

# Picton Town Centre Transport Plan 2026

Traffic Analysis and Strategic Design

8201817701

Prepared for  
Wollondilly Shire Council

11 July 2018



### Contact Information

**Cardno (NSW/ACT) Pty Ltd**

ABN 95 001 145 035

16 Burelli Street  
Wollongong 2500  
Australia

Phone +612 4228 4133

Fax +612 4228 6811

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Author(s):

Aaron Tran  
Traffic Engineer

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Approved By:



Tim Sullivan  
Manager – Traffic and Transport Planning

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## Executive Summary

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Picton town centre currently experiences traffic congestion in a few key locations, which is forecast to worsen in future years. The strategic context of the town, the surrounding topography and the existing transport networks result in a large proportion of through traffic travelling via the town centre. This through traffic is, in the main, travelling from Tahmoor, Thirlmere and smaller towns and villages to the south of Picton towards the Hume Motorway and Wollongong in the east. Due to a weight restriction on Prince Street, which provides the only other east-west connection, a high volume of heavy vehicles make up the traffic travelling through Picton, affecting pedestrian amenity, safety and the general attractiveness of the town centre.

Considering the historical traffic concerns, and the prospect of large scale land development exacerbating these issues in future, Wollondilly Shire Council developed the Picton Town Centre Transport Masterplan in 2017. This plan identified a number of deficiencies in the transport network and various road infrastructure mitigation measures, including several major intersection upgrades requiring property acquisition.

Subsequent to the masterplan being developed, Council commenced discussions with RMS and private developers regarding a southern bypass of Picton, connecting the Hume Motorway with the Old Hume Highway and funded in large part by development in Wilton Junction and the Greater Macarthur region. This bypass would effectively relieve Picton town centre and provide a more direct route for heavy vehicles to access the state road network. Acknowledging that the Picton Bypass may take 10 years or more to be delivered, Wollondilly Shire Council engaged Cardno to identify interim intersection upgrades in Picton town centre. Cardno's brief was to focus on low-cost, "quick-win" projects that could be delivered relatively quickly and at low cost, while avoiding the potential for redundant infrastructure when the bypass is delivered.

The following report details the design investigations undertaken by Cardno so far. Various upgrade proposals have been modelled using the Aimsun microsimulation modelling package to verify traffic performance and holistic network impacts. A summary of the recommendations from the study is shown in **Table 4-1**. Following on from the traffic modelling investigations, strategic designs were developed for several intersections within the study area. The main focus of the design effort was Prince Street, which is shown to require improvements at both Argyle Street and Menangle Street intersections before 2026 to keep the network running smoothly. In parallel to the traffic modelling and design work, Cardno also undertook a Road Safety Audit of existing conditions at particular locations of interest within the study area. The findings of the audit are detailed in **Appendix C**.

The collective recommendations arising from the traffic modelling, design and road safety investigations will be collated to form the 'Picton Town Centre Transport Plan 2026'. The next step is to discuss this plan with elected members and the wider community, with a view to securing support and funding to allow delivery of the plan by 2026.

# 1 Introduction

## 1.1 Background

The Wollondilly Local Government Area is set for significant population growth in the next 20-30 years. These demographic changes are likely to exacerbate traffic issues in Picton, which is a historic town with a constrained road network not equipped to carry large volumes of traffic. In response to this, the Picton Town Centre Transport Master Plan (TDG, 2017) proposed numerous road upgrades, including the replacement of an existing one lane bridge at Prince Street, to improve traffic conditions in the town centre.

Cardno understands the TDG proposals will require long term planning and funding arrangements in order to be implemented in full, due to the large extent of works and private property acquisition required. It is also likely the Picton Town Centre Transport Master Plan will need to be revised due to re-zoning of land and large scale residential development in the Greater Macarthur region.

In the interim, Council commissioned Cardno to identify short term network capacity improvements, essentially quick win schemes that can be implemented within 0-5 years, and then develop designs sufficient for strategic cost estimates and consultation with relevant stakeholders. Collectively these measures are to be known as the 'Picton Town Centre Transport Plan 2026'.



## 1.2 Scope of Work

The scope of work for this transport plan includes:

- > Familiarisation
  - Review of Picton Town Centre Transport Master Plan and other relevant documents.
  - Review and update of existing Aimsun traffic models for Picton town centre.
- > Traffic Analysis
  - Development of preferred short term improvement options in locations identified by Council.
  - Verify future network performance and design life of proposed short term upgrades using Aimsun and SIDRA modelling.
- > Design Drawings
  - Prepare strategic (pre-concept) design drawings for intersection / road improvements.
  - Determine at a high level the extent of civil works and impact on utilities.
  - Determine approximate land acquisition.
- > Cost estimation
  - Prepare strategic cost estimates based on design drawings.
- > Road Safety Audit
  - Conduct existing conditions road safety audit to determine current issues and road safety concerns.
  - Conduct pre-construction road safety audit of design drawings to determine suitability of proposed upgrades.

### 1.3 Reference Documents

- > Future Network Deficiency Assessment (TDG, 2015)
- > Planning Proposal Reports
  - Abbotsford
  - Argyle St Business Lands
  - Mushroom Tunnel
  - Picton East
  - Stonequarry Commercial
- > Picton Town Centre Microsimulation Model Development Technical Note (TDG, 2016)
- > Picton Town Centre Transport Master Plan (TDG, 2017)
- > Roads and Maritime Services Traffic Modelling Guidelines (RMS, 2013).

### 1.4 Report Structure

- > Section 1 introduces the background and objectives of the transport plan
- > Section 2 details the traffic modelling undertaken
- > Section 3 presents the strategic design development and cost estimation
- > Section 4 summarises the recommendations and conclusions.



## 2 Traffic Modelling

### 2.1 Base Model Development

Cardo adopted the Aimsun microsimulation models developed by TDG for the Picton Town Centre Transport Master Plan (September 2017, TDG) as a starting point for this transport plan. The Aimsun models cover the study area and include the following key intersections identified as a priority to assess:

- > Menangle Street / Argyle Street
- > Argyle Street / Margaret Street
- > Prince Street / Menangle Street
- > Prince Street / Argyle Street
- > Argyle Street / Barkers Lodge Road
- > Argyle Street / Lumsdaine Street.

Cardo reviewed the models and highlighted the need to amend and update the base model, primarily because the model was not stable. The following sections only summarise the recalibration and revalidation of the base model. Further details of the base model are documented in the Picton Town Centre Microsimulation Model Development Technical Note (December 2016, TDG).

#### 2.1.1 Recalibration

The base model was calibrated to turn counts and all modelled intersection record  $GEH < 5$ . The  $R^2$  values for light vehicles (LV) are within modelling guidelines but heavy vehicles (HV) fall outside of the criteria. However, this is typical when HV numbers are very low and thus more variance is expected. The model was not calibrated to core area standards (as prescribed in the RMS modelling guidelines) due to a lack of comprehensive survey data for the study area.

Table 1-1 summarises the base model calibration results.

Table 1-1 Base model calibration results

RMS Modelling Guidelines		AM (0800-0900)		PM (1600-1700)	
Measure	Criteria	LV	HV	LV	HV
$GEH < 5$	> 85%	100%	100%	100%	100%
$GEH < 10$	100%	100%	100%	100%	100%
$R^2$	>0.9	0.98	0.90	0.99	0.88

#### 2.1.2 Revalidation

##### 2.1.2.1 Travel Time

All travel time surveyed routes are within the one minute tolerance limit as prescribed in the RMS modelling guidelines. Travel time survey data was not available for the weekend modelling period, hence Cardo only updated the weekday peak hour models. Further details of the base model are documented in the Picton Town Centre Microsimulation Model Development Technical Note (December 2016, TDG).

