Option 1 - With River Crossing Relief (RCR)

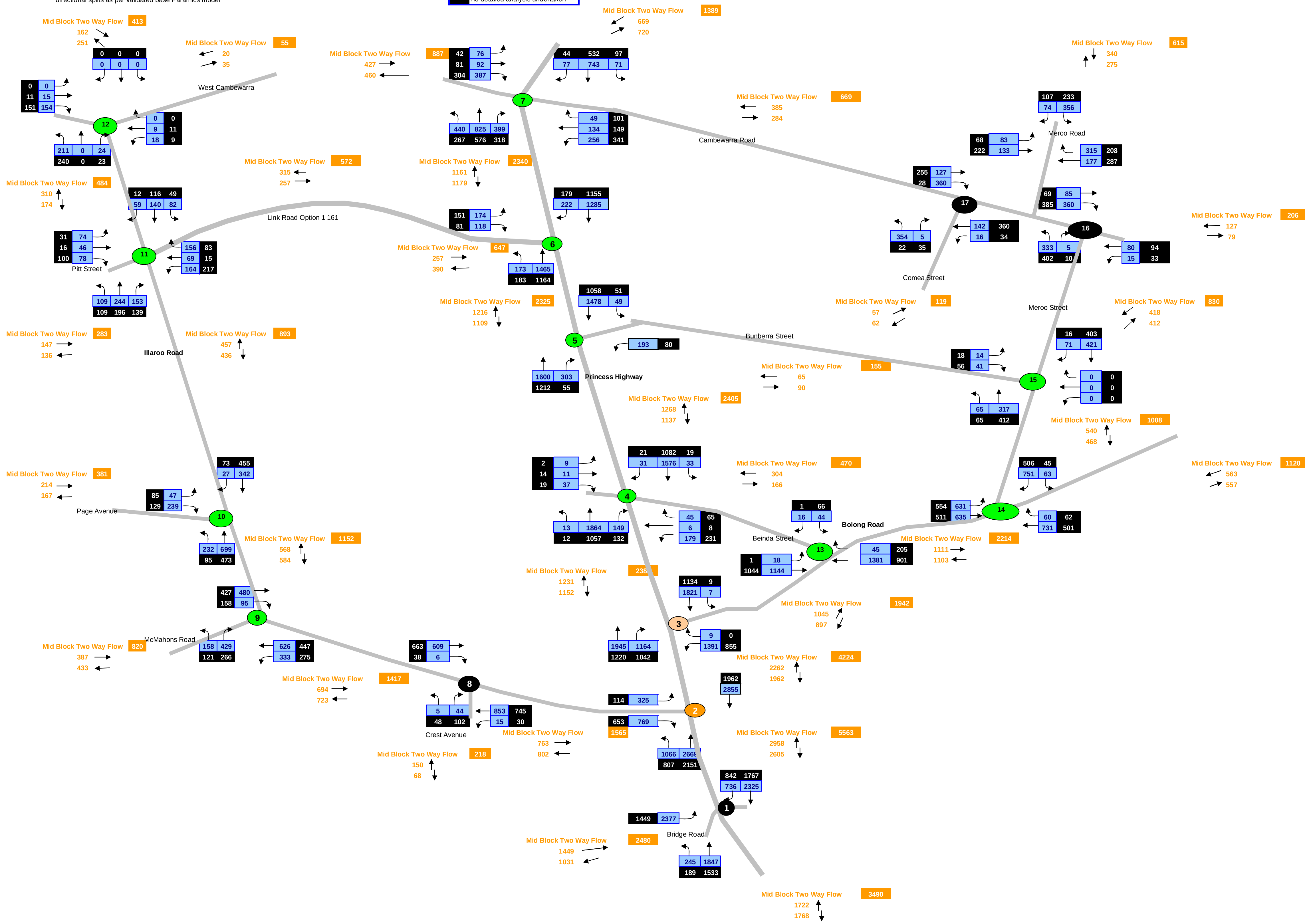
Legend

Traffic Counts/Volumes
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

Level of Service Legend

Indicated by node colour
- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model



Nowra 2016 PM Peak Option 2

Legend

Traffic Counts/Volumes

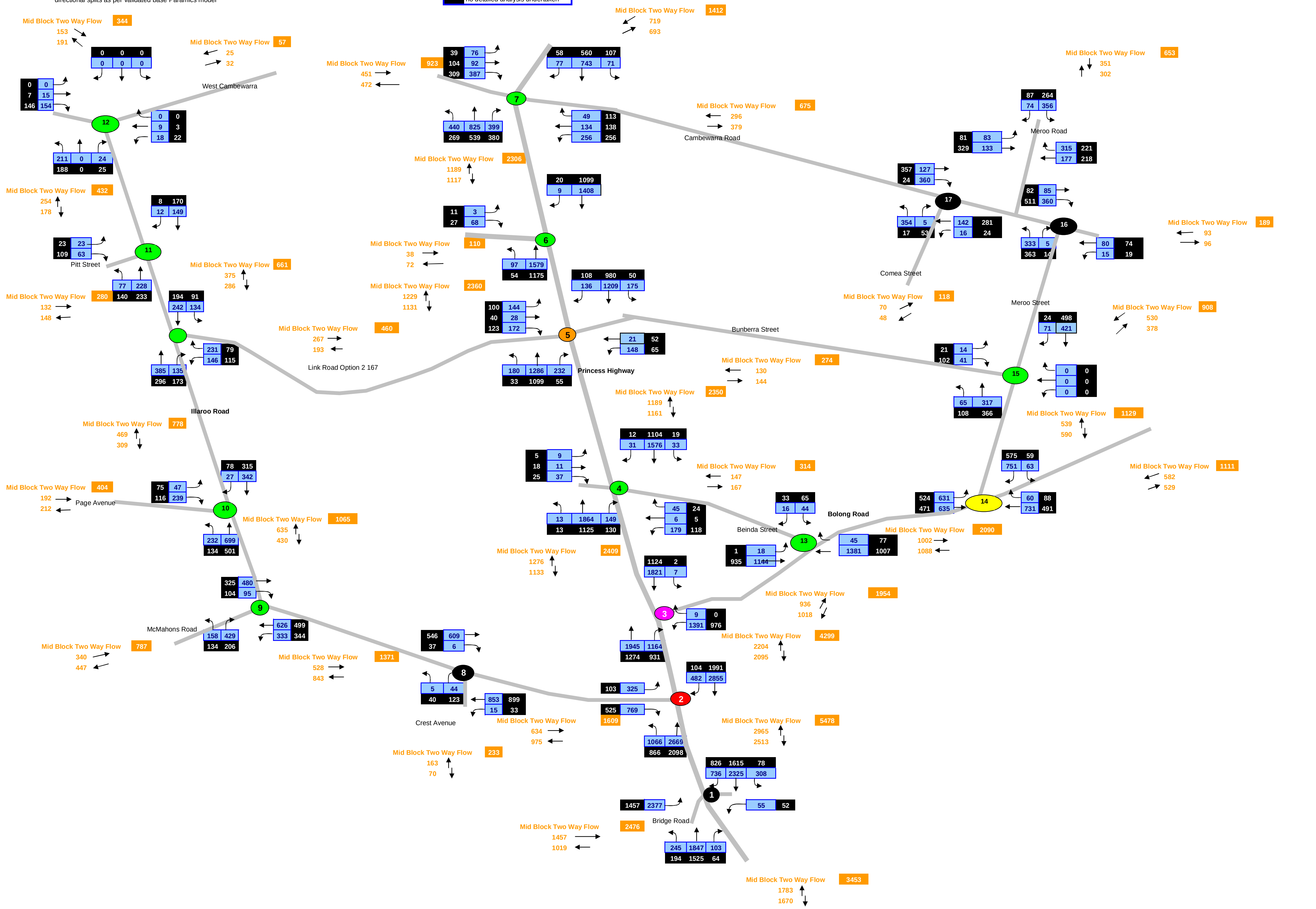
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



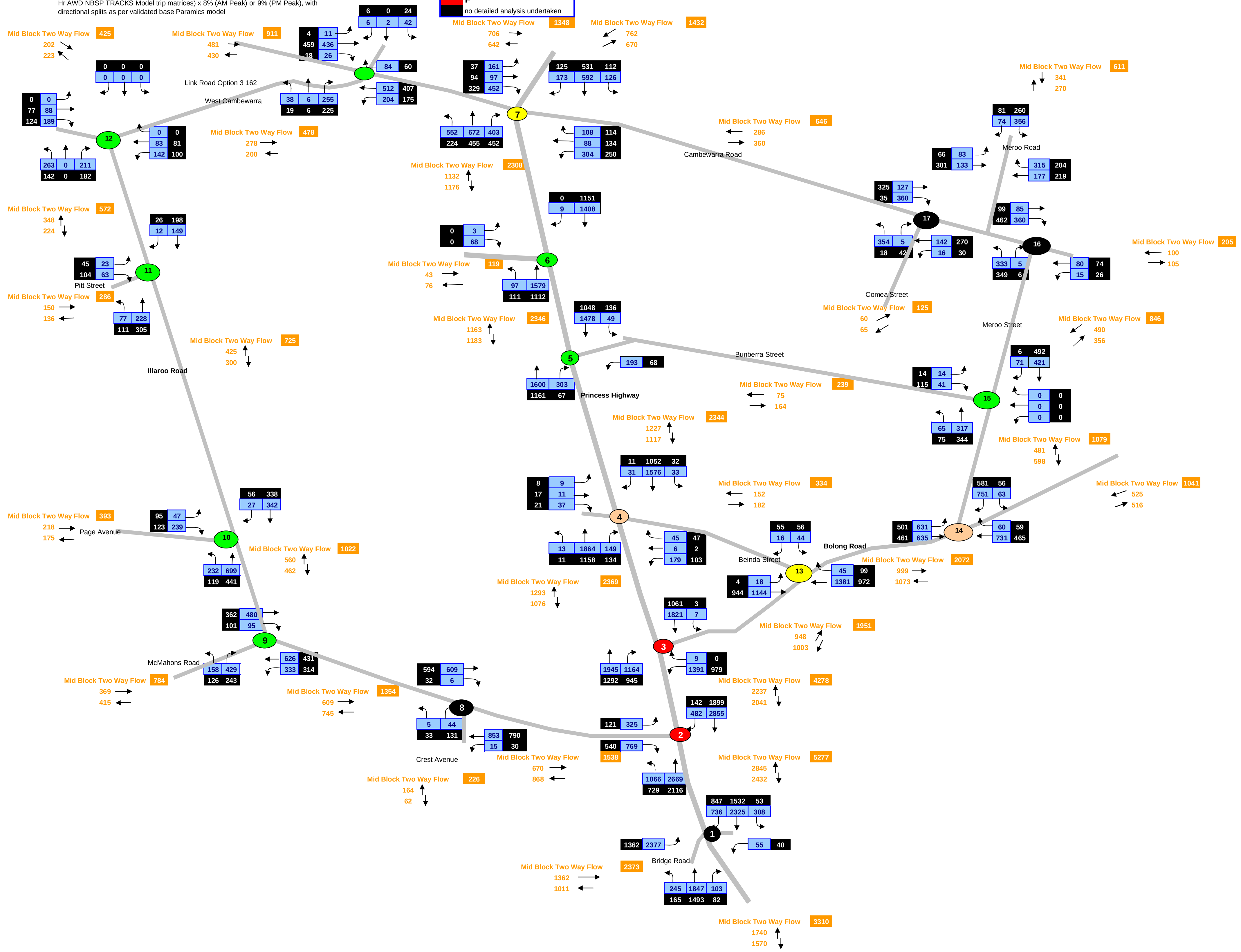
Nowra 2016 PM Peak Option 3 - Without Illaroo to Moss Vale Link Road

Legend

Traffic Counts/Volumes
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model

Level of Service Legend
Indicated by node colour
- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken



Nowra 2016 PM Peak Option 3 - With Illaroo to Moss Vale Link Road

Legend

Traffic Counts/Volumes

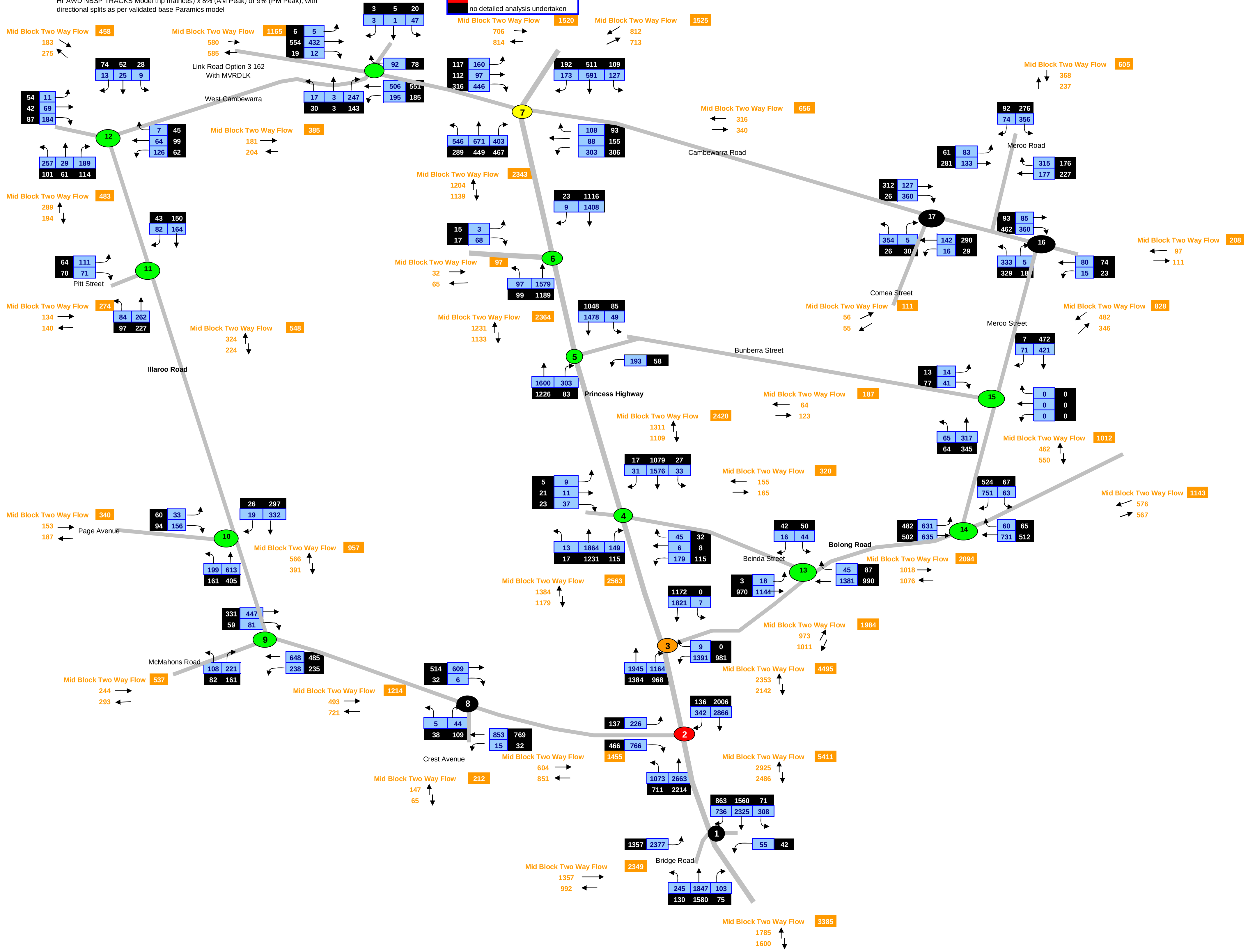
- 2016 Volume Estimates based on Peak % NBSP TRACKS Flow*
- Paramics modelled mid-block volumes
- Paramics modelled turning volumes

Level of Service Legend

Indicated by node colour

- A
- B
- C
- D
- E
- F
- no detailed analysis undertaken

* Agreed derivation of peak flows based on 85% of NBSP growth to 2016 (growth as per 24 Hr AWD NBSP TRACKS Model trip matrices) x 8% (AM Peak) or 9% (PM Peak), with directional splits as per validated base Paramics model



Nowra 2016 PM Link Flow Comparison

	2016 DN2P			2016 DNSP			2016 Option 1			2016 Option 1 RCR			2016 Option 1 MVRDLK			2016 Option 2			2016 Option 3			2016 Option 3 MVRDLK		
Stubb Roads	To node	From node	Total Flow	To node	From node	Total Flow	To node	From node	Total Flow	To node	From node	Total Flow	To node	From node	Total Flow	To node	From node	Total Flow	To node	From node	Total Flow	To node	From node	Total Flow
West Cambewarra	23	36	**59**	23	39	**62**	16	41	**57**	20	35	**55**	22	31	**53**	25	32	**57**	200	278	**478**	204	181	**385**
Illaroo Road (west of West Cambewarra)	143	243	**386**	158	229	**387**	168	216	**384**	162	251	**413**	185	261	**446**	153	191	**344**	202	223	**425**	183	275	**458**
Pitt Street	75	86	**161**	148	126	**274**	152	123	**275**	147	136	**283**	123	136	**259**	132	148	**280**	150	136	**286**	134	140	**274**
Page Avenue	121	132	**253**	200	181	**381**	184	198	**382**	214	167	**381**	161	190	**351**	192	212	**404**	218	175	**393**	153	187	**340**
McMahons Road	311	351	**662**	345	411	**756**	381	404	**785**	387	433	**820**	259	259	**518**	340	447	**787**	369	415	**784**	244	293	**537**
Crest Avenue	43	25	**68**	155	71	**226**	151	59	**210**	150	68	**218**	171	68	**239**	163	70	**233**	164	62	**226**	147	65	**212**
Bridge Road	806	649	**1455**	1267	1041	**2308**	1409	1005	**2414**	1449	1031	**2480**	1420	953	**2373**	1457	1019	**2476**	1362	1011	**2373**	1357	992	**2349**
SH1 (south)	1625	1734	**3359**	1694	1655	**3349**	1730	1662	**3392**	1722	1768	**3490**	1697	1654	**3351**	1783	1670	**3453**	1740	1570	**3310**	1785	1600	**3385**
Bolong Road (east)	569	456	**1025**	600	488	**1088**	603	580	**1183**	563	557	**1120**	602	549	**1151**	582	529	**1111**	525	516	**1041**	576	567	**1143**
Railway (east of Meroo Street)	71	77	**148**	94	97	**191**	103	87	**190**	127	79	**206**	103	89	**192**	93	96	**189**	100	105	**205**	97	111	**208**
Meroo Road	357	268	**625**	351	287	**638**	376	282	**658**	340	275	**615**	329	269	**598**	351	302	**653**	341	270	**611**	368	237	**605**
Comea Street	66	50	**116**	48	58	**106**	56	57	**113**	57	62	**119**	61	59	**120**	70	48	**118**	60	65	**125**	56	55	**111**
SH1 (north)	564	584	**1148**	749	618	**1367**	703	687	**1390**	669	720	**1389**	743	704	**1447**	719	693	**1412**	762	670	**1432**	812	713	**1525**
Moss Vale Road	356	452	**808**	460	417	**877**	505	464	**969**	427	460	**887**	562	557	**1119**	451	472	**923**						
Narang Road	14	27	**41**	43	72	**115**	291	271	**562**	257	390	**647**	272	260	**532**	38	72	**110**	43	76	**119**	32	65	**97**

Mid-block Locations	To first road	From first road	Total Flow	To first road	From first road	Total Flow	To first road	From first road	Total Flow	To first road	From first road	Total Flow	To first road	From first road	Total Flow	To first road	From first road	Total Flow	To first road	From first road	Total Flow	To first road	From first road	Total Flow
Illaroo Road between West Cambewarra and Pitt	273	154	**427**	297	178	**475**	273	183	**456**	310	174	**484**	370	213	**583**	254	178	**432**	348	224	**572**	289	194	**483**
Illaroo Road between Pitt and Page	340	207	**547**	379	277	**656**	431	314	**745**	457	436	**893**	455	211	**666**				425	300	**725**	324	224	**548**
Illaroo Road between Page and McMahons	491	360	**851**	644	572	**1216**	621	444	**1065**	568	584	**1152**	664	371	**1035**	635	430	**1065**	560	462	**1022**	566	391	**957**
Illaroo Road between McMahons and Crest	751	576	**1327**	921	754	**1675**	772	572	**1344**	723	694	**1417**	765	478	**1243**	843	528	**1371**	745	609	**1354**	721	493	**1214**
Illaroo Road between Crest and SH1	908	728	**1636**	1103	791	**1894**	889	631	**1520**	802	763	**1565**	898	605	**1503**	975	634	**1609**	868	670	**1538**	851	604	**1455**
SH1 between Bridge and Illaroo	2404	2413	**4817**	2518	2701	**5219**	2519	2921	**5440**	2605	2958	**5563**	2481	2903	**5384**	2513	2965	**5478**	2432	2845	**5277**	2486	2925	**5411**
SH1 between Illaroo and Bolong	2101	1930	**4031**	2295	2154	**4449**	2084	2227	**4311**	1962	2262	**4224**	2120	2235	**4355**	2095	2204	**4299**	2041	2237	**4278**	2142	2353	**4495**
SH1 between Bolong and Beinda	1195	1210	**2405**	1291	1214	**2505**	1140	1273	**2413**	1152	1231	**2383**	1222	1262	**2484**	1133	1276	**2409**	1076	1293	**2369**	1179	1384	**2563**
SH1 between Beinda and Bunberra	1100	1155	**2255**	1225	1149	**2374**	1087	1222	**2309**	1137	1268	**2405**	1172	1223	**2395**	1161	1189	**2350**	1117	1227	**2344**	1109	1311	**2420**
SH1 between Bunberra and Narang	1013	1037	**2050**	1195	1094	**2289**	1171	1155	**2326**	1109	1216	**2325**	1217	1144	**2361**	1131	1229	**2360**	1183	1163	**2346**	1133	1231	**2364**
SH1 between Narang and Cambewarra	1008	1015	**2023**	1198	1060	**2258**	1202	1194	**2396**	1179	1161	**2340**	1200	1136	**2336**	1117	1189	**2306**	1176	1132	**2308**	1139	1204	**2343**
Bolong Road between SH1 and Beinda	920	731	**1651**	1079	951	**2030**	996	963	**1959**	897	1045	**1942**	976	979	**1955**	1018	936	**1954**	1003	948	**1951**	1011	973	**1984**
Bolong Road between Beinda and Meroo	943	741	**1684**	1185	999	**2184**	1149	1027	**2176**	1103	1111	**2214**	1097	1022	**2119**	1088	1002	**2090**	1073	999	**2072**	1076	1018	**2094**
Meroo Street between Bolong and Bunberra	448	379	**827**	548	508	**1056**	605	474	**1079**	468	540	**1008**	511	486	**997**	590	539	**1129**	598	481	**1079**	550	462	**1012**
Meroo Street between Bunberra and Cambewarra	404	303	**707**	473	365	**838**	489	374	**863**	418	412	**830**	445	361	**806**	530	378	**908**	490	356	**846**	482	346	**828**
Cambewarra Road between SH1 and Comea	228	229	**457**	265	320	**585**	308	314	**622**	385	284	**669**	279	296	**575**	296	379	**675**	286	360	**646**	316	340	**656**
Bunberra Street between SH1 and Meroo	65	57	**122**	79	92	**171**	67	199	**266**	65	90	**155**	71	140	**211**	130	144	**274**	75	164	**239**	64	123	**187**
Beinda Street between SH1 and Bolong	115	86	**201**	187	160	**347**	177	120	**297**	304	166	**470**	203	135	**338**	147	167	**314**	152	182	**334**	155	165	**320**
Option 1 Link Road between Illaroo and SH1							208	291	**499**	315	257	**572**	162	272	**434**									
Option 2 Link Road between Illaroo and SH1																193	267	**460**						
Illaroo Road between Pitt and Option 2 Link Road																375	286	**661**						
Illaroo Road between Option 2 Link Road and Page																469	309	**778**						
Option 3 Link Road between Illaroo and Moss Vale																			200	278	**478**	204	181	**385**
Moss Vale Road between SH1 and Option 3 Link Road																			706	642	**1348**	706	814	**1520**
Moss Vale Road west of Option 3 Link Road																			481	430	**911**	580	585	**1165**
Option 4 Link Road between Illaroo and SH1																								

Appendix E

SIDRA Analysis Results

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SIDRA Analysis Results Tables
- Table E1: 2005 Existing Network Intersection Performance AM and PM peak 1
- Table E2: 2016 DN2P - Network Intersection Performance AM and PM peak 2
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- Table E4: 2016 Option 1 - Network Intersection Performance AM and PM peak 4
- Table E5: 2016 Option 1 MVRDLK - Network Intersection Performance AM and PM peak 5
- Table E6: 2016 Option 2 - Network Intersection Performance AM and PM peak 6
- Table E7: 2016 Option 3 - Network Intersection Performance AM and PM peak 7
- Table E8: 2016 Option 3 MVRDLK - Network Intersection Performance AM and PM peak 8

Intersection Performance - *For each of the following scenarios, aaSIDRA movement summaries are provided for each of the 13 key intersections.*
- 2005 AM
- 2005 PM
- 2016 DN2P AM
- 2016 DN2P PM
- 2016 DNSP AM
- 2016 DNSP PM
- 2016 Option 1 AM
- 2016 Option 1 PM
- 2016 Option 1 MVRDLK AM
- 2016 Option 1 MVRDLK PM
- 2016 Option 2 AM
- 2016 Option 2 PM
- 2016 Option 3 AM
- 2016 Option 3 PM
- 2016 Option 3 MVRDLK AM
- 2016 Option 3 MVRDLK PM

Intersection
- Princess Highway and Illaroo Road
- Princess Highway and Bolong Road
- Princess Highway and Beinda Street
- Princess Highway and West Bunberra Street
- Princess Highway and Narang Road
- Princess Highway and Cambewarra Road
- Illaroo Rd and McMahons Rd
- Illaroo Rd and Page Ave
- Illaroo Road and Pitt Street
- Illaroo Road and West Cambewarra Road
- Bolong Road and Beinda Street
- Bolong Road and Meroo Road
- Meroo Road and Bunberra Road

Intersection Layout
- Option 1
- Option 2
- Option 3

Table E1: 2005 Existing Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.194	83.2	F	1.012	41.7	D
3. Princes Highway and Bolong Road (Signalised Intersection)	0.772	31.6	C	0.856	37.0	D
4. Princes Highway and Beinda Street (Roundabout)	0.462	6.8	A	0.400	6.2	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.000	6.8	F*	1.000	7.8	F*
6. Princes Highway and Narang Road (Roundabout)	0.365	6.8	A	0.320	7.1	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.562	10.7	B	0.604	10.6	B
9. Illaroo Road and McMahons Road (Roundabout)	0.549	9.9	A	0.616	10.0	A
10. Illaroo Road and Page Avenue (Priority Intersection)	0.421	3.8	B*	0.507	4.4	B*
11. Illaroo Road and Pitt Street (Priority Intersection)	0.171	3.5	A*	0.159	3.7	A*
12. Illaroo Road and West Cambewarra Road (Priority Intersection)	0.134	8.8	A*	0.155	8.9	A*
13. Bolong Road and Beinda Street (Priority Intersection)	0.388	0.9	F*	0.451	1.4	F*
14. Bolong Road and Meroo Road (Roundabout)	0.583	10.9	B	0.643	11.9	B
15. Meroo Road and Bunberra Street (Priority Intersection)	0.211	2.7	C*	0.228	2.3	D*

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E2: 2016 DN2P - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.184	75.3	E	1.028	51.4	D
3. Princes Highway and Bolong Road (Signalised Intersection)	0.753	33.1	C	0.895	40.6	D
4. Princes Highway and Beinda Street (Roundabout)	0.508	7.0	A	0.400	6.4	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.000	13.8	F*	1.000	10.5	F*
6. Princes Highway and Narang Road (Roundabout)	0.412	6.8	A	0.342	7.0	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.638	11.9	B	0.646	10.7	B
9. Illaroo Road and McMahons Road (Roundabout)	0.592	10.3	A	0.608	10.1	A
10. Illaroo Road and Page Avenue (Priority Intersection)	0.502	4.2	B*	0.524	4.6	B*
11. Illaroo Road and Pitt Street (Priority Intersection)	0.281	3.0	A*	0.237	3.1	A*
12. Illaroo Road and West Cambewarra Road (Priority Intersection)	0.147	8.2	A*	0.134	8.4	A*
13. Bolong Road and Beinda Street (Priority Intersection)	0.430	1.1	B*	1.000	8.8	F*
14. Bolong Road and Meroo Road (Roundabout)	0.661	11.4	B	0.771	13.8	B
15. Meroo Road and Bunberra Street (Priority Intersection)	0.234	2.8	B*	0.453	4.4	B*

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E3: 2016 DNSP - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.293	105.3	F	1.107	93.1	F
3. Princes Highway and Bolong Road (Signalised Intersection)	0.950	43.4	D	0.912	39.9	D
4. Princes Highway and Beinda Street (Roundabout)	0.571	7.2	A	0.468	7.2	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.000	13.9	F*	1.000	19.5	F*
6. Princes Highway and Narang Road (Roundabout)	0.500	7.1	A	0.400	6.9	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.804	15.6	B	0.819	13.7	B
9. Illaroo Road and McMahons Road (Roundabout)	0.769	12.8	A	0.770	11.6	A
10. Illaroo Road and Page Avenue (Priority Intersection)	0.700	6.2	C*	0.999	5.9	C*
11. Illaroo Road and Pitt Street (Priority Intersection)	0.659	6.7	B*	0.517	5.3	B*
12. Illaroo Road and West Cambewarra Road (Priority Intersection)	0.154	8.2	A*	0.141	8.4	A*
13. Bolong Road and Beinda Street (Priority Intersection)	1.000	10.6	F*	1.000	20.3	F*
14. Bolong Road and Meroo Road (Roundabout)	0.832	14.3	B	1.046	37.6	D
15. Meroo Road and Bunberra Street (Priority Intersection)	0.536	5.0	D*	0.554	5.2	D*

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E4: 2016 Option 1 - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	0.993	50.0	D	1.072	71.3	E
3. Princes Highway and Bolong Road (Signalised Intersection)	0.757	27.2	C	1.054	60.0	E
4. Princes Highway and Beinda Street (Roundabout)	0.600	7.3	A	0.440	6.9	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.083	30.0	F*	1.000	32.6	F*
6. Princes Highway and Narang Road (Roundabout)	0.667	9.1	A	0.522	8.5	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.836	16.4	B	0.943	18.5	B
9. Illaroo Road and McMahons Road (Roundabout)	0.643	11.1	B	0.715	11.4	B
10. Illaroo Road and Page Avenue (Priority Intersection)	0.716	6.8	C*	0.784	6.5	C*
11. Illaroo Road and Pitt Street (Roundabout)	0.315	8.4	A	0.481	8.9	A
12. Illaroo Road and West Cambewarra Road (Priority Intersection)	0.150	8.2	A*	0.114	8.3	A*
13. Bolong Road and Beinda Street (Priority Intersection)	1.000	8.5	E*	1.000	12.2	F*
14. Bolong Road and Meroo Road (Roundabout)	0.814	13.9	B	1.051	42.9	D
15. Meroo Road and Bunberra Street (Priority Intersection)	0.677	6.7	D*	0.997	6.8	E*

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E5: 2016 Option 1 MVRDLK - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.169	68.2	E	1.046	64.3	E
3. Princes Highway and Bolong Road (Signalised Intersection)	0.874	39.0	D	1.074	57.6	E
4. Princes Highway and Beinda Street (Roundabout)	0.600	7.2	A	0.455	7.2	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.067	36.1	F*	1.000	35.7	F*
6. Princes Highway and Narang Road (Roundabout)	0.667	8.7	A	0.506	8.3	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.797	16.1	B	0.985	23.0	C
9. Illaroo Road and McMahons Road (Roundabout)	0.644	10.2	A	0.634	10.4	A
10. Illaroo Road and Page Avenue (Priority Intersection)	0.771	5.9	C*	0.545	5.4	B*
11. Illaroo Road and Pitt Street (Roundabout)	0.400	8.1	A	0.552	8.9	A
12. Illaroo Road and West Cambewarra Road (Roundabout)	0.181	7.7	A	0.258	7.6	A
13. Bolong Road and Beinda Street (Priority Intersection)	0.679	4.8	C*	1.000	19.7	F*
14. Bolong Road and Meroo Road (Roundabout)	0.772	13.2	B	0.933	22.5	C
15. Meroo Road and Bunberra Street (Priority Intersection)	0.689	6.9	D*	0.641	7.0	E*

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E6: 2016 Option 2 - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.183	69.7	E	1.056	65.4	E
3. Princes Highway and Bolong Road (Signalised Intersection)	0.880	48.5	D	1.004	54.1	D
4. Princes Highway and Beinda Street (Roundabout)	0.515	7.2	A	0.451	7.0	A
5. Princes Highway and Bunberra Street (Signalised Intersection)	0.757	40.3	C	0.909	42.8	D
6. Princes Highway and Narang Road (Roundabout)	0.441	7.0	A	0.400	6.9	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.829	16.6	B	0.811	14.2	B
9. Illaroo Road and McMahons Road (Roundabout)	0.647	11.1	B	0.761	11.0	B
10. Illaroo Road and Page Avenue (Priority Intersection)	0.827	6.4	B*	0.997	7.8	B*
11. Illaroo Road and Pitt Street (Priority Intersection)	0.524	5.9	B*	0.414	4.9	B*
12. Illaroo Road and West Cambewarra Road (Priority Intersection)	0.148	8.2	A*	0.122	8.3	A*
13. Bolong Road and Beinda Street (Priority Intersection)	1.000	11.2	F*	1.000	13.2	F*
14. Bolong Road and Meroo Road (Roundabout)	0.821	14.8	B	0.953	24.9	C
15. Meroo Road and Bunberra Street (Priority Intersection)	1.000	6.5	E*	0.878	6.5	F*
Illaroo Road and Link Road Option 2 (Roundabout)	0.343	7.2	A	0.401	7.3	A

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E7: 2016 Option 3 - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.355	72.1	E	1.077	76.4	E
3. Princes Highway and Bolong Road (Signalised Intersection)	0.957	57.2	E	1.027	53.0	D
4. Princes Highway and Beinda Street (Roundabout)	0.533	7.0	A	0.447	7.0	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.000	14.4	F*	1.000	19.4	F*
6. Princes Highway and Narang Road (Roundabout)	0.434	6.6	A	0.400	6.7	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.718	13.9	B	1.159	57.1	E
9. Illaroo Road and McMahons Road (Roundabout)	0.664	11.3	A	0.672	10.8	A
10. Illaroo Road and Page Avenue (Priority Intersection)	0.949	6.5	B*	0.705	6.7	B*
11. Illaroo Road and Pitt Street (Priority Intersection)	0.365	4.8	A*	0.440	4.8	B*
12. Illaroo Road and West Cambewarra Road (Roundabout)	0.221	8.4	A	0.251	8.4	A
13. Bolong Road and Beinda Street (Priority Intersection)	1.000	10.0	F*	1.000	19.9	F*
14. Bolong Road and Meroo Road (Roundabout)	0.905	17.2	B	0.912	23.3	C
15. Meroo Road and Bunberra Street (Priority Intersection)	0.976	6.5	D*	1.000	6.9	E*
West Cambewarra and Moss Vale (Link Road Option 3) (Roundabout)	0.591	8.5	A	0.432	7.4	A

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

Table E8: 2016 Option 3 MVRDLK - Network Intersection Performance AM and PM peak, using SIDRA

Location	AM Peak			PM Peak		
	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)	Degree of Saturation (%)	Average Delay (sec/veh)	Level of Service (LOS)
2. Princes Highway and Illaroo Road (Signalised Intersection)	1.169	69.6	E	1.090	79.6	E
3. Princes Highway and Bolong Road (Signalised Intersection)	0.975	56.3	E	1.063	64.7	E
4. Princes Highway and Beinda Street (Roundabout)	0.512	7.2	A	0.474	6.9	A
5. Princes Highway and Bunberra Street (Priority Intersection)	1.000	11.8	F*	1.000	24.4	F*
6. Princes Highway and Narang Road (Roundabout)	0.444	7.0	A	0.417	6.9	A
7. Princes Highway and Cambewarra Road (Roundabout)	0.657	12.9	B	1.209	65.3	E
9. Illaroo Road and McMahons Road (Roundabout)	0.602	9.8	A	0.606	10.0	A
10. Illaroo Road and Page Avenue (Priority Intersection)	0.638	5.3	B*	0.538	5.1	B*
11. Illaroo Road and Pitt Street (Priority Intersection)	0.371	4.3	A*	0.301	4.5	A*
12. Illaroo Road and West Cambewarra Road (Roundabout)	0.227	8.8	A	0.242	9.2	A
13. Bolong Road and Beinda Street (Priority Intersection)	1.000	15.2	F*	1.000	17.6	F*
14. Bolong Road and Meroo Road (Roundabout)	0.795	13.7	B	0.926	23.7	C
15. Meroo Road and Bunberra Street (Priority Intersection)	0.866	6.2	D*	0.743	7.0	E*
West Cambewarra and Moss Vale (Link Road Option 3) (Roundabout)	0.478	8.0	A	0.511	6.8	A

Source: Maunsell

* At priority (sign) controlled intersections - Level of Service is reported based on worst movement delay (typically right turn from minor approach). At signalised intersections - Level of Service is reported based on average intersection delay

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2005 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 122 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	362	3.9	0.203	9.6	LOS A#	5#	0.00	0.65	54.6
2	T	1258	4.0	0.669	25.5	LOS C	202	0.81	0.75	38.0
Approach		1620	4.0	0.669	22.0	LOS C	202	0.63	0.73	41.0
Princess Highway - North										
8	T	1838	3.9	0.764	16.4	LOS B	276	0.77	0.71	41.4
9	R	224	4.8	1.180	247.1	LOS F	181	1.00	1.55	7.7
Approach		2026	4.0	1.180	38.1	LOS D	276	0.80	0.80	29.6
Illaroo Road - West										
10	L	271	4.1	1.194	255.5	LOS F	562	1.00	1.99	7.5
12	R	854	4.0	1.194	255.3	LOS F	562	1.00	1.99	7.5
Approach		1125	4.0	1.194	255.4	LOS F	562	1.00	1.99	7.5
All Vehicles		4807	4.0	1.194	83.2	LOS F	562	0.78	1.05	18.6

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	21	42.6	LOS E	0	0.84	0.84
P7	21	19.5	LOS B	0	0.57	0.57
All Peds	42	31.1	LOS D	0	0.70	0.70

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2005 PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 126 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	702	4.0	0.395	9.6	LOS B#	10#	0.00	0.65	54.5
2	T	1735	4.0	0.922	48.5	LOS D	424	1.00	1.07	27.2
Approach		2436	4.0	0.922	37.3	LOS D	424	0.71	0.95	32.0
Princess Highway - North										
8	T	1916	4.0	0.714	12.1	LOS B	249	0.66	0.61	45.1
9	R	249	4.0	0.934	86.5	LOS F	141	1.00	1.10	17.8
Approach		2165	4.0	0.934	20.6	LOS C	249	0.70	0.67	38.3
Illaroo Road - West										
10	L	215	4.2	1.012	117.2	LOS F	248	1.00	1.31	14.2
12	R	536	3.9	1.012	117.0	LOS F	248	1.00	1.31	14.3
Approach		750	4.0	1.012	117.1	LOS F	248	1.00	1.31	14.3
All Vehicles		5351	4.0	1.012	41.7	LOS D	424	0.75	0.88	28.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	21	49.8	LOS E	0	0.89	0.89
P7	21	20.0	LOS C	0	0.56	0.56
All Peds	42	34.9	LOS D	0	0.73	0.73

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 DN2P AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 125 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	358	3.9	0.201	9.6	LOS A#	5#	0.00	0.65	54.6
2	T	1421	4.0	0.749	27.4	LOS C	246	0.86	0.80	36.8
Approach		1779	4.0	0.750	23.8	LOS C	246	0.69	0.77	39.5
Princess Highway - North										
8	T	1966	3.9	0.819	18.0	LOS B	324	0.82	0.77	40.1
9	R	227	4.9	1.184	252.7	LOS F	181	1.00	1.54	7.5
Approach		2151	4.0	1.185	38.5	LOS D	324	0.86	0.85	29.5
Illaroo Road - West										
10	L	275	4.0	1.166	232.9	LOS F	530	1.00	1.88	8.1
12	R	832	4.0	1.166	232.7	LOS F	530	1.00	1.88	8.2
Approach		1106	4.0	1.166	232.7	LOS F	530	1.00	1.88	8.1
All Vehicles		5079	4.0	1.184	75.3	LOS E	530	0.82	1.04	19.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	21	43.3	LOS E	0	0.83	0.83
P7	21	19.6	LOS B	0	0.56	0.56
All Peds	42	31.4	LOS D	0	0.70	0.70

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 DN2P PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 126 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	702	4.0	0.395	9.6	LOS B#	10#	0.00	0.65	54.5
2	T	1841	4.0	0.979	72.6	LOS E	550	1.00	1.22	20.9
Approach		2543	4.0	0.979	55.2	LOS E	550	0.72	1.07	25.4
Princess Highway - North										
8	T	1960	4.0	0.731	12.3	LOS B	260	0.67	0.63	44.8
9	R	252	4.0	0.945	89.5	LOS F	145	1.00	1.12	17.3
Approach		2212	4.0	0.945	21.1	LOS C	260	0.71	0.68	38.0
Illaroo Road - West										
10	L	204	3.9	1.028	126.9	LOS F	262	1.00	1.36	13.4
12	R	558	3.9	1.027	126.8	LOS F	262	1.00	1.36	13.5
Approach		762	3.9	1.027	126.8	LOS F	262	1.00	1.36	13.4
All Vehicles		5517	4.0	1.028	51.4	LOS D	550	0.76	0.95	25.7

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	21	49.8	LOS E	0	0.89	0.89
P7	21	20.0	LOS C	0	0.56	0.56
All Peds	42	34.9	LOS D	0	0.73	0.73

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 DNSP AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	487	3.9	0.273	9.6	LOS B#	7#	0.00	0.65	54.6
2	T	1643	4.0	0.905	48.8	LOS D	428	1.00	1.01	27.1
Approach		2130	4.0	0.905	39.8	LOS D	428	0.77	0.93	30.8
Princess Highway - North										
8	T	2136	4.0	0.861	21.4	LOS C	420	0.87	0.82	37.8
9	R	238	4.4	1.046	151.7	LOS F	181	1.00	1.29	11.6
Approach		2364	4.0	1.046	34.1	LOS C	420	0.89	0.87	31.0
Illaroo Road - West										
10	L	320	4.1	1.293	352.5	LOS F	787	1.00	2.20	5.6
12	R	929	4.0	1.293	352.3	LOS F	787	1.00	2.19	5.6
Approach		1249	4.0	1.293	352.3	LOS F	787	1.00	2.19	5.6
All Vehicles		5752	4.0	1.293	105.3	LOS F	787	0.87	1.18	15.7

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	48.0	LOS E	0	0.81	0.81
P7	22	23.8	LOS C	0	0.57	0.57
All Peds	44	35.9	LOS D	0	0.69	0.69

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 DNSP PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	862	3.9	0.485	9.6	LOS C#	13#	0.00	0.65	54.5
2	T	2138	4.0	1.107	170.8	LOS F	1015	1.00	1.69	10.8
Approach		3000	4.0	1.107	124.5	LOS F	1015	0.71	1.39	14.2
Princess Highway - North										
8	T	2183	3.8	0.867	18.6	LOS B	450	0.84	0.80	39.7
9	R	367	6.1	1.000#	125.3	LOS F	181	1.00	1.21	13.5
Approach		2430	4.0	1.000	30.4	LOS C	450	0.90	0.88	33.4
Illaroo Road - West										
10	L	258	3.9	1.076	172.1	LOS F	381	1.00	1.47	10.5
12	R	619	4.0	1.076	172.0	LOS F	381	1.00	1.47	10.5
Approach		876	4.0	1.076	172.0	LOS F	381	1.00	1.47	10.5
All Vehicles		6426	3.9	1.107	93.1	LOS F	1015	0.81	1.18	17.3

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	54.6	LOS E	0	0.85	0.85
P7	22	21.9	LOS C	0	0.54	0.54
All Peds	44	38.2	LOS D	0	0.70	0.70

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 1 AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 100 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	492	4.1	0.277	9.6	LOS B#	7#	0.00	0.65	54.6
2	T	1660	4.0	0.761	18.0	LOS B	218	0.81	0.77	43.8
Approach		2153	4.0	0.761	16.1	LOS B	218	0.63	0.74	46.0
Princess Highway - North										
8	T	2193	4.0	0.985	63.5	LOS E	568	1.00	1.35	21.9
Approach		2194	4.0	0.985	63.5	LOS E	568	1.00	1.35	21.9
Illaroo Road - West										
10	L	160	3.8	0.993	90.8	LOS F	287	1.00	1.34	17.2
12	R	910	4.0	0.992	90.7	LOS F	287	1.00	1.34	17.3
Approach		1070	3.9	0.992	90.7	LOS F	287	1.00	1.34	17.3
All Vehicles		5417	4.0	0.993	50.0	LOS D	568	0.85	1.11	26.0

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	32.0	LOS D	0	0.80	0.80
P7	22	12.5	LOS B	0	0.50	0.50
All Peds	44	22.2	LOS C	0	0.65	0.65

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 1 PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	881	4.0	0.496	9.6	LOS C#	13#	0.00	0.65	54.5
2	T	2364	4.0	1.072	135.7	LOS F	1035	1.00	1.56	13.0
Approach		3246	4.0	1.072	101.5	LOS F	1035	0.73	1.31	16.6
Princess Highway - North										
8	T	2209	4.0	0.799	14.5	LOS B	369	0.72	0.68	42.9
9	R	107	3.8	0.641	81.9	LOS F	69	1.00	0.81	18.5
Approach		2315	4.0	0.799	17.6	LOS B	369	0.73	0.69	40.4
Illaroo Road - West										
10	L	109	3.7	0.975	108.9	LOS F	240	1.00	1.18	15.0
12	R	591	4.1	0.974	108.8	LOS F	240	1.00	1.18	15.1
Approach		700	4.0	0.974	108.8	LOS F	240	1.00	1.18	15.1
All Vehicles		6261	4.0	1.072	71.3	LOS E	1035	0.76	1.07	20.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	58.1	LOS E	0	0.88	0.88
P7	22	16.3	LOS B	0	0.47	0.47
All Peds	44	37.2	LOS D	0	0.67	0.67

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Signalised - Fixed time　　　　Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	372	4.0	0.209	9.6	LOS A#	6#	0.00	0.65	54.6
2	T	1776	4.0	0.835	28.5	LOS C	363	0.90	0.84	36.1
Approach		2148	4.0	0.835	25.3	LOS C	363	0.74	0.81	38.5
Princess Highway - North										
8	T	2117	4.0	0.833	19.4	LOS B	392	0.82	0.77	39.1
9	R	100	4.0	1.025	138.0	LOS F	84	1.00	1.13	12.5
Approach		2217	4.0	1.025	24.8	LOS C	392	0.83	0.79	35.7
Illaroo Road - West										
10	L	164	4.2	1.169	244.5	LOS F	555	1.00	1.81	7.8
12	R	907	4.0	1.168	244.3	LOS F	555	1.00	1.80	7.8
Approach		1071	4.0	1.168	244.4	LOS F	555	1.00	1.80	7.8
All Vehicles		5436	4.0	1.169	68.2	LOS E	555	0.83	1.00	21.3

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	49.7	LOS E	0	0.83	0.83
P7	22	17.4	LOS B	0	0.49	0.49
All Peds	44	33.5	LOS D	0	0.66	0.66

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	866	4.0	0.487	9.6	LOS C#	13#	0.00	0.65	54.5
2	T	2361	4.0	1.046	114.0	LOS F	966	1.00	1.44	15.0
Approach		3227	4.0	1.046	86.0	LOS F	966	0.73	1.23	18.8
Princess Highway - North										
8	T	2227	4.0	0.791	13.3	LOS B	358	0.69	0.66	43.9
9	R	129	3.9	0.781	85.8	LOS F	83	1.00	0.89	17.9
Approach		2356	4.0	0.791	17.3	LOS B	358	0.71	0.67	40.7
Illaroo Road - West										
10	L	122	4.1	1.004	124.9	LOS F	247	1.00	1.25	13.5
12	R	551	4.0	1.004	124.8	LOS F	247	1.00	1.25	13.6
Approach		673	4.0	1.004	124.8	LOS F	247	1.00	1.25	13.6
All Vehicles		6256	4.0	1.046	64.3	LOS E	966	0.75	1.02	22.4

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	59.9	LOS E	0	0.89	0.89
P7	22	15.4	LOS B	0	0.45	0.45
All Peds	44	37.6	LOS D	0	0.67	0.67

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 2 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	443	4.1	0.250	9.6	LOS A#	7#	0.00	0.65	54.6
2	T	1643	4.0	0.773	26.8	LOS C	315	0.84	0.79	37.2
Approach		2088	4.0	0.773	23.2	LOS C	315	0.66	0.76	40.0
Princess Highway - North										
8	T	2134	4.0	0.839	19.6	LOS B	399	0.83	0.78	39.0
9	R	87	3.5	0.878	93.9	LOS F	61	1.00	0.95	16.8
Approach		2220	4.0	0.878	22.5	LOS C	399	0.84	0.79	37.1
Illaroo Road - West										
10	L	153	3.9	1.183	256.3	LOS F	576	1.00	1.85	7.4
12	R	931	4.0	1.182	256.1	LOS F	576	1.00	1.84	7.5
Approach		1084	4.0	1.182	256.2	LOS F	576	1.00	1.84	7.5
All Vehicles		5392	4.0	1.183	69.7	LOS E	576	0.80	0.99	21.0

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	49.7	LOS E	0	0.83	0.83
P7	22	17.4	LOS B	0	0.49	0.49
All Peds	44	33.5	LOS D	0	0.66	0.66

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 2 PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	962	4.0	0.541	9.7	LOS C#	14#	0.00	0.65	54.5
2	T	2331	4.0	1.056	123.1	LOS F	980	1.00	1.49	14.1
Approach		3293	4.0	1.056	90.0	LOS F	980	0.71	1.25	18.2
Princess Highway - North										
8	T	2212	4.0	0.800	14.6	LOS B	370	0.72	0.68	42.9
9	R	116	4.3	0.704	83.3	LOS F	75	1.00	0.84	18.2
Approach		2328	4.0	0.800	18.0	LOS B	370	0.74	0.69	40.2
Illaroo Road - West										
10	L	114	4.3	0.971	107.7	LOS F	238	1.00	1.18	15.1
12	R	583	3.9	0.972	107.6	LOS F	238	1.00	1.18	15.3
Approach		698	4.0	0.972	107.6	LOS F	238	1.00	1.18	15.2
All Vehicles		6319	4.0	1.056	65.4	LOS E	980	0.75	1.03	22.1

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	58.1	LOS E	0	0.88	0.88
P7	22	16.3	LOS B	0	0.47	0.47
All Peds	44	37.2	LOS D	0	0.67	0.67

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 3 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	440	4.1	0.248	9.6	LOS A#	7#	0.00	0.65	54.6
2	T	1721	4.0	0.819	28.7	LOS C	348	0.88	0.83	36.1
Approach		2161	4.0	0.819	24.8	LOS C	348	0.70	0.80	38.9
Princess Highway - North										
8	T	2186	4.0	0.870	21.1	LOS C	431	0.88	0.82	38.0
9	R	137	3.8	1.355	416.3	LOS F	180	1.00	1.59	4.8
Approach		2318	4.0	1.355	43.7	LOS D	431	0.88	0.87	27.3
Illaroo Road - West										
10	L	171	4.1	1.149	227.7	LOS F	541	1.00	1.75	8.3
12	R	911	4.0	1.149	227.5	LOS F	541	1.00	1.75	8.3
Approach		1082	4.0	1.149	227.6	LOS F	541	1.00	1.75	8.3
All Vehicles		5564	4.0	1.355	72.1	LOS E	541	0.84	1.01	20.6

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	48.8	LOS E	0	0.82	0.82
P7	22	17.9	LOS B	0	0.50	0.50
All Peds	44	33.4	LOS D	0	0.66	0.66

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 3 PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	810	4.0	0.456	9.6	LOS C#	12#	0.00	0.65	54.5
2	T	2351	4.0	1.077	140.9	LOS F	1043	1.00	1.59	12.6
Approach		3161	4.0	1.077	107.3	LOS F	1043	0.74	1.35	15.9
Princess Highway - North										
8	T	2110	4.0	0.770	14.4	LOS B	341	0.70	0.65	43.0
9	R	158	3.8	0.950	106.0	LOS F	110	1.00	1.07	15.3
Approach		2267	4.0	0.950	20.7	LOS C	341	0.72	0.68	38.2
Illaroo Road - West										
10	L	134	3.7	0.988	115.3	LOS F	260	1.00	1.22	14.4
12	R	600	4.0	0.988	115.2	LOS F	260	1.00	1.22	14.5
Approach		734	4.0	0.988	115.3	LOS F	260	1.00	1.22	14.5
All Vehicles		6162	4.0	1.077	76.4	LOS E	1043	0.76	1.09	19.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	57.2	LOS E	0	0.87	0.87
P7	22	16.8	LOS B	0	0.47	0.47
All Peds	44	37.0	LOS D	0	0.67	0.67

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	334	3.9	0.188	9.6	LOS A#	5#	0.00	0.65	54.6
2	T	1800	4.0	0.857	30.9	LOS C	384	0.92	0.87	34.8
Approach		2134	4.0	0.857	27.5	LOS C	384	0.78	0.84	37.0
Princess Highway - North										
8	T	2134	4.0	0.848	20.4	LOS C	407	0.85	0.80	38.4
9	R	78	3.8	0.799	89.3	LOS F	55	1.00	0.88	17.4
Approach		2212	4.0	0.848	22.9	LOS C	407	0.85	0.80	36.9
Illaroo Road - West										
10	L	178	3.9	1.169	245.0	LOS F	572	1.00	1.82	7.7
12	R	923	4.0	1.169	244.8	LOS F	572	1.00	1.81	7.8
Approach		1101	4.0	1.169	244.9	LOS F	572	1.00	1.81	7.8
All Vehicles		5447	4.0	1.169	69.6	LOS E	572	0.85	1.02	21.0

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	48.8	LOS E	0	0.82	0.82
P7	22	17.9	LOS B	0	0.50	0.50
All Peds	44	33.4	LOS D	0	0.66	0.66

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Illaroo Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	790	4.1	0.445	9.6	LOS C#	12#	0.00	0.65	54.5
2	T	2460	4.0	1.090	149.4	LOS F	1124	1.00	1.64	12.0
Approach		3250	4.0	1.090	115.5	LOS F	1124	0.76	1.40	15.0
Princess Highway - North										
8	T	2229	4.0	0.791	13.3	LOS B	359	0.70	0.66	43.9
9	R	151	4.0	0.915	97.8	LOS F	102	1.00	1.02	16.3
Approach		2380	4.0	0.915	18.7	LOS B	359	0.71	0.68	39.6
Illaroo Road - West										
10	L	152	3.9	0.999	122.5	LOS F	244	1.00	1.24	13.7
12	R	518	4.1	0.999	122.4	LOS F	244	1.00	1.24	13.8
Approach		670	4.0	0.999	122.4	LOS F	244	1.00	1.24	13.8
All Vehicles		6300	4.0	1.090	79.6	LOS E	1124	0.77	1.11	19.3

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P5	22	59.9	LOS E	0	0.89	0.89
P7	22	15.4	LOS B	0	0.45	0.45
All Peds	44	37.6	LOS D	0	0.67	0.67

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2005 AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 122 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	965	4.0	0.255	2.1	LOS B#	7#	0.00	0.19	66.0
3	R	563	4.1	0.706	51.9	LOS D	139	0.93	0.85	26.1
Approach		1530	4.1	0.706	20.5	LOS C	139	0.34	0.43	42.9
East Approach										
4	L	743	4.0	0.772	54.4	LOS D	159	0.98	0.91	24.3
6	R	4	20.0	0.011	42.7	LOS D	3	0.75	0.67	27.7
Approach		748	4.1	0.772	54.3	LOS D	159	0.98	0.90	24.3
Princes Highway - North										
7	L	1	50.0	0.515	56.7	LOS E	388	0.60	0.81	24.7
8	T	1301	4.0	0.538	31.7	LOS C	388	0.60	0.60	34.3
Approach		1303	4.1	0.538	31.7	LOS C	388	0.60	0.60	34.3
All Vehicles		3581	4.1	0.772	31.6	LOS C	388	0.57	0.59	34.4

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	21	11.5	LOS B	0	0.43	0.43
All Peds	21	11.5	LOS B	0	0.43	0.43

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2005 PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 126 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1217	4.0	0.321	2.1	LOS B#	9#	0.00	0.19	66.0
3	R	736	3.9	0.856	61.3	LOS E	213	0.96	0.97	23.5
Approach		1952	4.0	0.856	24.4	LOS C	213	0.36	0.48	40.0
East Approach										
4	L	867	4.0	0.809	55.3	LOS E	191	0.99	0.94	24.0
6	R	13	7.7	0.008	8.5	LOS A	0	0.10	0.66	48.7
Approach		881	4.1	0.809	54.7	LOS D	191	0.98	0.93	24.2
Princes Highway - North										
7	L	1	50.0	0.543	80.1	LOS F	535	0.63	0.82	19.6
8	T	1219	4.0	0.528	44.4	LOS D	535	0.63	0.61	28.6
Approach		1221	4.1	0.527	44.5	LOS D	535	0.63	0.61	28.6
All Vehicles		4054	4.0	0.856	37.0	LOS D	535	0.57	0.62	31.8

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	21	13.3	LOS B	0	0.46	0.46
All Peds	21	13.3	LOS B	0	0.46	0.46

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Movement Summary

Princess Highway and Bolong Road

2016 DN2P AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 125 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1061	4.0	0.280	2.1	LOS B#	8#	0.00	0.19	66.0
3	R	599	4.0	0.721	51.7	LOS D	152	0.92	0.86	26.2
Approach		1660	4.0	0.721	20.0	LOS B	152	0.33	0.43	43.3
East Approach										
4	L	771	4.0	0.753	52.6	LOS D	163	0.97	0.89	24.8
6	R	6	14.3	0.015	41.8	LOS D	4	0.74	0.68	28.0
Approach		778	4.1	0.753	52.5	LOS D	163	0.97	0.88	24.8
Princes Highway - North										
7	L	1	50.0	0.628	66.2	LOS E	392	0.67	0.83	22.3
8	T	1445	4.0	0.612	37.6	LOS D	392	0.67	0.65	31.4
Approach		1447	4.1	0.612	37.7	LOS D	392	0.67	0.65	31.4
All Vehicles		3885	4.0	0.753	33.1	LOS C	392	0.59	0.60	33.7

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	21	12.5	LOS B	0	0.45	0.45
All Peds	21	12.5	LOS B	0	0.45	0.45

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 DN2P PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 126 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1293	4.0	0.341	2.1	LOS B#	10#	0.00	0.19	66.0
3	R	753	4.0	0.877	63.1	LOS E	225	0.96	0.99	23.1
Approach		2046	4.0	0.877	24.6	LOS C	225	0.35	0.48	39.8
East Approach										
4	L	960	4.0	0.895	66.3	LOS E	238	1.00	1.05	21.5
6	R	8	11.1	0.006	8.5	LOS A	0	0.10	0.66	48.7
Approach		969	4.0	0.895	65.8	LOS E	238	0.99	1.05	21.6
Princes Highway - North										
7	L	1	50.0	0.536	85.1	LOS F	538	0.64	0.82	18.7
8	T	1265	4.0	0.548	47.1	LOS D	538	0.64	0.62	27.7
Approach		1268	4.1	0.548	47.1	LOS D	538	0.64	0.62	27.6
All Vehicles		4283	4.0	0.895	40.6	LOS D	538	0.58	0.65	30.3

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	21	13.3	LOS B	0	0.46	0.46
All Peds	21	13.3	LOS B	0	0.46	0.46

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 DNSP AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1033	4.0	0.272	2.1	LOS B#	8#	0.00	0.19	66.0
3	R	900	4.0	0.950	76.2	LOS E	374	0.98	1.04	20.3
Approach		1933	4.0	0.949	36.6	LOS D	374	0.46	0.59	32.8
East Approach										
4	L	892	4.0	0.700	50.2	LOS D	196	0.92	0.86	25.4
6	R	12	7.7	0.021	39.7	LOS D	7	0.67	0.69	28.7
Approach		906	4.1	0.700	50.1	LOS D	196	0.92	0.86	25.5
Princes Highway - North										
7	L	10	9.1	0.712	78.3	LOS E	717	0.79	0.87	19.9
8	T	1510	4.0	0.709	48.0	LOS D	717	0.79	0.76	27.3
Approach		1521	4.0	0.709	48.2	LOS D	717	0.79	0.76	27.3
All Vehicles		4360	4.0	0.950	43.4	LOS D	717	0.67	0.70	29.1

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	17.9	LOS B	0	0.50	0.50
All Peds	22	17.9	LOS B	0	0.50	0.50

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 DNSP PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1342	4.0	0.354	2.1	LOS B#	10#	0.00	0.19	65.9
3	R	1051	4.0	0.912	61.0	LOS E	410	0.97	0.99	23.6
Approach		2394	4.0	0.912	28.0	LOS C	410	0.43	0.54	37.5
East Approach										
4	L	1153	4.0	0.715	42.9	LOS D	242	0.87	0.86	27.8
6	R	6	16.7	0.004	8.4	LOS A	0	0.08	0.66	48.7
Approach		1159	4.1	0.715	42.7	LOS D	242	0.87	0.86	27.8
Princes Highway - North										
7	L	18	5.6	0.799	85.8	LOS F	595	0.92	0.91	18.7
8	T	1410	4.0	0.797	57.3	LOS E	595	0.92	0.86	24.5
Approach		1428	4.0	0.797	57.6	LOS E	595	0.92	0.86	24.4
All Vehicles		4981	4.0	0.912	39.9	LOS D	595	0.67	0.71	30.5

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	25.8	LOS C	0	0.59	0.59
All Peds	22	25.8	LOS C	0	0.59	0.59

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Movement Summary

Princess Highway and Bolong Road

Rev Phase 2016 Option 1 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 100 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1097	4.0	0.289	2.1	LOS B#	8#	0.00	0.19	66.0
3	R	829	4.0	0.753	38.6	LOS D	164	0.88	0.88	31.1
Approach		1926	4.0	0.753	17.8	LOS B	164	0.38	0.49	45.1
East Approach										
4	L	797	4.0	0.590	34.4	LOS C	121	0.85	0.83	31.1
6	R	11	8.3	0.018	28.6	LOS C	4	0.65	0.69	33.6
Approach		809	4.1	0.590	34.3	LOS C	121	0.85	0.83	31.1
Princes Highway - North										
7	L	7	14.3	0.754	56.5	LOS E	470	0.87	0.88	24.8
8	T	1444	4.0	0.757	35.6	LOS D	470	0.87	0.81	32.3
Approach		1452	4.1	0.757	35.7	LOS D	470	0.87	0.81	32.3
All Vehicles		4187	4.0	0.757	27.2	LOS C	470	0.64	0.66	36.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	16.8	LOS B	0	0.58	0.58
All Peds	22	16.8	LOS B	0	0.58	0.58

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Que

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 Option 1 PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1406	4.0	0.371	2.1	LOS B#	11#	0.00	0.19	65.9
3	R	1069	4.0	1.054	118.2	LOS F	626	1.00	1.26	14.6
Approach		2474	4.0	1.054	52.3	LOS D	626	0.43	0.65	26.8
East Approach										
4	L	1066	4.0	0.749	48.7	LOS D	239	0.92	0.87	25.9
6	R	1	50.0	0.002	8.3	LOS A	0	0.08	0.65	48.7
Approach		1068	4.1	0.749	48.7	LOS D	239	0.92	0.87	25.9
Princes Highway - North										
7	L	2	33.3	0.625	149.1	LOS F	1152	0.77	0.86	12.1
8	T	1253	4.0	0.629	84.7	LOS F	1152	0.77	0.73	18.7
Approach		1256	4.1	0.629	84.8	LOS F	1152	0.77	0.73	18.7
All Vehicles		4798	4.0	1.054	60.0	LOS E	1152	0.63	0.72	24.0

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	21.3	LOS C	0	0.53	0.53
All Peds	22	21.3	LOS C	0	0.53	0.53

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Movement Summary

Princess Highway and Bolong Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1097	4.0	0.289	2.1	LOS B#	8#	0.00	0.19	66.0
3	R	829	4.0	0.874	63.5	LOS E	290	0.95	0.97	23.0
Approach		1926	4.0	0.874	28.5	LOS C	290	0.41	0.52	37.2
East Approach										
4	L	797	4.0	0.625	48.7	LOS D	171	0.89	0.85	25.9
6	R	11	8.3	0.019	39.7	LOS D	6	0.67	0.69	28.7
Approach		809	4.1	0.625	48.6	LOS D	171	0.88	0.84	25.9
Princes Highway - North										
7	L	7	14.3	0.682	77.9	LOS E	743	0.77	0.86	20.0
8	T	1444	4.0	0.677	47.5	LOS D	743	0.77	0.74	27.5
Approach		1452	4.1	0.677	47.6	LOS D	743	0.77	0.74	27.5
All Vehicles		4187	4.0	0.874	39.0	LOS D	743	0.63	0.66	30.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	17.9	LOS B	0	0.50	0.50
All Peds	22	17.9	LOS B	0	0.50	0.50

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1401	4.0	0.370	2.1	LOS B#	11#	0.00	0.19	65.9
3	R	1084	4.0	1.074	129.7	LOS F	669	1.00	1.31	13.6
Approach		2485	4.0	1.074	57.7	LOS E	669	0.44	0.68	25.2
East Approach										
4	L	1044	4.0	0.734	48.4	LOS D	232	0.91	0.87	26.0
6	R	1	50.0	0.002	8.3	LOS A	0	0.08	0.65	48.7
Approach		1047	4.1	0.735	48.3	LOS D	232	0.91	0.87	26.0
Princes Highway - North										
7	L	7	14.3	0.658	107.8	LOS F	862	0.80	0.87	15.7
8	T	1336	4.0	0.672	64.4	LOS E	862	0.80	0.76	22.7
Approach		1342	4.0	0.672	64.6	LOS E	862	0.80	0.76	22.6
All Vehicles		4874	4.0	1.074	57.6	LOS E	862	0.64	0.74	24.6

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	21.3	LOS C	0	0.53	0.53
All Peds	22	21.3	LOS C	0	0.53	0.53

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Movement Summary

Princess Highway and Bolong Road

2016 Option 2 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	938	4.1	0.247	2.1	LOS B#	7#	0.00	0.19	66.0
3	R	836	4.0	0.880	64.1	LOS E	295	0.95	0.97	22.8
Approach		1773	4.0	0.880	31.3	LOS C	295	0.45	0.56	35.5
East Approach										
4	L	912	3.9	0.715	50.5	LOS D	201	0.93	0.86	25.4
6	R	11	8.3	0.019	39.7	LOS D	6	0.67	0.69	28.7
Approach		924	4.0	0.715	50.4	LOS D	201	0.92	0.86	25.4
Princes Highway - North										
7	L	1	50.0	0.585	123.1	LOS F	676	0.74	0.85	14.1
8	T	1343	4.0	0.628	69.7	LOS E	676	0.74	0.70	21.5
Approach		1346	4.1	0.628	69.7	LOS E	676	0.74	0.70	21.5
All Vehicles		4043	4.0	0.880	48.5	LOS D	676	0.65	0.68	27.2

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	17.9	LOS B	0	0.50	0.50
All Peds	22	17.9	LOS B	0	0.50	0.50

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 Option 2 PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1416	4.0	0.374	2.1	LOS B#	11#	0.00	0.19	65.9
3	R	1034	4.0	1.004	93.6	LOS F	527	1.00	1.14	17.5
Approach		2450	4.0	1.004	40.7	LOS D	527	0.42	0.59	31.0
East Approach										
4	L	1084	4.0	0.762	49.0	LOS D	244	0.93	0.88	25.8
6	R	1	50.0	0.002	8.3	LOS A	0	0.08	0.65	48.7
Approach		1086	4.1	0.762	49.0	LOS D	244	0.93	0.88	25.8
Princes Highway - North										
7	L	2	33.3	0.625	148.8	LOS F	1154	0.77	0.86	12.1
8	T	1249	4.0	0.627	84.5	LOS F	1154	0.77	0.73	18.8
Approach		1252	4.1	0.627	84.7	LOS F	1154	0.77	0.73	18.7
All Vehicles		4788	4.0	1.004	54.1	LOS D	1154	0.63	0.69	25.6

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	21.3	LOS C	0	0.53	0.53
All Peds	22	21.3	LOS C	0	0.53	0.53

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Movement Summary

Princess Highway and Bolong Road

2016 Option 3 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	957	4.0	0.252	2.1	LOS B#	7#	0.00	0.19	66.0
3	R	908	4.0	0.957	78.1	LOS E	384	0.98	1.05	19.9
Approach		1863	4.0	0.957	39.1	LOS D	384	0.48	0.61	31.6
East Approach										
4	L	938	4.1	0.736	51.0	LOS D	209	0.94	0.87	25.2
6	R	11	8.3	0.019	39.7	LOS D	6	0.67	0.69	28.7
Approach		950	4.1	0.736	50.8	LOS D	209	0.93	0.87	25.3
Princes Highway - North										
7	L	1	50.0	0.702	153.1	LOS F	731	0.76	0.86	11.9
8	T	1421	4.0	0.664	85.0	LOS F	731	0.76	0.73	18.7
Approach		1423	4.1	0.664	85.1	LOS F	731	0.76	0.73	18.7
All Vehicles		4236	4.0	0.957	57.2	LOS E	731	0.68	0.71	24.6

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	17.9	LOS B	0	0.50	0.50
All Peds	22	17.9	LOS B	0	0.50	0.50

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 Option 3 PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1436	4.0	0.378	2.1	LOS B#	11#	0.00	0.19	65.9
3	R	1050	4.0	1.027	104.2	LOS F	571	1.00	1.19	16.1
Approach		2485	4.0	1.027	45.3	LOS D	571	0.42	0.61	29.2
East Approach										
4	L	1088	4.0	0.765	49.1	LOS D	245	0.93	0.88	25.8
6	R	1	50.0	0.002	8.3	LOS A	0	0.08	0.65	48.7
Approach		1090	4.1	0.765	49.0	LOS D	245	0.93	0.88	25.8
Princes Highway - North										
7	L	3	25.0	0.578	126.4	LOS F	941	0.75	0.85	13.9
8	T	1179	4.0	0.593	72.8	LOS E	941	0.75	0.71	20.8
Approach		1183	4.1	0.593	73.0	LOS E	941	0.75	0.71	20.8
All Vehicles		4758	4.0	1.027	53.0	LOS D	941	0.62	0.70	25.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	21.3	LOS C	0	0.53	0.53
All Peds	22	21.3	LOS C	0	0.53	0.53

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Movement Summary

Princess Highway and Bolong Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1039	4.0	0.274	2.1	LOS B#	8#	0.00	0.19	66.0
3	R	924	4.0	0.975	83.5	LOS F	412	0.99	1.08	19.0
Approach		1963	4.0	0.975	40.4	LOS D	412	0.47	0.61	31.1
East Approach										
4	L	904	4.0	0.708	50.4	LOS D	199	0.92	0.86	25.4
6	R	12	7.7	0.021	39.7	LOS D	7	0.67	0.69	28.7
Approach		917	4.0	0.709	50.3	LOS D	199	0.92	0.86	25.4
Princes Highway - North										
7	L	1	50.0	0.586	151.5	LOS F	770	0.73	0.85	12.0
8	T	1334	4.0	0.623	83.8	LOS F	770	0.73	0.70	18.9
Approach		1336	4.0	0.623	83.9	LOS F	770	0.73	0.70	18.9
All Vehicles		4216	4.0	0.975	56.3	LOS E	770	0.65	0.69	24.9

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	17.9	LOS B	0	0.50	0.50
All Peds	22	17.9	LOS B	0	0.50	0.50

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue

SIDRA INTERSECTION

Movement Summary

Princess Highway and Bolong Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 150 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Highway - South										
2	T	1538	4.0	0.406	2.1	LOS C#	12#	0.00	0.19	65.9
3	R	1076	4.0	1.063	123.5	LOS F	646	1.00	1.28	14.1
Approach		2614	4.0	1.063	52.1	LOS D	646	0.41	0.64	26.9
East Approach										
4	L	1090	4.0	0.766	49.1	LOS D	246	0.93	0.88	25.8
6	R	1	50.0	0.002	8.3	LOS A	0	0.08	0.65	48.7
Approach		1092	4.1	0.766	49.1	LOS D	246	0.93	0.88	25.8
Princes Highway - North										
7	L	1	50.0	0.625	185.2	LOS F	894	0.79	0.86	10.1
8	T	1302	4.0	0.653	103.0	LOS F	894	0.79	0.74	16.2
Approach		1304	4.1	0.653	103.2	LOS F	894	0.79	0.74	16.2
All Vehicles		5010	4.1	1.063	64.7	LOS E	894	0.62	0.72	22.8

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P3	22	21.3	LOS C	0	0.53	0.53
All Peds	22	21.3	LOS C	0	0.53	0.53

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2005 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	36	2.9	0.302	6.8	LOS A	20	0.18	0.52	49.8
2	T	823	4.0	0.302	5.7	LOS A	20	0.19	0.44	50.9
3	R	99	4.0	0.302	11.4	LOS B	20	0.19	0.64	45.7
Approach		957	4.0	0.302	6.3	LOS A	20	0.19	0.47	50.3
Beinda St - East										
4	L	72	4.2	0.186	11.1	LOS B	8	0.72	0.87	46.1
5	T	5	16.7	0.188	10.3	LOS B	8	0.72	0.85	46.9
6	R	25	4.0	0.185	16.1	LOS B	8	0.72	0.87	42.4
Approach		103	4.9	0.186	12.2	LOS B	8	0.72	0.87	45.2
Princess Hwy - North										
7	L	48	4.2	0.449	7.5	LOS A	31	0.41	0.56	48.4
8	T	1205	4.0	0.447	6.4	LOS A	31	0.43	0.52	49.3
9	R	5	16.7	0.462	12.3	LOS B	30	0.44	0.67	44.7
Approach		1259	4.1	0.447	6.5	LOS A	31	0.43	0.52	49.2
Turley Ave - West										
10	L	4	20.0	0.079	9.9	LOS A	3	0.60	0.79	47.3
11	T	27	3.7	0.080	9.1	LOS A	3	0.60	0.74	48.1
12	R	22	4.5	0.080	14.9	LOS B	3	0.60	0.78	43.4
Approach		54	5.6	0.080	11.5	LOS B	3	0.60	0.77	45.9
All Vehicles		2373	4.1	0.462	6.8	LOS A	31	0.35	0.52	49.4

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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2005 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	23	4.3	0.377	6.8	LOS A	26	0.18	0.52	49.8
2	T	1111	4.0	0.376	5.7	LOS A	26	0.18	0.44	51.0
3	R	75	4.0	0.377	11.4	LOS B	26	0.19	0.64	45.7
Approach		1208	4.0	0.376	6.0	LOS A	26	0.18	0.46	50.6
Beinda St - East										
4	L	82	3.7	0.171	10.7	LOS B	7	0.68	0.85	46.5
5	T	8	11.1	0.170	9.9	LOS A	7	0.68	0.83	47.3
6	R	13	7.7	0.171	15.7	LOS B	7	0.68	0.85	42.7
Approach		104	4.8	0.171	11.3	LOS B	7	0.68	0.85	46.0
Princess Hwy - North										
7	L	1	50.0	0.400	7.0	LOS A	24	0.30	0.56	49.1
8	T	1100	4.0	0.376	6.0	LOS A	24	0.31	0.48	50.1
9	R	12	8.3	0.375	11.9	LOS B	24	0.33	0.65	45.2
Approach		1114	4.1	0.376	6.1	LOS A	24	0.31	0.48	50.0
Turley Ave - West										
10	L	2	33.3	0.047	10.9	LOS B	2	0.65	0.82	46.1
11	T	9	10.0	0.047	10.3	LOS B	2	0.65	0.77	46.9
12	R	13	7.7	0.047	16.1	LOS B	2	0.65	0.78	42.4
Approach		26	11.5	0.047	13.3	LOS B	2	0.65	0.78	44.4
All Vehicles		2452	4.2	0.400	6.4	LOS A	26	0.27	0.49	50.0

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 DN2P AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	32	3.2	0.344	6.9	LOS A	25	0.22	0.51	49.5
2	T	948	4.0	0.344	5.7	LOS A	25	0.23	0.45	50.7
3	R	101	4.0	0.345	11.5	LOS B	24	0.23	0.63	45.6
Approach		1080	4.0	0.344	6.3	LOS A	25	0.23	0.47	50.1
Beinda St - East										
4	L	95	4.2	0.271	11.9	LOS B	12	0.77	0.89	45.3
5	T	8	11.1	0.273	11.2	LOS B	12	0.77	0.88	46.1
6	R	32	3.2	0.270	16.9	LOS B	12	0.77	0.91	41.7
Approach		135	4.4	0.270	13.0	LOS B	12	0.77	0.90	44.4
Princess Hwy - North										
7	L	31	3.3	0.508	7.7	LOS A	37	0.47	0.57	48.1
8	T	1364	4.0	0.505	6.6	LOS A	37	0.49	0.54	48.9
9	R	4	20.0	0.500	12.5	LOS B	37	0.50	0.68	44.5
Approach		1400	4.1	0.505	6.7	LOS A	37	0.49	0.54	48.9
Turley Ave - West										
10	L	1	50.0	0.105	10.3	LOS B	4	0.64	0.83	46.7
11	T	40	5.0	0.105	9.7	LOS A	4	0.64	0.79	47.5
12	R	24	4.2	0.105	15.5	LOS B	4	0.64	0.81	42.9
Approach		66	6.1	0.105	11.8	LOS B	4	0.64	0.80	45.7
All Vehicles		2681	4.1	0.508	7.0	LOS A	37	0.40	0.53	49.0

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- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 DN2P PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	12	8.3	0.400	6.8	LOS A	29	0.17	0.52	49.8
2	T	1192	4.0	0.398	5.6	LOS A	29	0.18	0.44	51.0
3	R	81	3.7	0.397	11.4	LOS B	29	0.19	0.64	45.8
Approach		1285	4.0	0.398	6.0	LOS A	29	0.18	0.46	50.6
Beinda St - East										
4	L	101	4.0	0.207	11.0	LOS B	8	0.70	0.86	46.2
5	T	2	33.3	0.200	10.1	LOS B	8	0.70	0.84	47.0
6	R	18	5.6	0.207	16.0	LOS B	8	0.70	0.87	42.5
Approach		122	4.9	0.207	11.7	LOS B	8	0.70	0.86	45.6
Princess Hwy - North										
7	L	2	33.3	0.375	7.1	LOS A	26	0.32	0.55	49.0
8	T	1145	4.0	0.394	6.1	LOS A	26	0.33	0.48	49.9
9	R	9	10.0	0.400	11.9	LOS B	25	0.35	0.65	45.1
Approach		1158	4.1	0.394	6.1	LOS A	26	0.33	0.48	49.9
Turley Ave - West										
10	L	2	33.3	0.050	11.3	LOS B	2	0.66	0.84	45.7
11	T	9	10.0	0.050	10.7	LOS B	2	0.66	0.78	46.5
12	R	14	7.1	0.050	16.5	LOS B	2	0.66	0.78	42.1
Approach		27	11.1	0.050	13.8	LOS B	2	0.66	0.79	44.0
All Vehicles		2592	4.2	0.400	6.4	LOS A	29	0.28	0.49	49.9

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 DNSP AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	21	4.8	0.328	7.0	LOS A	23	0.27	0.52	49.2
2	T	858	4.0	0.326	5.8	LOS A	23	0.28	0.46	50.3
3	R	112	3.6	0.326	11.6	LOS B	23	0.29	0.63	45.4
Approach		990	3.9	0.326	6.5	LOS A	23	0.28	0.48	49.7
Beinda St - East										
4	L	118	4.2	0.368	12.9	LOS B	17	0.79	0.93	44.4
5	T	12	8.3	0.364	12.2	LOS B	17	0.79	0.92	45.1
6	R	51	3.9	0.367	17.9	LOS B	17	0.79	0.97	41.0
Approach		181	4.4	0.367	14.3	LOS B	17	0.79	0.94	43.4
Princess Hwy - North										
7	L	83	3.6	0.535	7.7	LOS A	41	0.47	0.57	48.1
8	T	1415	4.0	0.535	6.6	LOS A	41	0.48	0.53	48.9
9	R	3	25.0	0.571	12.5	LOS B	40	0.50	0.68	44.5
Approach		1502	4.1	0.535	6.7	LOS A	41	0.48	0.53	48.9
Turley Ave - West										
10	L	2	33.3	0.073	10.1	LOS B	3	0.63	0.83	47.0
11	T	24	4.2	0.073	9.5	LOS A	3	0.63	0.76	47.8
12	R	19	5.3	0.073	15.2	LOS B	3	0.63	0.79	43.1
Approach		46	6.5	0.073	11.9	LOS B	3	0.63	0.77	45.6
All Vehicles		2719	4.1	0.571	7.2	LOS A	41	0.43	0.54	48.7