Table 1-2 summarises the base model travel time validation results.

Table 1-2 Base model travel time validation results

Travel time	AM (0700-0900)			PM (1600-1800)		
	Observed	Modelled	Difference	Observed	Modelled	Difference
Route 1 NB	231	184.6	-46.4	191	210.2	19.2
Route 1 SB	163	155.8	-7.2	152	152.5	0.5
Route 2 NB	108	124.4	16.4	108	117.9	9.9
Route 2 SB	93	115.5	22.5	111	115.5	4.5
Route 3 EB	83	97.9	14.9	88	97.7	9.7
Route 3 WB	69	75.1	6.1	98	84.8	-13.2

### 2.1.3 Model Stability

The base models for each peak period are stable as shown in Figure 2-1 and Figure 2-2 below. Statistical analysis shows the model is stable enough and less than 5 random seeds are required.

Figure 2-1 Base model stability AM

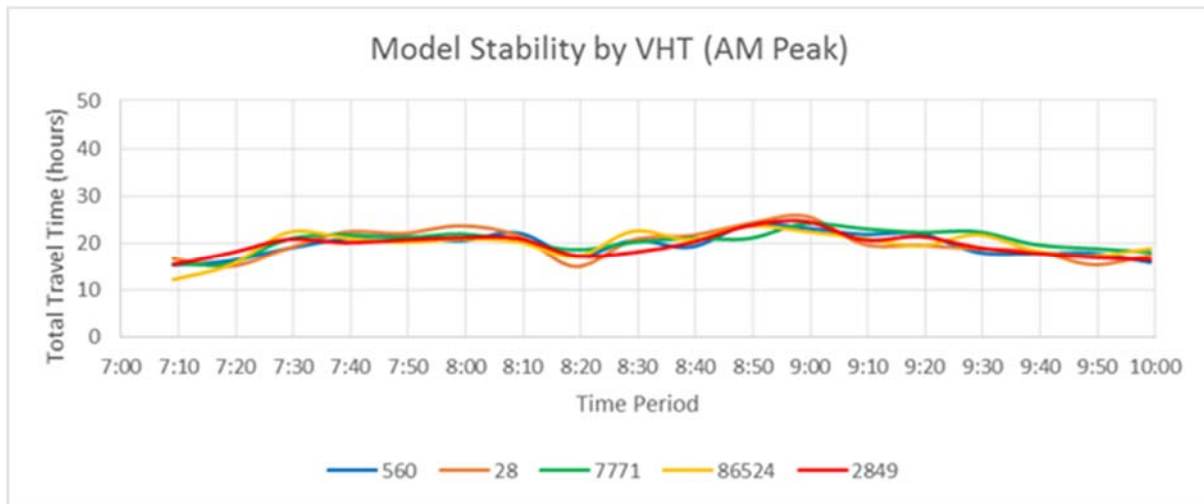
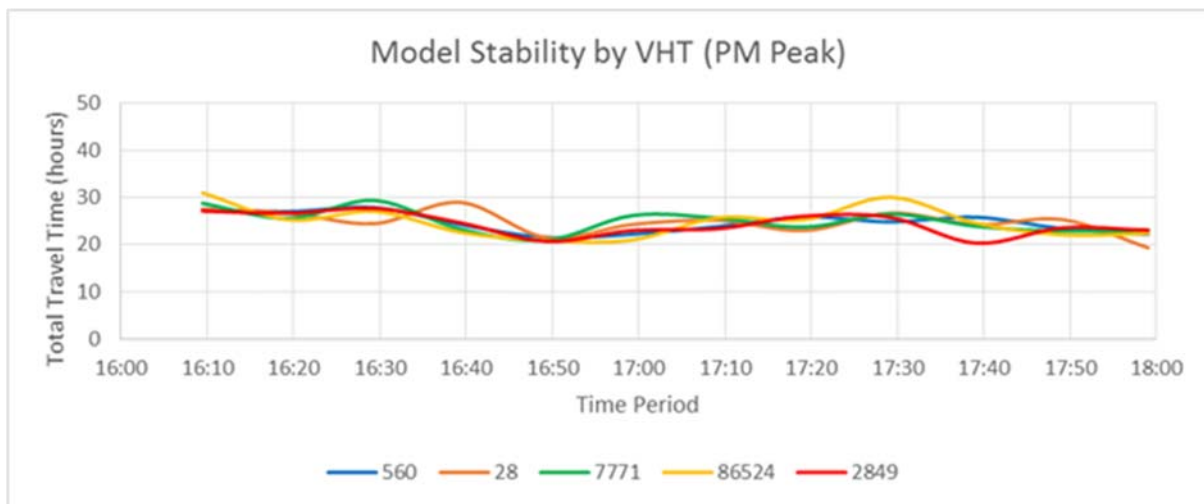


Figure 2-2 Base model stability PM



**2.1.4 Conclusion**

Cardo adopted and updated the Aimsun microsimulation models developed by TDG for the Picton Town Centre Transport Master Plan (September 2017, TDG). In summary, the updated base models have:

- > All turn counts GEH < 5
- > High regression value with R<sup>2</sup> > 0.9 for LVs
- > Stable with less than 5 seed runs required
- > All travel times within 1 minute.

The base models are considered to be stable, robust and fit for the purpose of future year option testing.

**2.2 Future Year 2026 Modelling**

Cardno developed the future year models (including demand estimation) by adopting the same future year modelling assumptions used in the Aimsun microsimulation models developed by TDG for the Picton Town Centre Transport Master Plan (September 2017, TDG):

- > Key developments included in the 2026 model include:
  - Abbotsford, located just to the northwest of Picton with access off Bakers Lodge Road
  - Mushroom Tunnel, located to the west of Picton with access off the Argyle Street / Lumsdaine Street intersection
  - Picton East, located to the east of Picton with access from Margaret Street, Baxters Lane and a new connection on Menangle Street
  - Stonequarry Commercial, located to the west of Picton town centre with access onto Elizabeth Street
- > Background traffic growth
  - Wollondilly Growth Management Strategy model used to obtain relative change in trip numbers.

Further details of the demand estimation are documented in the Picton Town Centre Microsimulation Model Development Technical Note (December 2016, TDG). In summary, Cardno estimated 2026 demand by adding the relative change in demand between the 2016 and 2026 models developed by TDG to the Cardno 2016 base matrix as shown in Figure 2-3. This methodology ensures the absolute growth in demand from the above future year modelling assumptions by TDG are reflected in the Cardno Aimsun models.

Figure 2-3 Demand estimation for future year 2026



**2.2.2 Future Year Base Conditions**

This section reports on the future year 2026 base modelling results. The results are an estimate of future year road network conditions and establishes a future baseline scenario for comparative assessment of options.

*2.2.2.1 Menangle Street / Argyle Street*

The future year base models indicate during the AM peak, there is a slow moving queue on the southern approach (Argyle Street), due to the short right turn bay and the pedestrian crossings before and after the intersection on Argyle Street. Further delay and queues are observed on the eastern approach (Menangle Street) due to the difficulty in finding gaps, especially for the through and right turners who give priority to the southern and northern approaches. The queue on the eastern approach is much worse during the PM peak.

Model snapshots of these observations are presented in Figure 2-4 and Figure 2-5.