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Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 DNSP PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	15	6.7	0.441	7.2	LOS A	34	0.38	0.54	48.6
2	T	1156	4.0	0.438	6.1	LOS A	34	0.39	0.48	49.5
3	R	105	3.8	0.438	11.9	LOS B	33	0.40	0.63	44.9
Approach		1276	4.0	0.438	6.6	LOS A	34	0.39	0.50	49.1
Beinda St - East										
4	L	109	3.7	0.369	12.4	LOS B	17	0.77	0.92	44.8
5	T	4	20.0	0.357	11.7	LOS B	17	0.77	0.91	45.6
6	R	85	3.5	0.370	17.4	LOS B	17	0.77	0.96	41.4
Approach		199	4.0	0.370	14.5	LOS B	17	0.77	0.94	43.3
Princess Hwy - North										
7	L	48	4.2	0.466	7.5	LOS A	34	0.42	0.56	48.4
8	T	1264	4.0	0.468	6.4	LOS A	34	0.43	0.51	49.3
9	R	14	7.1	0.467	12.2	LOS B	33	0.45	0.66	44.7
Approach		1327	4.1	0.468	6.5	LOS A	34	0.43	0.52	49.2
Turley Ave - West										
10	L	4	20.0	0.076	11.7	LOS B	3	0.71	0.86	45.5
11	T	11	9.1	0.075	10.9	LOS B	3	0.71	0.83	46.3
12	R	22	4.5	0.075	16.7	LOS B	3	0.71	0.81	41.9
Approach		38	7.9	0.075	14.3	LOS B	3	0.71	0.82	43.5
All Vehicles		2840	4.1	0.468	7.2	LOS A	34	0.44	0.54	48.6

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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 1 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	36	2.9	0.302	6.9	LOS A	21	0.22	0.51	49.6
2	T	775	4.0	0.302	5.7	LOS A	21	0.22	0.45	50.7
3	R	132	3.8	0.302	11.5	LOS B	21	0.23	0.63	45.6
Approach		941	3.9	0.302	6.6	LOS A	21	0.22	0.47	49.9
Beinda St - East										
4	L	113	4.4	0.340	13.0	LOS B	15	0.80	0.93	44.3
5	T	1	50.0	0.333	12.1	LOS B	15	0.80	0.92	45.1
6	R	42	4.8	0.341	18.0	LOS B	15	0.80	0.96	41.0
Approach		157	5.1	0.340	14.3	LOS B	15	0.80	0.94	43.3
Princess Hwy - North										
7	L	80	3.8	0.567	7.9	LOS A	44	0.51	0.59	47.9
8	T	1479	4.0	0.568	6.8	LOS A	44	0.53	0.56	48.6
9	R	2	33.3	0.600	12.6	LOS B	43	0.55	0.71	44.3
Approach		1562	4.0	0.567	6.9	LOS A	44	0.53	0.56	48.6
Turley Ave - West										
10	L	5	16.7	0.078	9.9	LOS A	3	0.61	0.79	47.3
11	T	32	3.2	0.078	9.2	LOS A	3	0.61	0.75	48.1
12	R	15	6.7	0.078	14.9	LOS B	3	0.61	0.78	43.3
Approach		52	5.8	0.078	10.9	LOS B	3	0.61	0.76	46.5
All Vehicles		2712	4.1	0.600	7.3	LOS A	44	0.44	0.55	48.6

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 1 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	11	9.1	0.440	7.0	LOS A	33	0.30	0.52	49.1
2	T	1223	4.0	0.437	5.9	LOS A	33	0.31	0.46	50.1
3	R	98	4.1	0.438	11.7	LOS B	33	0.32	0.63	45.2
Approach		1332	4.1	0.437	6.3	LOS A	33	0.31	0.47	49.7
Beinda St - East										
4	L	133	3.8	0.317	11.3	LOS B	14	0.74	0.88	45.9
5	T	7	12.5	0.320	10.6	LOS B	14	0.74	0.87	46.6
6	R	46	4.3	0.317	16.3	LOS B	14	0.74	0.91	42.2
Approach		186	4.3	0.318	12.5	LOS B	14	0.74	0.89	44.9
Princess Hwy - North										
7	L	7	12.5	0.400	7.4	LOS A	27	0.38	0.56	48.6
8	T	1123	4.0	0.403	6.3	LOS A	27	0.39	0.50	49.5
9	R	15	6.7	0.405	12.1	LOS B	26	0.41	0.66	44.9
Approach		1146	4.1	0.403	6.4	LOS A	27	0.39	0.51	49.5
Turley Ave - West										
10	L	1	50.0	0.077	11.5	LOS B	3	0.70	0.86	45.5
11	T	17	5.9	0.077	10.9	LOS B	3	0.70	0.83	46.3
12	R	21	4.8	0.077	16.7	LOS B	3	0.70	0.81	41.9
Approach		40	7.5	0.077	14.0	LOS B	3	0.70	0.82	43.8
All Vehicles		2704	4.1	0.440	6.9	LOS A	33	0.38	0.52	49.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	24	4.2	0.343	6.9	LOS A	25	0.23	0.51	49.5
2	T	909	4.0	0.342	5.7	LOS A	25	0.24	0.45	50.6
3	R	134	3.8	0.342	11.5	LOS B	24	0.25	0.63	45.5
Approach		1066	3.9	0.342	6.5	LOS A	25	0.24	0.47	49.8
Beinda St - East										
4	L	112	3.6	0.333	12.8	LOS B	15	0.80	0.92	44.5
5	T	3	25.0	0.333	12.0	LOS B	15	0.80	0.91	45.2
6	R	42	4.8	0.333	17.8	LOS B	15	0.80	0.96	41.1
Approach		157	4.5	0.333	14.1	LOS B	15	0.80	0.93	43.5
Princess Hwy - North										
7	L	63	4.7	0.552	7.8	LOS A	42	0.50	0.58	48.0
8	T	1457	4.0	0.553	6.8	LOS A	42	0.52	0.55	48.7
9	R	2	33.3	0.600	12.6	LOS B	42	0.54	0.71	44.4
Approach		1524	4.1	0.553	6.8	LOS A	42	0.52	0.55	48.6
Turley Ave - West										
10	L	3	25.0	0.073	10.4	LOS B	3	0.64	0.82	46.7
11	T	27	3.7	0.073	9.7	LOS A	3	0.64	0.77	47.5
12	R	14	7.1	0.073	15.4	LOS B	3	0.64	0.79	42.9
Approach		45	6.7	0.073	11.5	LOS B	3	0.64	0.78	45.9
All Vehicles		2792	4.1	0.600	7.2	LOS A	42	0.43	0.55	48.7

Symbols which may appear in this table:

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	9	10.0	0.455	7.2	LOS A	35	0.36	0.53	48.8
2	T	1185	4.0	0.448	6.0	LOS A	35	0.37	0.47	49.7
3	R	134	3.8	0.448	11.9	LOS B	34	0.38	0.63	45.0
Approach		1328	4.0	0.448	6.6	LOS A	35	0.37	0.49	49.2
Beinda St - East										
4	L	140	4.3	0.392	12.5	LOS B	19	0.78	0.93	44.8
5	T	6	14.3	0.389	11.7	LOS B	19	0.78	0.92	45.6
6	R	67	4.4	0.391	17.5	LOS B	19	0.78	0.97	41.4
Approach		215	4.7	0.392	14.0	LOS B	19	0.78	0.94	43.6
Princess Hwy - North										
7	L	4	20.0	0.455	7.5	LOS A	31	0.43	0.58	48.3
8	T	1215	4.0	0.444	6.4	LOS A	31	0.45	0.52	49.2
9	R	16	6.2	0.444	12.3	LOS B	31	0.46	0.66	44.7
Approach		1236	4.1	0.444	6.5	LOS A	31	0.45	0.52	49.1
Turley Ave - West										
10	L	3	25.0	0.055	12.0	LOS B	2	0.71	0.86	45.2
11	T	6	14.3	0.055	11.3	LOS B	2	0.71	0.83	45.9
12	R	15	6.7	0.055	17.1	LOS B	2	0.71	0.79	41.7
Approach		26	11.5	0.055	14.7	LOS B	2	0.71	0.81	43.2
All Vehicles		2805	4.2	0.455	7.2	LOS A	35	0.44	0.54	48.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 2 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	23	4.3	0.299	6.9	LOS A	20	0.25	0.52	49.4
2	T	755	4.0	0.300	5.8	LOS A	20	0.26	0.45	50.5
3	R	137	3.7	0.300	11.6	LOS B	20	0.26	0.63	45.4
Approach		914	3.9	0.300	6.7	LOS A	20	0.26	0.48	49.6
Beinda St - East										
4	L	92	4.3	0.286	11.7	LOS B	12	0.76	0.89	45.5
5	T	5	16.7	0.286	10.9	LOS B	12	0.76	0.88	46.3
6	R	48	4.2	0.286	16.7	LOS B	12	0.76	0.92	41.9
Approach		146	4.8	0.286	13.3	LOS B	12	0.76	0.90	44.3
Princess Hwy - North										
7	L	84	3.6	0.515	7.7	LOS A	38	0.47	0.58	48.1
8	T	1335	4.0	0.514	6.6	LOS A	38	0.49	0.54	48.9
9	R	7	12.5	0.500	12.5	LOS B	37	0.51	0.68	44.5
Approach		1426	4.0	0.514	6.7	LOS A	38	0.49	0.54	48.8
Turley Ave - West										
10	L	1	50.0	0.051	9.9	LOS A	2	0.61	0.81	47.1
11	T	15	6.7	0.051	9.3	LOS A	2	0.61	0.72	48.0
12	R	15	6.7	0.051	15.1	LOS B	2	0.61	0.76	43.2
Approach		32	9.4	0.051	12.0	LOS B	2	0.61	0.75	45.5
All Vehicles		2518	4.1	0.515	7.2	LOS A	38	0.42	0.54	48.8

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 2 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	14	7.1	0.424	6.9	LOS A	32	0.23	0.51	49.5
2	T	1189	4.0	0.424	5.7	LOS A	32	0.23	0.45	50.6
3	R	138	4.3	0.425	11.5	LOS B	32	0.25	0.63	45.5
Approach		1342	4.1	0.424	6.3	LOS A	32	0.24	0.47	50.0
Beinda St - East										
4	L	124	4.0	0.284	11.4	LOS B	12	0.75	0.88	45.8
5	T	5	16.7	0.286	10.6	LOS B	12	0.75	0.87	46.6
6	R	25	4.0	0.284	16.4	LOS B	12	0.75	0.90	42.2
Approach		155	4.5	0.284	12.1	LOS B	12	0.75	0.88	45.2
Princess Hwy - North										
7	L	21	4.8	0.447	7.7	LOS A	31	0.46	0.58	48.2
8	T	1196	4.0	0.451	6.6	LOS A	31	0.47	0.54	49.0
9	R	13	7.7	0.448	12.5	LOS B	30	0.49	0.68	44.6
Approach		1230	4.1	0.451	6.7	LOS A	31	0.47	0.54	48.9
Turley Ave - West										
10	L	5	16.7	0.092	11.4	LOS B	4	0.69	0.85	45.8
11	T	19	5.3	0.092	10.7	LOS B	4	0.69	0.83	46.5
12	R	26	3.8	0.092	16.4	LOS B	4	0.69	0.82	42.1
Approach		51	5.9	0.092	13.7	LOS B	4	0.69	0.83	44.0
All Vehicles		2778	4.1	0.451	7.0	LOS A	32	0.38	0.53	49.1

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- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 3 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	26	3.8	0.299	6.9	LOS A	20	0.21	0.52	49.6
2	T	792	4.0	0.298	5.7	LOS A	20	0.22	0.45	50.7
3	R	108	3.7	0.298	11.5	LOS B	20	0.23	0.63	45.6
Approach		926	4.0	0.298	6.4	LOS A	20	0.22	0.47	50.0
Beinda St - East										
4	L	106	3.8	0.294	12.1	LOS B	13	0.77	0.90	45.2
5	T	4	20.0	0.294	11.3	LOS B	13	0.77	0.89	45.9
6	R	36	2.9	0.294	17.1	LOS B	13	0.77	0.93	41.6
Approach		146	4.1	0.294	13.2	LOS B	13	0.77	0.90	44.3
Princess Hwy - North										
7	L	88	4.5	0.530	7.6	LOS A	40	0.46	0.57	48.2
8	T	1395	4.0	0.531	6.6	LOS A	40	0.48	0.53	49.0
9	R	7	12.5	0.533	12.5	LOS B	39	0.50	0.67	44.5
Approach		1492	4.1	0.531	6.7	LOS A	40	0.48	0.53	48.9
Turley Ave - West										
10	L	4	20.0	0.076	9.9	LOS A	3	0.61	0.79	47.3
11	T	27	3.7	0.076	9.1	LOS A	3	0.61	0.74	48.1
12	R	19	5.3	0.076	14.9	LOS B	3	0.61	0.78	43.4
Approach		51	5.9	0.076	11.3	LOS B	3	0.61	0.76	46.1
All Vehicles		2615	4.1	0.533	7.0	LOS A	40	0.41	0.54	48.9

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 3 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	12	8.3	0.444	7.0	LOS A	35	0.29	0.52	49.1
2	T	1219	4.0	0.447	5.9	LOS A	35	0.30	0.46	50.1
3	R	141	4.3	0.446	11.7	LOS B	34	0.32	0.62	45.2
Approach		1372	4.1	0.447	6.5	LOS A	35	0.30	0.47	49.6
Beinda St - East										
4	L	108	3.7	0.282	11.1	LOS B	12	0.74	0.88	46.1
5	T	2	33.3	0.273	10.2	LOS B	12	0.74	0.86	46.9
6	R	49	4.1	0.282	16.1	LOS B	12	0.74	0.89	42.4
Approach		160	4.4	0.282	12.6	LOS B	12	0.74	0.88	44.9
Princess Hwy - North										
7	L	35	2.9	0.430	7.7	LOS A	29	0.45	0.58	48.2
8	T	1128	4.0	0.432	6.6	LOS A	29	0.47	0.54	49.0
9	R	12	8.3	0.429	12.5	LOS B	29	0.48	0.68	44.6
Approach		1174	4.0	0.431	6.7	LOS A	29	0.47	0.54	49.0
Turley Ave - West										
10	L	8	11.1	0.093	11.7	LOS B	4	0.71	0.86	45.5
11	T	18	5.6	0.093	11.0	LOS B	4	0.71	0.85	46.3
12	R	22	4.5	0.093	16.7	LOS B	4	0.71	0.83	41.9
Approach		49	6.1	0.093	13.7	LOS B	4	0.71	0.84	44.0
All Vehicles		2755	4.1	0.447	7.0	LOS A	35	0.40	0.53	48.9

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Following LOS
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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	26	3.8	0.321	6.9	LOS A	23	0.22	0.51	49.5
2	T	842	4.0	0.320	5.7	LOS A	23	0.23	0.45	50.6
3	R	127	3.9	0.320	11.5	LOS B	22	0.24	0.63	45.6
Approach		995	4.0	0.320	6.5	LOS A	23	0.23	0.47	49.9
Beinda St - East										
4	L	133	3.8	0.339	12.0	LOS B	15	0.77	0.91	45.3
5	T	3	25.0	0.333	11.2	LOS B	15	0.77	0.90	46.0
6	R	42	4.8	0.339	17.0	LOS B	15	0.77	0.95	41.7
Approach		178	4.5	0.340	13.1	LOS B	15	0.77	0.92	44.4
Princess Hwy - North										
7	L	114	4.4	0.511	7.8	LOS A	37	0.48	0.58	48.1
8	T	1288	4.0	0.512	6.7	LOS A	37	0.50	0.55	48.8
9	R	2	33.3	0.500	12.5	LOS B	37	0.52	0.71	44.5
Approach		1406	4.1	0.512	6.8	LOS A	37	0.50	0.55	48.8
Turley Ave - West										
10	L	3	25.0	0.083	10.2	LOS B	3	0.63	0.82	47.0
11	T	37	2.8	0.084	9.4	LOS A	3	0.63	0.76	47.8
12	R	14	7.1	0.084	15.2	LOS B	3	0.63	0.80	43.1
Approach		54	5.6	0.084	11.0	LOS B	3	0.63	0.78	46.4
All Vehicles		2633	4.1	0.512	7.2	LOS A	37	0.42	0.55	48.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Beinda Street

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	18	5.6	0.474	7.0	LOS A	37	0.29	0.52	49.2
2	T	1316	4.0	0.471	5.9	LOS A	37	0.30	0.45	50.2
3	R	123	4.1	0.471	11.7	LOS B	37	0.31	0.62	45.3
Approach		1457	4.0	0.471	6.4	LOS A	37	0.30	0.47	49.7
Beinda St - East										
4	L	121	4.1	0.287	11.1	LOS B	12	0.74	0.88	46.1
5	T	8	11.1	0.290	10.4	LOS B	12	0.74	0.86	46.8
6	R	34	3.0	0.287	16.1	LOS B	12	0.74	0.90	42.4
Approach		163	4.3	0.286	12.1	LOS B	12	0.74	0.88	45.3
Princess Hwy - North										
7	L	28	3.6	0.431	7.6	LOS A	29	0.44	0.57	48.3
8	T	1136	4.0	0.429	6.5	LOS A	29	0.45	0.53	49.2
9	R	18	5.6	0.429	12.4	LOS B	28	0.46	0.67	44.7
Approach		1181	4.0	0.429	6.6	LOS A	29	0.45	0.53	49.1
Turley Ave - West										
10	L	5	16.7	0.102	12.0	LOS B	4	0.72	0.87	45.2
11	T	22	4.5	0.101	11.2	LOS B	4	0.72	0.85	46.0
12	R	24	4.2	0.101	17.0	LOS B	4	0.72	0.84	41.7
Approach		52	5.8	0.101	14.0	LOS B	4	0.72	0.85	43.8
All Vehicles		2853	4.1	0.474	6.9	LOS A	37	0.39	0.53	49.0

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	717	4.0	0.184	0.0	LOS A	0	0.00	0.00	60.0
3	R	125	4.0	0.389	22.4	LOS C	15	0.85	1.02	37.2
Approach		842	4.0	0.389	3.3	LOS A	15	0.13	0.15	55.0
West Bunberra St- East										
4	L	132	3.8	0.535	29.2	LOS D	20	0.89	1.08	33.3
6	R	1	50.0	1.000#	3755.9	LOS F	31	1.00	1.05	0.6
Approach		133	4.5	1.000	85.2	LOS F	31	0.89	1.08	17.9
Princess Hwy - North										
7	L	68	4.3	0.317	8.3	LOS A	0	0.00	0.67	49.0
8	T	1131	4.0	0.316	0.0	LOS A	0	0.00	0.00	60.0
Approach		1199	4.0	0.316	0.5	LOS A		0.00	0.04	59.2
All Vehicles		2174	4.0	1.000	6.8	Not Applicable	31	0.10	0.15	50.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2005AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	987	4.0	0.253	0.0	LOS A	0	0.00	0.00	60.0
3	R	149	4.0	0.353	18.3	LOS C	14	0.79	0.99	40.0
Approach		1136	4.0	0.353	2.4	LOS A	14	0.10	0.13	56.3
West Bunberra St - East										
4	L	116	4.3	0.361	21.2	LOS C	13	0.81	1.00	38.0
6	R	1	50.0	1.000#	6206.4	LOS F	32	1.00	1.07	0.3
Approach		118	5.1	1.000	126.0	LOS F	32	0.81	1.00	13.4
Princess Hwy - North										
7	L	36	2.9	0.271	8.3	LOS A	0	0.00	0.67	49.0
8	T	996	4.0	0.272	0.0	LOS A	0	0.00	0.00	60.0
Approach		1031	4.0	0.272	0.3	LOS A		0.00	0.02	59.5
All Vehicles		2285	4.0	1.000	7.8	Not Applicable	32	0.09	0.13	49.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2005PMPRINCECESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 DN2P AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	879	4.0	0.225	0.0	LOS A	0	0.00	0.00	60.0
3	R	124	4.0	0.508	29.8	LOS D	19	0.91	1.07	33.0
Approach		1003	4.0	0.507	3.7	LOS A	19	0.11	0.13	54.5
West Bunberra St- East										
4	L	131	3.8	0.710	45.0	LOS E	29	0.95	1.17	26.8
6	R	1	50.0	1.000#	12086.3	LOS F	33	1.00	1.10	0.2
Approach		132	4.5	1.000	227.4	LOS F	33	0.95	1.17	8.3
Princess Hwy - North										
7	L	71	4.2	0.357	8.3	LOS A	0	0.00	0.67	49.0
8	T	1281	4.0	0.357	0.0	LOS A	0	0.00	0.00	60.0
Approach		1352	4.0	0.357	0.4	LOS A		0.00	0.04	59.3
All Vehicles		2487	4.0	1.000	13.8	Not Applicable	33	0.10	0.13	43.5

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DN2P-AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 DN2P PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	1087	4.0	0.279	0.0	LOS A	0	0.00	0.00	60.0
3	R	134	3.8	0.333	18.6	LOS C	13	0.80	0.98	39.8
Approach		1220	3.9	0.332	2.0	LOS A	13	0.09	0.11	56.8
West Bunberra St - East										
4	L	123	4.1	0.407	22.8	LOS C	15	0.83	1.02	36.9
6	R	1	50.0	1.000#	9833.4	LOS F	33	1.00	1.09	0.2
Approach		125	4.8	1.000	179.8	LOS F	33	0.84	1.02	10.1
Princess Hwy - North										
7	L	33	3.1	0.281	8.3	LOS A	0	0.00	0.67	49.0
8	T	1034	4.0	0.280	0.0	LOS A	0	0.00	0.00	60.0
Approach		1065	3.9	0.281	0.3	LOS A		0.00	0.02	59.6
All Vehicles		2410	4.0	1.000	10.5	Not Applicable	33	0.09	0.12	46.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DN2P-PMPRINCECESBUNBERRA
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Movement Summary

Princess Highway and West Bunberra Street

2016 DNSP AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	867	4.0	0.223	0.0	LOS A	0	0.00	0.00	60.0
3	R	38	5.3	0.187	26.6	LOS D	6	0.88	0.97	34.7
Approach		906	4.1	0.223	1.1	LOS A	6	0.04	0.04	58.2
West Bunberra St- East										
4	L	129	3.9	0.854	71.0	LOS F	42	0.98	1.33	20.3
6	R	1	50.0	1.000#	11844.7	LOS F	33	1.00	1.10	0.2
Approach		131	4.6	1.000	250.8	LOS F	42	0.98	1.32	7.6
Princess Hwy - North										
7	L	64	4.6	0.380	8.3	LOS A	0	0.00	0.67	49.0
8	T	1376	4.0	0.380	0.0	LOS A	0	0.00	0.00	60.0
Approach		1441	4.0	0.380	0.4	LOS A		0.00	0.03	59.4
All Vehicles		2478	4.1	1.000	13.9	Not Applicable	42	0.07	0.10	43.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 DNSP PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	1165	4.0	0.299	0.0	LOS A	0	0.00	0.00	60.0
3	R	64	4.6	0.228	21.7	LOS C	7	0.84	0.96	37.7
Approach		1231	4.1	0.299	1.1	LOS A	7	0.04	0.05	58.2
West Bunberra St - East										
4	L	83	3.6	0.388	28.8	LOS D	13	0.88	1.02	33.5
6	R	1	50.0	1.000#	22989.0	LOS F	35	1.00	1.14	0.1
Approach		85	4.7	1.000	569.0	LOS F	35	0.89	1.02	3.6
Princess Hwy - North										
7	L	57	3.5	0.333	8.3	LOS A	0	0.00	0.67	49.0
8	T	1208	4.0	0.334	0.0	LOS A	0	0.00	0.00	60.0
Approach		1265	4.0	0.333	0.4	LOS A		0.00	0.03	59.4
All Vehicles		2581	4.0	1.000	19.5	Not Applicable	35	0.05	0.07	39.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-PMPRINCECESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 1 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	821	4.0	0.211	0.0	LOS A	0	0.00	0.00	60.0
3	R	41	4.9	0.353	46.7	LOS E	11	0.95	1.02	26.3
Approach		862	4.1	0.354	2.2	LOS A	11	0.05	0.05	56.6
West Bunberra St- East										
4	L	131	3.8	1.083	203.3	LOS F	108	1.00	2.03	9.1
6	R	1	50.0	1.000#	25715.1	LOS F	36	1.00	1.15	0.1
Approach		132	4.5	1.083	589.8	LOS F	108	1.00	2.01	3.5
Princess Hwy - North										
7	L	154	3.9	0.452	8.3	LOS A	0	0.00	0.67	49.0
8	T	1553	4.0	0.451	0.0	LOS A	0	0.00	0.00	60.0
Approach		1707	4.0	0.451	0.8	LOS A		0.00	0.06	58.8
All Vehicles		2701	4.0	1.083	30.0	Not Applicable	108	0.06	0.15	32.9

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 1 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	1213	4.0	0.311	0.0	LOS A	0	0.00	0.00	60.0
3	R	74	4.1	0.329	27.6	LOS D	11	0.89	1.00	34.2
Approach		1287	4.0	0.329	1.6	LOS A	11	0.05	0.06	57.5
West Bunberra St - East										
4	L	80	3.8	0.430	33.1	LOS D	14	0.91	1.03	31.4
6	R	1	50.0	1.000#	42031.9	LOS F	38	1.00	1.19	0.1
Approach		82	4.9	1.000	1057.4	LOS F	38	0.91	1.04	2.0
Princess Hwy - North										
7	L	175	4.0	0.370	8.3	LOS A	0	0.00	0.67	49.0
8	T	1221	4.0	0.370	0.0	LOS A	0	0.00	0.00	60.0
Approach		1396	4.0	0.370	1.0	LOS A		0.00	0.08	58.4
All Vehicles		2765	4.1	1.000	32.6	Not Applicable	38	0.05	0.10	31.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-PMPRINCECESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	946	4.0	0.243	0.0	LOS A	0	0.00	0.00	60.0
3	R	45	4.4	0.346	42.2	LOS E	10	0.94	1.01	27.8
Approach		991	4.0	0.346	1.9	LOS A	10	0.04	0.05	57.0
West Bunberra St- East										
4	L	128	3.9	1.067	182.8	LOS F	99	1.00	1.92	9.9
6	R	1	50.0	1.000#	36778.6	LOS F	37	1.00	1.18	0.1
Approach		130	4.6	1.067	745.8	LOS F	99	1.00	1.90	2.8
Princess Hwy - North										
7	L	162	3.7	0.438	8.3	LOS A	0	0.00	0.67	49.0
8	T	1496	4.0	0.438	0.0	LOS A	0	0.00	0.00	60.0
Approach		1658	4.0	0.438	0.8	LOS A		0.00	0.07	58.7
All Vehicles		2779	4.0	1.067	36.1	Not Applicable	99	0.06	0.14	30.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-MVRDLK-AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	1209	4.0	0.310	0.0	LOS A	0	0.00	0.00	60.0
3	R	77	3.9	0.339	27.6	LOS D	11	0.89	1.01	34.2
Approach		1286	4.0	0.340	1.7	LOS A	11	0.05	0.06	57.4
West Bunberra St - East										
4	L	81	3.7	0.455	34.8	LOS D	15	0.91	1.04	30.7
6	R	1	50.0	1.000#	46352.3	LOS F	39	1.00	1.20	0.0
Approach		83	4.8	1.000	1150.9	LOS F	39	0.92	1.05	1.8
Princess Hwy - North										
7	L	125	4.0	0.368	8.3	LOS A	0	0.00	0.67	49.0
8	T	1266	4.0	0.368	0.0	LOS A	0	0.00	0.00	60.0
Approach		1392	4.0	0.368	0.7	LOS A		0.00	0.06	58.8
All Vehicles		2761	4.0	1.000	35.7	Not Applicable	39	0.05	0.09	30.3

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-MVRDLK-PMPRINCECESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princes Highway and West Bunberra Street

2016 Option 2 AM Peak Intersection Analysis

Signalised - Fixed time   Cycle Time = 145 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princes Hwy - South										
1	L	25	4.0	0.452	36.7	LOS D	142	0.72	0.83	31.9
2	T	781	4.0	0.453	28.6	LOS C	142	0.72	0.67	36.1
3	R	34	3.0	0.439	87.5	LOS F	25	1.00	0.72	18.3
Approach		839	3.9	0.453	31.1	LOS C	142	0.73	0.68	34.6
West Bunberra St - East										
4	L	78	3.8	0.407	66.3	LOS E	67	0.94	0.79	20.0
5	T	41	4.9	0.407	58.9	LOS E	67	0.94	0.76	21.5
6	R	35	2.9	0.326	66.7	LOS E	22	0.91	0.72	20.0
Approach		153	3.9	0.407	64.4	LOS E	67	0.94	0.77	20.4
Princes Hwy - North										
7	L	68	4.3	0.755	42.8	LOS D	274	0.89	0.88	29.2
8	T	1274	4.0	0.755	34.7	LOS C	275	0.89	0.82	32.8
9	R	51	3.9	0.682	89.8	LOS F	38	1.00	0.79	18.0
Approach		1394	4.0	0.756	37.1	LOS D	275	0.89	0.82	31.6
Link Road Option 2 - West										
10	L	158	3.8	0.756	63.9	LOS E	133	1.00	0.90	23.7
11	T	122	4.1	0.757	56.3	LOS E	133	1.00	0.90	25.9
12	R	111	3.6	0.326	65.5	LOS E	61	0.91	0.79	23.4
Approach		390	3.8	0.756	62.0	LOS E	133	0.98	0.87	24.2
All Vehicles		2776	4.0	0.757	40.3	LOS D	275	0.86	0.78	30.2

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P1	21	66.6	LOS F	0	0.96	0.96
P3	21	23.2	LOS C	0	0.57	0.57
P5	21	60.1	LOS F	0	0.91	0.91

SIDRA INTERSECTION

Movement Summary

Princes Highway and West Bunberra Street

2016 Option 2 PM Peak Intersection Analysis

Signalised - Fixed time Cycle Time = 90 seconds

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princes Hwy - South										
1	L	35	2.9	0.907	54.7	LOS D	228	1.00	1.09	25.2
2	T	1157	4.0	0.909	46.7	LOS D	228	1.00	1.09	27.8
3	R	58	3.4	0.412	54.7	LOS D	27	0.99	0.75	25.2
Approach		1249	3.9	0.909	47.3	LOS D	228	1.00	1.08	27.6
West Bunberra St - East										
4	L	68	4.3	0.274	36.6	LOS D	43	0.84	0.78	27.6
5	T	55	3.6	0.274	29.3	LOS C	43	0.84	0.68	30.5
6	R	20	5.0	0.127	49.8	LOS D	9	0.95	0.70	23.7
Approach		144	4.2	0.274	35.6	LOS D	43	0.86	0.73	27.9
Princes Hwy - North										
7	L	53	3.8	0.828	43.2	LOS D	178	0.98	0.97	29.1
8	T	1032	4.0	0.827	35.3	LOS D	178	0.98	0.95	32.5
9	R	114	4.4	0.814	60.3	LOS E	52	1.00	0.91	23.7
Approach		1198	4.0	0.827	38.1	LOS D	178	0.98	0.95	31.2
Link Road Option 2 - West										
10	L	105	3.8	0.296	38.1	LOS D	49	0.83	0.80	33.0
11	T	42	4.8	0.297	30.4	LOS C	49	0.83	0.71	37.3
12	R	129	3.9	0.803	60.0	LOS E	57	1.00	0.89	24.8
Approach		276	4.0	0.803	47.2	LOS D	57	0.91	0.83	29.0
All Vehicles		2867	4.0	0.909	42.8	LOS D	228	0.98	0.98	29.2

Pedestrian Movements

Mov ID	Dem Flow (ped/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate
P1	21	39.2	LOS D	0	0.93	0.93
P3	21	22.8	LOS C	0	0.71	0.71
P5	21	39.2	LOS D	0	0.93	0.93

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 3 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	846	4.0	0.217	0.0	LOS A	0	0.00	0.00	60.0
3	R	33	3.1	0.179	29.1	LOS D	5	0.90	0.97	33.4
Approach		878	4.0	0.217	1.1	LOS A	5	0.03	0.04	58.3
West Bunberra St- East										
4	L	124	4.0	0.879	80.8	LOS F	44	0.98	1.36	18.6
6	R	1	50.0	1.000#	12014.2	LOS F	33	1.00	1.10	0.2
Approach		126	4.8	1.000	270.2	LOS F	44	0.98	1.36	7.1
Princess Hwy - North										
7	L	146	4.1	0.400	8.3	LOS A	0	0.00	0.67	49.0
8	T	1366	4.0	0.400	0.0	LOS A	0	0.00	0.00	60.0
Approach		1513	4.0	0.400	0.8	LOS A		0.00	0.06	58.7
All Vehicles		2517	4.1	1.000	14.4	Not Applicable	44	0.06	0.12	43.0

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Following Queue
- Density for continuous movement

Site: 2016OPT3-AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 3 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	1222	4.0	0.313	0.0	LOS A	0	0.00	0.00	60.0
3	R	71	4.2	0.240	21.4	LOS C	8	0.84	0.97	37.9
Approach		1293	4.0	0.313	1.2	LOS A	8	0.05	0.05	58.1
West Bunberra St - East										
4	L	85	3.5	0.353	25.8	LOS D	12	0.86	1.00	35.2
6	R	1	50.0	1.000#	22989.0	LOS F	35	1.00	1.14	0.1
Approach		87	4.6	1.000	553.6	LOS F	35	0.86	1.01	3.7
Princess Hwy - North										
7	L	143	4.2	0.329	8.3	LOS A	0	0.00	0.67	49.0
8	T	1103	4.0	0.330	0.0	LOS A	0	0.00	0.00	60.0
Approach		1246	4.0	0.330	1.0	LOS A		0.00	0.08	58.5
All Vehicles		2626	4.0	1.000	19.4	Not Applicable	35	0.05	0.10	39.2

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SIDRA SOLUTIONS

Site: 2016OPT3-PMPRINCECESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	884	4.0	0.227	0.0	LOS A	0	0.00	0.00	60.0
3	R	45	4.4	0.204	25.4	LOS D	6	0.87	0.97	35.4
Approach		929	4.0	0.227	1.2	LOS A	6	0.04	0.05	58.0
West Bunberra St- East										
4	L	138	4.3	0.793	53.9	LOS F	36	0.97	1.25	24.2
6	R	1	50.0	1.000#	9778.3	LOS F	33	1.00	1.09	0.2
Approach		140	5.0	1.000	192.9	LOS F	36	0.97	1.25	9.5
Princess Hwy - North										
7	L	129	3.9	0.371	8.3	LOS A	0	0.00	0.67	49.0
8	T	1274	4.0	0.371	0.0	LOS A	0	0.00	0.00	60.0
Approach		1403	4.0	0.371	0.8	LOS A		0.00	0.06	58.8
All Vehicles		2472	4.0	1.000	11.8	Not Applicable	36	0.07	0.12	45.3

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SIDRA SOLUTIONS

Site: 2016OPT3-MVRDLK-AMPRINCESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and West Bunberra Street

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
2	T	1291	4.0	0.331	0.0	LOS A	0	0.00	0.00	60.0
3	R	87	3.4	0.268	20.5	LOS C	9	0.82	0.97	38.5
Approach		1378	4.0	0.331	1.3	LOS A	9	0.05	0.06	58.0
West Bunberra St - East										
4	L	75	4.0	0.296	23.9	LOS C	10	0.84	0.98	36.2
6	R	1	50.0	1.000#	30116.9	LOS F	36	1.00	1.16	0.1
Approach		77	5.2	1.000	805.6	LOS F	36	0.85	0.99	2.6
Princess Hwy - North										
7	L	89	4.4	0.315	8.3	LOS A	0	0.00	0.67	49.0
8	T	1103	4.0	0.315	0.0	LOS A	0	0.00	0.00	60.0
Approach		1193	4.0	0.315	0.6	LOS A		0.00	0.05	59.0
All Vehicles		2648	4.0	1.000	24.4	Not Applicable	36	0.05	0.08	35.9

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SIDRA SOLUTIONS

Site: 2016OPT3-MVRDLK-PMPRINCECESBUNBERRA
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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2005 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	5	16.7	0.222	7.8	LOS A	13	0.12	0.56	54.5
2	T	712	3.9	0.224	6.6	LOS A	13	0.12	0.49	55.9
3	R	3	25.0	0.222	12.3	LOS B	13	0.13	0.67	49.5
Approach		721	4.2	0.223	6.7	LOS A	13	0.12	0.49	55.9
West Birriley St - East										
4	L	35	2.9	0.077	9.7	LOS A	3	0.64	0.79	41.8
5	T	1	50.0	0.077	8.8	LOS A	3	0.64	0.79	42.5
6	R	11	9.1	0.077	14.8	LOS B	3	0.64	0.80	38.9
Approach		47	6.4	0.077	10.9	LOS B	3	0.64	0.79	41.1
Princess Hwy - North										
7	L	36	2.9	0.365	7.7	LOS A	25	0.12	0.55	54.5
8	T	1157	4.0	0.365	6.6	LOS A	25	0.12	0.48	55.9
9	R	12	8.3	0.364	12.3	LOS B	25	0.13	0.67	49.5
Approach		1204	4.0	0.365	6.7	LOS A	25	0.12	0.49	55.8
Narang Rd - West										
10	L	1	50.0	0.007	14.5	LOS B	0	0.63	0.70	38.2
11	T	1	50.0	0.018	6.6	LOS A	1	0.52	0.62	43.7
12	R	13	7.7	0.017	12.5	LOS B	1	0.52	0.71	40.4
Approach		17	17.6	0.018	12.1	LOS B	1	0.53	0.69	40.5
All Vehicles		1989	4.2	0.365	6.8	LOS A	25	0.14	0.50	55.2

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2005 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	16	6.2	0.314	7.8	LOS A	20	0.18	0.55	54.1
2	T	936	4.0	0.311	6.7	LOS A	20	0.19	0.48	55.4
3	R	36	2.9	0.310	12.4	LOS B	20	0.19	0.65	49.2
Approach		986	4.0	0.311	6.9	LOS A	20	0.19	0.49	55.1
West Birriley St - East										
4	L	27	3.7	0.081	9.0	LOS A	3	0.62	0.76	42.4
5	T	1	50.0	0.080	8.1	LOS A	3	0.62	0.78	43.1
6	R	24	4.2	0.081	14.1	LOS B	3	0.62	0.78	39.3
Approach		53	5.7	0.081	11.3	LOS B	3	0.62	0.77	40.9
Princess Hwy - North										
7	L	7	12.5	0.320	7.9	LOS A	19	0.19	0.55	54.0
8	T	983	4.0	0.320	6.8	LOS A	19	0.20	0.49	55.3
9	R	13	7.7	0.317	12.5	LOS B	19	0.21	0.66	49.1
Approach		1004	4.1	0.320	6.9	LOS A	19	0.20	0.49	55.2
Narang Rd - West										
10	L	8	11.1	0.014	9.1	LOS A	1	0.60	0.68	42.3
11	T	1	50.0	0.017	7.5	LOS A	1	0.59	0.67	43.4
12	R	9	10.0	0.017	13.4	LOS B	1	0.59	0.74	39.8
Approach		21	14.3	0.017	11.0	LOS B	1	0.60	0.70	41.1
All Vehicles		2064	4.2	0.320	7.1	LOS A	20	0.21	0.50	54.5

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 DN2P AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	4	20.0	0.263	7.7	LOS A	17	0.10	0.56	54.6
2	T	868	4.0	0.268	6.6	LOS A	17	0.11	0.49	56.1
3	R	6	14.3	0.269	12.3	LOS B	17	0.11	0.68	49.6
Approach		881	4.2	0.268	6.7	LOS A	17	0.11	0.49	56.0
West Birriley St - East										
4	L	43	4.7	0.095	10.3	LOS B	4	0.67	0.82	41.3
5	T	1	50.0	0.095	9.5	LOS A	4	0.67	0.81	42.0
6	R	8	11.1	0.095	15.4	LOS B	4	0.67	0.83	38.5
Approach		54	7.4	0.095	11.1	LOS B	4	0.67	0.82	40.8
Princess Hwy - North										
7	L	32	3.2	0.408	7.8	LOS A	30	0.13	0.55	54.4
8	T	1309	4.0	0.409	6.6	LOS A	30	0.14	0.48	55.8
9	R	6	14.3	0.412	12.3	LOS B	29	0.14	0.66	49.4
Approach		1347	4.0	0.409	6.7	LOS A	30	0.14	0.48	55.7
Narang Rd - West										
10	L	2	33.3	0.009	13.3	LOS B	0	0.63	0.72	39.0
11	T	1	50.0	0.018	7.0	LOS A	1	0.56	0.65	43.6
12	R	12	8.3	0.018	13.0	LOS B	1	0.56	0.72	40.1
Approach		17	17.6	0.018	12.3	LOS B	1	0.57	0.71	40.3
All Vehicles		2299	4.3	0.412	6.8	LOS A	30	0.14	0.49	55.2

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 DN2P PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	19	5.3	0.339	7.8	LOS A	23	0.18	0.55	54.1
2	T	1043	4.0	0.342	6.7	LOS A	23	0.19	0.48	55.4
3	R	29	3.4	0.341	12.4	LOS B	23	0.19	0.65	49.2
Approach		1091	4.0	0.342	6.9	LOS A	23	0.19	0.49	55.2
West Birriley St - East										
4	L	11	9.1	0.060	9.3	LOS A	2	0.63	0.76	42.1
5	T	1	50.0	0.061	8.4	LOS A	2	0.63	0.78	42.8
6	R	24	4.2	0.060	14.4	LOS B	2	0.63	0.77	39.1
Approach		37	8.1	0.060	12.6	LOS B	2	0.63	0.77	40.1
Princess Hwy - North										
7	L	6	14.3	0.333	7.9	LOS A	21	0.18	0.55	54.1
8	T	1045	4.0	0.335	6.7	LOS A	21	0.18	0.48	55.4
9	R	9	10.0	0.333	12.4	LOS B	21	0.19	0.66	49.2
Approach		1062	4.1	0.335	6.8	LOS A	21	0.18	0.49	55.3
Narang Rd - West										
10	L	5	16.7	0.012	10.4	LOS B	0	0.63	0.70	41.2
11	T	1	50.0	0.017	7.8	LOS A	1	0.61	0.69	43.3
12	R	9	10.0	0.017	13.7	LOS B	1	0.61	0.75	39.6
Approach		18	16.7	0.017	12.0	LOS B	1	0.62	0.73	40.5
All Vehicles		2208	4.3	0.342	7.0	LOS A	23	0.20	0.49	54.7

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 DNSP AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	9	10.0	0.278	7.9	LOS A	17	0.19	0.55	54.0
2	T	859	4.0	0.280	6.8	LOS A	17	0.20	0.49	55.3
3	R	1	50.0	0.286	12.3	LOS B	17	0.21	0.67	49.1
Approach		871	4.1	0.280	6.8	LOS A	17	0.20	0.49	55.2
West Birriley St - East										
4	L	1	50.0	0.023	16.1	LOS B	1	0.76	0.85	37.2
5	T	1	50.0	0.023	15.4	LOS B	1	0.76	0.84	37.7
6	R	1	50.0	0.023	21.2	LOS C	1	0.76	0.77	35.0
Approach		6	50.0	0.023	17.6	LOS B	1	0.76	0.82	36.6
Princess Hwy - North										
7	L	1	50.0	0.500	7.8	LOS A	37	0.26	0.55	53.5
8	T	1394	4.0	0.461	6.9	LOS A	37	0.27	0.48	54.7
9	R	47	4.3	0.461	12.6	LOS B	36	0.28	0.64	48.8
Approach		1443	4.1	0.461	7.0	LOS A	37	0.27	0.49	54.5
Narang Rd - West										
10	L	3	25.0	0.012	12.5	LOS B	0	0.63	0.72	39.7
11	T	1	50.0	0.056	7.4	LOS A	2	0.57	0.66	43.0
12	R	48	4.2	0.056	12.6	LOS B	2	0.56	0.77	40.3
Approach		54	7.4	0.056	12.4	LOS B	2	0.57	0.76	40.3
All Vehicles		2374	4.3	0.500	7.1	LOS A	37	0.25	0.49	54.2

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 DNSP PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	47	4.3	0.356	7.8	LOS A	23	0.15	0.55	54.3
2	T	1104	4.0	0.356	6.7	LOS A	23	0.16	0.48	55.6
3	R	1	50.0	0.333	12.2	LOS B	23	0.16	0.67	49.3
Approach		1153	4.1	0.356	6.7	LOS A	23	0.16	0.49	55.6
West Birriley St - East										
4	L	1	50.0	0.020	14.6	LOS B	1	0.71	0.81	38.2
5	T	1	50.0	0.020	13.8	LOS B	1	0.71	0.79	38.8
6	R	1	50.0	0.020	19.6	LOS B	1	0.71	0.76	35.9
Approach		6	50.0	0.020	16.0	LOS B	1	0.71	0.79	37.5
Princess Hwy - North										
7	L	1	50.0	0.400	7.7	LOS A	30	0.19	0.55	54.0
8	T	1240	4.0	0.395	6.7	LOS A	30	0.20	0.48	55.3
9	R	26	3.8	0.394	12.4	LOS B	29	0.21	0.65	49.1
Approach		1268	4.1	0.395	6.8	LOS A	30	0.20	0.48	55.1
Narang Rd - West										
10	L	14	7.1	0.024	9.8	LOS A	1	0.62	0.73	41.7
11	T	1	50.0	0.040	7.3	LOS A	2	0.60	0.71	43.3
12	R	31	3.3	0.040	13.2	LOS B	2	0.60	0.78	39.9
Approach		46	6.5	0.040	11.9	LOS B	2	0.61	0.76	40.6
All Vehicles		2473	4.2	0.400	6.9	LOS A	30	0.19	0.49	54.9

Symbols which may appear in this table:

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 1 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	63	4.7	0.309	8.3	LOS A	21	0.38	0.57	52.7
2	T	797	4.0	0.310	7.2	LOS A	21	0.39	0.52	53.7
3	R	1	50.0	0.333	12.8	LOS B	20	0.40	0.69	48.2
Approach		863	4.2	0.310	7.3	LOS A	21	0.39	0.53	53.6
West Birriley St - East										
4	L	1	50.0	0.038	22.0	LOS C	2	0.87	0.93	33.8
5	T	1	50.0	0.038	21.2	LOS C	2	0.87	0.92	34.3
6	R	1	50.0	0.038	27.1	LOS C	2	0.87	0.79	32.2
Approach		6	50.0	0.038	23.4	LOS C	2	0.87	0.88	33.3
Princess Hwy - North										
7	L	1	50.0	0.667	9.5	LOS A	56	0.73	0.76	50.6
8	T	1435	4.0	0.638	8.9	LOS A	58	0.74	0.68	51.1
9	R	129	3.9	0.639	15.1	LOS B	58	0.76	0.76	46.7
Approach		1565	4.0	0.638	9.4	LOS A	58	0.74	0.69	50.7
Narang Rd - West										
10	L	158	3.8	0.225	8.8	LOS A	9	0.64	0.82	42.5
11	T	1	50.0	0.286	6.9	LOS A	14	0.65	0.68	43.1
12	R	272	4.0	0.307	12.9	LOS B	14	0.65	0.87	40.0
Approach		432	4.2	0.307	11.4	LOS B	14	0.64	0.85	40.9
All Vehicles		2866	4.2	0.667	9.1	LOS A	58	0.62	0.67	49.6

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 1 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	94	4.3	0.475	8.8	LOS A	35	0.52	0.61	51.8
2	T	1162	4.0	0.474	7.8	LOS A	35	0.53	0.58	52.6
3	R	1	50.0	0.500	13.5	LOS B	34	0.55	0.74	47.6
Approach		1258	4.1	0.475	7.9	LOS A	35	0.53	0.58	52.5
West Birriley St - East										
4	L	1	50.0	0.027	17.6	LOS B	1	0.80	0.89	36.3
5	T	1	50.0	0.027	16.8	LOS B	1	0.80	0.88	36.8
6	R	1	50.0	0.027	22.7	LOS C	1	0.80	0.78	34.3
Approach		6	50.0	0.027	19.0	LOS B	1	0.80	0.85	35.7
Princess Hwy - North										
7	L	1	50.0	0.500	8.4	LOS A	43	0.50	0.63	52.0
8	T	1249	4.0	0.522	7.5	LOS A	43	0.51	0.55	52.8
9	R	194	4.1	0.522	13.3	LOS B	42	0.53	0.66	47.7
Approach		1445	4.1	0.522	8.3	LOS A	43	0.52	0.57	52.0
Narang Rd - West										
10	L	141	4.3	0.237	9.6	LOS A	10	0.73	0.86	41.9
11	T	1	50.0	0.200	7.6	LOS A	9	0.71	0.74	42.8
12	R	146	4.1	0.205	13.5	LOS B	9	0.71	0.91	39.7
Approach		289	4.5	0.237	11.6	LOS B	10	0.72	0.89	40.7
All Vehicles		2998	4.2	0.522	8.5	LOS A	43	0.54	0.61	50.8

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	36	2.9	0.347	8.3	LOS A	24	0.38	0.56	52.8
2	T	940	4.0	0.346	7.2	LOS A	24	0.39	0.52	53.7
3	R	1	50.0	0.333	12.8	LOS B	23	0.40	0.69	48.2
Approach		977	4.1	0.346	7.3	LOS A	24	0.39	0.52	53.7
West Birriley St - East										
4	L	1	50.0	0.034	20.6	LOS C	2	0.85	0.92	34.5
5	T	1	50.0	0.034	19.9	LOS B	2	0.85	0.91	35.0
6	R	1	50.0	0.034	25.7	LOS C	2	0.85	0.79	32.8
Approach		6	50.0	0.035	22.1	LOS C	2	0.85	0.87	34.1
Princess Hwy - North										
7	L	1	50.0	0.667	9.1	LOS A	53	0.66	0.71	51.0
8	T	1427	4.0	0.608	8.3	LOS A	53	0.68	0.63	51.6
9	R	121	4.1	0.608	14.2	LOS B	51	0.70	0.72	46.9
Approach		1550	4.1	0.608	8.8	LOS A	53	0.68	0.64	51.1
Narang Rd - West										
10	L	140	4.3	0.214	9.3	LOS A	9	0.66	0.83	42.2
11	T	1	50.0	0.286	7.2	LOS A	12	0.67	0.71	43.0
12	R	231	3.9	0.277	13.2	LOS B	12	0.67	0.89	39.9
Approach		372	4.3	0.277	11.7	LOS B	12	0.67	0.87	40.7
All Vehicles		2905	4.2	0.667	8.7	LOS A	53	0.58	0.63	50.2

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	100	4.0	0.444	8.5	LOS A	33	0.44	0.58	52.3
2	T	1136	4.0	0.445	7.5	LOS A	33	0.46	0.54	53.2
3	R	1	50.0	0.500	13.1	LOS B	32	0.47	0.71	47.9
Approach		1237	4.0	0.445	7.6	LOS A	33	0.46	0.55	53.1
West Birriley St - East										
4	L	1	50.0	0.027	17.2	LOS B	1	0.80	0.88	36.5
5	T	1	50.0	0.027	16.4	LOS B	1	0.80	0.87	37.1
6	R	1	50.0	0.027	22.2	LOS C	1	0.80	0.77	34.5
Approach		6	50.0	0.027	18.6	LOS B	1	0.80	0.84	36.0
Princess Hwy - North										
7	L	1	50.0	0.500	8.5	LOS A	41	0.51	0.64	51.9
8	T	1229	4.0	0.506	7.6	LOS A	41	0.53	0.56	52.7
9	R	146	4.1	0.505	13.4	LOS B	40	0.54	0.67	47.6
Approach		1377	4.1	0.506	8.2	LOS A	41	0.53	0.57	52.1
Narang Rd - West										
10	L	124	4.0	0.206	9.6	LOS A	8	0.70	0.85	41.9
11	T	1	50.0	0.222	7.5	LOS A	10	0.70	0.74	42.8
12	R	162	3.7	0.217	13.5	LOS B	10	0.70	0.91	39.7
Approach		288	4.2	0.218	11.8	LOS B	10	0.70	0.88	40.6
All Vehicles		2908	4.2	0.506	8.3	LOS A	41	0.52	0.59	51.0

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 2 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	39	5.1	0.307	7.9	LOS A	19	0.20	0.55	53.9
2	T	917	4.0	0.308	6.8	LOS A	19	0.21	0.49	55.2
3	R	1	50.0	0.333	12.4	LOS B	19	0.22	0.67	49.1
Approach		958	4.2	0.308	6.9	LOS A	19	0.21	0.49	55.1
West Birriley St - East										
4	L	1	50.0	0.022	15.7	LOS B	1	0.74	0.84	37.4
5	T	1	50.0	0.022	14.9	LOS B	1	0.74	0.82	38.0
6	R	1	50.0	0.022	20.8	LOS C	1	0.74	0.77	35.3
Approach		6	50.0	0.022	17.1	LOS B	1	0.74	0.81	36.8
Princess Hwy - North										
7	L	1	50.0	0.400	7.7	LOS A	35	0.21	0.55	53.9
8	T	1359	4.0	0.441	6.8	LOS A	35	0.22	0.48	55.1
9	R	49	4.1	0.441	12.4	LOS B	34	0.23	0.64	49.0
Approach		1410	4.0	0.441	7.0	LOS A	35	0.22	0.48	54.9
Narang Rd - West										
10	L	3	25.0	0.011	12.4	LOS B	0	0.63	0.72	39.7
11	T	1	50.0	0.041	6.8	LOS A	2	0.57	0.67	43.5
12	R	34	3.0	0.041	12.8	LOS B	2	0.57	0.76	40.2
Approach		39	7.7	0.041	12.4	LOS B	2	0.58	0.75	40.3
All Vehicles		2413	4.3	0.441	7.0	LOS A	35	0.22	0.49	54.6

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 2 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	57	3.5	0.396	7.8	LOS A	26	0.14	0.55	54.4
2	T	1237	4.0	0.396	6.7	LOS A	27	0.14	0.48	55.7
3	R	1	50.0	0.400	12.2	LOS B	27	0.15	0.67	49.4
Approach		1295	4.0	0.396	6.7	LOS A	27	0.14	0.49	55.7
West Birriley St - East										
4	L	1	50.0	0.019	14.0	LOS B	1	0.70	0.79	38.6
5	T	1	50.0	0.019	13.2	LOS B	1	0.70	0.77	39.2
6	R	1	50.0	0.019	19.0	LOS B	1	0.70	0.75	36.2
Approach		6	50.0	0.019	15.4	LOS B	1	0.70	0.77	37.9
Princess Hwy - North										
7	L	1	50.0	0.400	7.7	LOS A	27	0.18	0.55	54.1
8	T	1163	4.0	0.369	6.7	LOS A	27	0.18	0.48	55.4
9	R	21	4.8	0.368	12.4	LOS B	27	0.19	0.65	49.2
Approach		1187	4.1	0.369	6.8	LOS A	27	0.18	0.48	55.3
Narang Rd - West										
10	L	12	8.3	0.023	10.6	LOS B	1	0.64	0.75	41.1
11	T	1	50.0	0.038	7.6	LOS A	2	0.62	0.75	43.2
12	R	28	3.6	0.039	13.6	LOS B	2	0.62	0.79	39.7
Approach		42	7.1	0.039	12.4	LOS B	2	0.63	0.78	40.2
All Vehicles		2530	4.2	0.400	6.9	LOS A	27	0.17	0.49	55.1

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 3 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	41	4.9	0.258	7.7	LOS A	17	0.04	0.58	55.1
2	T	837	3.9	0.259	6.6	LOS A	17	0.04	0.50	56.6
3	R	1	50.0	0.250	12.1	LOS B	16	0.04	0.71	49.9
Approach		879	4.1	0.258	6.6	LOS A	17	0.04	0.50	56.5
West Birriley St - East										
4	L	1	50.0	0.020	15.9	LOS B	1	0.73	0.83	37.3
5	T	1	50.0	0.020	15.1	LOS B	1	0.73	0.82	37.9
6	R	1	50.0	0.020	20.9	LOS C	1	0.73	0.77	35.2
Approach		6	50.0	0.020	17.3	LOS B	1	0.73	0.81	36.7
Princess Hwy - North										
7	L	1	50.0	0.400	7.5	LOS A	33	0.05	0.57	55.0
8	T	1475	4.0	0.434	6.6	LOS A	33	0.05	0.50	56.6
9	R	1	50.0	0.400	12.1	LOS B	33	0.05	0.70	49.9
Approach		1479	4.1	0.434	6.6	LOS A	33	0.05	0.50	56.5
Narang Rd - West										
10	L	1	50.0	0.005	12.1	LOS B	0	0.61	0.67	39.9
11	T	1	50.0	0.008	8.7	LOS A	0	0.58	0.62	42.6
12	R	1	50.0	0.008	14.6	LOS B	0	0.58	0.73	38.9
Approach		6	50.0	0.008	11.8	LOS B	0	0.59	0.67	40.4
All Vehicles		2370	4.3	0.434	6.6	LOS A	33	0.05	0.50	56.4

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 3 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	117	4.3	0.379	7.7	LOS A	27	0.04	0.57	55.0
2	T	1171	4.0	0.378	6.6	LOS A	27	0.05	0.50	56.6
3	R	1	50.0	0.400	12.1	LOS B	27	0.05	0.70	49.9
Approach		1290	4.1	0.378	6.7	LOS A	27	0.05	0.51	56.4
West Birriley St - East										
4	L	1	50.0	0.018	13.9	LOS B	1	0.68	0.78	38.6
5	T	1	50.0	0.018	13.2	LOS B	1	0.68	0.76	39.2
6	R	1	50.0	0.018	19.0	LOS B	1	0.68	0.75	36.2
Approach		6	50.0	0.018	15.4	LOS B	1	0.68	0.77	37.9
Princess Hwy - North										
7	L	1	50.0	0.333	7.5	LOS A	25	0.04	0.58	55.1
8	T	1212	4.0	0.357	6.6	LOS A	25	0.04	0.50	56.6
9	R	1	50.0	0.333	12.1	LOS B	25	0.05	0.70	49.9
Approach		1215	4.1	0.357	6.6	LOS A	25	0.04	0.50	56.6
Narang Rd - West										
10	L	1	50.0	0.006	14.3	LOS B	0	0.68	0.73	38.3
11	T	1	50.0	0.009	10.1	LOS B	0	0.63	0.67	41.5
12	R	1	50.0	0.009	15.9	LOS B	0	0.63	0.77	38.1
Approach		6	50.0	0.009	13.4	LOS B	0	0.64	0.73	39.2
All Vehicles		2517	4.3	0.400	6.7	LOS A	27	0.05	0.50	56.4

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SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	41	4.9	0.291	7.9	LOS A	18	0.18	0.55	54.1
2	T	866	4.0	0.290	6.8	LOS A	18	0.19	0.49	55.4
3	R	1	50.0	0.286	12.3	LOS B	17	0.20	0.67	49.2
Approach		910	4.2	0.290	6.8	LOS A	18	0.19	0.49	55.3
West Birriley St - East										
4	L	1	50.0	0.022	15.7	LOS B	1	0.75	0.84	37.4
5	T	1	50.0	0.022	15.0	LOS B	1	0.75	0.83	38.0
6	R	1	50.0	0.022	20.8	LOS C	1	0.75	0.77	35.2
Approach		6	50.0	0.022	17.2	LOS B	1	0.75	0.81	36.8
Princess Hwy - North										
7	L	1	50.0	0.400	7.7	LOS A	35	0.23	0.55	53.8
8	T	1363	4.0	0.444	6.8	LOS A	35	0.24	0.48	54.9
9	R	42	4.8	0.442	12.5	LOS B	34	0.25	0.64	48.9
Approach		1408	4.1	0.444	7.0	LOS A	35	0.24	0.48	54.7
Narang Rd - West										
10	L	3	25.0	0.011	12.2	LOS B	0	0.62	0.71	39.9
11	T	1	50.0	0.048	6.7	LOS A	2	0.56	0.65	43.5
12	R	40	5.0	0.048	12.7	LOS B	2	0.56	0.76	40.3
Approach		46	8.7	0.048	12.4	LOS B	2	0.56	0.75	40.4
All Vehicles		2370	4.3	0.444	7.0	LOS A	35	0.23	0.49	54.5

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Narang Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	104	3.8	0.416	7.8	LOS A	28	0.15	0.55	54.3
2	T	1252	4.0	0.417	6.7	LOS A	28	0.16	0.48	55.6
3	R	1	50.0	0.400	12.2	LOS B	28	0.17	0.67	49.3
Approach		1358	4.1	0.417	6.8	LOS A	28	0.16	0.49	55.5
West Birriley St - East										
4	L	1	50.0	0.019	14.0	LOS B	1	0.69	0.79	38.6
5	T	1	50.0	0.019	13.2	LOS B	1	0.69	0.77	39.2
6	R	1	50.0	0.019	19.1	LOS B	1	0.69	0.75	36.2
Approach		6	50.0	0.019	15.4	LOS B	1	0.69	0.77	37.9
Princess Hwy - North										
7	L	1	50.0	0.400	7.6	LOS A	27	0.14	0.55	54.4
8	T	1175	4.0	0.366	6.6	LOS A	27	0.14	0.48	55.7
9	R	24	4.2	0.364	12.3	LOS B	26	0.15	0.66	49.4
Approach		1201	4.1	0.366	6.8	LOS A	27	0.14	0.48	55.6
Narang Rd - West										
10	L	16	6.2	0.026	9.6	LOS A	1	0.63	0.73	41.9
11	T	1	50.0	0.027	7.7	LOS A	1	0.62	0.74	43.2
12	R	18	5.6	0.027	13.6	LOS B	1	0.62	0.78	39.6
Approach		36	8.3	0.027	11.5	LOS B	1	0.63	0.76	40.8
All Vehicles		2601	4.2	0.417	6.9	LOS A	28	0.16	0.49	55.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2005 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	191	4.2	0.261	7.1	LOS A	16	0.36	0.52	54.0
2	T	302	4.0	0.261	7.2	LOS A	16	0.37	0.52	53.9
3	R	232	3.9	0.261	14.0	LOS B	16	0.38	0.67	47.4
Approach		724	4.0	0.261	9.3	LOS A	16	0.37	0.57	51.6
Cambewarra Rd - East										
21	L	286	3.8	0.560	11.2	LOS B	35	0.82	0.99	40.6
22	T	37	2.8	0.562	9.9	LOS A	35	0.82	0.97	41.7
23	R	64	4.6	0.560	15.3	LOS B	35	0.82	1.00	38.4
Approach		387	3.9	0.560	11.8	LOS B	35	0.82	0.99	40.3
Princess Hwy - North										
7	L	116	4.3	0.406	10.2	LOS B	28	0.79	0.78	50.8
8	T	582	4.0	0.405	10.2	LOS B	28	0.80	0.80	51.0
9	R	36	2.9	0.407	18.0	LOS B	26	0.80	0.87	44.8
Approach		733	4.0	0.405	10.5	LOS B	28	0.79	0.80	50.6
Moss Vale Road - West										
27	L	45	4.4	0.500	9.9	LOS A	25	0.61	0.86	47.2
28	T	68	4.3	0.500	8.5	LOS A	25	0.61	0.77	48.1
29	R	336	3.9	0.501	13.2	LOS B	25	0.61	0.86	44.7
Approach		449	4.0	0.502	12.1	LOS B	25	0.61	0.84	45.4
All Vehicles		2293	4.0	0.562	10.7	LOS B	35	0.63	0.77	47.8

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2005 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	236	3.8	0.378	7.6	LOS A	26	0.51	0.58	52.9
2	T	436	3.9	0.378	7.7	LOS A	26	0.52	0.58	52.7
3	R	301	4.0	0.378	14.6	LOS B	25	0.53	0.70	46.8
Approach		971	3.9	0.378	9.8	LOS A	26	0.52	0.62	50.7
Cambewarra Rd - East										
21	L	304	3.9	0.603	10.3	LOS B	40	0.78	0.97	41.3
22	T	96	4.2	0.604	9.0	LOS A	40	0.78	0.95	42.4
23	R	84	3.6	0.604	14.4	LOS B	40	0.78	0.97	39.0
Approach		484	3.9	0.603	10.8	LOS B	40	0.78	0.97	41.1
Princess Hwy - North										
7	L	79	3.8	0.302	9.9	LOS A	20	0.74	0.75	51.1
8	T	435	3.9	0.302	9.8	LOS A	20	0.75	0.76	51.4
9	R	38	5.3	0.302	17.6	LOS B	18	0.75	0.84	45.1
Approach		551	4.0	0.302	10.4	LOS B	20	0.75	0.76	50.8
Moss Vale Road - West										
27	L	17	5.9	0.447	10.4	LOS B	21	0.66	0.89	46.8
28	T	69	4.3	0.449	8.9	LOS A	21	0.66	0.81	47.8
29	R	264	4.2	0.448	13.6	LOS B	21	0.66	0.90	44.3
Approach		352	4.3	0.448	12.5	LOS B	21	0.66	0.88	45.0
All Vehicles		2358	4.0	0.604	10.6	LOS B	40	0.65	0.76	47.6

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- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 DN2P AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	236	3.8	0.315	7.2	LOS A	21	0.39	0.52	53.8
2	T	393	4.1	0.314	7.3	LOS A	21	0.40	0.53	53.6
3	R	242	4.1	0.314	14.1	LOS B	20	0.41	0.67	47.3
Approach		870	4.0	0.314	9.1	LOS A	21	0.40	0.57	51.7
Cambewarra Rd - East										
21	L	268	4.1	0.620	13.6	LOS B	41	0.88	1.06	38.9
22	T	42	4.8	0.618	12.3	LOS B	41	0.88	1.05	39.9
23	R	65	4.5	0.623	17.6	LOS B	41	0.88	1.08	37.0
Approach		377	4.2	0.620	14.2	LOS B	41	0.88	1.07	38.6
Princess Hwy - North										
7	L	102	3.9	0.488	12.0	LOS B	39	0.90	0.88	49.9
8	T	647	4.0	0.488	12.3	LOS B	39	0.89	0.91	49.5
9	R	35	2.9	0.486	20.5	LOS C	37	0.89	0.97	42.7
Approach		783	4.0	0.488	12.6	LOS B	39	0.89	0.91	49.2
Moss Vale Road - West										
27	L	49	4.1	0.636	11.5	LOS B	39	0.72	0.96	45.6
28	T	60	3.3	0.638	10.1	LOS B	39	0.72	0.93	47.1
29	R	432	3.9	0.636	14.8	LOS B	39	0.72	0.96	43.3
Approach		540	3.9	0.636	14.0	LOS B	39	0.72	0.96	43.9
All Vehicles		2570	4.0	0.638	11.9	LOS B	41	0.69	0.83	46.9

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- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 DN2P PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	326	4.0	0.434	7.9	LOS A	32	0.58	0.61	52.3
2	T	493	4.1	0.434	8.1	LOS A	32	0.59	0.62	52.2
3	R	257	3.9	0.434	15.0	LOS B	30	0.60	0.72	46.5
Approach		1076	4.0	0.434	9.7	LOS A	32	0.59	0.64	50.7
Cambewarra Rd - East										
21	L	277	4.0	0.646	11.4	LOS B	45	0.82	1.02	40.5
22	T	118	4.2	0.645	10.0	LOS B	45	0.82	1.00	41.6
23	R	98	4.1	0.645	15.4	LOS B	45	0.82	1.03	38.3
Approach		493	4.1	0.646	11.8	LOS B	45	0.82	1.02	40.3
Princess Hwy - North										
7	L	57	3.5	0.322	9.7	LOS A	21	0.74	0.74	51.1
8	T	503	4.0	0.322	9.6	LOS A	21	0.75	0.75	51.4
9	R	38	5.3	0.322	17.4	LOS B	20	0.75	0.84	45.3
Approach		598	4.0	0.322	10.1	LOS B	21	0.75	0.76	50.9
Moss Vale Road - West										
27	L	28	3.6	0.500	11.0	LOS B	26	0.71	0.92	46.2
28	T	69	4.3	0.496	9.6	LOS A	26	0.71	0.87	47.5
29	R	277	4.0	0.496	14.2	LOS B	26	0.71	0.93	43.8
Approach		375	4.0	0.496	13.1	LOS B	26	0.71	0.92	44.6
All Vehicles		2542	4.0	0.646	10.7	LOS B	45	0.69	0.78	47.4

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 DNSP AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	235	3.8	0.312	7.2	LOS A	21	0.39	0.52	53.8
2	T	309	3.9	0.312	7.2	LOS A	21	0.40	0.53	53.7
3	R	319	4.1	0.312	14.1	LOS B	20	0.41	0.67	47.3
Approach		862	3.9	0.312	9.7	LOS A	21	0.40	0.58	51.0
Cambewarra Rd - East										
21	L	301	4.0	0.717	17.4	LOS B	55	0.94	1.17	36.4
22	T	44	4.5	0.721	16.1	LOS B	55	0.94	1.16	37.3
23	R	58	3.4	0.716	21.4	LOS C	55	0.94	1.18	34.8
Approach		403	4.0	0.716	17.9	LOS B	55	0.94	1.17	36.3
Princess Hwy - North										
7	L	116	4.3	0.624	19.0	LOS B	65	1.00	1.09	43.1
8	T	629	4.0	0.625	19.9	LOS B	65	1.00	1.12	42.3
9	R	40	5.0	0.625	28.8	LOS C	58	1.00	1.15	37.2
Approach		785	4.1	0.625	20.2	LOS C	65	1.00	1.12	42.1
Moss Vale Road - West										
27	L	82	3.7	0.804	14.3	LOS B	68	0.84	1.09	43.1
28	T	94	4.3	0.803	12.8	LOS B	68	0.84	1.08	44.5
29	R	511	3.9	0.802	17.5	LOS B	68	0.84	1.10	41.2
Approach		686	3.9	0.802	16.5	LOS B	68	0.84	1.10	41.8
All Vehicles		2736	4.0	0.804	15.6	LOS B	68	0.76	0.95	43.4

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 DNSP PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	252	4.0	0.467	8.1	LOS A	35	0.63	0.63	51.9
2	T	514	4.1	0.466	8.2	LOS A	35	0.64	0.64	51.8
3	R	353	4.0	0.466	15.2	LOS B	34	0.65	0.74	46.3
Approach		1119	4.0	0.466	10.4	LOS B	35	0.64	0.67	49.9
Cambewarra Rd - East										
21	L	294	4.1	0.819	18.0	LOS B	74	0.95	1.26	36.1
22	T	135	3.7	0.817	16.7	LOS B	74	0.95	1.25	37.0
23	R	98	4.1	0.817	22.0	LOS C	74	0.95	1.27	34.5
Approach		526	4.0	0.819	18.4	LOS B	74	0.95	1.26	36.0
Princess Hwy - North										
7	L	101	4.0	0.518	13.5	LOS B	44	0.94	0.94	48.2
8	T	628	4.0	0.518	14.0	LOS B	44	0.93	0.97	47.8
9	R	48	4.2	0.516	22.4	LOS C	41	0.92	1.03	41.4
Approach		777	4.0	0.518	14.4	LOS B	44	0.93	0.97	47.4
Moss Vale Road - West										
27	L	35	2.9	0.680	13.3	LOS B	43	0.82	1.03	44.0
28	T	105	3.8	0.682	11.8	LOS B	43	0.82	1.01	45.4
29	R	344	4.1	0.683	16.5	LOS B	43	0.82	1.05	41.9
Approach		483	3.9	0.682	15.3	LOS B	43	0.82	1.04	42.8
All Vehicles		2905	4.0	0.819	13.7	LOS B	74	0.81	0.92	44.9

Symbols which may appear in this table:

Following Degree of Saturation
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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 1 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	267	4.1	0.352	7.3	LOS A	25	0.44	0.54	53.4
2	T	348	4.0	0.352	7.4	LOS A	25	0.45	0.54	53.3
3	R	339	4.1	0.352	14.2	LOS B	24	0.46	0.68	47.1
Approach		955	4.1	0.352	9.8	LOS A	25	0.45	0.59	50.9
Cambewarra Rd - East										
21	L	346	4.0	0.834	23.0	LOS C	79	0.98	1.34	33.3
22	T	51	3.9	0.836	21.7	LOS C	79	0.98	1.34	34.1
23	R	71	4.2	0.835	27.0	LOS C	79	0.98	1.35	32.1
Approach		468	4.1	0.833	23.5	LOS C	79	0.98	1.34	33.2
Princess Hwy - North										
7	L	117	4.3	0.629	18.8	LOS B	66	1.00	1.10	43.2
8	T	658	4.0	0.630	19.7	LOS B	66	1.00	1.12	42.5
9	R	39	5.1	0.629	28.5	LOS C	59	1.00	1.15	37.4
Approach		814	4.1	0.630	20.0	LOS B	66	1.00	1.12	42.3
Moss Vale Road - West										
27	L	67	4.4	0.782	14.2	LOS B	62	0.83	1.08	43.2
28	T	85	3.5	0.780	12.8	LOS B	62	0.83	1.06	44.6
29	R	485	3.9	0.780	17.5	LOS B	62	0.83	1.10	41.2
Approach		638	3.9	0.779	16.5	LOS B	62	0.83	1.09	41.8
All Vehicles		2875	4.0	0.836	16.4	LOS B	79	0.78	0.97	42.7

Symbols which may appear in this table:

Following Degree of Saturation
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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 1 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	271	4.1	0.561	8.6	LOS A	46	0.74	0.68	51.1
2	T	560	3.9	0.562	8.8	LOS A	46	0.75	0.70	51.0
3	R	445	4.0	0.562	16.1	LOS B	45	0.76	0.79	45.9
Approach		1276	4.0	0.562	11.3	LOS B	46	0.75	0.73	49.0
Cambewarra Rd - East										
21	L	320	4.1	0.941	31.3	LOS C	133	1.00	1.67	29.6
22	T	169	4.1	0.939	29.9	LOS C	133	1.00	1.67	30.2
23	R	115	4.3	0.943	35.3	LOS D	133	1.00	1.67	28.7
Approach		605	4.1	0.940	31.7	LOS C	133	1.00	1.67	29.6
Princess Hwy - North										
7	L	109	3.7	0.574	17.3	LOS B	55	1.00	1.05	44.5
8	T	586	3.9	0.575	18.1	LOS B	55	0.99	1.08	43.9
9	R	48	4.2	0.571	26.9	LOS C	49	0.99	1.11	38.4
Approach		743	3.9	0.575	18.5	LOS B	55	0.99	1.08	43.5
Moss Vale Road - West										
27	L	48	4.2	0.842	19.0	LOS B	70	0.93	1.21	39.5
28	T	115	4.3	0.846	17.5	LOS B	70	0.93	1.20	40.6
29	R	363	4.1	0.845	22.2	LOS C	70	0.93	1.22	38.0
Approach		527	4.2	0.844	20.9	LOS C	70	0.93	1.21	38.6
All Vehicles		3151	4.0	0.943	18.5	LOS B	133	0.89	1.07	40.9

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	278	4.0	0.394	7.3	LOS A	29	0.45	0.54	53.3
2	T	394	4.1	0.394	7.4	LOS A	29	0.45	0.54	53.2
3	R	408	3.9	0.395	14.2	LOS B	28	0.47	0.67	47.1
Approach		1080	4.0	0.394	9.9	LOS A	29	0.46	0.59	50.6
Cambewarra Rd - East										
21	L	338	4.1	0.797	19.4	LOS B	68	0.96	1.25	35.3
22	T	55	3.6	0.797	18.0	LOS B	68	0.96	1.25	36.1
23	R	62	3.2	0.795	23.4	LOS C	68	0.96	1.26	33.8
Approach		455	4.0	0.797	19.8	LOS B	68	0.96	1.25	35.2
Princess Hwy - North										
7	L	115	4.3	0.657	20.5	LOS C	73	1.00	1.14	41.8
8	T	695	4.0	0.658	21.5	LOS C	73	1.00	1.16	41.0
9	R	37	2.8	0.655	30.5	LOS C	64	1.00	1.18	36.2
Approach		846	4.0	0.658	21.8	LOS C	73	1.00	1.15	40.9
Moss Vale Road - West										
27	L	61	3.3	0.753	14.1	LOS B	54	0.82	1.07	43.3
28	T	98	4.1	0.754	12.6	LOS B	54	0.82	1.05	44.7
29	R	426	4.0	0.751	17.3	LOS B	54	0.82	1.08	41.3
Approach		585	3.9	0.752	16.2	LOS B	54	0.82	1.08	42.0
All Vehicles		2966	4.0	0.797	16.1	LOS B	73	0.76	0.95	43.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	301	4.0	0.583	9.5	LOS A	50	0.79	0.75	50.8
2	T	548	4.0	0.584	9.9	LOS A	50	0.79	0.77	50.7
3	R	411	3.9	0.583	17.3	LOS B	49	0.81	0.85	45.3
Approach		1259	4.0	0.584	12.2	LOS B	50	0.80	0.79	48.7
Cambewarra Rd - East										
21	L	331	3.9	0.985	45.8	LOS D	177	1.00	2.02	24.7
22	T	175	4.0	0.983	44.5	LOS D	177	1.00	2.02	25.2
23	R	101	4.0	0.981	49.8	LOS D	177	1.00	2.02	24.3
Approach		606	4.0	0.984	46.1	LOS D	177	1.00	2.02	24.8
Princess Hwy - North										
7	L	88	4.5	0.589	16.8	LOS B	58	1.00	1.05	45.0
8	T	572	4.0	0.588	17.2	LOS B	58	0.99	1.07	44.6
9	R	124	4.0	0.588	26.2	LOS C	52	0.99	1.11	38.8
Approach		785	4.1	0.589	18.6	LOS B	58	0.99	1.08	43.5
Moss Vale Road - West										
27	L	119	4.2	0.930	26.6	LOS C	108	0.98	1.45	34.7
28	T	115	4.3	0.927	25.2	LOS C	108	0.98	1.44	35.6
29	R	358	3.9	0.930	29.8	LOS C	108	0.98	1.45	33.7
Approach		592	4.1	0.931	28.3	LOS C	108	0.98	1.45	34.2
All Vehicles		3242	4.0	0.985	23.0	LOS C	177	0.92	1.21	37.9

Symbols which may appear in this table:

Following Degree of Saturation
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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 2 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	232	3.9	0.332	7.2	LOS A	23	0.41	0.53	53.7
2	T	348	4.0	0.333	7.3	LOS A	23	0.41	0.53	53.6
3	R	340	4.1	0.333	14.1	LOS B	22	0.43	0.67	47.3
Approach		919	4.0	0.333	9.8	LOS A	23	0.42	0.58	51.0
Cambewarra Rd - East										
21	L	248	4.0	0.646	15.5	LOS B	46	0.91	1.11	37.6
22	T	48	4.2	0.649	14.2	LOS B	46	0.91	1.10	38.6
23	R	65	4.5	0.647	19.6	LOS B	46	0.91	1.12	35.8
Approach		362	4.1	0.647	16.1	LOS B	46	0.91	1.11	37.4
Princess Hwy - North										
7	L	158	3.8	0.684	22.3	LOS C	79	1.00	1.16	40.4
8	T	647	4.0	0.685	23.5	LOS C	79	1.00	1.18	39.6
9	R	28	3.6	0.683	32.5	LOS C	69	1.00	1.20	35.1
Approach		833	4.0	0.685	23.6	LOS C	79	1.00	1.18	39.5
Moss Vale Road - West										
27	L	80	3.8	0.825	15.5	LOS B	73	0.87	1.14	42.2
28	T	107	3.7	0.829	14.0	LOS B	73	0.87	1.13	43.5
29	R	499	4.0	0.829	18.7	LOS B	73	0.87	1.15	40.3
Approach		686	3.9	0.828	17.6	LOS B	73	0.87	1.15	41.0
All Vehicles		2800	4.0	0.829	16.6	LOS B	79	0.76	0.97	42.8