Figure 2-4 Model snapshots of future base Menangle Street / Argyle Street during AM peak

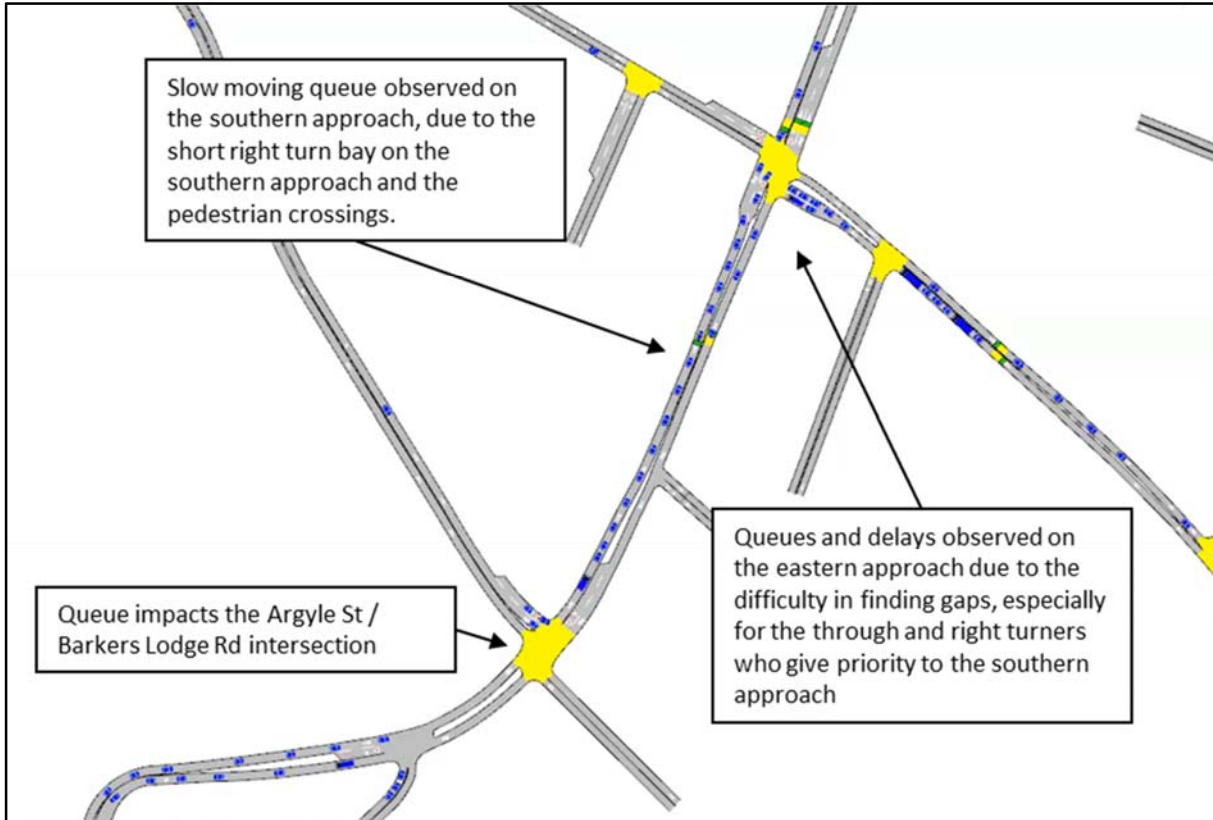
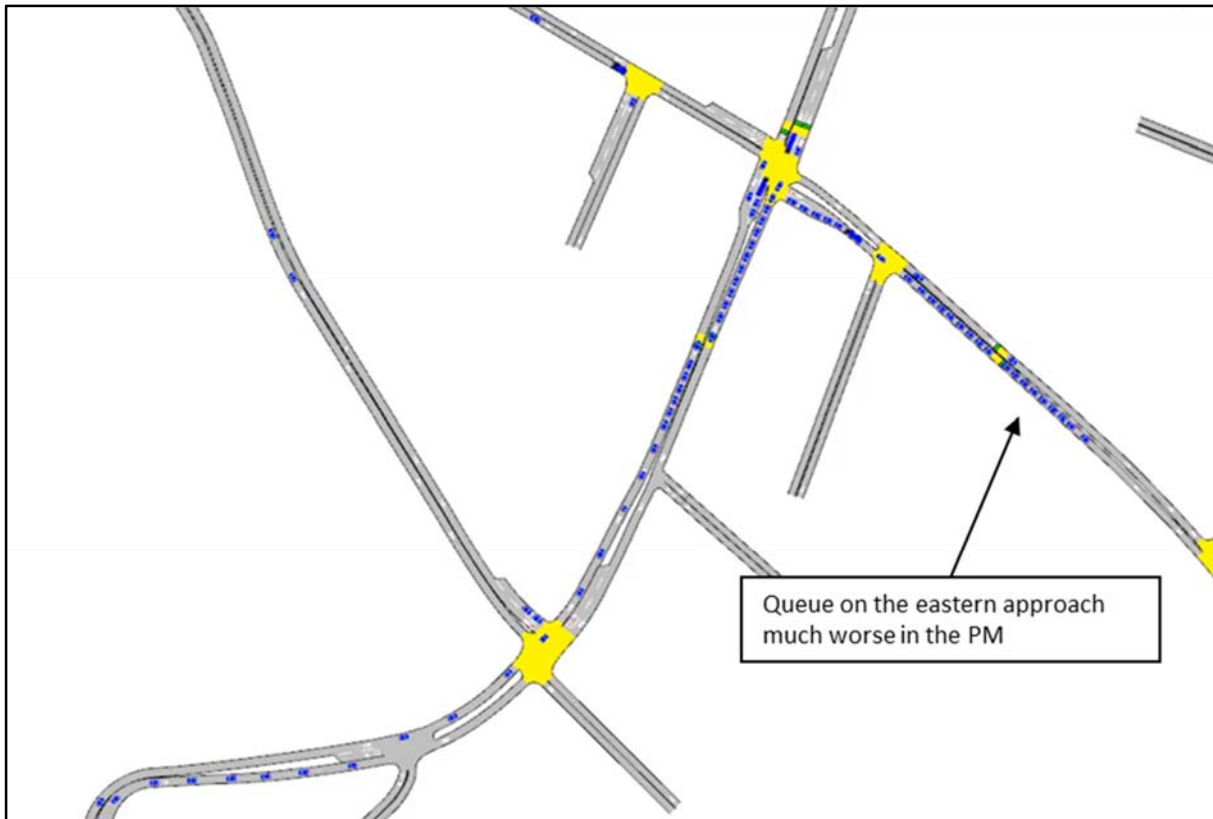


Figure 2-5 Model snapshots of future base Menangle Street / Argyle Street during PM peak



The intersection performance of the Menangle Street / Argyle Street intersection is:

- > LOS D during the AM peak
- > LOS F during the PM peak.

2.2.2.2 Argyle Street / Margaret Street / Cliffe Street

The future year base models indicate no significant issues are anticipated for the Argyle Street / Margaret Street / Cliffe Street intersection.

The intersection performance of the Argyle Street / Margaret Street intersection is:

- > LOS D during the AM peak
- > LOS D during the PM peak.

2.2.2.3 Prince Street / Menangle Street

The future year base models indicate during the AM and PM peak, there are queue and delays observed on the western approach (Prince Street) due to the difficulty in finding gaps, especially for the right turners who give priority to the southern and northern approaches (Menangle Street). The queue on Prince Street can extend to the bridge which is problematic because the bridge is one lane, two way.

Model snapshots of these observations are presented in Figure 2-6 and Figure 2-7.

Figure 2-6 Model snapshots of future base Prince Street / Menangle Street during AM peak

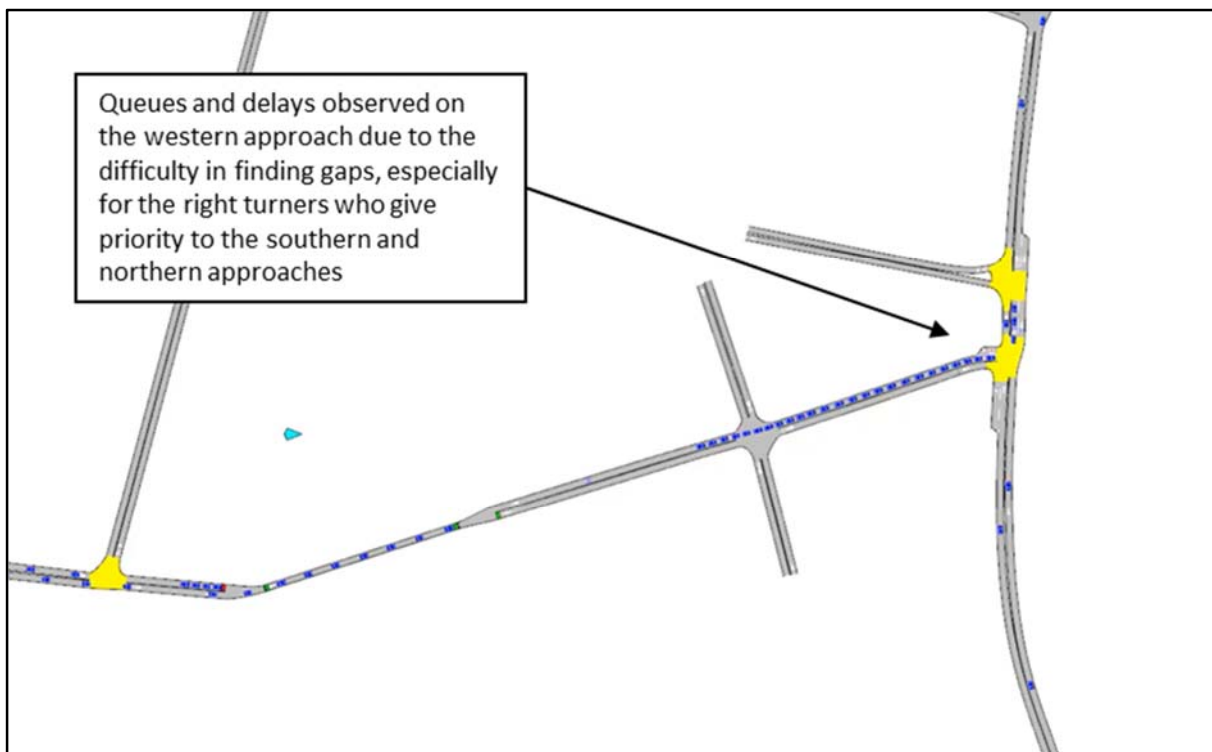
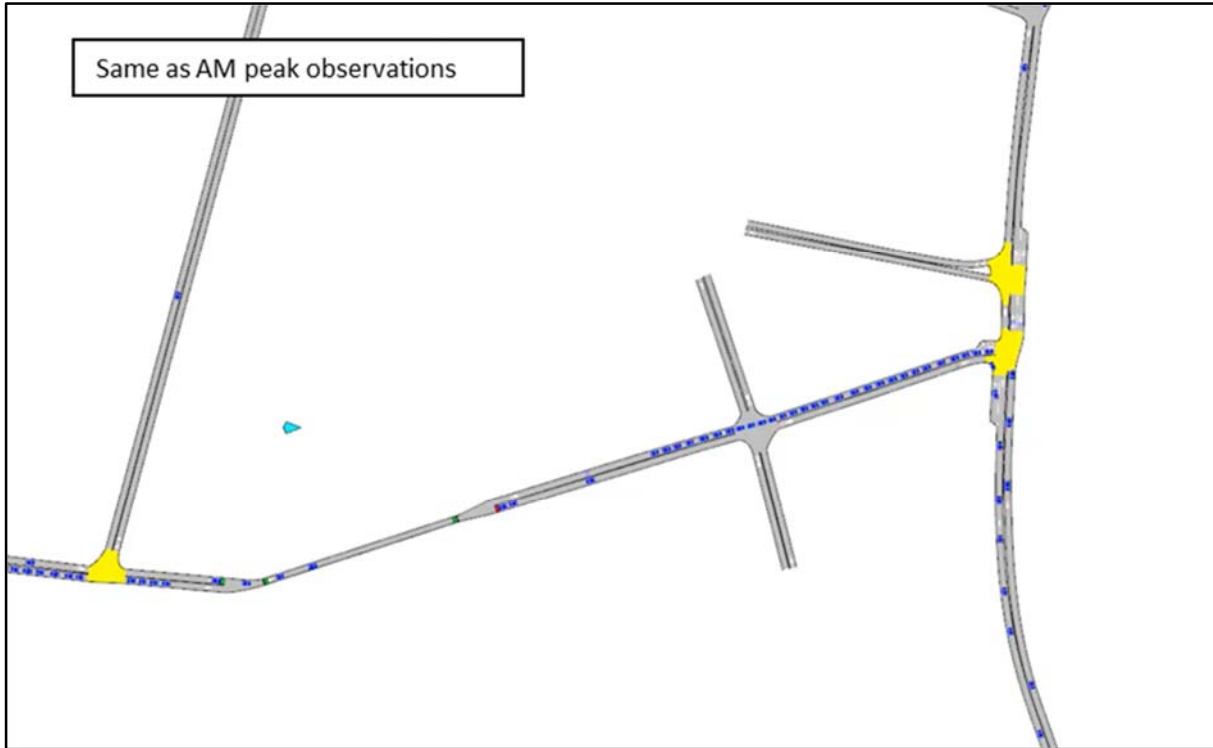


Figure 2-7 Model snapshots of future base Prince Street / Menangle Street during PM peak



The intersection performance of the Prince Street / Menangle Street intersection is:

- > **LOS F** during the AM peak
- > **LOS F** during the PM peak.

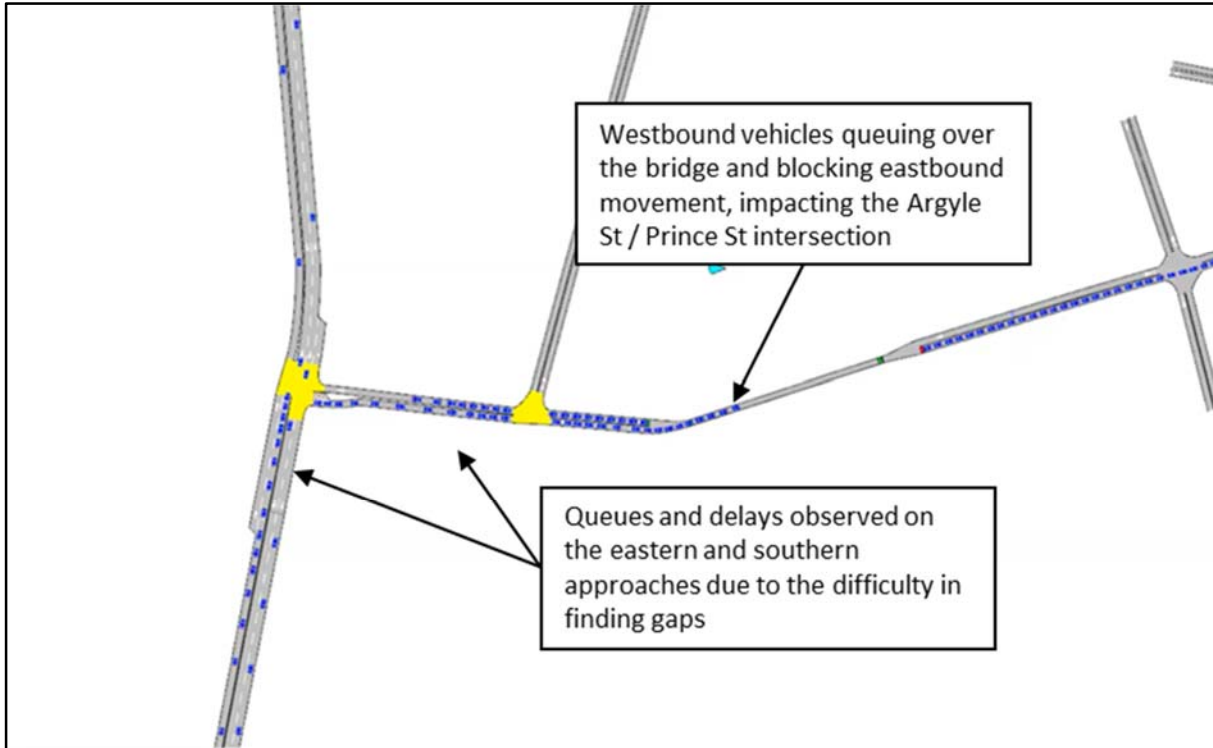
#### 2.2.2.4 Prince Street / Argyle Street