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 2 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	283	3.9	0.543	8.5	LOS A	43	0.72	0.68	51.3
2	T	567	4.0	0.543	8.7	LOS A	43	0.72	0.69	51.2
3	R	400	4.0	0.543	15.8	LOS B	42	0.74	0.77	46.0
Approach		1251	4.0	0.543	10.9	LOS B	43	0.73	0.71	49.4
Cambewarra Rd - East										
21	L	269	4.1	0.811	17.0	LOS B	73	0.95	1.24	36.7
22	T	145	4.1	0.810	15.7	LOS B	73	0.95	1.23	37.6
23	R	119	4.2	0.810	21.1	LOS C	73	0.95	1.24	35.0
Approach		534	4.1	0.810	17.6	LOS B	73	0.95	1.24	36.5
Princess Hwy - North										
7	L	113	4.4	0.528	14.2	LOS B	46	0.95	0.97	47.5
8	T	589	4.1	0.528	14.8	LOS B	46	0.95	1.00	47.0
9	R	61	3.3	0.526	23.3	LOS C	42	0.94	1.05	40.7
Approach		764	4.1	0.528	15.4	LOS B	46	0.95	1.00	46.4
Moss Vale Road - West										
27	L	41	4.9	0.745	15.2	LOS B	51	0.87	1.09	42.4
28	T	109	3.7	0.741	13.7	LOS B	51	0.87	1.07	43.7
29	R	325	4.0	0.740	18.4	LOS B	51	0.87	1.10	40.5
Approach		475	4.0	0.740	17.1	LOS B	51	0.87	1.09	41.3
All Vehicles		3024	4.0	0.811	14.2	LOS B	73	0.84	0.94	44.5

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Following Degree of Saturation
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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 3 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	193	4.1	0.307	7.2	LOS A	20	0.41	0.53	53.6
2	T	296	4.1	0.307	7.3	LOS A	20	0.41	0.53	53.6
3	R	348	4.0	0.307	14.2	LOS B	20	0.43	0.68	47.2
Approach		837	4.1	0.307	10.1	LOS B	20	0.42	0.59	50.7
Cambewarra Rd - East										
21	L	320	4.1	0.716	15.7	LOS B	54	0.92	1.14	37.5
22	T	51	3.9	0.718	14.4	LOS B	54	0.92	1.14	38.5
23	R	60	3.3	0.714	19.7	LOS B	54	0.92	1.16	35.7
Approach		431	3.9	0.716	16.1	LOS B	54	0.92	1.15	37.3
Princess Hwy - North										
7	L	109	3.7	0.559	15.6	LOS B	52	0.98	1.01	46.1
8	T	627	4.0	0.558	16.3	LOS B	52	0.97	1.04	45.5
9	R	45	4.4	0.556	24.9	LOS C	47	0.96	1.09	39.6
Approach		781	4.0	0.558	16.7	LOS B	52	0.97	1.04	45.1
Moss Vale Road - West										
27	L	48	4.2	0.667	11.9	LOS B	43	0.74	0.98	45.3
28	T	93	4.3	0.669	10.4	LOS B	43	0.74	0.95	46.8
29	R	428	4.0	0.671	15.1	LOS B	43	0.74	0.98	43.1
Approach		569	4.0	0.670	14.0	LOS B	43	0.74	0.98	43.8
All Vehicles		2618	4.0	0.718	13.9	LOS B	54	0.73	0.90	44.9

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 3 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	236	3.8	0.547	9.0	LOS A	43	0.76	0.72	51.0
2	T	479	4.0	0.547	9.2	LOS A	43	0.76	0.73	51.0
3	R	476	4.0	0.546	16.7	LOS B	43	0.78	0.83	45.8
Approach		1190	3.9	0.547	12.2	LOS B	43	0.77	0.77	48.7
Cambewarra Rd - East										
21	L	263	4.2	0.913	31.1	LOS C	112	1.00	1.58	29.7
22	T	141	4.3	0.916	29.7	LOS C	112	1.00	1.58	30.3
23	R	120	4.2	0.916	35.1	LOS D	112	1.00	1.58	28.8
Approach		525	4.2	0.913	31.6	LOS C	112	1.00	1.58	29.6
Princess Hwy - North										
7	L	118	4.2	0.781	35.9	LOS D	111	1.00	1.36	32.3
8	T	559	3.9	0.782	37.3	LOS D	111	1.00	1.35	31.7
9	R	132	3.8	0.784	47.7	LOS D	92	1.00	1.34	28.7
Approach		808	4.0	0.782	38.8	LOS D	111	1.00	1.35	31.2
Moss Vale Road - West										
27	L	60	3.3	1.154	164.6	LOS F	560	1.00	4.32	10.8
28	T	153	3.9	1.159	163.2	LOS F	560	1.00	4.32	11.0
29	R	533	3.9	1.159	167.9	LOS F	560	1.00	4.32	11.1
Approach		745	3.9	1.160	166.6	LOS F	560	1.00	4.32	11.1
All Vehicles		3268	4.0	1.159	57.1	LOS E	560	0.91	1.85	24.1

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- Based on density for continuous movements

Following Queue
- Density for continuous movement

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	225	4.0	0.321	7.3	LOS A	21	0.42	0.54	53.5
2	T	323	4.0	0.321	7.4	LOS A	21	0.43	0.54	53.4
3	R	320	4.1	0.321	14.2	LOS B	21	0.44	0.68	47.2
Approach		868	4.0	0.321	9.9	LOS A	21	0.43	0.59	50.9
Cambewarra Rd - East										
21	L	298	4.0	0.656	13.5	LOS B	46	0.89	1.08	39.0
22	T	49	4.1	0.653	12.2	LOS B	46	0.89	1.07	40.0
23	R	64	4.6	0.657	17.5	LOS B	46	0.89	1.09	37.0
Approach		412	4.1	0.656	14.0	LOS B	46	0.89	1.08	38.7
Princess Hwy - North										
7	L	128	3.9	0.536	14.1	LOS B	47	0.95	0.97	47.6
8	T	615	4.1	0.536	14.7	LOS B	47	0.94	1.00	47.1
9	R	53	3.8	0.535	23.1	LOS C	43	0.93	1.05	40.8
Approach		796	4.0	0.536	15.1	LOS B	47	0.94	0.99	46.6
Moss Vale Road - West										
27	L	41	4.9	0.641	11.6	LOS B	39	0.72	0.96	45.6
28	T	119	4.2	0.640	10.1	LOS B	39	0.72	0.93	47.1
29	R	378	4.0	0.639	14.8	LOS B	39	0.72	0.97	43.3
Approach		538	4.1	0.638	13.5	LOS B	39	0.72	0.96	44.2
All Vehicles		2614	4.1	0.657	12.9	LOS B	47	0.72	0.87	45.9

Symbols which may appear in this table:

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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Princess Highway and Cambewarra Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Princess Hwy - South										
1	L	304	3.9	0.615	10.7	LOS B	57	0.83	0.82	50.5
2	T	473	4.0	0.616	11.0	LOS B	57	0.84	0.83	50.3
3	R	492	4.1	0.616	18.7	LOS B	55	0.85	0.91	44.1
Approach		1269	4.0	0.616	13.9	LOS B	57	0.84	0.86	47.6
Cambewarra Rd - East										
21	L	322	4.0	0.985	47.6	LOS D	175	1.00	2.03	24.2
22	T	163	4.3	0.988	46.3	LOS D	175	1.00	2.03	24.7
23	R	98	4.1	0.990	51.6	LOS D	175	1.00	2.03	23.8
Approach		584	4.1	0.986	47.9	LOS D	175	1.00	2.03	24.3
Princess Hwy - North										
7	L	115	4.3	0.723	25.9	LOS C	90	1.00	1.23	37.9
8	T	538	4.1	0.721	26.6	LOS C	90	1.00	1.23	37.5
9	R	202	4.0	0.721	36.6	LOS D	77	1.00	1.25	33.1
Approach		855	4.1	0.721	28.9	LOS C	90	1.00	1.24	36.3
Moss Vale Road - West										
27	L	162	3.7	1.209	204.6	LOS F	674	1.00	4.90	9.0
28	T	155	3.9	1.202	203.2	LOS F	674	1.00	4.90	9.2
29	R	438	4.1	1.207	207.9	LOS F	674	1.00	4.90	9.3
Approach		755	4.0	1.206	206.2	LOS F	674	1.00	4.90	9.2
All Vehicles		3463	4.0	1.209	65.3	LOS E	674	0.94	2.03	22.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2005 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	206	3.9	0.288	7.0	LOS A	19	0.15	0.53	49.8
5	T	222	4.1	0.288	10.3	LOS B	19	0.15	0.67	46.6
Approach		428	4.0	0.288	8.7	LOS A	19	0.15	0.60	48.1
Illaroo Rd - West										
28	T	516	4.1	0.549	9.7	LOS A	39	0.69	0.73	46.9
29	R	23	4.3	0.548	13.7	LOS B	39	0.69	0.79	43.9
Approach		539	4.1	0.549	9.8	LOS A	39	0.69	0.73	46.8
McMahons Rd - South										
30	L	12	8.3	0.293	9.2	LOS A	16	0.46	0.67	47.5
31	T	299	4.0	0.296	11.7	LOS B	16	0.46	0.71	45.5
Approach		311	4.2	0.296	11.6	LOS B	16	0.46	0.71	45.6
All Vehicles		1278	4.1	0.549	9.9	LOS A	39	0.45	0.68	46.9

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2005 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	397	4.0	0.616	7.3	LOS A	59	0.34	0.52	48.7
5	T	493	4.1	0.615	10.6	LOS B	59	0.34	0.62	45.9
Approach		890	4.0	0.615	9.1	LOS A	59	0.34	0.57	47.1
Illaroo Rd - West										
28	T	338	4.1	0.392	8.8	LOS A	25	0.59	0.67	47.4
29	R	48	4.2	0.393	12.9	LOS B	25	0.59	0.74	44.5
Approach		386	4.1	0.392	9.3	LOS A	25	0.59	0.68	47.0
McMahons Rd - South										
30	L	44	4.5	0.379	11.4	LOS B	22	0.70	0.81	45.7
31	T	263	4.2	0.379	13.8	LOS B	22	0.70	0.84	43.7
Approach		308	4.2	0.379	13.5	LOS B	22	0.70	0.83	44.0
All Vehicles		1584	4.1	0.616	10.0	LOS B	59	0.47	0.65	46.4

Symbols which may appear in this table:

Following Degree of Saturation
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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2005PMILLAROOMCMAHONS
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Produced by SIDRA Intersection 3.1.061208.34

SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 DN2P AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	211	3.8	0.313	7.0	LOS A	21	0.18	0.53	49.6
5	T	246	4.1	0.313	10.3	LOS B	21	0.18	0.66	46.5
Approach		456	3.9	0.313	8.8	LOS A	21	0.18	0.60	47.9
Illaroo Rd - West										
28	T	533	3.9	0.587	10.4	LOS B	46	0.73	0.78	46.6
29	R	29	3.4	0.592	14.5	LOS B	46	0.73	0.82	43.2
Approach		561	3.9	0.586	10.6	LOS B	46	0.73	0.78	46.5
McMahons Rd - South										
30	L	28	3.6	0.341	9.5	LOS A	19	0.50	0.68	47.3
31	T	322	4.0	0.340	11.9	LOS B	19	0.50	0.72	45.4
Approach		350	4.0	0.340	11.7	LOS B	19	0.50	0.72	45.5
All Vehicles		1367	4.0	0.592	10.3	LOS B	46	0.49	0.70	46.7

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DN2P-AMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 DN2P PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	377	4.0	0.608	7.2	LOS A	58	0.30	0.51	48.9
5	T	521	4.0	0.608	10.5	LOS B	58	0.30	0.62	46.1
Approach		898	4.0	0.608	9.1	LOS A	58	0.30	0.58	47.2
Illaroo Rd - West										
28	T	340	4.1	0.388	8.8	LOS A	24	0.59	0.67	47.4
29	R	40	5.0	0.388	12.9	LOS B	24	0.59	0.74	44.5
Approach		380	4.2	0.388	9.2	LOS A	24	0.59	0.68	47.0
McMahons Rd - South										
30	L	62	3.2	0.411	11.8	LOS B	24	0.72	0.83	45.4
31	T	265	4.1	0.411	14.2	LOS B	24	0.72	0.85	43.4
Approach		328	4.0	0.411	13.7	LOS B	24	0.72	0.85	43.8
All Vehicles		1606	4.0	0.608	10.1	LOS B	58	0.46	0.66	46.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DN2P-PMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 DNSP AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	312	3.9	0.427	7.1	LOS A	34	0.26	0.52	49.1
5	T	296	4.1	0.427	10.4	LOS B	34	0.26	0.64	46.2
Approach		607	4.0	0.426	8.7	LOS A	34	0.26	0.58	47.6
Illaroo Rd - West										
28	T	591	4.1	0.769	16.7	LOS B	90	0.96	1.08	41.2
29	R	43	4.7	0.768	20.7	LOS C	90	0.96	1.09	38.6
Approach		634	4.1	0.769	16.9	LOS B	90	0.96	1.08	41.0
McMahons Rd - South										
30	L	34	3.0	0.485	10.2	LOS B	31	0.63	0.73	46.7
31	T	451	4.0	0.488	12.6	LOS B	31	0.63	0.76	44.8
Approach		484	3.9	0.488	12.4	LOS B	31	0.63	0.76	44.9
All Vehicles		1725	4.0	0.769	12.8	LOS B	90	0.62	0.81	44.3

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-AMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 DNSP PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	402	4.0	0.770	7.8	LOS A	101	0.59	0.51	47.4
5	T	674	4.0	0.769	11.1	LOS B	101	0.59	0.58	45.1
Approach		1076	4.0	0.769	9.9	LOS A	101	0.59	0.55	45.9
Illaroo Rd - West										
28	T	533	3.9	0.624	10.4	LOS B	55	0.78	0.78	46.4
29	R	68	4.3	0.622	14.5	LOS B	55	0.78	0.82	43.3
Approach		601	4.0	0.624	10.9	LOS B	55	0.78	0.78	46.0
McMahons Rd - South										
30	L	69	4.3	0.560	16.1	LOS B	44	0.90	1.03	41.6
31	T	295	4.1	0.561	18.5	LOS B	44	0.90	1.04	40.0
Approach		365	4.1	0.561	18.0	LOS B	44	0.90	1.04	40.3
All Vehicles		2042	4.0	0.770	11.6	LOS B	101	0.70	0.71	44.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-PMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 1 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	247	4.0	0.393	7.5	LOS A	28	0.37	0.55	48.6
5	T	252	4.0	0.393	10.8	LOS B	28	0.37	0.65	45.8
Approach		499	4.0	0.393	9.1	LOS A	28	0.37	0.60	47.1
Illaroo Rd - West										
28	T	501	4.0	0.641	11.7	LOS B	57	0.80	0.85	45.5
29	R	92	4.3	0.643	15.7	LOS B	57	0.80	0.88	42.2
Approach		593	4.0	0.642	12.3	LOS B	57	0.80	0.85	45.0
McMahons Rd - South										
30	L	103	3.9	0.440	9.7	LOS A	28	0.57	0.70	47.0
31	T	351	4.0	0.440	12.1	LOS B	28	0.57	0.73	45.1
Approach		454	4.0	0.441	11.6	LOS B	28	0.57	0.73	45.5
All Vehicles		1546	4.0	0.643	11.1	LOS B	57	0.59	0.73	45.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-AMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 1 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	347	4.0	0.715	8.2	LOS A	75	0.63	0.58	47.2
5	T	565	4.1	0.715	11.5	LOS B	75	0.63	0.63	44.9
Approach		913	4.1	0.715	10.2	LOS B	75	0.63	0.61	45.7
Illaroo Rd - West										
28	T	358	3.9	0.472	8.8	LOS A	33	0.63	0.68	47.2
29	R	116	4.3	0.472	12.9	LOS B	33	0.63	0.74	44.3
Approach		474	4.0	0.472	9.8	LOS A	33	0.63	0.69	46.4
McMahons Rd - South										
30	L	149	4.0	0.552	14.2	LOS B	43	0.85	0.96	43.2
31	T	251	4.0	0.552	16.6	LOS B	43	0.85	0.98	41.4
Approach		400	4.0	0.551	15.7	LOS B	43	0.85	0.97	42.0
All Vehicles		1787	4.0	0.715	11.4	LOS B	75	0.68	0.71	45.0

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-PMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	137	3.7	0.302	7.5	LOS A	19	0.35	0.55	48.7
5	T	235	3.8	0.302	10.8	LOS B	19	0.35	0.66	45.9
Approach		370	3.8	0.302	9.6	LOS A	19	0.35	0.62	46.9
Illaroo Rd - West										
28	T	596	4.0	0.644	9.4	LOS A	55	0.70	0.70	46.8
29	R	103	3.9	0.644	13.5	LOS B	55	0.70	0.75	44.1
Approach		699	4.0	0.644	10.0	LOS B	55	0.70	0.71	46.4
McMahons Rd - South										
30	L	95	4.2	0.314	9.4	LOS A	18	0.49	0.67	47.3
31	T	227	4.0	0.314	11.8	LOS B	18	0.49	0.72	45.4
Approach		322	4.0	0.313	11.1	LOS B	18	0.49	0.70	45.9
All Vehicles		1391	4.0	0.644	10.2	LOS B	55	0.56	0.68	46.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-MVRDLK-AMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	239	4.2	0.634	7.4	LOS A	60	0.38	0.52	48.5
5	T	659	3.9	0.634	10.7	LOS B	60	0.38	0.62	45.8
Approach		898	4.0	0.634	9.8	LOS A	60	0.38	0.59	46.5
Illaroo Rd - West										
28	T	333	3.9	0.351	8.0	LOS A	22	0.47	0.60	48.0
29	R	59	3.4	0.351	12.1	LOS B	22	0.47	0.69	44.8
Approach		391	3.8	0.351	8.6	LOS A	22	0.47	0.61	47.5
McMahons Rd - South										
30	L	107	3.7	0.395	13.1	LOS B	24	0.79	0.88	44.2
31	T	166	4.2	0.396	15.5	LOS B	24	0.79	0.90	42.3
Approach		274	4.0	0.395	14.5	LOS B	24	0.79	0.90	43.0
All Vehicles		1563	4.0	0.634	10.4	LOS B	60	0.48	0.65	46.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-MVRDLK-PMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 2 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	218	4.1	0.368	7.5	LOS A	25	0.37	0.55	48.5
5	T	241	4.1	0.368	10.8	LOS B	25	0.37	0.65	45.8
Approach		459	4.1	0.368	9.2	LOS A	25	0.37	0.61	47.1
Illaroo Rd - West										
28	T	503	4.0	0.645	11.6	LOS B	58	0.80	0.84	45.6
29	R	99	4.0	0.647	15.7	LOS B	58	0.80	0.88	42.3
Approach		602	4.0	0.645	12.3	LOS B	58	0.80	0.85	45.0
McMahons Rd - South										
30	L	124	4.0	0.448	9.6	LOS A	28	0.56	0.69	47.0
31	T	344	4.1	0.447	12.0	LOS B	28	0.56	0.73	45.2
Approach		468	4.1	0.448	11.4	LOS B	28	0.56	0.72	45.6
All Vehicles		1529	4.1	0.647	11.1	LOS B	58	0.60	0.74	45.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT2-AMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 2 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	403	4.0	0.760	8.3	LOS A	87	0.67	0.57	46.9
5	T	585	3.9	0.761	11.6	LOS B	87	0.67	0.62	44.8
Approach		988	3.9	0.760	10.2	LOS B	87	0.67	0.60	45.6
Illaroo Rd - West										
28	T	344	4.1	0.433	8.5	LOS A	29	0.57	0.65	47.5
29	R	109	3.7	0.433	12.6	LOS B	29	0.57	0.72	44.5
Approach		453	4.0	0.432	9.5	LOS A	29	0.57	0.66	46.7
McMahons Rd - South										
30	L	141	4.3	0.509	13.8	LOS B	37	0.84	0.94	43.6
31	T	217	4.1	0.508	16.2	LOS B	37	0.84	0.96	41.8
Approach		358	4.2	0.508	15.2	LOS B	37	0.84	0.95	42.5
All Vehicles		1799	4.0	0.761	11.0	LOS B	87	0.68	0.69	45.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT2-PMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 3 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	231	3.9	0.383	7.4	LOS A	27	0.34	0.54	48.7
5	T	267	4.1	0.383	10.7	LOS B	27	0.34	0.65	45.9
Approach		498	4.0	0.383	9.1	LOS A	27	0.34	0.60	47.2
Illaroo Rd - West										
28	T	531	4.0	0.663	12.1	LOS B	62	0.82	0.87	45.1
29	R	79	3.8	0.664	16.2	LOS B	62	0.82	0.90	41.9
Approach		609	3.9	0.662	12.6	LOS B	62	0.82	0.87	44.7
McMahons Rd - South										
30	L	98	4.1	0.447	9.8	LOS A	28	0.59	0.71	46.9
31	T	356	3.9	0.448	12.2	LOS B	28	0.59	0.74	45.1
Approach		454	4.0	0.448	11.7	LOS B	28	0.59	0.74	45.5
All Vehicles		1561	4.0	0.664	11.3	LOS B	62	0.60	0.75	45.7

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-AMILLAROOMCMAHONS
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 3 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	365	4.1	0.672	8.0	LOS A	66	0.56	0.56	47.5
5	T	501	4.0	0.671	11.3	LOS B	66	0.56	0.63	45.2
Approach		867	4.0	0.671	9.9	LOS A	66	0.56	0.60	46.1
Illaroo Rd - West										
28	T	381	3.9	0.485	8.9	LOS A	34	0.64	0.68	47.1
29	R	106	3.8	0.484	13.0	LOS B	34	0.64	0.75	44.3
Approach		487	3.9	0.485	9.8	LOS A	34	0.64	0.70	46.5
McMahons Rd - South										
30	L	133	3.8	0.496	12.5	LOS B	34	0.79	0.88	44.7
31	T	256	3.9	0.495	14.9	LOS B	34	0.79	0.90	42.8
Approach		388	3.9	0.495	14.1	LOS B	34	0.79	0.89	43.4
All Vehicles		1742	4.0	0.672	10.8	LOS B	66	0.63	0.69	45.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-PMILLAROOMCMAHONS
\\AUSYD1FP001\Projects\60012769_NOWRA\05_Eng_Plan\Analysis\SIDRA\Nowra SIDRA\Illaroo_McMahons\PM\PM Illaroo_McMahons.aap
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	133	3.8	0.251	7.3	LOS A	15	0.29	0.54	49.0
5	T	183	3.8	0.251	10.6	LOS B	15	0.29	0.65	46.1
Approach		315	3.8	0.251	9.3	LOS A	15	0.29	0.61	47.2
Illaroo Rd - West										
28	T	567	4.0	0.602	9.0	LOS A	46	0.66	0.68	47.0
29	R	83	3.6	0.601	13.1	LOS B	46	0.66	0.74	44.2
Approach		651	4.0	0.602	9.5	LOS A	46	0.66	0.69	46.6
McMahons Rd - South										
30	L	73	4.1	0.277	8.9	LOS A	15	0.42	0.64	47.6
31	T	229	3.9	0.277	11.3	LOS B	15	0.42	0.69	45.6
Approach		302	4.0	0.276	10.8	LOS B	15	0.42	0.68	46.1
All Vehicles		1268	3.9	0.602	9.8	LOS A	46	0.51	0.67	46.7

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-MVRDLK-AMILLAROOMCMAHONS
\\AUSYD1FP001\Projects\60012769_NOWRA\05_Eng_Plan\Analysis\SIDRA\Nowra SIDRA\Illaroo_McMahons\AM\AM Illaroo_McMahons.aap
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and McMahons Rd

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
4	L	277	4.0	0.606	7.4	LOS A	55	0.37	0.53	48.5
5	T	573	4.0	0.606	10.7	LOS B	55	0.37	0.62	45.8
Approach		850	4.0	0.606	9.6	LOS A	55	0.37	0.59	46.6
Illaroo Rd - West										
28	T	349	4.0	0.369	8.0	LOS A	24	0.48	0.60	48.0
29	R	62	3.2	0.369	12.1	LOS B	24	0.48	0.69	44.8
Approach		411	3.9	0.368	8.7	LOS A	24	0.48	0.62	47.5
McMahons Rd - South										
30	L	86	3.5	0.340	12.0	LOS B	19	0.73	0.83	45.2
31	T	169	4.1	0.340	14.4	LOS B	19	0.73	0.85	43.2
Approach		256	3.9	0.340	13.6	LOS B	19	0.73	0.85	43.9
All Vehicles		1517	4.0	0.606	10.0	LOS B	55	0.46	0.64	46.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-MVRDLK-PMILLAROOMCMAHONS
\\AUSYD1FP001\Projects\60012769_NOWRA\05_Eng_Plan\Analysis\SIDRA\Nowra SIDRA\Illaroo_McMahons\PM\PM Illaroo_McMahons.aap
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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	65	4.5	0.107	8.1	LOS A	0	0.00	0.67	49.2
22	T	134	3.8	0.107	0.0	LOS A	0	0.00	0.00	60.0
Approach		199	4.0	0.107	2.7	LOS A		0.00	0.22	56.0
Illaroo Rd - North										
28	T	424	4.0	0.217	0.0	LOS A	0	0.00	0.00	60.0
29	R	26	3.8	0.048	10.3	LOS A	1	0.30	0.68	46.7
Approach		450	4.0	0.217	0.6	LOS A	1	0.02	0.04	59.0
Page Ave - West										
10	L	11	9.1	0.011	9.0	LOS A	0	0.27	0.62	42.2
12	R	104	3.8	0.421	19.5	LOS B	13	0.70	0.98	35.1
Approach		115	4.3	0.421	18.5	LOS B	13	0.66	0.94	35.7
All Vehicles		764	4.1	0.421	3.8	Not Applicable	13	0.11	0.22	53.1

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2005 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	98	4.1	0.256	8.1	LOS A	0	0.00	0.67	49.2
22	T	383	3.9	0.256	0.0	LOS A	0	0.00	0.00	60.0
Approach		481	4.0	0.256	1.6	LOS A		0.00	0.14	57.5
Illaroo Rd - North										
28	T	276	4.0	0.142	0.0	LOS A	0	0.00	0.00	60.0
29	R	18	5.6	0.042	12.4	LOS A	1	0.49	0.76	44.8
Approach		294	4.1	0.142	0.8	LOS A	1	0.03	0.05	58.8
Page Ave - West										
10	L	23	4.3	0.032	10.8	LOS A	1	0.46	0.72	41.1
12	R	111	3.6	0.507	25.0	LOS B	18	0.79	1.05	32.2
Approach		133	3.8	0.506	22.6	LOS B	18	0.73	0.99	33.5
All Vehicles		908	4.0	0.507	4.4	Not Applicable	18	0.12	0.23	52.4

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 DN2P AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	74	4.1	0.128	8.1	LOS A	0	0.00	0.67	49.2
22	T	164	4.2	0.128	0.0	LOS A	0	0.00	0.00	60.0
Approach		239	4.2	0.128	2.5	LOS A		0.00	0.21	56.2
Illaroo Rd - North										
28	T	445	4.0	0.228	0.0	LOS A	0	0.00	0.00	60.0
29	R	17	5.9	0.033	10.6	LOS A	1	0.33	0.68	46.6
Approach		462	4.1	0.228	0.4	LOS A	1	0.01	0.02	59.4
Page Ave - West										
10	L	8	11.1	0.010	9.3	LOS A	0	0.31	0.62	42.1
12	R	117	4.3	0.502	22.7	LOS B	17	0.75	1.03	33.4
Approach		126	4.8	0.502	21.7	LOS B	17	0.72	1.00	33.9
All Vehicles		827	4.2	0.502	4.2	Not Applicable	17	0.12	0.23	52.5

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 DN2P PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	119	4.2	0.275	8.1	LOS A	0	0.00	0.67	49.2
22	T	398	4.0	0.275	0.0	LOS A	0	0.00	0.00	60.0
Approach		517	4.1	0.275	1.9	LOS A		0.00	0.15	57.1
Illaroo Rd - North										
28	T	268	4.1	0.138	0.0	LOS A	0	0.00	0.00	60.0
29	R	20	5.0	0.047	12.8	LOS A	1	0.51	0.78	44.5
Approach		289	4.2	0.138	0.9	LOS A	1	0.03	0.05	58.6
Page Ave - West										
10	L	16	6.2	0.024	11.1	LOS A	1	0.48	0.72	40.9
12	R	112	3.6	0.524	26.3	LOS B	18	0.80	1.06	31.6
Approach		127	3.9	0.524	24.4	LOS B	18	0.76	1.02	32.6
All Vehicles		933	4.1	0.524	4.6	Not Applicable	18	0.11	0.24	52.2

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 DNSP AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	66	4.5	0.146	8.1	LOS A	0	0.00	0.67	49.2
22	T	207	3.9	0.146	0.0	LOS A	0	0.00	0.00	60.0
Approach		274	4.0	0.146	2.0	LOS A		0.00	0.16	57.0
Illaroo Rd - North										
28	T	488	4.1	0.251	0.0	LOS A	0	0.00	0.00	60.0
29	R	33	3.1	0.062	10.8	LOS A	1	0.36	0.70	46.4
Approach		521	4.0	0.251	0.7	LOS A	1	0.02	0.04	58.9
Page Ave - West										
10	L	12	8.3	0.014	9.5	LOS A	0	0.34	0.63	42.0
12	R	145	4.1	0.700	33.7	LOS C	30	0.85	1.21	28.5
Approach		157	4.5	0.699	31.8	LOS C	30	0.81	1.17	29.3
All Vehicles		952	4.1	0.700	6.2	Not Applicable	30	0.15	0.26	50.1

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Movement Summary

Illaroo Rd and Page Ave

2016 DNSP PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	162	3.7	0.361	8.1	LOS A	0	0.00	0.67	49.2
22	T	516	4.1	0.361	0.0	LOS A	0	0.00	0.00	60.0
Approach		678	4.0	0.361	1.9	LOS A		0.00	0.16	57.0
Illaroo Rd - North										
28	T	424	4.0	0.217	0.0	LOS A	0	0.00	0.00	60.0
29	R	28	3.6	0.077	14.9	LOS B	2	0.61	0.88	42.7
Approach		452	4.0	0.217	0.9	LOS A	2	0.04	0.05	58.5
Page Ave - West										
10	L	38	3.1	0.117	12.9	LOS A	4	0.57	0.86	39.6
12	R	173	4.8	0.999#	36.9	LOS C	33	1.00	1.00	27.4
Approach		185	4.3	1.000	33.8	LOS C	33	0.99	1.09	30.2
All Vehicles		1341	3.9	0.999	5.9	Not Applicable	33	0.15	0.25	50.5

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 1 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	63	4.7	0.178	8.1	LOS A	0	0.00	0.67	49.2
22	T	269	4.1	0.178	0.0	LOS A	0	0.00	0.00	60.0
Approach		334	4.2	0.178	1.5	LOS A		0.00	0.13	57.6
Illaroo Rd - North										
28	T	461	3.9	0.236	0.0	LOS A	0	0.00	0.00	60.0
29	R	96	4.2	0.194	11.4	LOS A	4	0.42	0.76	45.8
Approach		557	3.9	0.236	2.0	LOS A	4	0.07	0.13	57.0
Page Ave - West										
10	L	57	3.5	0.067	9.9	LOS A	2	0.39	0.69	41.8
12	R	132	3.8	0.716	39.8	LOS C	31	0.89	1.22	26.4
Approach		188	3.7	0.717	30.7	LOS C	31	0.74	1.06	29.8
All Vehicles		1079	4.0	0.716	6.8	Not Applicable	31	0.17	0.29	49.3

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 1 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	144	4.2	0.348	8.1	LOS A	0	0.00	0.67	49.2
22	T	509	3.9	0.347	0.0	LOS A	0	0.00	0.00	60.0
Approach		653	4.0	0.348	1.8	LOS A		0.00	0.15	57.2
Illaroo Rd - North										
28	T	342	4.1	0.175	0.0	LOS A	0	0.00	0.00	60.0
29	R	64	4.6	0.176	14.8	LOS B	4	0.61	0.89	42.7
Approach		407	4.2	0.176	2.4	LOS A	4	0.10	0.14	56.4
Page Ave - West										
10	L	62	3.2	0.109	12.6	LOS A	3	0.55	0.84	39.8
12	R	132	3.8	0.784	39.9	LOS C	31	0.95	1.09	26.4
Approach		193	3.6	0.786	31.1	LOS C	31	0.82	1.01	29.6
All Vehicles		1253	4.0	0.784	6.5	Not Applicable	31	0.16	0.28	49.8

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	60	3.3	0.154	8.1	LOS A	0	0.00	0.67	49.2
22	T	231	3.9	0.154	0.0	LOS A	0	0.00	0.00	60.0
Approach		290	3.8	0.154	1.7	LOS A		0.00	0.14	57.4
Illaroo Rd - North										
28	T	555	4.0	0.285	0.0	LOS A	0	0.00	0.00	60.0
29	R	23	4.3	0.045	10.9	LOS A	1	0.37	0.70	46.3
Approach		578	4.0	0.285	0.4	LOS A	1	0.01	0.03	59.3
Page Ave - West										
10	L	42	4.8	0.047	9.6	LOS A	2	0.35	0.66	42.0
12	R	145	4.1	0.771	35.4	LOS C	31	0.89	1.16	27.9
Approach		187	4.3	0.773	29.6	LOS C	31	0.77	1.05	30.2
All Vehicles		1055	4.0	0.771	5.9	Not Applicable	31	0.15	0.24	50.3

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	171	4.1	0.373	8.1	LOS A	0	0.00	0.67	49.2
22	T	528	4.0	0.373	0.0	LOS A	0	0.00	0.00	60.0
Approach		699	4.0	0.373	2.0	LOS A		0.00	0.16	57.0
Illaroo Rd - North										
28	T	285	3.9	0.146	0.0	LOS A	0	0.00	0.00	60.0
29	R	28	3.6	0.079	15.2	LOS B	2	0.63	0.90	42.4
Approach		313	3.8	0.146	1.4	LOS A	2	0.06	0.08	57.9
Page Ave - West										
10	L	69	4.3	0.130	13.1	LOS A	4	0.58	0.86	39.4
12	R	103	3.9	0.545	36.0	LOS C	23	0.89	1.10	27.7
Approach		173	4.0	0.546	26.7	LOS B	23	0.77	1.01	31.5
All Vehicles		1185	4.0	0.545	5.4	Not Applicable	23	0.13	0.26	51.2

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 2 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	64	4.6	0.186	8.1	LOS A	0	0.00	0.67	49.2
22	T	285	3.9	0.186	0.0	LOS A	0	0.00	0.00	60.0
Approach		350	4.0	0.186	1.5	LOS A		0.00	0.12	57.7
Illaroo Rd - North										
28	T	444	4.1	0.228	0.0	LOS A	0	0.00	0.00	60.0
29	R	63	4.7	0.132	11.4	LOS A	3	0.42	0.75	45.8
Approach		508	4.1	0.228	1.4	LOS A	3	0.05	0.09	57.7
Page Ave - West										
10	L	54	3.7	0.064	10.0	LOS A	2	0.40	0.69	41.7
12	R	158	3.8	0.827	32.3	LOS C	31	0.90	1.10	29.1
Approach		212	3.8	0.825	26.6	LOS B	31	0.77	1.00	31.5
All Vehicles		1070	4.0	0.827	6.4	Not Applicable	31	0.18	0.28	49.6

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 2 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	141	4.3	0.386	8.1	LOS A	0	0.00	0.67	49.2
22	T	585	3.9	0.386	0.0	LOS A	0	0.00	0.00	60.0
Approach		726	4.0	0.386	1.6	LOS A		0.00	0.13	57.6
Illaroo Rd - North										
28	T	344	4.1	0.176	0.0	LOS A	0	0.00	0.00	60.0
29	R	109	3.7	0.318	17.4	LOS B	9	0.70	0.96	40.7
Approach		453	4.0	0.318	4.2	LOS A	9	0.17	0.23	53.9
Page Ave - West										
10	L	141	2.6	0.457	16.5	LOS B	20	0.72	1.02	37.2
12	R	217	6.9	0.997	40.3	LOS C	32	1.00	1.00	26.2
Approach		271	4.2	1.000	33.2	LOS B	32	1.09	1.34	32.3
All Vehicles		1537	3.8	0.997	7.8	Not Applicable	32	0.24	0.36	47.9

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 3 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	75	4.0	0.181	8.1	LOS A	0	0.00	0.67	49.2
22	T	263	4.2	0.181	0.0	LOS A	0	0.00	0.00	60.0
Approach		339	4.1	0.181	1.8	LOS A		0.00	0.15	57.2
Illaroo Rd - North										
28	T	422	4.0	0.216	0.0	LOS A	0	0.00	0.00	60.0
29	R	82	3.7	0.166	11.4	LOS A	3	0.42	0.75	45.8
Approach		504	4.0	0.216	1.9	LOS A	3	0.07	0.12	57.1
Page Ave - West										
10	L	38	5.3	0.045	9.9	LOS A	1	0.38	0.68	41.8
12	R	187	3.7	0.949	26.9	LOS B	31	0.93	1.01	31.3
Approach		225	4.0	0.949	24.0	LOS B	31	0.84	0.95	32.8
All Vehicles		1068	4.0	0.949	6.5	Not Applicable	31	0.21	0.31	49.4

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 3 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	125	4.0	0.314	8.1	LOS A	0	0.00	0.67	49.2
22	T	464	4.1	0.314	0.0	LOS A	0	0.00	0.00	60.0
Approach		590	4.1	0.314	1.7	LOS A		0.00	0.14	57.4
Illaroo Rd - North										
28	T	356	3.9	0.183	0.0	LOS A	0	0.00	0.00	60.0
29	R	59	3.4	0.148	13.8	LOS A	3	0.56	0.87	43.6
Approach		415	3.9	0.183	2.0	LOS A	3	0.08	0.12	57.0
Page Ave - West										
10	L	100	4.0	0.161	12.1	LOS A	5	0.54	0.84	40.1
12	R	129	3.9	0.705	40.2	LOS C	31	0.93	1.15	26.3
Approach		229	3.9	0.706	27.9	LOS B	31	0.76	1.01	31.0
All Vehicles		1234	4.0	0.705	6.7	Not Applicable	31	0.17	0.30	49.4

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	21	4.8	0.112	8.1	LOS A	0	0.00	0.67	49.2
22	T	191	4.2	0.112	0.0	LOS A	0	0.00	0.00	60.0
Approach		212	4.2	0.112	0.8	LOS A		0.00	0.07	58.7
Illaroo Rd - North										
28	T	517	4.1	0.265	0.0	LOS A	0	0.00	0.00	60.0
29	R	45	4.4	0.085	10.4	LOS A	2	0.31	0.69	46.7
Approach		562	4.1	0.265	0.8	LOS A	2	0.03	0.06	58.7
Page Ave - West										
10	L	27	3.7	0.028	9.2	LOS A	1	0.30	0.63	42.2
12	R	133	3.8	0.638	30.8	LOS C	25	0.84	1.15	29.7
Approach		159	3.8	0.637	27.1	LOS B	25	0.74	1.06	31.3
All Vehicles		933	4.1	0.638	5.3	Not Applicable	25	0.14	0.23	51.1

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SIDRA INTERSECTION

Movement Summary

Illaroo Rd and Page Ave

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	169	4.1	0.319	8.1	LOS A	0	0.00	0.67	49.2
22	T	427	4.0	0.319	0.0	LOS A	0	0.00	0.00	60.0
Approach		597	4.0	0.319	2.3	LOS A		0.00	0.19	56.5
Illaroo Rd - North										
28	T	313	4.2	0.161	0.0	LOS A	0	0.00	0.00	60.0
29	R	27	3.7	0.068	13.7	LOS A	1	0.55	0.83	43.7
Approach		340	4.1	0.161	1.1	LOS A	1	0.04	0.07	58.3
Page Ave - West										
10	L	63	4.7	0.101	11.8	LOS A	3	0.52	0.80	40.4
12	R	99	4.0	0.538	31.6	LOS C	19	0.85	1.08	29.3
Approach		163	4.3	0.539	23.8	LOS B	19	0.72	0.97	32.9
All Vehicles		1100	4.1	0.538	5.1	Not Applicable	19	0.12	0.27	51.5

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	40	5.0	0.021	8.3	LOS A	0	0.00	0.67	49.0
22	T	133	3.8	0.068	0.0	LOS A	0	0.00	0.00	60.0
Approach		172	4.1	0.068	1.9	LOS A		0.00	0.16	57.0
Illaroo Rd - North										
28	T	280	3.9	0.167	1.0	LOS A	11	0.36	0.00	55.3
29	R	20	5.0	0.167	9.5	LOS A	11	0.36	0.66	47.3
Approach		300	4.0	0.167	1.6	LOS A	11	0.36	0.04	54.7
Pitt St - West										
30	L	20	5.0	0.023	8.0	LOS A	1	0.25	0.60	42.9
32	R	77	3.9	0.171	13.3	LOS A	6	0.58	0.84	39.1
Approach		97	4.1	0.171	12.2	LOS A	6	0.51	0.79	39.8
All Vehicles		569	4.0	0.171	3.5	Not Applicable	11	0.28	0.21	52.0