The future year base models indicate during the PM peak, there are queue and delays observed on the eastern approach (Prince Street) and southern approach (Argyle Street) due to the difficulty for vehicles turning to find gaps in traffic. The queue on Prince Street can extend to the bridge which is problematic because the bridge is one lane, two way.

There were no significant issues observed during the AM peak at this intersection.

Model snapshots of these observations are presented below in Figure 2-8.

Figure 2-8 Model snapshots of future base Prince Street / Argyle Street during PM peak



The intersection performance of the Prince Street / Menangle Street intersection is:

- > LOS B during the AM peak
- > LOS E during the PM peak.

2.2.2.5 Argyle Street / Barkers Lodge Road

The future year base models indicate during the AM and PM peak, there are queue and delays observed on the western approach (Barkers Lodge Road) due to the queuing on Argyle Street originating from the Menangle Street / Argyle Street intersection.

Model snapshots of these observations are presented below in Figure 2-9 and Figure 2-10.

Figure 2-9 Model snapshots of future base Argyle Street / Barkers Lodge Road during AM peak

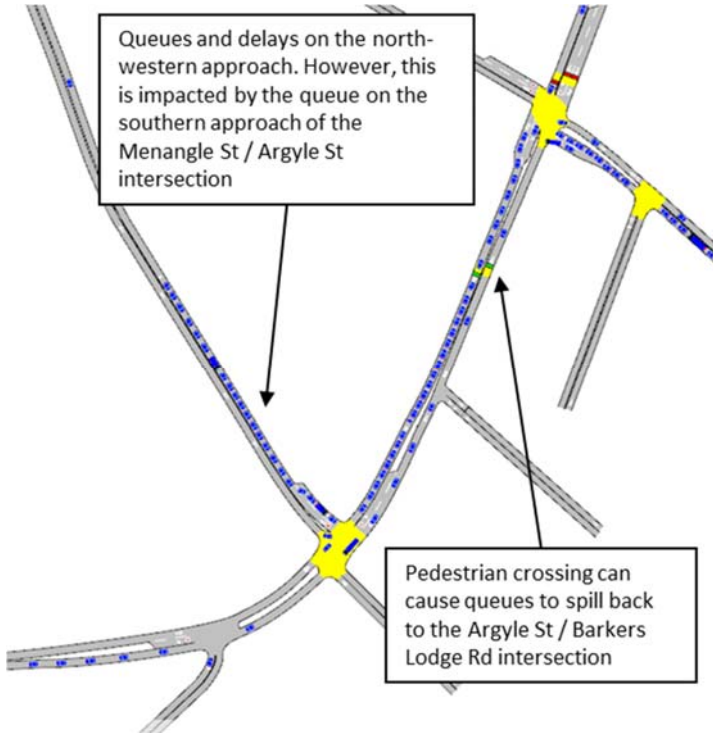
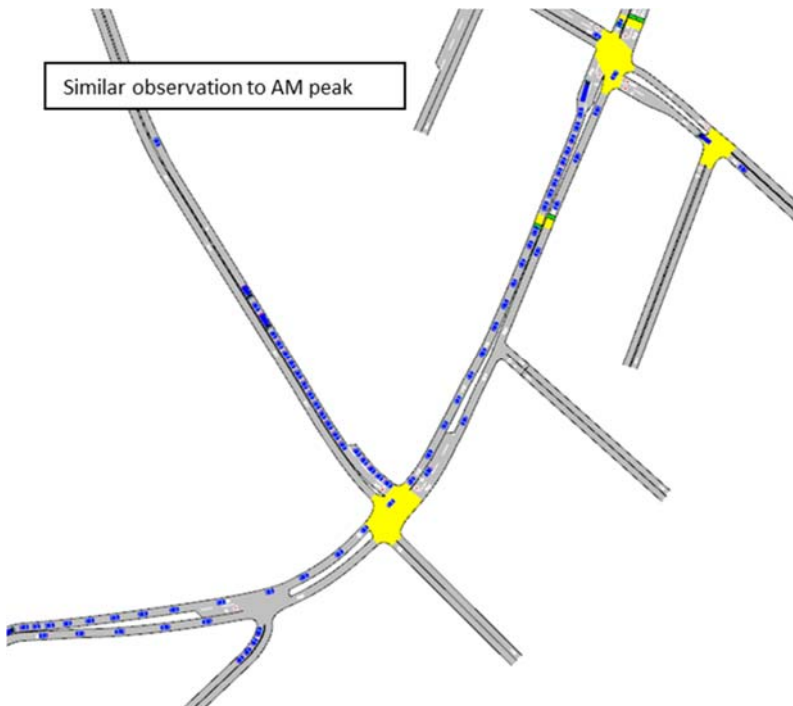


Figure 2-10 Model snapshots of future base Argyle Street / Barkers Lodge Road during PM peak



The intersection performance of the Argyle Street / Barkers Lodge Road intersection is:

- > LOS F during the AM peak
- > LOS E during the PM peak.



2.2.2.6 Argyle Street / Lumsdaine Street

The future year base models show there are no significant issues expected during the AM and PM peaks. However, upgrades are being considered at this intersection to improve pedestrian safety and connectivity, particularly across Argyle Street.

The intersection performance of the Argyle Street / Barkers Lodge Road intersection is:

- > LOS A\* during the AM peak
- > LOS A\* during the PM peak.

*The eastern approach (Lumsdaine Street) was LOS C during both the AM and PM peaks, however the volume for this approach is less than 20 vph during both the AM and PM peaks. The average delay of the next worst approach was adopted for the intersection performance as recommended in the RMS Traffic Modelling Guidelines.*

2.2.3 Options

This section describes and comparatively assesses the options proposed for each intersection to address the capacity issues identified in the future base conditions.

2.2.3.1 Menangle Street / Argyle Street

The proposed option for this intersection is a right turn ban on the eastern approach (Menangle Street) as pictured in Figure 2-11. This improves the intersection performance by removing the right turn movement, which incurs the highest delay of the intersection and blocks left turning vehicles out of the eastern approach.

Table 2-1 presents the intersection performance results. The results indicate the proposed option reduces the average delay on the eastern approach from a LOS D to a LOS C in the AM peak, and LOS F to a LOS D in the PM peak when compared to the base case in 2026.

Figure 2-11 Option for Menangle Street / Argyle Street

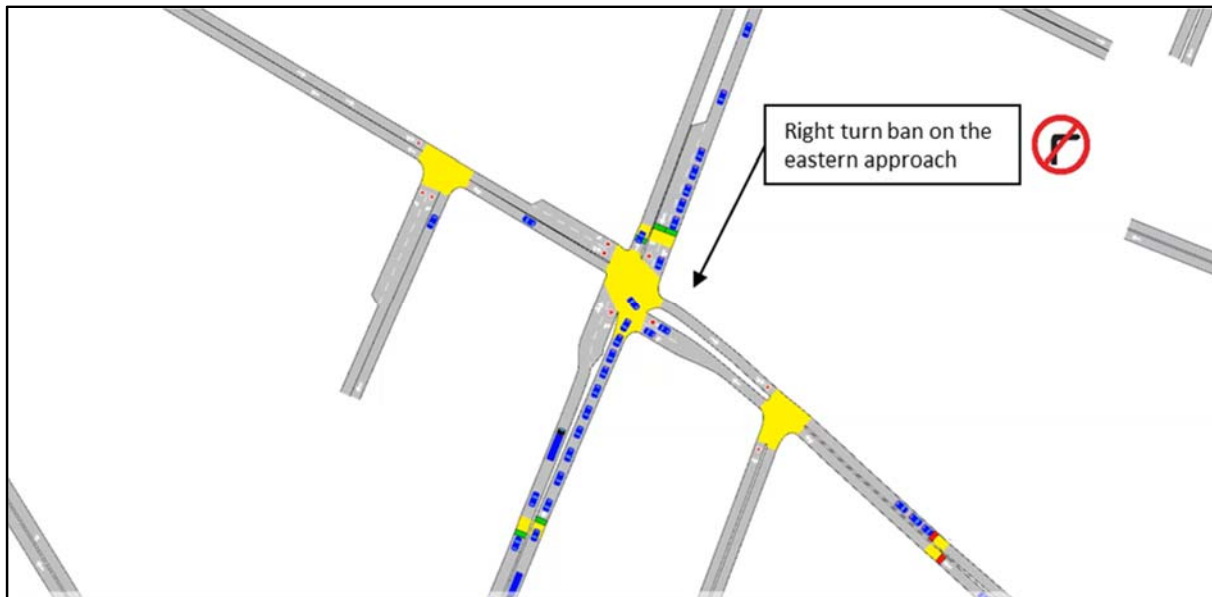


Table 2-1 Intersection Performance Menangle Street / Argyle Street

	AM	PM
Future Year 2026 Base	LOS D	LOS F
Future Year 2026 Option	LOS C	LOS D

The right turn ban impacts about 30 vph during the AM peak and 27 vph during the PM peak. Since vehicles are rerouted to the Argyle Street / Margaret Street / Cliffe Street intersection, the impact to Argyle Street / Margaret Street / Cliffe Street intersection was also assessed.

Table 2-2 presents the intersection performance results. The results indicate with minor adjustments to the signal control plan (maximum green time increased from 15s to 20s for the eastern approach), the proposed option will have minimal impact to this intersection.

Table 2-2 Intersection Performance Argyle Street / Margaret Street / Cliffe Street

	AM	PM
Future Year 2026 Base	LOS D	LOS D
Future Year 2026 Option	LOS D	LOS D

2.2.3.2 Argyle Street / Margaret Street / Cliffe Street

Aside from minor adjustments to the signal control plan proposed as part of the Menangle Street / Argyle Street option, no further upgrades have been proposed for this intersection because no significant issues were identified in the future year base conditions.

2.2.3.3 Prince Street / Menangle Street

The modelling for this intersection assumed the implementation of the upgrade proposed for Menangle Street / Argyle Street, discussed above.

2.2.3.3.1 Option 1

The proposed option for this intersection is signalling the intersection as pictured in Figure 2-12. This is shown to improve intersection performance by being able to control the priority of movements, especially giving priority to vehicles on the western approach.

Figure 2-12 Option for Prince Street / Menangle Street

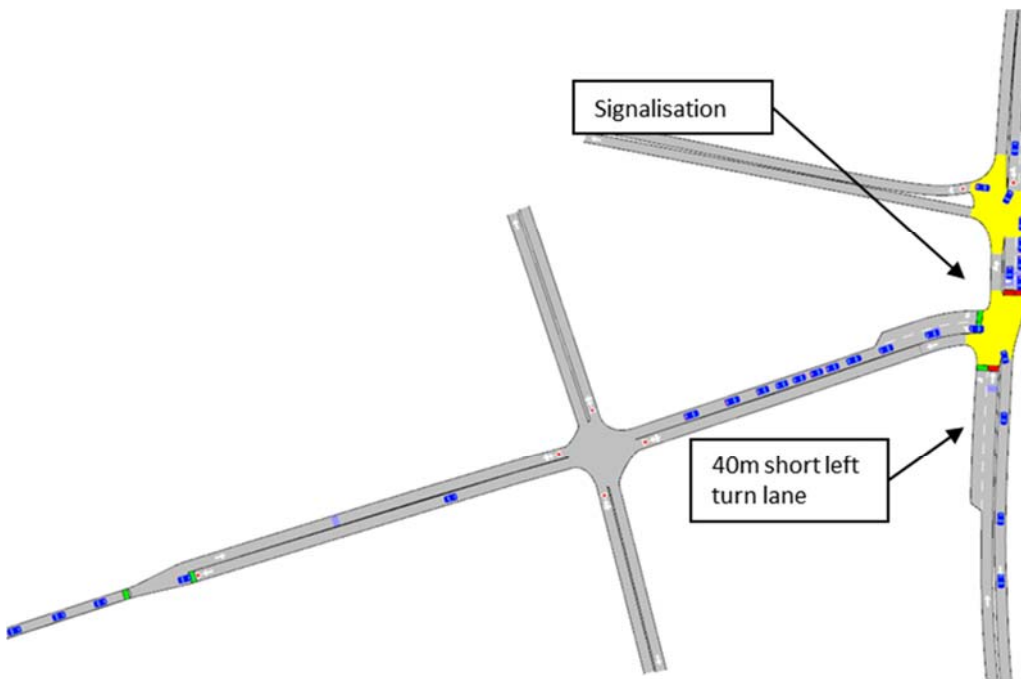


Table 2-3 presents the intersection performance results. The results indicate the proposed option significantly reduces the performance of the intersection from a LOS F to a LOS B in the AM peak, and LOS F to a LOS B in the PM peak when compared to the base case in 2026.

Table 2-3 Intersection Performance Prince Street / Menangle Street

	AM	PM
Future Year 2026 Base	LOS F	LOS F
Future Year 2026 Option 1	LOS B	LOS B

2.2.3.3.2 Option 2

Option 2 proposed for this intersection is the same as Option 1 except the west approach (Prince Street) is one lane only (a shared left and right turn). The intersection performance results, as reported in Table 2-4, indicate there is no significant impact to the performance of the intersection by reducing the west approach to one lane. This is likely to be because there are relatively few left turners from Prince Street, with the vast majority of vehicles turning right in both peak hours.

Table 2-4 Intersection Performance Prince Street / Menangle Street

	AM	PM
Future Year 2026 Option 1	LOS B	LOS B
Future Year 2026 Option 2	LOS B	LOS B

2.2.3.3.3 SIDRA Assessment

Option 1 and Option 2 were modelled in SIDRA v7.0 to optimise the signal control plan and validate the results produced by the Aimsun model. The SIDRA layouts of Option 1 and Option 2 are presented in Figure 2-13, the signal control plan in Figure 2-14 and the intersection results in Table 2-5. The SIDRA results indicate Option 1 and Option 2 have similar intersection performance, which is consistent with the results from Aimsun. For detailed movement summaries please see Appendix E.