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2005 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	95	4.2	0.049	8.3	LOS A	0	0.00	0.67	49.0
22	T	311	3.9	0.159	0.0	LOS A	0	0.00	0.00	60.0
Approach		405	4.0	0.159	2.0	LOS A		0.00	0.16	57.0
Illaroo Rd - North										
28	T	153	3.9	0.090	3.1	LOS A	8	0.59	0.00	52.7
29	R	5	16.7	0.090	11.6	LOS A	8	0.59	0.78	45.5
Approach		159	4.4	0.090	3.5	LOS A	8	0.59	0.03	52.4
Pitt St - West										
30	L	15	6.7	0.019	9.2	LOS A	1	0.41	0.65	42.2
32	R	60	3.3	0.149	14.4	LOS A	5	0.60	0.86	38.3
Approach		75	4.0	0.149	13.4	LOS A	5	0.56	0.82	39.0
All Vehicles		639	4.1	0.159	3.7	Not Applicable	8	0.21	0.20	53.0

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 DN2P AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	38	5.3	0.108	8.3	LOS A	0	0.00	0.67	49.0
22	T	164	4.2	0.108	0.0	LOS A	0	0.00	0.00	60.0
Approach		203	4.4	0.108	1.6	LOS A		0.00	0.12	57.6
Illaroo Rd - North										
28	T	304	3.9	0.156	0.0	LOS A	0	0.00	0.00	60.0
29	R	20	5.0	0.038	9.5	LOS A	1	0.30	0.65	47.5
Approach		324	4.0	0.156	0.6	LOS A	1	0.02	0.04	59.0
Pitt St - West										
30	L	17	5.9	0.017	8.2	LOS A	1	0.29	0.60	42.8
32	R	78	3.8	0.281	15.3	LOS C	7	0.60	0.90	37.7
Approach		95	4.2	0.281	14.0	LOS B	7	0.55	0.85	38.5
All Vehicles		622	4.2	0.281	3.0	Not Applicable	7	0.09	0.19	54.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 DN2P PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	95	4.2	0.220	8.3	LOS A	0	0.00	0.67	49.0
22	T	319	4.1	0.221	0.0	LOS A	0	0.00	0.00	60.0
Approach		414	4.1	0.221	1.9	LOS A		0.00	0.15	57.1
Illaroo Rd - North										
28	T	152	3.9	0.078	0.0	LOS A	0	0.00	0.00	60.0
29	R	11	9.1	0.026	11.1	LOS B	1	0.46	0.70	46.1
Approach		163	4.3	0.078	0.7	LOS A	1	0.03	0.05	58.8
Pitt St - West										
30	L	15	6.7	0.020	9.4	LOS A	1	0.42	0.66	42.1
32	R	63	4.7	0.237	15.2	LOS C	6	0.61	0.88	37.7
Approach		79	5.1	0.237	14.1	LOS B	6	0.57	0.84	38.5
All Vehicles		656	4.3	0.237	3.1	Not Applicable	6	0.08	0.21	54.3

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DN2P-PMILLAROOPITT
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 DNSP AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	81	3.7	0.153	8.3	LOS A	0	0.00	0.67	49.0
22	T	205	3.9	0.153	0.0	LOS A	0	0.00	0.00	60.0
Approach		286	3.8	0.153	2.4	LOS A		0.00	0.19	56.4
Illaroo Rd - North										
28	T	304	3.9	0.156	0.0	LOS A	0	0.00	0.00	60.0
29	R	40	5.0	0.079	10.0	LOS B	2	0.37	0.69	47.1
Approach		344	4.1	0.156	1.2	LOS A	2	0.04	0.08	58.2
Pitt St - West										
30	L	25	4.0	0.027	8.5	LOS A	1	0.34	0.63	42.6
32	R	167	4.2	0.659	25.0	LOS C	28	0.74	1.15	32.2
Approach		193	4.1	0.658	22.9	LOS C	28	0.69	1.08	33.3
All Vehicles		823	4.0	0.659	6.7	Not Applicable	28	0.18	0.35	49.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-AMILLAROOPITT
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 DNSP PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	163	4.3	0.297	8.3	LOS A	0	0.00	0.67	49.0
22	T	391	4.1	0.297	0.0	LOS A	0	0.00	0.00	60.0
Approach		555	4.1	0.297	2.5	LOS A		0.00	0.20	56.3
Illaroo Rd - North										
28	T	171	4.1	0.088	0.0	LOS A	0	0.00	0.00	60.0
29	R	17	5.9	0.042	12.3	LOS B	1	0.52	0.77	44.9
Approach		188	4.3	0.088	1.1	LOS A	1	0.05	0.07	58.2
Pitt St - West										
30	L	35	2.9	0.050	10.3	LOS B	2	0.49	0.74	41.3
32	R	121	4.1	0.517	23.5	LOS C	18	0.75	1.05	33.0
Approach		155	3.9	0.516	20.6	LOS C	18	0.70	0.98	34.5
All Vehicles		898	4.1	0.517	5.3	Not Applicable	18	0.13	0.31	51.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-PMILLAROOPITT
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 1 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	68	4.3	0.228	5.8	LOS A	15	0.29	0.45	50.4
22	T	79	3.8	0.228	4.9	LOS A	15	0.29	0.41	51.3
23	R	186	3.8	0.228	11.8	LOS A	15	0.29	0.61	45.5
Approach		334	3.9	0.228	8.9	LOS A	15	0.29	0.53	47.6
Link Road Option 1										
24	L	156	3.8	0.175	6.1	LOS A	11	0.55	0.56	43.6
25	T	1	50.0	0.182	6.2	LOS A	11	0.55	0.57	49.3
26	R	36	2.9	0.175	12.1	LOS A	11	0.55	0.65	40.5
Approach		193	4.1	0.175	7.2	LOS A	11	0.55	0.57	43.0
Illaroo Rd - North										
27	L	135	3.7	0.315	7.7	LOS A	20	0.62	0.63	48.1
28	T	168	4.1	0.315	6.8	LOS A	20	0.62	0.61	48.8
29	R	41	4.9	0.315	13.7	LOS A	20	0.62	0.70	44.1
Approach		344	4.1	0.315	8.0	LOS A	20	0.62	0.63	47.9
Pitt St - West										
30	L	16	6.2	0.152	6.0	LOS A	9	0.53	0.54	43.8
31	T	57	3.5	0.152	6.2	LOS A	9	0.53	0.54	49.5
32	R	99	4.0	0.152	12.0	LOS A	9	0.53	0.65	40.6
Approach		172	4.1	0.152	9.5	LOS A	9	0.53	0.60	43.3
All Vehicles		1043	4.0	0.315	8.4	LOS A	20	0.49	0.58	46.0

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Movement Summary

Illaroo Road and Pitt Street

2016 Option 1 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	112	3.6	0.481	6.7	LOS A	34	0.51	0.55	48.9
22	T	229	3.9	0.479	5.7	LOS A	34	0.51	0.52	49.6
23	R	231	3.9	0.479	12.6	LOS A	34	0.51	0.65	44.6
Approach		570	3.9	0.479	8.7	LOS A	34	0.51	0.57	47.2
Link Road Option 1										
24	L	138	4.3	0.276	5.8	LOS A	15	0.49	0.55	44.0
25	T	39	5.1	0.277	6.1	LOS A	15	0.49	0.54	49.7
26	R	111	3.6	0.276	11.9	LOS A	15	0.49	0.66	40.7
Approach		287	4.2	0.276	8.2	LOS A	15	0.49	0.59	43.2
Illaroo Rd - North										
27	L	64	4.6	0.209	7.7	LOS A	11	0.56	0.63	48.5
28	T	116	4.3	0.209	6.8	LOS A	11	0.56	0.60	49.2
29	R	13	7.7	0.210	13.7	LOS A	11	0.56	0.70	44.3
Approach		194	4.6	0.209	7.5	LOS A	11	0.56	0.62	48.6
Pitt St - West										
30	L	24	4.2	0.209	8.0	LOS A	12	0.69	0.71	42.9
31	T	23	4.3	0.209	8.3	LOS A	12	0.69	0.71	48.3
32	R	113	4.4	0.208	14.1	LOS A	12	0.69	0.74	39.7
Approach		160	4.4	0.209	12.3	LOS A	12	0.69	0.73	41.1
All Vehicles		1211	4.1	0.481	8.9	LOS A	34	0.54	0.61	45.5

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	53	3.8	0.209	6.1	LOS A	14	0.39	0.49	49.7
22	T	76	3.9	0.210	5.2	LOS A	14	0.39	0.44	50.5
23	R	152	3.9	0.210	12.1	LOS A	14	0.39	0.62	45.0
Approach		281	3.9	0.210	9.1	LOS A	14	0.39	0.55	47.2
Link Road Option 1										
24	L	139	4.3	0.249	6.8	LOS A	16	0.65	0.63	43.1
25	T	74	4.1	0.249	7.0	LOS A	16	0.65	0.63	48.6
26	R	42	4.8	0.250	12.8	LOS A	16	0.65	0.69	40.1
Approach		255	4.3	0.249	7.9	LOS A	16	0.65	0.64	44.0
Illaroo Rd - North										
27	L	164	4.2	0.399	7.6	LOS A	28	0.62	0.63	48.1
28	T	279	3.9	0.399	6.6	LOS A	28	0.62	0.60	48.8
29	R	14	7.1	0.400	13.5	LOS A	28	0.62	0.69	44.1
Approach		458	4.1	0.399	7.2	LOS A	28	0.62	0.61	48.4
Pitt St - West										
30	L	36	2.9	0.154	5.8	LOS A	9	0.51	0.53	43.9
31	T	40	5.0	0.154	6.0	LOS A	9	0.51	0.52	49.6
32	R	103	3.9	0.154	11.8	LOS A	9	0.51	0.64	40.6
Approach		178	3.9	0.154	9.3	LOS A	9	0.51	0.59	42.9
All Vehicles		1172	4.1	0.400	8.1	LOS A	28	0.56	0.60	46.2

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Movement Summary

Illaroo Road and Pitt Street

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	113	4.4	0.551	7.5	LOS A	40	0.64	0.64	48.0
22	T	307	3.9	0.552	6.6	LOS A	40	0.64	0.59	48.6
23	R	178	3.9	0.551	13.5	LOS A	40	0.64	0.69	44.0
Approach		598	4.0	0.552	8.8	LOS A	40	0.64	0.63	47.0
Link Road Option 1										
24	L	124	4.0	0.297	5.6	LOS A	17	0.46	0.52	44.1
25	T	26	3.8	0.295	5.8	LOS A	17	0.46	0.52	49.9
26	R	175	4.0	0.297	11.6	LOS A	17	0.46	0.65	40.8
Approach		325	4.0	0.297	8.8	LOS A	17	0.46	0.59	42.6
Illaroo Rd - North										
27	L	78	3.8	0.221	7.0	LOS A	12	0.49	0.57	49.0
28	T	106	3.8	0.221	6.0	LOS A	12	0.49	0.54	49.7
29	R	41	4.9	0.220	12.9	LOS A	12	0.49	0.67	44.6
Approach		225	4.0	0.221	7.6	LOS A	12	0.49	0.57	48.4
Pitt St - West										
30	L	56	3.6	0.187	8.8	LOS A	11	0.74	0.75	42.6
31	T	20	5.0	0.187	9.0	LOS A	11	0.74	0.74	48.0
32	R	54	3.7	0.188	14.8	LOS B	11	0.74	0.75	39.2
Approach		130	3.8	0.187	11.3	LOS A	11	0.74	0.75	41.8
All Vehicles		1278	4.0	0.552	8.9	LOS A	40	0.58	0.62	45.4

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Movement Summary

Illaroo Road and Pitt Street

2016 Option 2 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	73	4.1	0.086	8.3	LOS A	0	0.00	0.67	49.0
22	T	87	3.4	0.086	0.0	LOS A	0	0.00	0.00	60.0
Approach		160	3.8	0.086	3.8	LOS A		0.00	0.30	54.4
Illaroo Rd - North										
28	T	289	4.1	0.149	0.0	LOS A	0	0.00	0.00	60.0
29	R	52	3.8	0.094	9.3	LOS A	2	0.27	0.65	47.7
Approach		342	4.1	0.149	1.4	LOS A	2	0.04	0.10	57.7
Pitt St - West										
30	L	21	4.8	0.020	7.9	LOS A	1	0.23	0.60	43.0
32	R	153	3.9	0.524	17.8	LOS C	18	0.64	1.01	36.1
Approach		174	4.0	0.524	16.6	LOS C	18	0.59	0.96	36.8
All Vehicles		676	4.0	0.524	5.9	Not Applicable	18	0.17	0.37	49.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 2 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	148	4.1	0.211	8.3	LOS A	0	0.00	0.67	49.0
22	T	246	4.1	0.212	0.0	LOS A	0	0.00	0.00	60.0
Approach		394	4.1	0.211	3.1	LOS A		0.00	0.25	55.3
Illaroo Rd - North										
28	T	179	3.9	0.092	0.0	LOS A	0	0.00	0.00	60.0
29	R	8	11.1	0.021	11.0	LOS B	0	0.45	0.69	46.2
Approach		188	4.3	0.092	0.5	LOS A	0	0.02	0.03	59.2
Pitt St - West										
30	L	24	4.2	0.029	9.0	LOS A	1	0.39	0.65	42.4
32	R	115	4.3	0.414	17.1	LOS C	13	0.63	0.96	36.5
Approach		139	4.3	0.414	15.7	LOS C	13	0.59	0.91	37.4
All Vehicles		721	4.2	0.414	4.9	Not Applicable	13	0.12	0.32	51.5

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 3 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	82	3.7	0.160	8.3	LOS A	0	0.00	0.67	49.0
22	T	219	4.1	0.161	0.0	LOS A	0	0.00	0.00	60.0
Approach		301	4.0	0.161	2.3	LOS A		0.00	0.18	56.5
Illaroo Rd - North										
28	T	206	3.9	0.106	0.0	LOS A	0	0.00	0.00	60.0
29	R	47	4.3	0.093	10.1	LOS B	2	0.38	0.70	47.0
Approach		253	4.0	0.106	1.9	LOS A	2	0.07	0.13	57.1
Pitt St - West										
30	L	78	3.8	0.086	8.7	LOS A	3	0.36	0.66	42.5
32	R	101	4.0	0.365	16.5	LOS C	11	0.62	0.94	36.9
Approach		179	3.9	0.365	13.1	LOS B	11	0.51	0.82	39.2
All Vehicles		733	4.0	0.365	4.8	Not Applicable	11	0.15	0.32	51.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 3 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	117	4.3	0.234	8.3	LOS A	0	0.00	0.67	49.0
22	T	321	4.0	0.234	0.0	LOS A	0	0.00	0.00	60.0
Approach		438	4.1	0.234	2.2	LOS A		0.00	0.18	56.6
Illaroo Rd - North										
28	T	208	3.8	0.107	0.0	LOS A	0	0.00	0.00	60.0
29	R	27	3.7	0.059	11.1	LOS B	1	0.47	0.74	46.0
Approach		235	3.8	0.107	1.3	LOS A	1	0.05	0.08	58.0
Pitt St - West										
30	L	47	4.3	0.061	9.5	LOS A	2	0.44	0.70	41.9
32	R	109	3.7	0.440	20.4	LOS C	14	0.71	1.00	34.6
Approach		156	3.8	0.439	17.1	LOS C	14	0.63	0.91	36.5
All Vehicles		829	4.0	0.440	4.8	Not Applicable	14	0.13	0.29	51.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	55	3.6	0.118	8.3	LOS A	0	0.00	0.67	49.0
22	T	166	4.2	0.118	0.0	LOS A	0	0.00	0.00	60.0
Approach		222	4.1	0.118	2.1	LOS A		0.00	0.17	56.8
Illaroo Rd - North										
28	T	282	3.9	0.145	0.0	LOS A	0	0.00	0.00	60.0
29	R	43	4.7	0.081	9.6	LOS A	2	0.32	0.66	47.4
Approach		325	4.0	0.145	1.3	LOS A	2	0.04	0.09	58.0
Pitt St - West										
30	L	61	3.3	0.062	8.3	LOS A	2	0.30	0.63	42.8
32	R	102	3.9	0.371	16.7	LOS C	11	0.63	0.94	36.7
Approach		163	3.7	0.371	13.6	LOS B	11	0.51	0.82	38.8
All Vehicles		710	3.9	0.371	4.3	Not Applicable	11	0.14	0.28	51.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

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Site: 2016OPT3-MVRDLK-AMILLAROOPITT
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and Pitt Street

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - South										
21	L	146	4.1	0.262	8.3	LOS A	0	0.00	0.67	49.0
22	T	343	4.1	0.261	0.0	LOS A	0	0.00	0.00	60.0
Approach		489	4.1	0.261	2.5	LOS A		0.00	0.20	56.2
Illaroo Rd - North										
28	T	158	3.8	0.081	0.0	LOS A	0	0.00	0.00	60.0
29	R	45	4.4	0.103	11.7	LOS B	2	0.50	0.78	45.5
Approach		203	3.9	0.103	2.6	LOS A	2	0.11	0.17	56.0
Pitt St - West										
30	L	67	4.4	0.093	9.9	LOS A	3	0.47	0.74	41.6
32	R	74	4.1	0.301	18.3	LOS C	8	0.68	0.94	35.8
Approach		142	4.2	0.301	14.3	LOS B	8	0.58	0.84	38.4
All Vehicles		834	4.1	0.301	4.5	Not Applicable	8	0.13	0.30	52.1

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	146	4.1	0.085	10.2	LOS A	6	0.46	0.38	47.0
23	R	6	14.3	0.085	10.3	LOS A	6	0.46	0.71	46.8
Approach		153	4.6	0.085	10.2	LOS A	6	0.46	0.39	47.0
West Cambewarra Rd - East										
24	L	22	4.5	0.031	9.3	LOS A	1	0.38	0.63	42.2
25	T	1	50.0	0.031	8.8	LOS A	1	0.38	0.72	42.3
Approach		24	8.3	0.031	9.2	LOS A	1	0.38	0.64	42.2
Illaroo Rd - West										
10	L	1	50.0	0.133	8.3	LOS A	0	0.00	0.69	48.8
11	T	251	4.0	0.134	8.0	LOS A	0	0.00	0.66	49.3
Approach		253	4.3	0.134	8.0	LOS A		0.00	0.66	49.3
All Vehicles		430	4.7	0.134	8.8	Not Applicable	6	0.18	0.57	48.0

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Movement Summary

Illaroo Road and West Cambewarra Road

2005 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	238	4.2	0.155	9.3	LOS A	10	0.33	0.46	47.5
23	R	31	3.3	0.155	9.5	LOS A	10	0.33	0.67	47.3
Approach		268	4.1	0.155	9.3	LOS A	10	0.33	0.49	47.5
West Cambewarra Rd - East										
24	L	17	5.9	0.031	9.3	LOS A	1	0.32	0.60	42.1
25	T	6	14.3	0.031	9.0	LOS A	1	0.32	0.69	42.3
Approach		24	8.3	0.031	9.2	LOS A	1	0.32	0.62	42.2
Illaroo Rd - West										
10	L	14	7.1	0.082	8.4	LOS A	0	0.00	0.69	48.8
11	T	141	4.3	0.082	8.0	LOS A	0	0.00	0.66	49.3
Approach		155	4.5	0.082	8.0	LOS A		0.00	0.67	49.2
All Vehicles		447	4.5	0.155	8.9	Not Applicable	10	0.22	0.56	47.7

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 AM DN2P Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	173	4.0	0.089	8.4	LOS A	0	0.00	0.69	48.8
23	R	8	11.1	0.020	10.2	LOS B	0	0.37	0.66	47.0
Approach		182	4.4	0.089	8.5	LOS A	0	0.02	0.69	48.7
West Cambewarra Rd - East										
24	L	15	6.7	0.026	9.9	LOS A	1	0.42	0.64	41.7
25	T	2	33.3	0.026	9.4	LOS A	1	0.42	0.72	41.8
Approach		18	11.1	0.026	9.8	LOS A	1	0.42	0.65	41.7
Illaroo Rd - West										
10	L	1	50.0	0.143	8.3	LOS A	0	0.00	0.69	48.8
11	T	277	4.0	0.147	7.8	LOS A	0	0.00	0.65	49.5
Approach		279	4.3	0.147	7.9	LOS A		0.00	0.65	49.5
All Vehicles		479	4.6	0.147	8.2	Not Applicable	1	0.02	0.67	48.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

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Site: 2016DN2P-AMILLAROOCAMBEWARRA
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 DN2P PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	262	3.8	0.134	8.4	LOS A	0	0.00	0.69	48.8
23	R	25	4.0	0.045	9.3	LOS A	1	0.25	0.65	47.6
Approach		287	3.8	0.134	8.5	LOS A	1	0.02	0.69	48.7
West Cambewarra Rd - East										
24	L	17	5.9	0.033	9.4	LOS A	1	0.32	0.60	42.1
25	T	7	12.5	0.033	9.0	LOS A	1	0.32	0.69	42.3
Approach		25	8.0	0.033	9.3	LOS A	1	0.32	0.62	42.1
Illaroo Rd - West										
10	L	12	8.3	0.080	8.4	LOS A	0	0.00	0.69	48.8
11	T	139	4.3	0.080	7.8	LOS A	0	0.00	0.65	49.5
Approach		151	4.6	0.080	7.9	LOS A		0.00	0.65	49.4
All Vehicles		463	4.3	0.134	8.4	Not Applicable	1	0.03	0.67	48.5

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Movement Summary

Illaroo Road and West Cambewarra Road

2016 DNSP AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	223	4.0	0.114	8.4	LOS A	0	0.00	0.69	48.8
23	R	7	12.5	0.018	10.3	LOS B	0	0.38	0.67	46.8
Approach		231	4.3	0.114	8.5	LOS A	0	0.01	0.69	48.7
West Cambewarra Rd - East										
24	L	27	3.7	0.046	9.8	LOS A	2	0.43	0.66	41.7
25	T	5	16.7	0.046	9.5	LOS A	2	0.43	0.74	41.9
Approach		33	6.1	0.046	9.8	LOS A	2	0.43	0.67	41.7
Illaroo Rd - West										
10	L	12	8.3	0.154	8.4	LOS A	0	0.00	0.69	48.8
11	T	279	3.9	0.154	7.8	LOS A	0	0.00	0.65	49.5
Approach		291	4.1	0.154	7.9	LOS A		0.00	0.65	49.4
All Vehicles		555	4.3	0.154	8.2	Not Applicable	2	0.03	0.67	48.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016DNSP-AMILLAROOCAMBEWARRA
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 DNSP PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	274	4.0	0.141	8.4	LOS A	0	0.00	0.69	48.8
23	R	39	5.1	0.072	9.4	LOS A	1	0.27	0.66	47.6
Approach		313	4.2	0.141	8.6	LOS A	1	0.03	0.69	48.6
West Cambewarra Rd - East										
24	L	15	6.7	0.036	9.9	LOS A	1	0.37	0.60	41.6
25	T	9	10.0	0.036	9.6	LOS A	1	0.37	0.70	41.8
Approach		25	8.0	0.036	9.8	LOS A	1	0.37	0.64	41.7
Illaroo Rd - West										
10	L	8	11.1	0.088	8.4	LOS A	0	0.00	0.69	48.8
11	T	158	3.8	0.088	7.8	LOS A	0	0.00	0.65	49.5
Approach		167	4.2	0.088	7.9	LOS A		0.00	0.65	49.4
All Vehicles		505	4.4	0.141	8.4	Not Applicable	1	0.04	0.68	48.5

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 1 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	181	3.9	0.093	8.4	LOS A	0	0.00	0.69	48.8
23	R	21	4.8	0.041	10.1	LOS B	1	0.36	0.68	47.1
Approach		202	4.0	0.093	8.6	LOS A	1	0.04	0.69	48.6
West Cambewarra Rd - East										
24	L	24	4.2	0.036	9.6	LOS A	1	0.41	0.65	41.9
25	T	2	33.3	0.037	9.1	LOS A	1	0.41	0.74	42.1
Approach		27	7.4	0.036	9.5	LOS A	1	0.41	0.66	41.9
Illaroo Rd - West										
10	L	8	11.1	0.150	8.4	LOS A	0	0.00	0.69	48.8
11	T	274	4.0	0.149	7.8	LOS A	0	0.00	0.65	49.5
Approach		283	4.2	0.149	7.9	LOS A		0.00	0.65	49.4
All Vehicles		512	4.3	0.150	8.2	Not Applicable	1	0.04	0.67	48.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-AMILLAROOCAMBEWARRA
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 1 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	222	4.1	0.114	8.4	LOS A	0	0.00	0.69	48.8
23	R	29	3.4	0.053	9.4	LOS A	1	0.28	0.66	47.5
Approach		251	4.0	0.114	8.6	LOS A	1	0.03	0.69	48.6
West Cambewarra Rd - East										
24	L	13	7.7	0.025	9.5	LOS A	1	0.35	0.60	42.0
25	T	4	20.0	0.025	9.1	LOS A	1	0.35	0.69	42.2
Approach		18	11.1	0.025	9.4	LOS A	1	0.35	0.62	42.1
Illaroo Rd - West										
10	L	14	7.1	0.095	8.4	LOS A	0	0.00	0.69	48.8
11	T	163	4.3	0.094	7.8	LOS A	0	0.00	0.65	49.5
Approach		178	4.5	0.094	7.9	LOS A		0.00	0.65	49.4
All Vehicles		447	4.5	0.114	8.3	Not Applicable	1	0.03	0.67	48.6

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
South East Approach										
22	T	132	3.1	0.089	5.7	LOS A	4	0.17	0.45	51.1
23	R	1	0.0	0.091	11.4	LOS A	4	0.17	0.64	46.0
Approach		132	3.0	0.089	5.7	LOS A	4	0.17	0.45	51.0
North East Approach										
24	L	21	4.8	0.038	7.2	LOS A	2	0.50	0.55	48.9
25	T	12	8.3	0.038	11.9	LOS A	2	0.50	0.65	45.4
26	R	6	14.3	0.037	14.3	LOS A	2	0.50	0.66	43.9
Approach		40	7.5	0.037	9.8	LOS A	2	0.50	0.60	46.8
North Approach										
7	L	8	11.1	0.167	7.2	LOS A	8	0.39	0.57	48.9
8	T	168	1.8	0.168	5.3	LOS A	8	0.39	0.48	50.5
9	R	35	2.9	0.168	12.3	LOS A	8	0.39	0.65	45.0
Approach		212	2.4	0.168	6.6	LOS A	8	0.39	0.51	49.4
West Approach										
10	L	54	1.9	0.181	5.6	LOS A	9	0.17	0.45	51.1
11	T	226	2.2	0.181	9.9	LOS A	9	0.17	0.61	47.1
Approach		281	2.1	0.181	9.1	LOS A	9	0.17	0.58	47.8
All Vehicles		665	2.7	0.181	7.7	LOS A	9	0.26	0.53	48.8

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
South East Approach										
22	T	363	3.3	0.258	6.3	LOS A	14	0.24	0.48	50.1
23	R	24	0.0	0.258	11.5	LOS A	14	0.24	0.63	45.7
Approach		388	3.1	0.258	6.6	LOS A	14	0.24	0.49	49.8
North East Approach										
24	L	13	7.7	0.022	6.5	LOS A	1	0.39	0.49	49.6
25	T	4	20.0	0.022	11.2	LOS A	1	0.39	0.62	45.8
26	R	6	14.3	0.022	13.6	LOS A	1	0.39	0.64	44.3
Approach		25	12.0	0.022	9.4	LOS A	1	0.39	0.56	47.1
North Approach										
7	L	3	25.0	0.108	6.7	LOS A	5	0.32	0.54	49.4
8	T	75	1.4	0.108	5.0	LOS A	5	0.32	0.44	51.1
9	R	64	1.6	0.108	11.9	LOS A	5	0.32	0.63	45.3
Approach		142	2.1	0.108	8.2	LOS A	5	0.32	0.53	48.1
West Approach										
10	L	58	1.7	0.149	6.1	LOS A	7	0.34	0.50	49.9
11	T	137	2.2	0.149	10.4	LOS A	7	0.34	0.62	46.4
Approach		195	2.1	0.149	9.1	LOS A	7	0.34	0.59	47.3
All Vehicles		750	2.9	0.258	7.6	LOS A	14	0.29	0.52	48.7

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 2 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	99	4.0	0.051	8.4	LOS A	0	0.00	0.69	48.8
23	R	9	10.0	0.021	10.1	LOS B	0	0.37	0.66	47.0
Approach		109	4.6	0.051	8.6	LOS A	0	0.03	0.69	48.6
West Cambewarra Rd - East										
24	L	28	3.6	0.040	9.2	LOS A	1	0.39	0.65	42.2
25	T	3	25.0	0.040	8.9	LOS A	1	0.39	0.70	42.4
Approach		32	6.2	0.040	9.2	LOS A	1	0.39	0.65	42.2
Illaroo Rd - West										
10	L	13	7.7	0.148	8.4	LOS A	0	0.00	0.69	48.8
11	T	265	4.1	0.147	7.8	LOS A	0	0.00	0.65	49.5
Approach		279	4.3	0.147	7.9	LOS A		0.00	0.65	49.4
All Vehicles		420	4.5	0.148	8.2	Not Applicable	1	0.04	0.66	48.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT2-AMILLAROOCAMBEWARRA
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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 2 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Illaroo Rd - East										
22	T	238	4.2	0.122	8.4	LOS A	0	0.00	0.69	48.8
23	R	32	3.2	0.056	9.4	LOS A	1	0.27	0.65	47.6
Approach		269	4.1	0.122	8.5	LOS A	1	0.03	0.69	48.6
West Cambewarra Rd - East										
24	L	23	4.3	0.032	8.9	LOS A	1	0.30	0.60	42.5
25	T	3	25.0	0.033	8.6	LOS A	1	0.30	0.69	42.7
Approach		27	7.4	0.032	8.8	LOS A	1	0.30	0.62	42.5
Illaroo Rd - West										
10	L	7	12.5	0.086	8.4	LOS A	0	0.00	0.69	48.8
11	T	154	3.9	0.086	7.8	LOS A	0	0.00	0.65	49.5
Approach		162	4.3	0.086	7.9	LOS A		0.00	0.65	49.4
All Vehicles		458	4.4	0.122	8.3	Not Applicable	1	0.04	0.67	48.5

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 3 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
ILLAROO SOUTH										
22	T	82	3.7	0.183	4.5	LOS A	10	0.13	0.38	52.7
23	R	214	4.2	0.183	11.4	LOS B	10	0.13	0.64	46.2
Approach		296	4.1	0.183	9.5	LOS A	10	0.13	0.57	47.7
WEST CAMBEWARRA										
24	L	81	3.7	0.082	6.0	LOS A	4	0.31	0.48	50.1
25	T	27	3.7	0.082	10.7	LOS B	4	0.31	0.62	46.2
Approach		108	3.7	0.082	7.2	LOS A	4	0.31	0.51	49.0
ILLAROO NORTH										
11	T	284	3.9	0.221	7.7	LOS A	11	0.39	0.57	48.5
Approach		284	3.9	0.221	7.7	LOS A	11	0.39	0.57	48.5
All Vehicles		688	3.9	0.221	8.4	LOS A	11	0.27	0.56	48.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-AMILLAROOCAMBEWARRA
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Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 3 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
ILLAROO SOUTH										
22	T	161	3.7	0.250	4.8	LOS A	14	0.27	0.41	51.5
23	R	207	3.9	0.251	11.7	LOS A	14	0.27	0.63	45.6
Approach		368	3.8	0.251	8.7	LOS A	14	0.27	0.53	47.9
WEST CAMBEWARRA										
24	L	113	4.4	0.150	6.0	LOS A	8	0.30	0.48	50.2
25	T	91	4.4	0.150	10.7	LOS A	8	0.30	0.62	46.2
Approach		204	4.4	0.150	8.1	LOS A	8	0.30	0.54	48.3
ILLAROO NORTH										
11	T	212	3.8	0.165	8.1	LOS A	8	0.38	0.57	48.1
Approach		211	3.8	0.165	8.1	LOS A	8	0.38	0.57	48.1
All Vehicles		783	4.0	0.251	8.4	LOS A	14	0.31	0.55	48.1

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
South East Approach										
22	T	54	3.7	0.161	5.7	LOS A	8	0.21	0.45	50.9
23	R	184	3.8	0.161	11.6	LOS A	8	0.21	0.63	45.8
Approach		238	3.8	0.161	10.3	LOS A	8	0.21	0.59	46.8
North East Approach										
24	L	93	4.3	0.119	6.3	LOS A	6	0.38	0.51	49.6
25	T	44	4.5	0.119	11.0	LOS A	6	0.38	0.64	45.9
26	R	13	7.7	0.119	13.4	LOS A	6	0.38	0.66	44.3
Approach		150	4.7	0.119	8.3	LOS A	6	0.38	0.56	47.9
North Approach										
7	L	11	9.1	0.065	8.1	LOS A	3	0.52	0.61	48.2
8	T	44	4.5	0.065	6.3	LOS A	3	0.52	0.54	49.5
9	R	14	7.1	0.065	13.2	LOS A	3	0.52	0.67	44.5
Approach		69	5.8	0.065	8.0	LOS A	3	0.52	0.58	48.1
West Approach										
10	L	29	3.4	0.227	6.4	LOS A	12	0.40	0.53	49.5
11	T	262	3.8	0.227	8.2	LOS A	12	0.40	0.58	48.0
Approach		291	3.8	0.227	8.1	LOS A	12	0.40	0.58	48.2
All Vehicles		748	4.1	0.227	8.8	LOS A	12	0.35	0.58	47.7

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SIDRA INTERSECTION

Movement Summary

Illaroo Road and West Cambewarra Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
South East Approach										
22	T	179	3.9	0.242	6.9	LOS A	13	0.43	0.55	49.0
23	R	126	4.0	0.242	12.4	LOS A	13	0.43	0.67	44.9
Approach		305	3.9	0.242	9.2	LOS A	13	0.43	0.60	47.1
North East Approach										
24	L	66	4.5	0.174	6.4	LOS A	9	0.40	0.53	49.5
25	T	105	3.8	0.174	11.1	LOS A	9	0.40	0.65	45.8
26	R	48	4.2	0.175	13.5	LOS A	9	0.40	0.66	44.3
Approach		220	4.1	0.174	10.2	LOS A	9	0.40	0.61	46.4
North Approach										
7	L	29	3.4	0.132	7.3	LOS A	6	0.41	0.57	48.8
8	T	55	3.6	0.132	5.5	LOS A	6	0.41	0.49	50.4
9	R	78	3.8	0.132	12.4	LOS A	6	0.41	0.65	44.9
Approach		162	3.7	0.132	9.2	LOS A	6	0.41	0.58	47.2
West Approach										
10	L	57	3.5	0.155	6.5	LOS A	8	0.42	0.53	49.4
11	T	136	3.7	0.155	8.7	LOS A	8	0.42	0.59	47.6
Approach		192	3.6	0.155	8.0	LOS A	8	0.42	0.58	48.1
All Vehicles		879	3.9	0.242	9.2	LOS A	13	0.42	0.60	47.2

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	756	4.0	0.388	0.0	LOS A	0	0.00	0.00	60.0
26	R	25	4.0	0.061	12.3	LOS A	1	0.53	0.79	44.9
Approach		781	4.0	0.388	0.4	LOS A	1	0.02	0.03	59.4
Beinda St - North										
27	L	39	5.1	0.066	11.3	LOS A	2	0.53	0.79	40.6
29	R	1	50.0	0.125	208.9	LOS F	4	0.98	0.99	8.6
Approach		41	7.3	0.122	20.9	LOS B	4	0.55	0.80	34.4
Bolong Rd - West										
30	L	5	16.7	0.300	8.3	LOS A	0	0.00	0.67	49.0
31	T	552	4.0	0.294	0.0	LOS A	0	0.00	0.00	60.0
Approach		558	4.1	0.294	0.1	LOS A		0.00	0.01	59.9
All Vehicles		1380	4.1	0.388	0.9	Not Applicable	4	0.03	0.04	58.3

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2005 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	880	4.0	0.451	0.0	LOS A	0	0.00	0.00	60.0
26	R	25	4.0	0.075	15.1	LOS B	2	0.66	0.89	42.4
Approach		905	4.0	0.451	0.4	LOS A	2	0.02	0.02	59.3
Beinda St - North										
27	L	23	4.3	0.054	13.9	LOS A	2	0.66	0.88	38.7
29	R	1	50.0	0.400	791.6	LOS F	12	0.99	1.01	2.6
Approach		25	8.0	0.377	76.1	LOS F	12	0.69	0.89	18.4
Bolong Rd - West										
30	L	5	16.7	0.400	8.3	LOS A	0	0.00	0.67	49.0
31	T	738	4.1	0.392	0.0	LOS A	0	0.00	0.00	60.0
Approach		744	4.2	0.392	0.1	LOS A		0.00	0.01	59.9
All Vehicles		1674	4.1	0.451	1.4	Not Applicable	12	0.02	0.03	57.7

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 DN2P AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	838	4.1	0.430	0.0	LOS A	0	0.00	0.00	60.0
26	R	22	4.5	0.056	12.8	LOS A	1	0.55	0.81	44.4
Approach		860	4.1	0.430	0.3	LOS A	1	0.01	0.02	59.5
Beinda St - North										
27	L	58	3.4	0.105	11.9	LOS A	3	0.57	0.84	40.1
29	R	1	50.0	0.182	336.4	LOS F	6	0.99	1.00	5.7
Approach		60	5.0	0.187	22.7	LOS B	6	0.58	0.84	33.4
Bolong Rd - West										
30	L	3	25.0	0.308	8.3	LOS A	0	0.00	0.67	49.0
31	T	596	4.0	0.316	0.0	LOS A	0	0.00	0.00	60.0
Approach		600	4.2	0.316	0.1	LOS A		0.00	0.00	59.9
All Vehicles		1520	4.1	0.430	1.1	Not Applicable	6	0.03	0.05	57.9

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 DN2P PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	968	4.0	0.497	0.0	LOS A	0	0.00	0.00	60.0
26	R	24	4.2	0.075	15.6	LOS B	2	0.68	0.90	42.0
Approach		993	4.0	0.497	0.4	LOS A	2	0.02	0.02	59.4
Beinda St - North										
27	L	25	4.0	0.062	14.4	LOS A	2	0.68	0.88	38.3
29	R	91	4.4	1.000#	173.0	LOS F	31	1.00	1.12	10.1
Approach		116	4.3	1.000	138.9	LOS F	31	0.93	1.07	12.0
Bolong Rd - West										
30	L	4	20.0	0.417	8.3	LOS A	0	0.00	0.67	49.0
31	T	765	4.0	0.406	0.0	LOS A	0	0.00	0.00	60.0
Approach		771	4.2	0.406	0.1	LOS A		0.00	0.00	59.9
All Vehicles		1880	4.1	1.000	8.8	Not Applicable	31	0.07	0.08	47.9

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 DNSP AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	907	4.0	0.465	0.0	LOS A	0	0.00	0.00	60.0
26	R	105	3.8	0.378	21.3	LOS B	11	0.81	1.00	37.9
Approach		1012	4.0	0.465	2.2	LOS A	11	0.08	0.10	56.6
Beinda St - North										
27	L	144	4.2	0.450	21.1	LOS B	17	0.83	1.04	34.3
29	R	73	4.1	1.000#	231.3	LOS F	31	1.00	1.14	7.9
Approach		217	4.1	1.000	91.9	LOS F	31	0.89	1.07	16.2
Bolong Rd - West										
30	L	5	16.7	0.462	8.3	LOS A	0	0.00	0.67	49.0
31	T	867	4.0	0.460	0.0	LOS A	0	0.00	0.00	60.0
Approach		874	4.1	0.460	0.1	LOS A		0.00	0.00	59.9
All Vehicles		2103	4.0	1.000	10.6	Not Applicable	31	0.13	0.16	45.9

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Movement Summary

Bolong Road and Beinda Street

2016 DNSP PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1121	4.0	0.575	0.0	LOS A	0	0.00	0.00	60.0
26	R	120	4.2	0.543	31.1	LOS C	20	0.91	1.08	32.3
Approach		1241	4.0	0.575	3.0	LOS A	20	0.09	0.10	55.4
Beinda St - North										
27	L	92	4.3	0.413	26.8	LOS B	14	0.88	1.03	31.5
29	R	72	4.2	1.000#	594.0	LOS F	31	1.00	1.19	3.4
Approach		164	4.3	1.000	275.8	LOS F	31	0.93	1.10	6.8
Bolong Rd - West										
30	L	4	20.0	0.556	8.3	LOS A	0	0.00	0.67	49.0
31	T	1008	4.0	0.533	0.0	LOS A	0	0.00	0.00	60.0
Approach		1013	4.0	0.533	0.0	LOS A		0.00	0.00	59.9
All Vehicles		2418	4.1	1.000	20.3	Not Applicable	31	0.11	0.13	38.3