Due to the reduced land acquisition, Option 2 is the recommended option. It is noted, however, that the single lane approach on Prince Street is a departure from RMS' preferred TCS layout. Early consultation with RMS should be undertaken to explain the reasons for the preferred design and seek approval in principle prior to proceeding with detailed design.

Figure 2-13 Prince Street / Menangle Street Option 1 and Option 2 SIDRA Layout

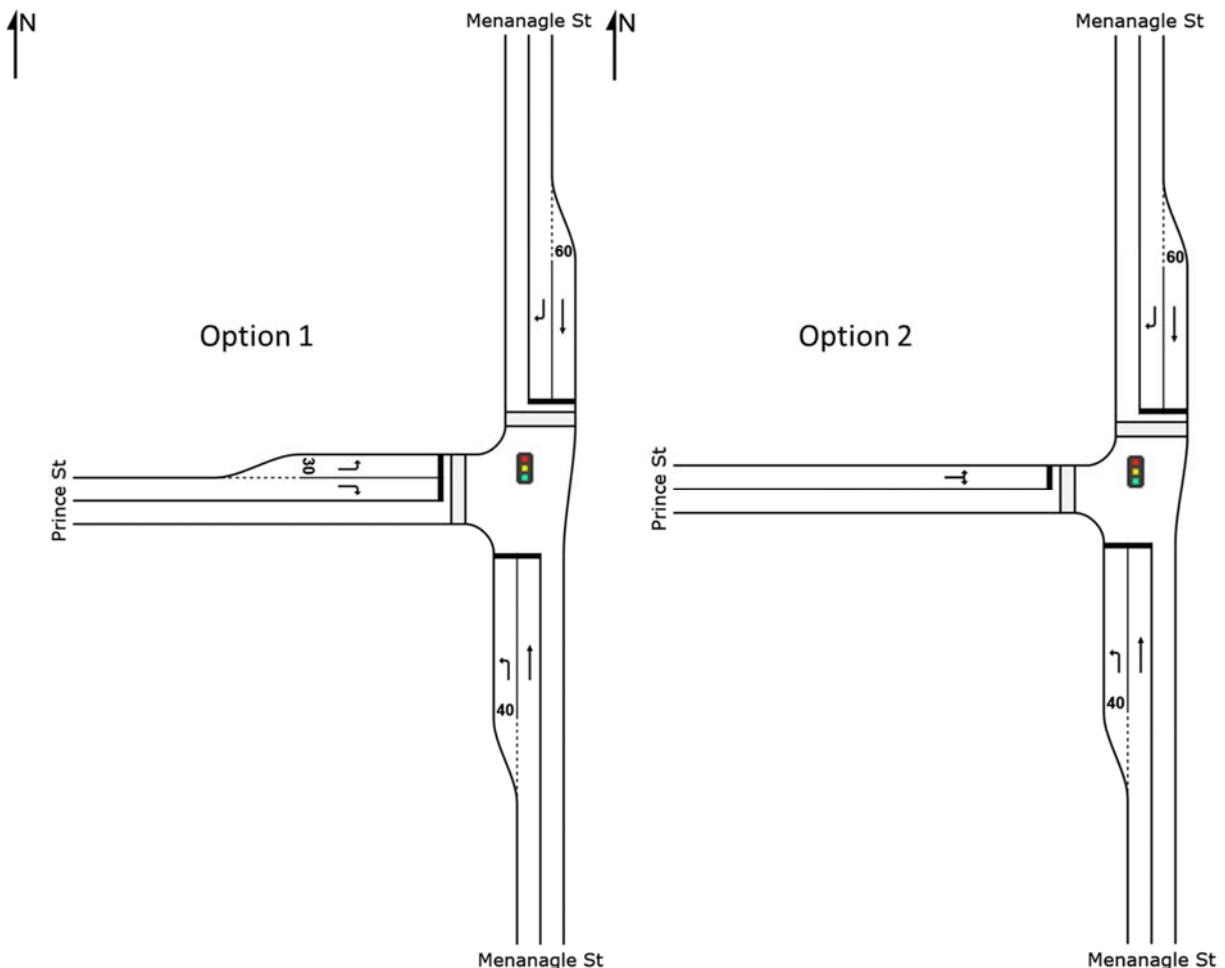


Figure 2-14 Prince Street / Menangle Street Proposed Signal Control Plan

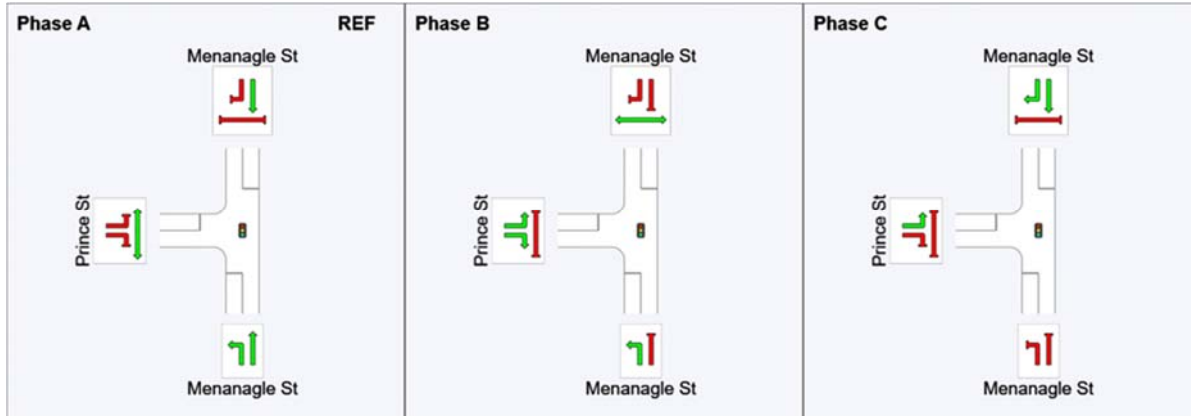


Table 2-5 SIDRA Intersection Performance Prince Street / Menangle Street

	AM	PM
Future Year 2026 Option 1	LOS B	LOS C
Future Year 2026 Option 2	LOS B	LOS C

2.2.3.4 Prince Street / Argyle Street

The modelling for this intersection included the cumulative upgrades proposed for the other intersections within the study area and discussed above (Menangle Street / Argyle Street and Prince Street / Menangle Street).

The proposed option for this intersection is provision for a continuous left turn out of the eastern approach (Prince Street), formalising a 90m right turn bay on the southern approach (Argyle Street) and a reduction to one lane southbound on the northern approach (Argyle Street) as pictured below in Figure 2-15. This improves the intersection performance by removing conflicts for the left turn out of Prince Street, which is the movement that incurs the highest delay at the intersection.

Table 2-6 presents the intersection performance results. The results indicate the proposed option significantly reduces the average delay of the intersection from LOS E to LOS B in the PM peak when compared to the base case in 2026.