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 1 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	941	4.0	0.483	0.0	LOS A	0	0.00	0.00	60.0
26	R	62	3.2	0.204	17.4	LOS B	5	0.74	0.93	40.6
Approach		1003	4.0	0.483	1.1	LOS A	5	0.05	0.06	58.3
Beinda St - North										
27	L	173	4.0	0.473	19.6	LOS B	19	0.81	1.05	35.2
29	R	64	4.6	1.000#	200.5	LOS F	31	1.00	1.13	8.9
Approach		238	4.2	1.000	69.0	LOS E	31	0.86	1.07	19.5
Bolong Rd - West										
30	L	7	12.5	0.421	8.3	LOS A	0	0.00	0.67	49.0
31	T	808	4.0	0.430	0.0	LOS A	0	0.00	0.00	60.0
Approach		816	4.0	0.430	0.1	LOS A		0.00	0.01	59.9
All Vehicles		2057	4.0	1.000	8.5	Not Applicable	31	0.12	0.15	47.8

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Movement Summary

Bolong Road and Beinda Street

2016 Option 1 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1046	4.0	0.536	0.0	LOS A	0	0.00	0.00	60.0
26	R	161	3.7	0.732	37.8	LOS C	31	0.94	1.18	29.4
Approach		1207	4.0	0.733	5.0	LOS A	31	0.13	0.16	52.7
Beinda St - North										
27	L	84	3.6	0.382	26.4	LOS B	12	0.88	1.02	31.7
29	R	36	2.9	1.000#	581.3	LOS F	31	1.00	1.19	3.5
Approach		119	3.4	1.000	189.6	LOS F	31	0.91	1.07	9.4
Bolong Rd - West										
30	L	1	50.0	0.500	8.2	LOS A	0	0.00	0.67	49.0
31	T	1014	4.0	0.535	0.0	LOS A	0	0.00	0.00	60.0
Approach		1016	4.1	0.535	0.0	LOS A		0.00	0.00	60.0
All Vehicles		2342	4.0	1.000	12.2	Not Applicable	31	0.11	0.14	44.6

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	881	4.0	0.452	0.0	LOS A	0	0.00	0.00	60.0
26	R	66	4.5	0.217	17.1	LOS B	6	0.73	0.93	40.8
Approach		948	4.0	0.452	1.2	LOS A	6	0.05	0.07	58.1
Beinda St - North										
27	L	200	4.0	0.529	20.0	LOS B	23	0.82	1.08	34.9
29	R	19	5.3	0.679	229.0	LOS F	19	0.99	1.08	8.0
Approach		219	4.1	0.679	38.1	LOS C	23	0.84	1.08	27.0
Bolong Rd - West										
30	L	4	20.0	0.417	8.3	LOS A	0	0.00	0.67	49.0
31	T	794	4.0	0.421	0.0	LOS A	0	0.00	0.00	60.0
Approach		799	4.1	0.421	0.1	LOS A		0.00	0.00	59.9
All Vehicles		1966	4.1	0.679	4.8	Not Applicable	23	0.12	0.15	52.1

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1454	4.0	0.746	0.0	LOS A	0	0.00	0.00	60.0
26	R	132	3.8	0.627	35.3	LOS C	24	0.93	1.12	30.4
Approach		1585	4.0	0.746	2.9	LOS A	24	0.08	0.09	55.6
Beinda St - North										
27	L	117	4.3	0.560	31.7	LOS C	20	0.91	1.10	29.4
29	R	25	4.0	1.000#	1837.7	LOS F	31	1.00	1.22	1.2
Approach		142	4.2	1.000	349.7	LOS F	31	0.93	1.12	5.5
Bolong Rd - West										
30	L	2	33.3	0.500	8.2	LOS A	0	0.00	0.67	49.0
31	T	1032	4.0	0.544	0.0	LOS A	0	0.00	0.00	60.0
Approach		1034	4.1	0.544	0.0	LOS A		0.00	0.00	60.0
All Vehicles		2761	4.0	1.000	19.7	Not Applicable	31	0.09	0.11	38.7

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 2 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	931	4.0	0.477	0.0	LOS A	0	0.00	0.00	60.0
26	R	61	3.3	0.197	17.0	LOS B	5	0.73	0.92	41.0
Approach		991	3.9	0.477	1.0	LOS A	5	0.04	0.06	58.3
Beinda St - North										
27	L	129	3.9	0.343	17.5	LOS B	12	0.77	0.98	36.4
29	R	105	3.8	1.000#	184.8	LOS F	31	1.00	1.13	9.5
Approach		234	3.8	1.000	92.6	LOS F	31	0.87	1.05	16.1
Bolong Rd - West										
30	L	6	14.3	0.412	8.3	LOS A	0	0.00	0.67	49.0
31	T	796	4.0	0.423	0.0	LOS A	0	0.00	0.00	60.0
Approach		803	4.1	0.423	0.1	LOS A		0.00	0.01	59.9
All Vehicles		2028	4.0	1.000	11.2	Not Applicable	31	0.12	0.15	45.2

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 2 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1060	4.0	0.544	0.0	LOS A	0	0.00	0.00	60.0
26	R	81	3.7	0.339	25.3	LOS B	11	0.86	1.00	35.4
Approach		1141	3.9	0.544	1.8	LOS A	11	0.06	0.07	57.2
Beinda St - North										
27	L	117	4.3	0.490	26.9	LOS B	17	0.89	1.06	31.4
29	R	59	3.4	1.000#	425.1	LOS F	31	1.00	1.18	4.6
Approach		176	4.0	1.000	160.4	LOS F	31	0.92	1.10	10.7
Bolong Rd - West										
30	L	1	50.0	0.500	8.2	LOS A	0	0.00	0.67	49.0
31	T	984	4.0	0.519	0.0	LOS A	0	0.00	0.00	60.0
Approach		986	4.1	0.519	0.0	LOS A		0.00	0.00	60.0
All Vehicles		2303	4.0	1.000	13.2	Not Applicable	31	0.10	0.12	43.7

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 3 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1011	4.0	0.518	0.0	LOS A	0	0.00	0.00	60.0
26	R	48	4.2	0.173	18.5	LOS B	4	0.76	0.93	39.8
Approach		1058	4.0	0.518	0.8	LOS A	4	0.03	0.04	58.7
Beinda St - North										
27	L	154	3.9	0.478	21.5	LOS B	18	0.84	1.05	34.1
29	R	66	4.5	1.000#	258.3	LOS F	31	1.00	1.15	7.2
Approach		221	4.1	1.000	93.3	LOS F	31	0.89	1.08	16.0
Bolong Rd - West										
30	L	6	14.3	0.467	8.3	LOS A	0	0.00	0.67	49.0
31	T	864	4.0	0.459	0.0	LOS A	0	0.00	0.00	60.0
Approach		872	4.1	0.459	0.1	LOS A		0.00	0.01	59.9
All Vehicles		2151	4.0	1.000	10.0	Not Applicable	31	0.11	0.13	46.4

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 3 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1023	4.0	0.525	0.0	LOS A	0	0.00	0.00	60.0
26	R	104	3.8	0.450	28.1	LOS B	15	0.88	1.04	33.9
Approach		1127	4.0	0.525	2.6	LOS A	15	0.08	0.10	56.0
Beinda St - North										
27	L	97	4.1	0.418	26.1	LOS B	14	0.88	1.03	31.8
29	R	96	4.2	1.000#	423.0	LOS F	31	1.00	1.18	4.6
Approach		193	4.1	1.000	223.5	LOS F	31	0.94	1.11	8.2
Bolong Rd - West										
30	L	4	20.0	0.500	8.3	LOS A	0	0.00	0.67	49.0
31	T	994	4.0	0.526	0.0	LOS A	0	0.00	0.00	60.0
Approach		999	4.1	0.526	0.0	LOS A		0.00	0.00	59.9
All Vehicles		2319	4.1	1.000	19.9	Not Applicable	31	0.12	0.14	38.4

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	900	4.0	0.462	0.0	LOS A	0	0.00	0.00	60.0
26	R	95	4.2	0.347	21.1	LOS B	10	0.80	0.99	38.0
Approach		995	4.0	0.462	2.0	LOS A	10	0.08	0.09	56.9
Beinda St - North										
27	L	151	3.8	0.498	22.3	LOS B	19	0.85	1.07	33.7
29	R	125	4.2	1.000#	227.7	LOS F	31	1.00	1.14	8.0
Approach		271	4.0	1.000	113.6	LOS F	31	0.93	1.12	14.1
Bolong Rd - West										
30	L	1	50.0	0.500	8.2	LOS A	0	0.00	0.67	49.0
31	T	879	4.0	0.464	0.0	LOS A	0	0.00	0.00	60.0
Approach		881	4.1	0.464	0.0	LOS A		0.00	0.00	60.0
All Vehicles		2152	4.0	1.000	15.2	Not Applicable	31	0.15	0.19	41.6

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Beinda Street

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
25	T	1042	4.0	0.534	0.0	LOS A	0	0.00	0.00	60.0
26	R	92	4.3	0.430	29.2	LOS C	14	0.89	1.03	33.3
Approach		1134	4.1	0.534	2.4	LOS A	14	0.07	0.08	56.3
Beinda St - North										
27	L	94	4.3	0.437	28.0	LOS B	15	0.89	1.04	30.9
29	R	78	3.8	1.000#	458.5	LOS F	31	1.00	1.18	4.3
Approach		172	4.1	1.000	223.2	LOS F	31	0.94	1.11	8.2
Bolong Rd - West										
30	L	3	25.0	0.571	8.3	LOS A	0	0.00	0.67	49.0
31	T	1021	4.0	0.540	0.0	LOS A	0	0.00	0.00	60.0
Approach		1025	4.1	0.540	0.0	LOS A		0.00	0.00	59.9
All Vehicles		2331	4.1	1.000	17.6	Not Applicable	31	0.10	0.12	40.1

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2005 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	421	4.0	0.581	11.6	LOS B	49	0.81	0.83	45.6
6	R	81	3.7	0.583	15.7	LOS B	49	0.81	0.87	42.3
Approach		502	4.0	0.581	12.3	LOS B	49	0.81	0.84	45.0
Meroo Rd - North										
7	L	53	3.8	0.445	9.4	LOS A	29	0.66	0.72	41.9
8	T	360	3.9	0.444	11.9	LOS B	29	0.66	0.76	40.2
Approach		413	3.9	0.444	11.6	LOS B	29	0.66	0.76	40.4
Bolong Rd - West										
30	L	303	4.0	0.468	7.6	LOS A	39	0.41	0.54	48.3
31	T	305	3.9	0.467	10.8	LOS B	39	0.41	0.63	45.7
Approach		608	3.9	0.467	9.2	LOS A	39	0.41	0.59	47.0
All Vehicles		1523	3.9	0.583	10.9	LOS B	49	0.61	0.72	44.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2005AMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2005 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	441	4.1	0.643	14.3	LOS B	61	0.91	0.97	43.2
6	R	54	3.7	0.643	18.3	LOS B	61	0.91	0.98	40.2
Approach		495	4.0	0.642	14.7	LOS B	61	0.91	0.97	42.8
Meroo Rd - North										
7	L	46	4.3	0.561	11.3	LOS B	45	0.78	0.84	40.5
8	T	446	4.0	0.562	13.8	LOS B	45	0.78	0.86	38.9
Approach		492	4.1	0.562	13.6	LOS B	45	0.78	0.86	39.0
Bolong Rd - West										
30	L	391	4.1	0.545	7.4	LOS A	53	0.37	0.52	48.5
31	T	371	4.0	0.544	10.6	LOS B	53	0.37	0.61	45.8
Approach		762	4.1	0.544	9.0	LOS A	53	0.37	0.56	47.2
All Vehicles		1749	4.1	0.643	11.9	LOS B	61	0.64	0.76	43.4

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2005PMBOLONGMEROO
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Movement Summary

Bolong Road and Meroo Road

2016 DN2P AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	505	4.0	0.661	12.9	LOS B	65	0.87	0.89	44.4
6	R	74	4.1	0.661	17.0	LOS B	65	0.87	0.91	41.3
Approach		579	4.0	0.661	13.4	LOS B	65	0.87	0.89	44.0
Meroo Rd - North										
7	L	55	3.6	0.462	9.9	LOS A	31	0.70	0.76	41.6
8	T	355	3.9	0.462	12.4	LOS B	31	0.70	0.79	39.9
Approach		410	3.9	0.462	12.1	LOS B	31	0.70	0.78	40.1
Bolong Rd - West										
30	L	294	4.1	0.485	7.5	LOS A	42	0.40	0.53	48.4
31	T	348	4.0	0.485	10.8	LOS B	42	0.40	0.63	45.7
Approach		642	4.0	0.485	9.3	LOS A	42	0.40	0.58	46.9
All Vehicles		1631	4.0	0.661	11.4	LOS B	65	0.64	0.74	44.0

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 DN2P PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	536	3.9	0.771	18.1	LOS B	95	1.00	1.10	40.2
6	R	63	4.7	0.771	22.1	LOS C	95	1.00	1.10	37.7
Approach		599	4.0	0.771	18.5	LOS B	95	1.00	1.10	39.9
Meroo Rd - North										
7	L	48	4.2	0.600	13.0	LOS B	52	0.84	0.93	39.2
8	T	440	4.1	0.601	15.6	LOS B	52	0.84	0.95	37.8
Approach		488	4.1	0.601	15.3	LOS B	52	0.84	0.95	37.9
Bolong Rd - West										
30	L	356	3.9	0.576	7.5	LOS A	59	0.43	0.52	48.2
31	T	435	3.9	0.576	10.8	LOS B	59	0.43	0.61	45.6
Approach		790	3.9	0.576	9.3	LOS A	59	0.43	0.57	46.7
All Vehicles		1877	4.0	0.771	13.8	LOS B	95	0.72	0.84	41.9

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 DNSP AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	600	4.0	0.832	21.4	LOS C	121	1.00	1.19	37.8
6	R	49	4.1	0.831	25.5	LOS C	121	1.00	1.19	35.6
Approach		649	4.0	0.832	21.7	LOS C	121	1.00	1.19	37.6
Meroo Rd - North										
7	L	44	4.5	0.587	12.6	LOS B	50	0.83	0.91	39.5
8	T	442	4.1	0.590	15.1	LOS B	50	0.83	0.93	38.0
Approach		486	4.1	0.590	14.9	LOS B	50	0.83	0.92	38.2
Bolong Rd - West										
30	L	528	4.0	0.662	7.4	LOS A	80	0.45	0.50	48.1
31	T	420	4.0	0.661	10.7	LOS B	80	0.45	0.59	45.6
Approach		948	4.0	0.662	8.9	LOS A	80	0.45	0.54	47.0
All Vehicles		2083	4.0	0.832	14.3	LOS B	121	0.71	0.83	41.5

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 DNSP PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	567	4.0	1.046	93.7	LOS F	345	1.00	2.48	16.7
6	R	67	4.4	1.046	97.8	LOS F	345	1.00	2.48	16.5
Approach		636	4.1	1.047	94.1	LOS F	345	1.00	2.48	16.7
Meroo Rd - North										
7	L	44	4.5	0.863	25.6	LOS C	137	1.00	1.38	31.9
8	T	609	3.9	0.865	28.2	LOS C	137	1.00	1.38	31.0
Approach		653	4.0	0.865	28.0	LOS C	137	1.00	1.38	31.1
Bolong Rd - West										
30	L	562	3.9	0.756	7.8	LOS A	108	0.62	0.50	47.2
31	T	491	4.1	0.757	11.1	LOS B	108	0.62	0.56	45.0
Approach		1053	4.0	0.756	9.4	LOS A	108	0.62	0.53	46.1
All Vehicles		2342	4.0	1.046	37.6	LOS D	345	0.83	1.30	28.6

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 1 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	595	4.0	0.814	19.7	LOS B	113	1.00	1.14	39.0
6	R	57	3.5	0.814	23.7	LOS C	113	1.00	1.14	36.7
Approach		652	4.0	0.814	20.0	LOS C	113	1.00	1.14	38.8
Meroo Rd - North										
7	L	87	3.4	0.613	12.9	LOS B	54	0.84	0.92	39.3
8	T	421	4.0	0.613	15.4	LOS B	54	0.84	0.94	37.8
Approach		508	3.9	0.613	15.0	LOS B	54	0.84	0.94	38.1
Bolong Rd - West										
30	L	503	4.0	0.653	7.5	LOS A	77	0.47	0.51	48.0
31	T	414	4.1	0.653	10.8	LOS B	77	0.47	0.59	45.5
Approach		917	4.0	0.653	9.0	LOS A	77	0.47	0.55	46.8
All Vehicles		2077	4.0	0.814	13.9	LOS B	113	0.73	0.83	41.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 1 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	569	4.0	1.044	91.5	LOS F	337	1.00	2.44	17.0
6	R	62	3.2	1.051	95.5	LOS F	337	1.00	2.44	16.8
Approach		632	4.0	1.043	91.9	LOS F	337	1.00	2.44	17.0
Meroo Rd - North										
7	L	78	3.8	0.963	48.1	LOS D	232	1.00	1.96	24.0
8	T	612	3.9	0.965	50.7	LOS D	232	1.00	1.96	23.6
Approach		689	3.9	0.966	50.4	LOS D	232	1.00	1.96	23.6
Bolong Rd - West										
30	L	537	3.9	0.765	7.8	LOS A	112	0.61	0.50	47.3
31	T	542	4.1	0.764	11.1	LOS B	112	0.61	0.56	45.0
Approach		1078	4.0	0.764	9.4	LOS A	112	0.61	0.53	46.1
All Vehicles		2399	4.0	1.051	42.9	LOS D	337	0.83	1.44	26.8

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-PMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	552	4.0	0.772	17.5	LOS B	96	1.00	1.08	40.6
6	R	65	4.5	0.767	21.6	LOS C	96	1.00	1.08	38.0
Approach		618	4.0	0.772	18.0	LOS B	96	1.00	1.08	40.3
Meroo Rd - North										
7	L	96	4.2	0.608	12.4	LOS B	53	0.83	0.89	39.7
8	T	419	4.1	0.606	14.9	LOS B	53	0.83	0.91	38.2
Approach		515	4.1	0.607	14.4	LOS B	53	0.83	0.91	38.5
Bolong Rd - West										
30	L	489	4.1	0.641	7.6	LOS A	73	0.49	0.52	47.9
31	T	391	4.1	0.641	10.9	LOS B	73	0.49	0.60	45.4
Approach		881	4.1	0.641	9.1	LOS A	73	0.49	0.55	46.7
All Vehicles		2014	4.1	0.772	13.2	LOS B	96	0.73	0.81	42.3

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-MVRDLK-AMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	554	4.0	0.933	38.7	LOS D	185	1.00	1.58	29.1
6	R	78	3.8	0.929	42.8	LOS D	185	1.00	1.58	27.9
Approach		632	4.0	0.933	39.2	LOS D	185	1.00	1.58	28.9
Meroo Rd - North										
7	L	63	4.7	0.853	25.7	LOS C	124	1.00	1.37	31.9
8	T	529	4.0	0.848	28.2	LOS C	124	1.00	1.37	31.0
Approach		593	4.0	0.848	27.9	LOS C	124	1.00	1.37	31.1
Bolong Rd - West										
30	L	541	4.1	0.794	8.2	LOS A	119	0.74	0.52	46.6
31	T	537	3.9	0.794	11.5	LOS B	119	0.74	0.56	44.6
Approach		1077	4.0	0.795	9.8	LOS A	119	0.74	0.54	45.6
All Vehicles		2302	4.0	0.933	22.5	LOS C	185	0.88	1.04	35.7

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT1-MVRDLK-PMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 2 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	523	4.0	0.821	23.1	LOS C	112	1.00	1.24	36.7
6	R	54	3.7	0.818	27.2	LOS C	112	1.00	1.24	34.7
Approach		577	4.0	0.821	23.5	LOS C	112	1.00	1.24	36.5
Meroo Rd - North										
7	L	78	3.8	0.661	12.6	LOS B	64	0.84	0.89	39.6
8	T	519	4.0	0.660	15.1	LOS B	64	0.84	0.91	38.1
Approach		597	4.0	0.660	14.8	LOS B	64	0.84	0.91	38.2
Bolong Rd - West										
30	L	498	4.0	0.603	7.4	LOS A	66	0.42	0.51	48.3
31	T	351	4.0	0.603	10.7	LOS B	66	0.42	0.60	45.7
Approach		849	4.0	0.603	8.8	LOS A	66	0.42	0.55	47.2
All Vehicles		2023	4.0	0.821	14.8	LOS B	112	0.71	0.85	40.9

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT2-AMBOLONGMEROO
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Movement Summary

Bolong Road and Meroo Road

2016 Option 2 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	517	4.1	0.945	46.1	LOS D	190	1.00	1.69	26.4
6	R	61	3.3	0.953	50.2	LOS D	190	1.00	1.69	25.5
Approach		578	4.0	0.946	46.5	LOS D	190	1.00	1.69	26.3
Meroo Rd - North										
7	L	62	3.2	0.886	28.5	LOS C	152	1.00	1.46	30.6
8	T	605	4.0	0.887	31.0	LOS C	152	1.00	1.46	29.8
Approach		667	3.9	0.887	30.8	LOS C	152	1.00	1.46	29.9
Bolong Rd - West										
30	L	555	4.0	0.750	7.8	LOS A	106	0.60	0.50	47.3
31	T	498	4.0	0.750	11.1	LOS B	106	0.60	0.56	45.0
Approach		1053	4.0	0.750	9.3	LOS A	106	0.60	0.53	46.2
All Vehicles		2298	4.0	0.953	24.9	LOS C	190	0.82	1.09	34.3

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT2-PMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 3 AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	623	4.0	0.898	28.8	LOS C	162	1.00	1.37	33.5
6	R	57	3.5	0.905	32.8	LOS C	162	1.00	1.37	31.9
Approach		680	4.0	0.898	29.1	LOS C	162	1.00	1.37	33.4
Meroo Rd - North										
7	L	94	4.3	0.676	14.5	LOS B	68	0.90	0.99	38.2
8	T	461	3.9	0.677	17.0	LOS B	68	0.90	1.01	36.8
Approach		555	4.0	0.677	16.6	LOS B	68	0.90	1.00	37.1
Bolong Rd - West										
30	L	522	4.0	0.673	7.6	LOS A	82	0.49	0.51	47.9
31	T	425	4.0	0.672	10.8	LOS B	82	0.49	0.59	45.4
Approach		947	4.0	0.673	9.0	LOS A	82	0.49	0.54	46.7
All Vehicles		2182	4.0	0.905	17.2	LOS B	162	0.75	0.92	39.2

Symbols which may appear in this table:

Following Degree of Saturation
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* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-AMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 3 PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	489	4.1	0.911	38.1	LOS D	157	1.00	1.53	29.3
6	R	62	3.2	0.912	42.2	LOS D	157	1.00	1.53	28.1
Approach		552	4.0	0.911	38.5	LOS D	157	1.00	1.53	29.2
Meroo Rd - North										
7	L	59	3.4	0.894	30.3	LOS C	161	1.00	1.51	29.9
8	T	612	3.9	0.899	32.8	LOS C	161	1.00	1.51	29.1
Approach		670	3.9	0.898	32.6	LOS C	161	1.00	1.51	29.2
Bolong Rd - West										
30	L	548	4.0	0.752	7.8	LOS A	107	0.60	0.50	47.3
31	T	504	4.0	0.751	11.1	LOS B	107	0.60	0.56	45.0
Approach		1052	4.0	0.752	9.4	LOS A	107	0.60	0.53	46.2
All Vehicles		2274	4.0	0.912	23.3	LOS C	161	0.82	1.06	35.2

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-PMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	562	3.9	0.795	19.5	LOS B	104	1.00	1.14	39.1
6	R	46	4.3	0.793	23.6	LOS C	104	1.00	1.14	36.7
Approach		608	3.9	0.795	19.8	LOS B	104	1.00	1.14	38.9
Meroo Rd - North										
7	L	73	4.1	0.635	13.5	LOS B	59	0.86	0.95	38.9
8	T	452	4.0	0.636	16.0	LOS B	59	0.86	0.97	37.5
Approach		525	4.0	0.636	15.7	LOS B	59	0.86	0.96	37.6
Bolong Rd - West										
30	L	540	4.1	0.666	7.4	LOS A	82	0.43	0.50	48.2
31	T	422	4.0	0.666	10.7	LOS B	82	0.43	0.59	45.6
Approach		962	4.1	0.666	8.9	LOS A	82	0.43	0.54	47.0
All Vehicles		2095	4.0	0.795	13.7	LOS B	104	0.70	0.82	41.9

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-MVRDLK-AMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Bolong Road and Meroo Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bolong Rd - East										
5	T	539	4.1	0.926	38.2	LOS D	176	1.00	1.56	29.3
6	R	68	4.3	0.920	42.2	LOS D	176	1.00	1.56	28.1
Approach		608	4.1	0.926	38.6	LOS D	176	1.00	1.56	29.1
Meroo Rd - North										
7	L	71	4.2	0.887	31.2	LOS C	151	1.00	1.52	29.5
8	T	552	4.0	0.890	33.7	LOS C	151	1.00	1.52	28.8
Approach		623	4.0	0.891	33.4	LOS C	151	1.00	1.52	28.9
Bolong Rd - West										
30	L	526	4.0	0.776	8.0	LOS A	115	0.67	0.51	47.0
31	T	547	4.0	0.776	11.2	LOS B	115	0.67	0.56	44.8
Approach		1073	4.0	0.776	9.6	LOS A	115	0.67	0.53	45.8
All Vehicles		2304	4.0	0.926	23.7	LOS C	176	0.85	1.07	35.0

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: 2016OPT3-MVRDLK-PMBOLONGMEROO
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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2005 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	71	4.2	0.190	7.3	LOS A	0	0.00	0.64	43.8
2	T	287	3.8	0.190	0.0	LOS A	0	0.00	0.00	51.3
3	R	26	3.8	0.046	9.0	LOS A	1	0.41	0.66	42.3
Approach		384	3.9	0.190	2.0	LOS A	1	0.03	0.16	49.0
Railway St Car Park										
4	L	1	50.0	0.020	22.7	LOS B	1	0.69	0.73	33.4
5	T	1	50.0	0.020	21.4	LOS B	1	0.69	0.85	34.0
6	R	1	50.0	0.025	35.0	LOS C	1	0.81	0.92	28.0
Approach		6	50.0	0.025	26.4	LOS B	1	0.73	0.83	31.6
Meroo St - North										
7	L	14	7.1	0.189	7.3	LOS A	0	0.00	0.64	43.8
8	T	344	4.1	0.189	0.0	LOS A	0	0.00	0.00	51.3
9	R	19	5.3	0.034	9.0	LOS A	1	0.41	0.65	42.3
Approach		377	4.2	0.189	0.7	LOS A	1	0.02	0.06	50.4
Bunberra St - West										
10	L	8	11.1	0.026	13.4	LOS A	1	0.54	0.67	39.0
11	T	1	50.0	0.026	12.0	LOS A	1	0.54	0.79	39.9
12	R	46	4.3	0.211	19.4	LOS B	6	0.72	0.92	35.2
Approach		57	7.0	0.211	18.2	LOS B	6	0.69	0.87	35.9
All Vehicles		824	4.6	0.211	2.7	Not Applicable	6	0.08	0.17	48.2

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Movement Summary

Meroo Road and Bunberra Road

2005 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	64	4.6	0.223	7.3	LOS A	0	0.00	0.64	43.8
2	T	356	3.9	0.223	0.0	LOS A	0	0.00	0.00	51.3
3	R	27	3.7	0.050	9.5	LOS A	1	0.46	0.69	41.9
Approach		448	4.0	0.223	1.6	LOS A	1	0.03	0.13	49.4
Railway St Car Park										
4	L	4	20.0	0.030	20.8	LOS B	1	0.68	0.75	34.4
5	T	1	50.0	0.030	19.4	LOS B	1	0.68	0.86	35.1
6	R	1	50.0	0.034	50.2	LOS D	1	0.88	0.96	23.4
Approach		9	33.3	0.034	27.1	LOS B	1	0.73	0.82	31.3
Meroo St - North										
7	L	6	14.3	0.226	7.3	LOS A	0	0.00	0.64	43.8
8	T	426	4.0	0.228	0.0	LOS A	0	0.00	0.00	51.3
9	R	1	50.0	0.008	11.7	LOS A	0	0.53	0.66	40.1
Approach		435	4.4	0.228	0.2	LOS A	0	0.00	0.01	51.1
Bunberra St - West										
10	L	12	8.3	0.061	15.2	LOS B	2	0.60	0.74	37.8
11	T	11	9.1	0.061	13.9	LOS A	2	0.60	0.82	38.7
12	R	36	2.9	0.189	23.5	LOS B	5	0.79	0.93	33.0
Approach		58	5.2	0.189	19.9	LOS B	5	0.71	0.87	34.9
All Vehicles		950	4.5	0.228	2.3	Not Applicable	5	0.06	0.13	48.6

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 DN2P AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	61	3.3	0.177	7.3	LOS A	0	0.00	0.64	43.8
2	T	273	4.0	0.177	0.0	LOS A	0	0.00	0.00	51.3
3	R	34	3.0	0.058	9.0	LOS A	1	0.40	0.66	42.3
Approach		367	3.8	0.177	2.0	LOS A	1	0.04	0.17	49.0
Railway St Car Park										
4	L	1	50.0	0.018	20.8	LOS B	1	0.66	0.71	34.4
5	T	1	50.0	0.018	19.5	LOS B	1	0.66	0.82	35.1
6	R	1	50.0	0.023	32.2	LOS C	1	0.79	0.90	29.1
Approach		6	50.0	0.023	24.2	LOS B	1	0.71	0.81	32.6
Meroo St - North										
7	L	13	7.7	0.181	7.3	LOS A	0	0.00	0.64	43.8
8	T	327	4.0	0.179	0.0	LOS A	0	0.00	0.00	51.3
9	R	5	16.7	0.013	9.2	LOS A	0	0.42	0.63	42.2
Approach		346	4.3	0.179	0.4	LOS A	0	0.01	0.03	50.7
Bunberra St - West										
10	L	12	8.3	0.028	11.9	LOS A	1	0.50	0.65	40.1
11	T	1	50.0	0.027	10.5	LOS A	1	0.50	0.77	41.0
12	R	54	3.7	0.234	18.6	LOS B	6	0.70	0.92	35.7
Approach		68	5.9	0.234	17.2	LOS B	6	0.66	0.87	36.5
All Vehicles		787	4.6	0.234	2.8	Not Applicable	6	0.08	0.17	48.1

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 DN2P PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	69	4.3	0.206	7.3	LOS A	0	0.00	0.64	43.8
2	T	317	4.1	0.206	0.0	LOS A	0	0.00	0.00	51.3
3	R	29	3.4	0.054	9.5	LOS A	1	0.46	0.69	41.9
Approach		416	4.1	0.206	1.9	LOS A	1	0.03	0.16	49.1
Railway St Car Park										
4	L	4	20.0	0.029	20.0	LOS B	1	0.67	0.75	34.9
5	T	1	50.0	0.029	18.5	LOS B	1	0.67	0.85	35.6
6	R	1	50.0	0.036	52.9	LOS D	1	0.88	0.96	22.8
Approach		9	33.3	0.036	27.0	LOS B	1	0.72	0.82	31.3
Meroo St - North										
7	L	4	20.0	0.227	7.3	LOS A	0	0.00	0.64	43.8
8	T	428	4.0	0.228	0.0	LOS A	0	0.00	0.00	51.3
9	R	3	25.0	0.010	10.0	LOS A	0	0.47	0.64	41.5
Approach		437	4.3	0.228	0.2	LOS A	0	0.00	0.01	51.0
Bunberra St - West										
10	L	46	4.3	0.164	13.6	LOS A	6	0.58	0.76	38.9
11	T	32	3.2	0.164	12.3	LOS A	6	0.58	0.81	39.8
12	R	87	3.4	0.453	28.1	LOS B	15	0.82	1.04	30.9
Approach		164	3.7	0.452	21.0	LOS B	15	0.71	0.92	34.3
All Vehicles		1026	4.4	0.453	4.4	Not Applicable	15	0.13	0.22	46.4

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 DNSP AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	47	4.3	0.240	7.3	LOS A	0	0.00	0.64	43.8
2	T	407	3.9	0.240	0.0	LOS A	0	0.00	0.00	51.3
3	R	84	3.6	0.156	9.7	LOS A	3	0.48	0.73	41.8
Approach		538	3.9	0.240	2.1	LOS A	3	0.07	0.17	48.8
Railway St Car Park										
4	L	1	50.0	0.036	37.5	LOS C	1	0.82	0.84	27.2
5	T	1	50.0	0.036	36.2	LOS C	1	0.82	0.92	27.6
6	R	1	50.0	0.047	71.6	LOS F	1	0.92	0.97	19.0
Approach		6	50.0	0.047	48.4	LOS D	1	0.85	0.91	23.9
Meroo St - North										
7	L	1	50.0	0.222	7.2	LOS A	0	0.00	0.64	43.8
8	T	433	3.9	0.229	0.0	LOS A	0	0.00	0.00	51.3
9	R	33	3.1	0.060	9.7	LOS A	1	0.47	0.70	41.8
Approach		466	4.1	0.229	0.7	LOS A	1	0.03	0.05	50.4
Bunberra St - West										
10	L	13	7.7	0.047	16.7	LOS B	2	0.64	0.75	36.9
11	T	1	50.0	0.048	15.2	LOS B	2	0.64	0.84	37.7
12	R	89	4.4	0.536	39.6	LOS C	21	0.90	1.10	26.5
Approach		105	5.7	0.535	36.3	LOS C	21	0.87	1.05	27.6
All Vehicles		1115	4.4	0.536	5.0	Not Applicable	21	0.14	0.21	45.9

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 DNSP PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	97	4.1	0.283	7.3	LOS A	0	0.00	0.64	43.8
2	T	437	3.9	0.283	0.0	LOS A	0	0.00	0.00	51.3
3	R	73	4.1	0.144	10.2	LOS A	3	0.51	0.76	41.4
Approach		606	4.0	0.283	2.4	LOS A	3	0.06	0.19	48.6
Railway St Car Park										
4	L	4	20.0	0.053	32.5	LOS C	2	0.81	0.85	29.1
5	T	1	50.0	0.053	31.1	LOS C	2	0.81	0.91	29.6
6	R	1	50.0	0.061	92.9	LOS F	2	0.94	0.98	16.0
Approach		9	33.3	0.060	45.6	LOS D	2	0.84	0.89	24.7
Meroo St - North										
7	L	1	50.0	0.250	7.2	LOS A	0	0.00	0.64	43.8
8	T	503	4.0	0.266	0.0	LOS A	0	0.00	0.00	51.3
9	R	8	11.1	0.021	10.6	LOS A	0	0.52	0.70	41.1
Approach		514	4.3	0.266	0.2	LOS A	0	0.01	0.01	51.0
Bunberra St - West										
10	L	16	6.2	0.174	21.6	LOS B	6	0.77	0.89	34.0
11	T	27	3.7	0.174	20.3	LOS B	6	0.77	0.90	34.7
12	R	77	3.9	0.554	47.5	LOS D	21	0.92	1.10	24.2
Approach		120	4.2	0.555	37.9	LOS C	21	0.87	1.03	27.1
All Vehicles		1249	4.3	0.554	5.2	Not Applicable	21	0.12	0.21	45.7

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 1 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	66	4.5	0.237	7.3	LOS A	0	0.00	0.64	43.8
2	T	379	4.0	0.237	0.0	LOS A	0	0.00	0.00	51.3
3	R	77	3.9	0.141	9.5	LOS A	3	0.46	0.72	42.0
Approach		523	4.0	0.237	2.3	LOS A	3	0.07	0.19	48.6
Railway St Car Park										
4	L	1	50.0	0.032	33.7	LOS C	1	0.80	0.81	28.6
5	T	1	50.0	0.032	32.4	LOS C	1	0.80	0.91	29.0
6	R	1	50.0	0.043	66.3	LOS E	1	0.91	0.97	19.9
Approach		6	50.0	0.044	44.1	LOS D	1	0.83	0.90	25.1
Meroo St - North										
7	L	1	50.0	0.222	7.2	LOS A	0	0.00	0.64	43.8
8	T	404	4.0	0.214	0.0	LOS A	0	0.00	0.00	51.3
9	R	27	3.7	0.051	9.6	LOS A	1	0.47	0.69	41.9
Approach		433	4.2	0.214	0.6	LOS A	1	0.03	0.05	50.5
Bunberra St - West										
10	L	46	4.3	0.106	12.4	LOS A	3	0.55	0.76	39.8
11	T	8	11.1	0.106	11.1	LOS A	3	0.55	0.80	40.7
12	R	128	3.9	0.677	40.7	LOS C	31	0.92	1.17	26.2
Approach		183	4.4	0.676	32.1	LOS C	31	0.81	1.05	29.2
All Vehicles		1145	4.4	0.677	6.7	Not Applicable	31	0.18	0.28	44.3

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Movement Summary

Meroo Road and Bunberra Road

2016 Option 1 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	84	3.6	0.275	7.3	LOS A	0	0.00	0.64	43.8
2	T	436	3.9	0.275	0.0	LOS A	0	0.00	0.00	51.3
3	R	69	4.3	0.138	10.2	LOS A	3	0.51	0.76	41.4
Approach		589	3.9	0.275	2.3	LOS A	3	0.06	0.18	48.7
Railway St Car Park										
4	L	1	50.0	0.048	47.8	LOS D	2	0.87	0.92	24.1
5	T	1	50.0	0.048	46.5	LOS D	2	0.87	0.94	24.4
6	R	1	50.0	0.053	98.0	LOS F	2	0.94	0.98	15.4
Approach		6	50.0	0.053	64.1	LOS E	2	0.89	0.95	20.4
Meroo St - North										
7	L	1	50.0	0.286	7.2	LOS A	0	0.00	0.64	43.8
8	T	506	4.0	0.268	0.0	LOS A	0	0.00	0.00	51.3
9	R	8	11.1	0.020	10.4	LOS A	0	0.51	0.70	41.2
Approach		517	4.3	0.268	0.2	LOS A	0	0.01	0.01	51.0
Bunberra St - West										
10	L	27	3.7	0.321	23.2	LOS B	12	0.78	0.99	33.2
11	T	37	1.7	0.321	21.9	LOS B	12	0.78	0.95	33.8
12	R	163	4.9	0.997	38.3	LOS C	33	1.00	1.00	26.9
Approach		205	3.9	1.000	35.9	LOS C	33	1.02	1.09	29.1
All Vehicles		1339	4.2	0.997	6.8	Not Applicable	33	0.19	0.26	44.2

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 1 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	73	4.1	0.239	7.3	LOS A	0	0.00	0.64	43.8
2	T	376	4.0	0.238	0.0	LOS A	0	0.00	0.00	51.3
3	R	92	4.3	0.175	9.8	LOS A	4	0.49	0.75	41.7
Approach		541	4.1	0.238	2.7	LOS A	4	0.08	0.21	48.3
Railway St Car Park										
4	L	1	50.0	0.036	37.8	LOS C	1	0.82	0.84	27.1
5	T	1	50.0	0.036	36.5	LOS C	1	0.82	0.92	27.5
6	R	1	50.0	0.051	79.1	LOS F	2	0.93	0.97	17.8
Approach		6	50.0	0.052	51.1	LOS D	2	0.86	0.91	23.2
Meroo St - North										
7	L	34	3.0	0.239	7.3	LOS A	0	0.00	0.64	43.8
8	T	421	4.0	0.240	0.0	LOS A	0	0.00	0.00	51.3
9	R	27	3.7	0.051	9.6	LOS A	1	0.47	0.70	41.8
Approach		481	4.0	0.240	1.0	LOS A	1	0.03	0.08	50.0
Bunberra St - West										
10	L	68	4.3	0.132	11.7	LOS A	4	0.53	0.77	40.3
11	T	5	16.7	0.130	10.4	LOS A	4	0.53	0.79	41.2
12	R	122	4.1	0.689	43.3	LOS D	31	0.93	1.18	25.4
Approach		197	4.6	0.688	31.2	LOS C	31	0.78	1.02	29.5
All Vehicles		1225	4.3	0.689	6.9	Not Applicable	31	0.18	0.30	44.2

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Movement Summary

Meroo Road and Bunberra Road

2016 Option 1 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	85	3.5	0.265	7.3	LOS A	0	0.00	0.64	43.8
2	T	414	4.1	0.265	0.0	LOS A	0	0.00	0.00	51.3
3	R	96	4.2	0.184	9.9	LOS A	4	0.50	0.76	41.6
Approach		595	4.0	0.265	2.6	LOS A	4	0.08	0.21	48.3
Railway St Car Park										
4	L	1	50.0	0.043	43.6	LOS D	2	0.85	0.88	25.3
5	T	1	50.0	0.043	42.3	LOS C	2	0.85	0.93	25.6
6	R	1	50.0	0.062	96.7	LOS F	2	0.94	0.98	15.6
Approach		6	50.0	0.062	60.9	LOS E	2	0.88	0.93	21.0
Meroo St - North										
7	L	1	50.0	0.250	7.2	LOS A	0	0.00	0.64	43.8
8	T	464	4.1	0.246	0.0	LOS A	0	0.00	0.00	51.3
9	R	7	12.5	0.018	10.3	LOS A	0	0.50	0.69	41.3
Approach		475	4.4	0.246	0.2	LOS A	0	0.01	0.01	51.0
Bunberra St - West										
10	L	39	5.1	0.342	22.9	LOS B	13	0.77	1.00	33.4
11	T	56	3.6	0.341	21.6	LOS B	13	0.77	0.96	34.0
12	R	98	4.1	0.641	48.5	LOS D	27	0.93	1.16	23.9
Approach		193	4.1	0.641	35.5	LOS C	27	0.85	1.07	27.9
All Vehicles		1269	4.4	0.641	7.0	Not Applicable	27	0.17	0.27	44.0

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 2 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	66	4.5	0.247	7.3	LOS A	0	0.00	0.64	43.8
2	T	399	4.0	0.247	0.0	LOS A	0	0.00	0.00	51.3
3	R	78	3.8	0.152	10.1	LOS A	3	0.51	0.76	41.4
Approach		544	4.0	0.247	2.4	LOS A	3	0.07	0.19	48.6
Railway St Car Park										
4	L	1	50.0	0.042	43.1	LOS D	2	0.85	0.89	25.4
5	T	1	50.0	0.042	41.8	LOS C	2	0.85	0.93	25.8
6	R	1	50.0	0.057	87.9	LOS F	2	0.93	0.98	16.6
Approach		6	50.0	0.057	57.6	LOS E	2	0.88	0.93	21.7
Meroo St - North										
7	L	25	4.0	0.263	7.3	LOS A	0	0.00	0.64	43.8
8	T	473	4.0	0.263	0.0	LOS A	0	0.00	0.00	51.3
9	R	32	3.2	0.059	9.8	LOS A	1	0.48	0.71	41.7
Approach		529	4.0	0.263	0.9	LOS A	1	0.03	0.07	50.2
Bunberra St - West										
10	L	46	4.3	0.107	12.9	LOS A	3	0.57	0.77	39.4
11	T	5	16.7	0.107	11.6	LOS A	3	0.57	0.81	40.3
12	R	156	3.8	1.000#	35.8	LOS C	34	1.00	1.00	27.8
Approach		208	4.3	0.997	30.0	LOS C	34	0.89	0.94	30.0
All Vehicles		1287	4.3	1.000	6.5	Not Applicable	34	0.19	0.27	44.5

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 2 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	129	3.9	0.302	7.3	LOS A	0	0.00	0.64	43.8
2	T	438	4.1	0.302	0.0	LOS A	0	0.00	0.00	51.3
3	R	78	3.8	0.156	10.4	LOS A	3	0.52	0.78	41.2
Approach		645	4.0	0.302	2.7	LOS A	3	0.06	0.22	48.2
Railway St Car Park										
4	L	1	50.0	0.061	59.0	LOS E	2	0.90	0.96	21.4
5	T	1	50.0	0.061	57.7	LOS E	2	0.90	0.95	21.7
6	R	1	50.0	0.057	105.6	LOS F	2	0.95	0.98	14.6
Approach		6	50.0	0.060	74.1	LOS F	2	0.91	0.97	18.6
Meroo St - North										
7	L	1	50.0	0.286	7.2	LOS A	0	0.00	0.64	43.8
8	T	524	4.0	0.277	0.0	LOS A	0	0.00	0.00	51.3
9	R	25	4.0	0.052	10.5	LOS A	1	0.53	0.74	41.1
Approach		551	4.2	0.277	0.5	LOS A	1	0.02	0.04	50.7
Bunberra St - West										
10	L	22	4.5	0.172	20.9	LOS B	5	0.75	0.89	34.4
11	T	22	4.5	0.172	19.6	LOS B	5	0.75	0.89	35.1
12	R	108	3.7	0.878	49.9	LOS D	31	0.98	1.07	23.5
Approach		152	3.9	0.879	41.3	LOS C	31	0.92	1.02	26.0
All Vehicles		1354	4.3	0.878	6.5	Not Applicable	31	0.15	0.24	44.5

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 3 AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	49	4.1	0.233	7.3	LOS A	0	0.00	0.64	43.8
2	T	392	4.1	0.233	0.0	LOS A	0	0.00	0.00	51.3
3	R	105	3.8	0.195	9.7	LOS A	4	0.48	0.74	41.8
Approach		546	4.0	0.234	2.5	LOS A	4	0.09	0.20	48.4
Railway St Car Park										
4	L	1	50.0	0.036	38.4	LOS C	1	0.83	0.84	26.9
5	T	1	50.0	0.036	37.1	LOS C	1	0.83	0.92	27.3
6	R	1	50.0	0.049	74.4	LOS F	1	0.92	0.97	18.6
Approach		6	50.0	0.049	49.9	LOS D	1	0.86	0.91	23.5
Meroo St - North										
7	L	1	50.0	0.222	7.2	LOS A	0	0.00	0.64	43.8
8	T	432	3.9	0.228	0.0	LOS A	0	0.00	0.00	51.3
9	R	37	2.8	0.067	9.6	LOS A	1	0.47	0.70	41.9
Approach		469	4.1	0.228	0.8	LOS A	1	0.04	0.06	50.4
Bunberra St - West										
10	L	15	6.7	0.056	15.6	LOS B	2	0.61	0.75	37.6
11	T	4	20.0	0.056	14.3	LOS A	2	0.61	0.83	38.4
12	R	161	3.7	0.976	34.3	LOS C	33	0.99	1.00	28.3
Approach		181	4.4	0.975	32.2	LOS C	33	0.95	0.97	29.1
All Vehicles		1202	4.3	0.976	6.5	Not Applicable	33	0.20	0.26	44.4

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 3 PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	92	4.3	0.273	7.3	LOS A	0	0.00	0.64	43.8
2	T	421	4.0	0.273	0.0	LOS A	0	0.00	0.00	51.3
3	R	76	3.9	0.151	10.3	LOS A	3	0.52	0.77	41.3
Approach		589	4.1	0.273	2.5	LOS A	3	0.07	0.20	48.5
Railway St Car Park										
4	L	1	50.0	0.049	49.0	LOS D	2	0.87	0.93	23.8
5	T	1	50.0	0.049	47.7	LOS D	2	0.87	0.94	24.1
6	R	1	50.0	0.053	97.8	LOS F	2	0.94	0.98	15.5
Approach		6	50.0	0.053	64.9	LOS E	2	0.90	0.95	20.2
Meroo St - North										
7	L	1	50.0	0.286	7.2	LOS A	0	0.00	0.64	43.8
8	T	518	4.1	0.274	0.0	LOS A	0	0.00	0.00	51.3
9	R	6	14.3	0.017	10.6	LOS A	0	0.52	0.69	41.1
Approach		527	4.4	0.274	0.2	LOS A	0	0.01	0.01	51.1
Bunberra St - West										
10	L	19	5.3	0.317	25.6	LOS B	12	0.81	1.00	32.0
11	T	41	3.6	0.316	24.3	LOS B	12	0.81	0.96	32.6
12	R	154	4.3	1.000#	38.6	LOS C	33	1.00	1.00	26.8
Approach		200	4.2	1.000	36.2	LOS C	33	1.00	1.06	28.5
All Vehicles		1336	4.4	1.000	6.9	Not Applicable	33	0.19	0.26	44.2

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 3 MVRDLK AM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	59	3.4	0.252	7.3	LOS A	0	0.00	0.64	43.8
2	T	418	4.1	0.253	0.0	LOS A	0	0.00	0.00	51.3
3	R	83	3.6	0.151	9.5	LOS A	3	0.46	0.72	42.0
Approach		560	3.9	0.253	2.2	LOS A	3	0.07	0.17	48.8
Railway St Car Park										
4	L	1	50.0	0.034	35.7	LOS C	1	0.81	0.81	27.8
5	T	1	50.0	0.034	34.4	LOS C	1	0.81	0.91	28.3
6	R	1	50.0	0.044	67.0	LOS E	1	0.91	0.97	19.8
Approach		6	50.0	0.044	45.7	LOS D	1	0.84	0.90	24.6
Meroo St - North										
7	L	11	9.1	0.216	7.3	LOS A	0	0.00	0.64	43.8
8	T	395	4.1	0.214	0.0	LOS A	0	0.00	0.00	51.3
9	R	24	4.2	0.046	9.8	LOS A	1	0.48	0.70	41.7
Approach		430	4.2	0.214	0.7	LOS A	1	0.03	0.06	50.4
Bunberra St - West										
10	L	15	6.7	0.058	15.5	LOS B	2	0.62	0.76	37.6
11	T	5	16.7	0.058	14.2	LOS A	2	0.62	0.83	38.4
12	R	155	3.9	0.866	33.2	LOS C	31	0.97	1.01	28.7
Approach		176	4.5	0.868	31.1	LOS C	31	0.93	0.98	29.6
All Vehicles		1172	4.4	0.866	6.2	Not Applicable	31	0.19	0.26	44.8

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SIDRA INTERSECTION

Movement Summary

Meroo Road and Bunberra Road

2016 Option 3 MVRDLK PM Peak Intersection Analysis

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Meroo St - South										
1	L	80	3.8	0.270	7.3	LOS A	0	0.00	0.64	43.8
2	T	429	4.0	0.270	0.0	LOS A	0	0.00	0.00	51.3
3	R	66	4.5	0.133	10.2	LOS A	3	0.51	0.76	41.4
Approach		576	4.0	0.270	2.2	LOS A	3	0.06	0.18	48.8
Railway St Car Park										
4	L	1	50.0	0.045	45.8	LOS D	2	0.86	0.91	24.6
5	T	1	50.0	0.045	44.5	LOS D	2	0.86	0.94	25.0
6	R	1	50.0	0.061	94.9	LOS F	2	0.94	0.98	15.8
Approach		6	50.0	0.061	61.7	LOS E	2	0.89	0.94	20.9
Meroo St - North										
7	L	11	9.1	0.268	7.3	LOS A	0	0.00	0.64	43.8
8	T	497	4.0	0.268	0.0	LOS A	0	0.00	0.00	51.3
9	R	7	12.5	0.018	10.4	LOS A	0	0.51	0.69	41.2
Approach		516	4.3	0.268	0.3	LOS A	0	0.01	0.02	50.9
Bunberra St - West										
10	L	19	5.3	0.279	24.7	LOS B	10	0.80	0.97	32.5
11	T	47	4.3	0.280	23.4	LOS B	10	0.80	0.95	33.1
12	R	111	3.6	0.743	50.1	LOS D	31	0.95	1.16	23.5
Approach		176	4.0	0.742	40.2	LOS C	31	0.89	1.08	26.3
All Vehicles		1274	4.3	0.743	7.0	Not Applicable	31	0.16	0.24	44.1

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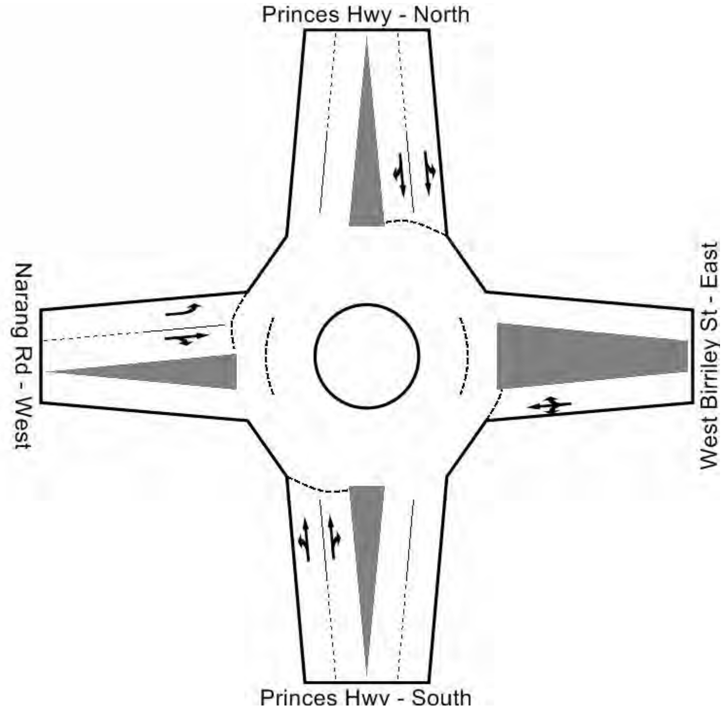
Option 1

Princes Highway and Narang Road

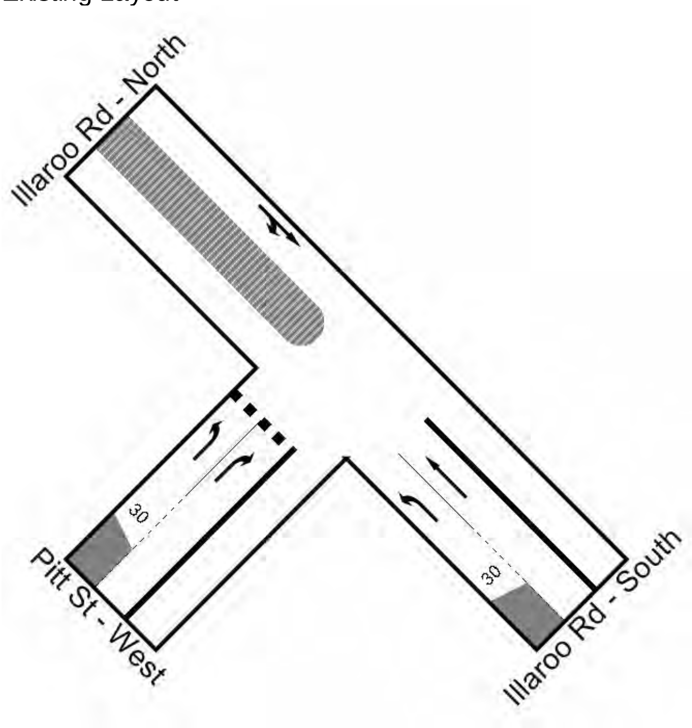
Existing Layout



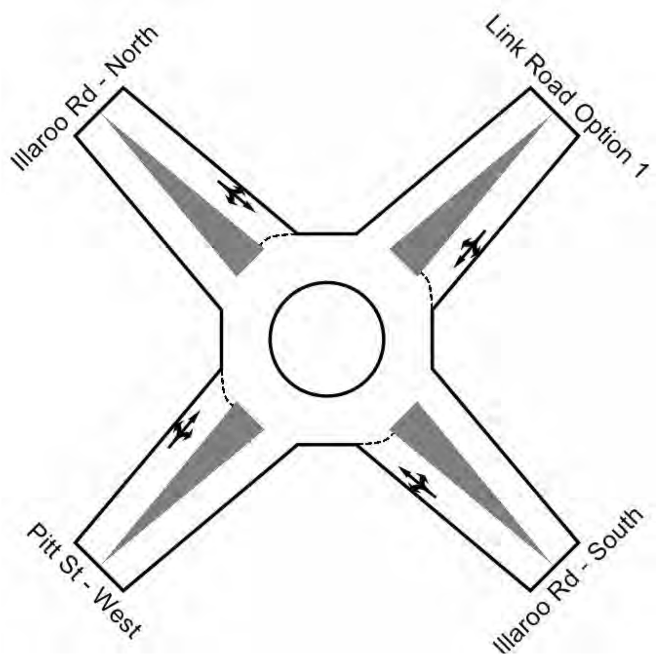
Option 1

Illaroo Road and Pitt Street

Existing Layout



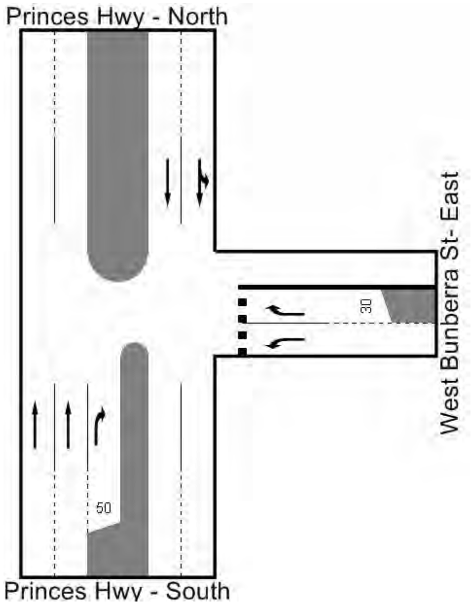
Option 1 & Option 1 MVRDLK required layout



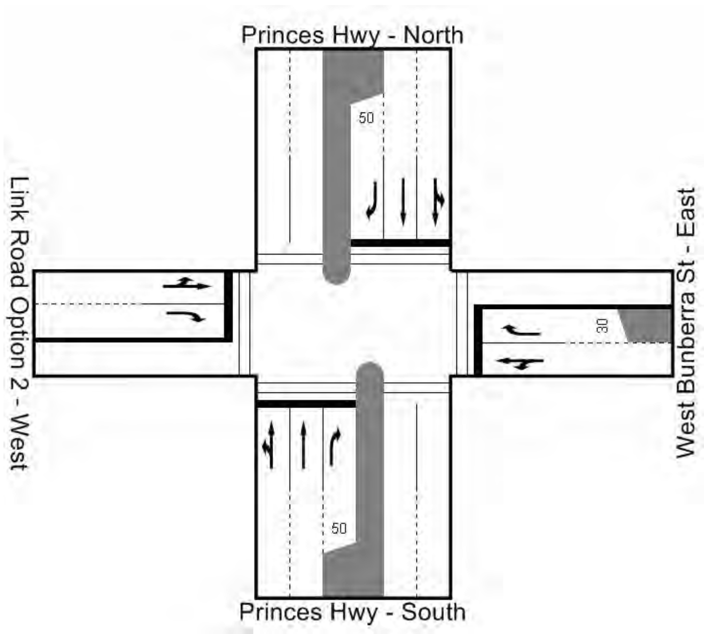
Option 2

Princes Highway and Bunberra Street

Existing Layout



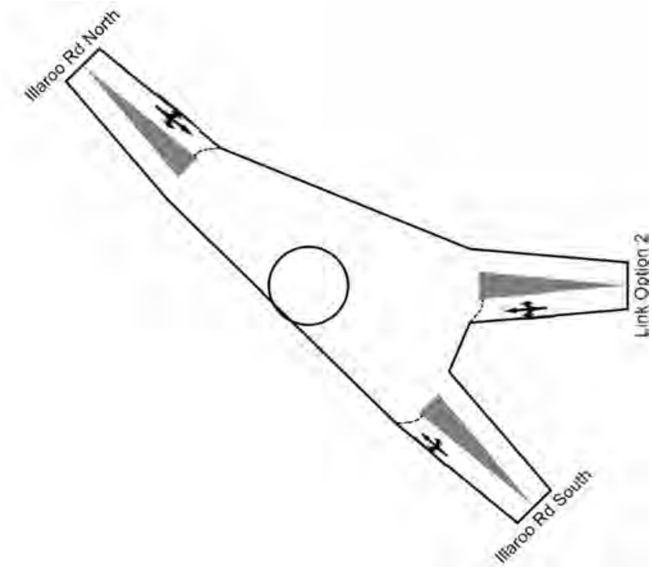
2016 Option 2 required layout



Option 2

Illaroo Road and the Link Road

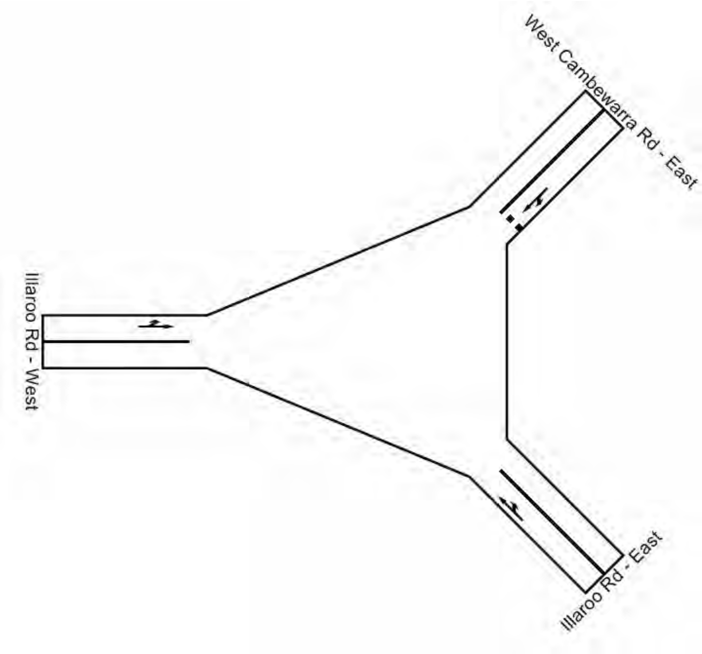
Required layout



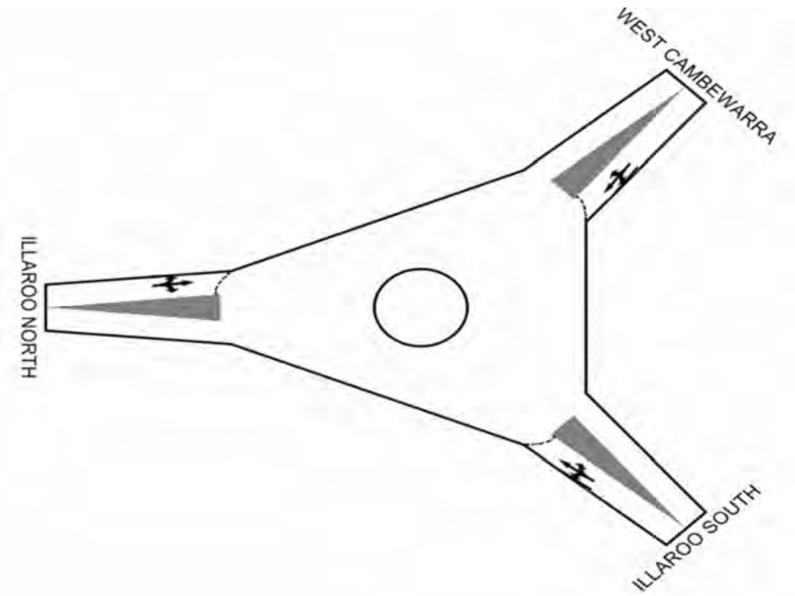
Option 3

Illaroo Road and West Cambewarra Road

Existing



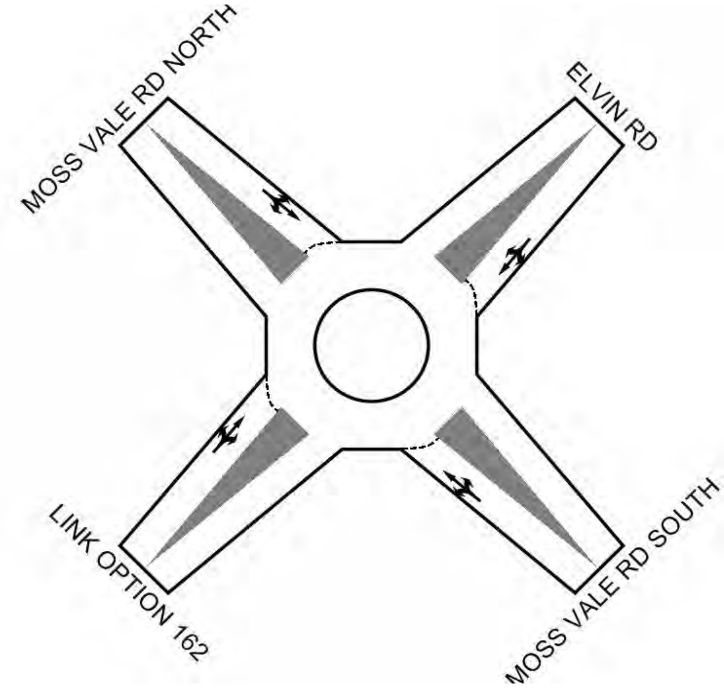
2016 Option 3 required layout



Option 3

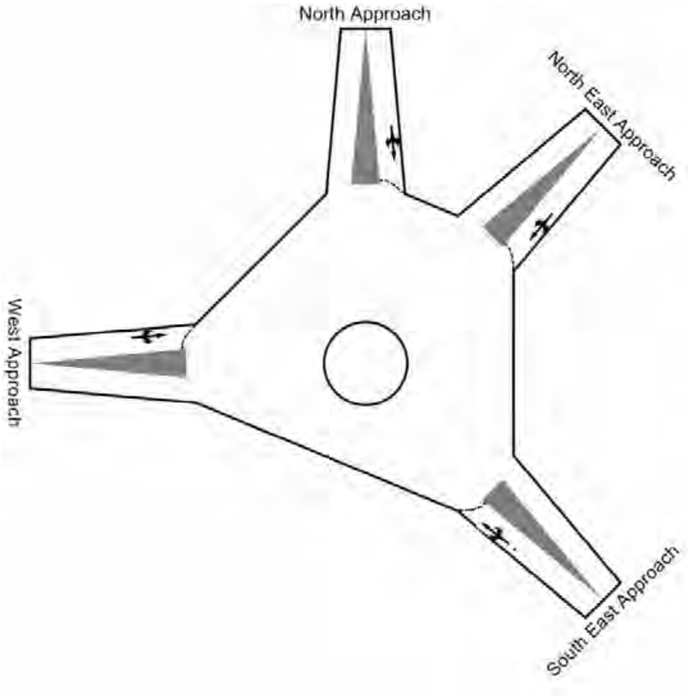
Moss Vale Road and West Cambewarra Road (Option 3 link)

Required layout



Illaroo Road and West Cambewarra

Option 1 MVRDLK & Option 3 MVRDLK



Appendix F

Council's TRACKS Analysis

GABITES PORTER
Traffic & Transportation
Engineering & Planning

Telephone +64 (3) 366 9871
Facsimile +64 (3) 366 9870
Postal Address PO Box 25 103
Christchurch
New Zealand

17 June 2010
JN: 4508

Wayne Brighton
Project Manager
Shoalhaven City Council
P O BOX 42
Nowra
NSW
AUSTRALIA 2541

Dear Wayne

RE: REVIEW OF COUNCIL'S TRACKS ANALYSIS

Please find attached our review of the Council's TRACKS Analysis of the North Nowra Link Road as requested in your letter of 27th May 2010.

Please do not hesitate in contacting us if any further information or explanation is required.

Yours faithfully
GABTES PORTER CONSULTANTS LTD

Grant Smith
Managing Director

REVIEW OF SHOALHAVEN CITY COUNCIL TRACKS ANALYSIS
NORTH NOWRA LINK ROAD

Introduction

Shoalhaven City Council (SCC) has requested Gabites Porter to review the initial in-house TRACKS assessment of alternative route options for the development of a sub-arterial road linking Bomaderry and North Nowra.

The purpose of this initial assessment was to determine the best three alignment options, from an original pool of eleven possible alignments, to carry forward into further detailed analysis undertaken by external consultants. This later detailed analysis involved traffic modelling, road safety investigation, noise impact assessment, and economic analysis of each of the three routes plus a do nothing option.

This initial assessment however was of a more "strategic" nature as its sole purpose was to eliminate alignments that were either unlikely to be economically viable or were less economic than other directly competing alignments.

This review investigates the methodology and the results of this initial assessment undertaken by SCC staff.

The Use of TRACKS

The initial assessment was undertaken using the TRACKS Suite of transportation network modelling programs. The TRACKS software was developed by Gabites Porter for the purpose of modelling road networks of varying sizes and detail. It allows for the analysis of existing traffic conditions and future conditions due to changes in the road network, as a result of adding or removing road links, and changes in land use such as housing and employment.

Detailed TRACKS models are used in many locations throughout New South Wales and are of varying size and complexity. TRACKS has been accepted by the Roads and Traffic Authority (RTA) Southern Region as the modelling system of choice for the analysis of both local and strategic level changes in road networks and land use.

As the SCC already has a TRACKS model of the Nowra Bomaderry area in place, it is considered both sensible and practical to use it as a tool to undertake this initial assessment.

The TRACKS Model

As indicated above, the SCC has a validated model covering the Nowra Bomaderry area that includes all roads and intersections in the area. This model was developed in 2002 by Gabites Porter and included validated networks for a typical 1996 day, morning peak, shopping peak and evening peak. These networks were validated to a set of standards, for both parking and traffic flow, which were more stringent than those normally required in Australia and are therefore very accurate. A copy of the Nowra Bomaderry Model Building Report is attached to this review for reference.

Consequently, the Nowra Bomaderry is very well suited for the in-house assessment of these initial options. Furthermore, using the all day network to analyse the strategic flow and economic results of each option is entirely appropriate and exactly what the model was developed for.

The SCC Modeller Level of Experience

The SCC modeller responsible for the in-house TRACKS assessment of these initial options is believed to be Mr Scott Wells, Traffic & Transport Manager, Strategic Planning Services. Mr Wells has had hands-on experience in TRACKS transportation modelling for approximately 17 years and is arguably the most proficient TRACKS user in any Council in the Illawarra.

Gabites Porter has the utmost confidence in Mr Wells' ability to correctly code, operate and analyse the Nowra Bomaderry TRACKS model.

Assessment Methodology

As indicated earlier, the initial SCC assessment was undertaken to analyse each of eleven possible alignment options for the North Nowra Link Road and where appropriate reduce them to three options that would undergo rigorous detailed analysis by external consultants. The methodology used was as follows:

1. Create a TRACKS network for each of the eleven alignments.
2. Create updated 2006/2016/2036 land uses for the Nowra Bomaderry area.
3. Use the new land uses to create new all day matrices of trips to and from each zone within the Nowra Bomaderry area for each year.
4. Assign each of the 2006/2016/2036 all day matrices to a network model of the existing Nowra Bomaderry area to obtain the "do-nothing" situation.
5. Assign each of the 2006/2016/2036 all day matrices to each of the eleven alignment networks to obtain all day flows and intersection delays throughout Nowra Bomaderry.
6. Determine network road user benefits for each year and each option using standard values for vehicle time and operating costs.
7. Create a simple benefit cost analysis for each option, compared to the do-nothing, for each year.

In order to have confidence in the robustness of any analysis of this kind, a sensitivity test should be undertaken. In this instance the sensitivity test involved analysing each alignment option with the proposed Moss Vale Road Link in place. The assessment methodology was repeated for each of the alignment options with the Moss Vale Road Link in place. As the Moss Vale Road Link is, in effect, competing with each of the alignment options, its impact on the benefits for each alignment could be great and could therefore affect the relative "ranking" of each option.

Undertaking this sensitivity test is entirely appropriate.

The network options all appear to have been coded according to standard practice. Various link speeds have been coded for each option to take into account different alignments, topography and property access. Where appropriate, intersections at the end of each alignment option have been coded to allow for the new link. Where intersections exist, a new approach has been added and where an entirely new intersection has been created this has been coded as either a roundabout or traffic signal. Plots of the eleven alignment options are shown in Figures 1 – 12.

There is a marginal difference between routes 165 and 168 to assess a minor variation of the placement of a bridge in an alternative location. In consideration of the scale of the same graphic supports both options.

Option network coding all appears appropriate.

The land use variables used in creating the 2006/2016/2036 trip matrices have been calculated in spreadsheet form using expected changes in households, employees, car ownership and jobs within the Nowra Bomaderry area. Gabites Porter believes that these future land use projections are consistent with the Nowra Bomaderry Structure Plan.

These changes all appear reasonable and appear to be generally in line with changes occurring elsewhere in the Illawarra. In particular, the relationship between the number of jobs and the number of employees available in the area has been maintained. This correctly ensures that the demand and supply for employment in the area is held in balance.

Given that the original base Nowra Bomaderry TRACKS networks have been shown to be very well validated, the development of future models to test future infrastructure requirements is both appropriate and standard practice. In the SCC assessment, the development of 2006, 2016 and 2036 models has been undertaken using the latest land use projections consistent with the adopted Nowra Bomaderry Structure Plan.

As long as these future land use projections remain current, the future models and reported future year results will also remain current. Given robust nature of the approved Nowra Bomaderry Structure Plan, it is likely that future land use projections are not only robust but will remain applicable for some time into the future.

Whilst it is not the subject of this review, we understand that the Maunsell Paramics traffic model was based on thorough local validation of 2006 traffic conditions. In addition, the future 2016 modeling was based on traffic and land use assumptions taken directly from the 2016 SCC TRACKS model. This is a typical approach for micro-simulation modeling and is used in most instances where detailed strategic model outputs are available.

As long as the future land use assumptions remain current, the future TRACKS model outputs remain applicable and therefore any Micro-simulation modeling derived from those TRACKS outputs will also remain applicable irrespective of when the analysis was undertaken.

TRACKS Model Outputs

Assessment of the alignment options, with and without the Moss Vale Road Link, for each of the three analysis years results in a total of sixty nine modelled networks with associated flows and time and distance matrices. The total number of trips used in the models grows at approximately 2.4% per annum from 2006 until 2036. This is in line with projected changes in land use used in the model and considered sensible.

The modelled flows appear to be sensible and are all of the order of magnitude expected for this type of analysis and assumed trip rates. There are no apparent instances of inappropriate trip routing as a result of unrealistic modelled link or intersection behaviour.

It is apparent from the modelled results, that the TRACKS assessment for each of the alignment options has been done accurately and is producing reasonable, repeatable and robust results.

Benefit Cost Analysis

An effective, and recognised, method for ranking similar network alignment options is to undertake a benefit cost analysis for each option and compare their "value for money". This is particularly useful in quickly analysing a large number of possible options and eliminating those that are economically unsustainable so that a smaller number of core options can be analysed in much greater detail. This method has been used in this initial assessment of the eleven alignment options for the North Nowra Link Road.

To determine the benefits from each option, the assessment assumed standard values for both vehicle travel time cost and vehicle operating cost. These values have been derived from data provided by the RTA. These values have been used in the TRACKS Netben program which calculates the total road user benefits for each option based on that option's volumes, delays and travel speeds.

The assessment undertook a spreadsheet analysis of benefits and costs for each option and each analysis year. The level of detail used in the spreadsheet analysis appears very good for this preliminary option elimination phase. The estimated cost of each option takes into account all major cost factors namely land acquisition, bridge, pavement and intersection construction, and made allowance for additional minor costs and contingencies.

The option benefits were correctly calculated by subtracting the "do-nothing" network benefit from each option benefit thereby creating the overall benefit gained by building the option alignment. These benefits were then converted into a nett present value by summing twenty years of benefits and discounting them by the correct 7% discount factor. This process was undertaken for every option (with and without the Moss Vale Link Road) for the benefits obtained from the 2006, 2016 and 2036 network analyses.

Each option has its benefit cost ratio calculated and ranked from 1 - 11 (highest to lowest B/C ratio) for each of the three analysis years. The decision as to which options proceeded to more detailed analysis was based on these benefit cost rankings.

This process defers from the typical benefit cost analysis in two ways:

1. Normally the benefits from each of the three analysis years are used to interpolate assumed benefits from the years between and where necessary extrapolated beyond the last year to enable a thirty year analysis period. The thirty years of benefits are then added and discounted and one set of benefit cost ratios are obtained.
2. The benefit stream used in the analysis was for only twenty years instead of the typical thirty years.

As indicated Point 1 above, combining the three analysis year benefits into a single benefit stream enables a single benefit cost ratio to be calculated. This method does not however allow for an investigation of how the ranking of each alignment option changes with time. As a network gets more congested new traffic patterns can affect both alignment volumes and delays and therefore possibly affect the ranking of that option relative to others.

By producing separate benefit cost ratios for each analysis year, the SCC assessment has allowed for the investigation of possible option ranking movement to occur. This extended benefit cost methodology further demonstrates the robustness of the SCC assessment.

Point 2 above deals with the use of a twenty year benefit stream instead of the standard thirty years. By restricting the analysis to only twenty years of benefits, the SCC assessment has adopted a very conservative approach. Typically, a reasonably large proportion of total benefits are produced in the last ten years of a thirty years analysis. These additional benefits have not been considered. Had they been included in the analysis the differences between the benefit cost ratios of some options may very well have increased, therefore reinforcing ranking.

This SCC process is believed to be an appropriate and robust methodology for this early option elimination assessment.

As part of this review, Gabites Porter calculated the ranking of each option based on the typical benefit cost ratio method. This review found that the review option rankings were consistent with the rankings calculated in the SCC preliminary assessment.

The following Tables 1 and 2 show the benefit cost ratios and rankings calculated by both the SCC assessment and the Gabites Porter review process.

B/C Ratios					Table 1
Alignment Option		**SCC Assessment**			**GP Review**
		2006	**2016**	**2036**	
Without Moss Vale Road Link	**161**[1]	2.38	4.33	23.97	5.30
	162[3]	1.66	3.36	17.30	4.18
	163	0.78	1.85	10.39	2.33
	164	1.31	2.32	11.45	2.84
	165	1.07	2.33	15.15	2.91
	166	1.42	2.81	17.69	3.47
	167[2]	0.91	1.90	13.06	2.36
	168	1.20	2.44	15.01	3.02
	169	1.60	3.19	18.46	3.93
	170	1.20	2.57	15.77	3.20
	171	1.33	3.19	21.15	4.01
With Moss Vale Road Link	**161**[1]	1.04	1.46	8.95	1.72
	162[3]	0.53	0.76	3.47	0.90
	163	NA	NA	NA	NA
	164	0.85	1.15	5.05	1.36
	165	0.37	0.59	5.82	0.70
	166	0.39	0.65	6.20	0.78
	167[2]	0.06	0.25	4.58	0.32
	168	0.43	0.65	5.79	0.78
	169	0.52	0.82	6.53	0.95
	170	0.29	0.43	4.45	0.51
	171	0.12	0.39	5.47	0.49

1. Corresponds to Option 1 in the 3A major project assessment
2. Corresponds to Option 2 in the 3A major project assessment
3. Corresponds to Option 3 in the 3A major project assessment

B/C Ratios					Table 2
Alignment Option		SCC Assessment			GP Review
		2006	2016	2036	
Without Moss Vale Road Link	161[1]	1	1	1	1
	162[3]	2	2	5	2
	163	11	11	11	11
	164	6	9	10	9
	165	9	8	7	8
	166	4	5	4	5
	167[2]	10	10	9	10
	168	8	7	8	7
	169	3	4	3	4
	170	7	6	6	6
	171	5	3	2	3
With Moss Vale Road Link	161[1]	1	1	1	1
	162[3]	3	4	10	4
	163	NA	NA	NA	NA
	164	2	2	7	2
	165	7	7	4	7
	166	6	6	3	6
	167[2]	10	10	8	10
	168	5	5	5	5
	169	4	3	2	3
	170	8	8	9	8
	171	9	9	6	9

4. Corresponds to Option 1 in the 3A major project assessment
5. Corresponds to Option 2 in the 3A major project assessment
6. Corresponds to Option 3 in the 3A major project assessment

Conclusion

Gabites Porter concludes the following:

1. The methodology and level of detail used in the preliminary TRACKS analysis of the North Nowra Link Road by the Shoalhaven City Council was appropriate for this preliminary option assessment.
2. The coding used in the option assessment was appropriate.
3. The future models are based on projected future land use that is sound, consistent with the Nowra Bomaderry Structure Plan and current.
4. The total number of trips used in the models grows at approximately 2.4% per annum from 2006 until 2036 and appear consistent with other areas in the Illawarra.
5. The modelled flows appear reasonable from option to option and from one future year to another.
6. The simplified benefit cost analysis, used in preliminary ranking of the initial options, was of sufficient detail and accuracy to serve as an appropriate option elimination tool.

SCC Review	**Do-Nothing Network** **With and Without Moss Vale Road Link**	**Figure 1**
Gabites Porter		

SCC Review	**Alignment 161 Network With and Without Moss Vale Road Link (Consistent with Option 1 – Central Route – Pitt St to Narang Rd)**	**Figure 2**
Gabites Porter		