Figure 2-15 Option for Prince Street / Argyle Street

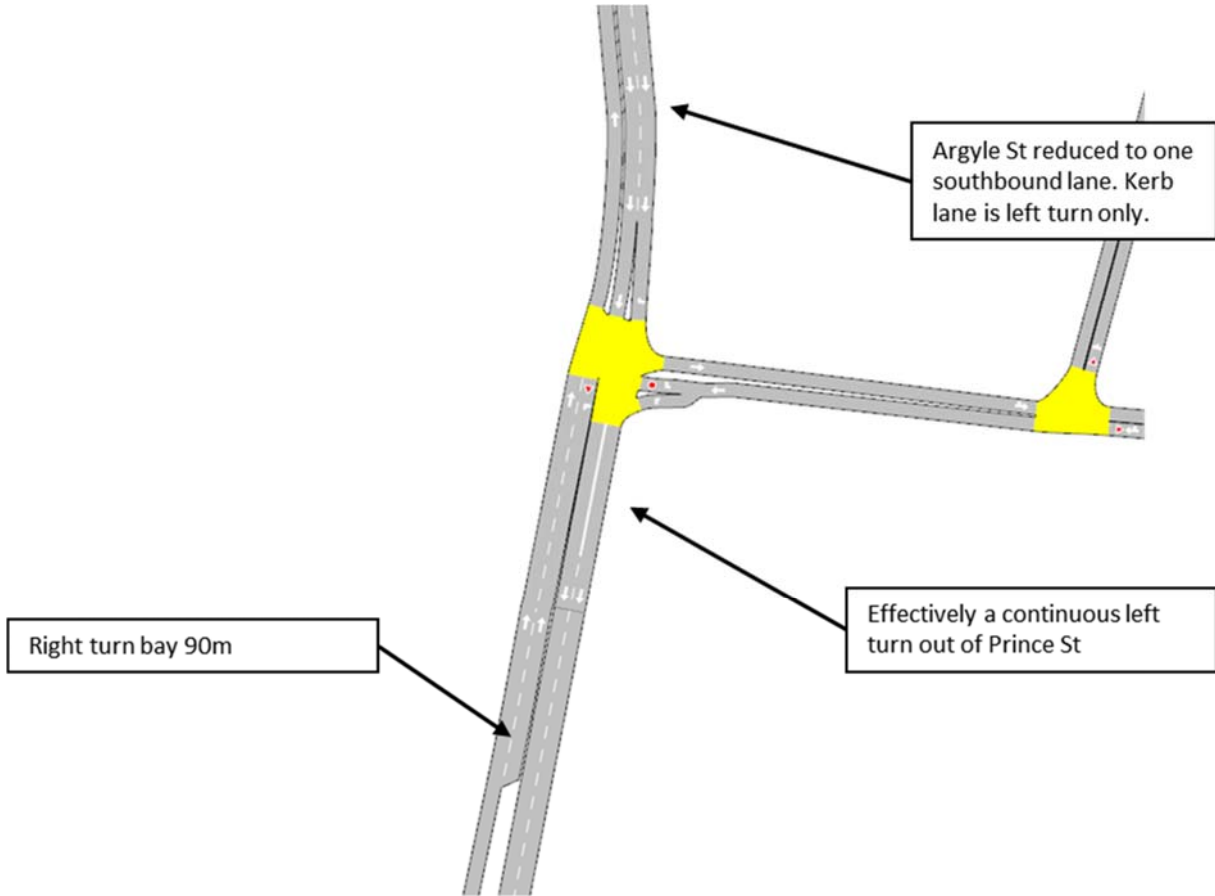


Table 2-6 Intersection Performance Prince Street / Argyle Street

	AM	PM
Future Year 2026 Base	LOS B	LOS E
Future Year 2026 Option	LOS B	LOS B

2.2.3.5 Argyle Street / Barkers Lodge Road

The modelling for this intersection included the cumulative upgrades proposed for the other intersections within the study area and discussed above (Menangle Street / Argyle Street, Prince Street / Menangle Street and Prince Street / Argyle Street).

No further upgrades have been proposed for the Argyle Street / Barkers Lodge Road intersection because the cumulative impact of the options proposed thus far significantly improve the performance of the intersection, from a **LOS F** to a **LOS E** in the AM peak and **LOS F** to a **LOS B** in the PM peak. The intersection performance results are presented in Table 2-7.

Table 2-7 Intersection Performance Argyle Street / Barkers Lodge Road

	AM	PM
Future Year 2026 Base	LOS F	LOS F
Future Year 2026 "Cumulative Options"	LOS E	LOS B

The intersection improvement is due to a reduction in vehicles on Argyle Street northbound, increasing the number of gaps for vehicles to turn out of Barkers Lodge Road. The reduction of vehicles on Argyle Street northbound can be traced back to the improved performance of Prince Street and it's intersections with Argyle Street and Menangle Street, with more vehicles turning right into Prince Street from Argyle Street than was the case in the Future Year 2026 Base model. This analysis is summarised in Table 2-8 and pictured in Figure 2-16.

Figure 2-16 Impact of Cumulative Options to Argyle Street / Barkers Lodge Road intersection

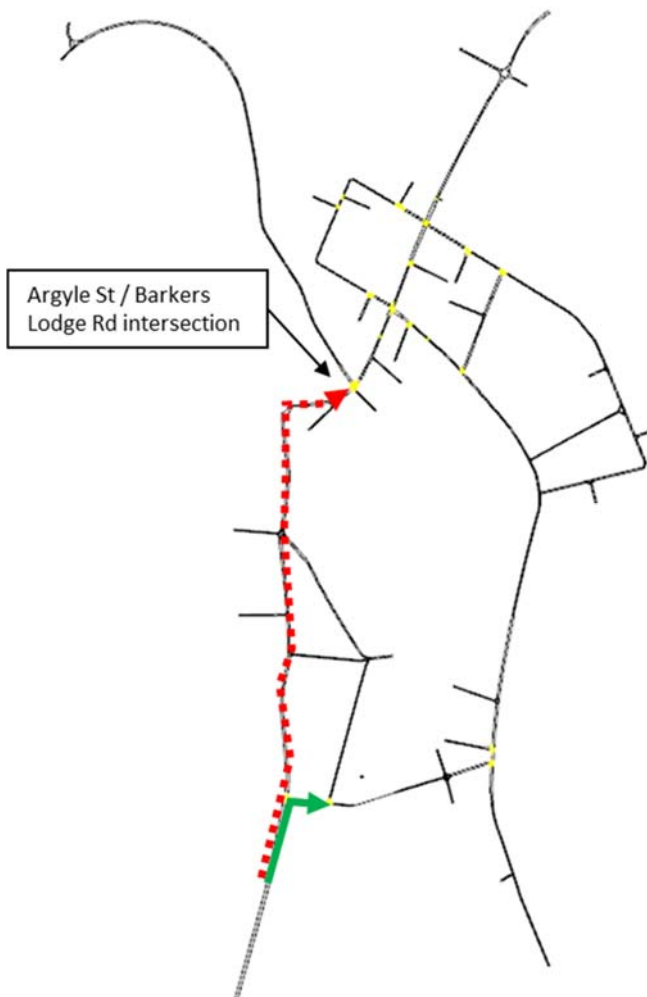


Table 2-8 Intersection Analysis of Argyle Street / Prince Street

	AM (vph)		PM (vph)	
	NB Through	NB Right Turn	NB Through	NB Right Turn
Future Year 2026 Base	1020	348	803	221
Future Year 2026 "Cumulative Options"	808	561	639	388
<b>Difference</b>	<b>-212</b>	<b>+213</b>	<b>-164</b>	<b>+167</b>

2.2.3.6 Argyle Street / Lumsdaine Street

The modelling for this intersection included the cumulative upgrades proposed for the other intersections within the study area and discussed above (Menangle Street / Argyle Street, Prince Street / Menangle Street and Prince Street / Argyle Street). This intersection is proposed to be upgraded to improve pedestrian safety and connectivity while minimising impact to nearby intersections.

2.2.3.6.1 Option 1

The proposed option for this intersection is traffic lights as illustrated in Figure 2-17. This option includes pedestrian crossings on three legs of the intersection. As a conservative assessment, 100 pedestrians per hour were modelled on each leg, replicating worst case conditions during school drop off and pick up periods.

Figure 2-17 Argyle Street / Lumsdaine Street – Option 1

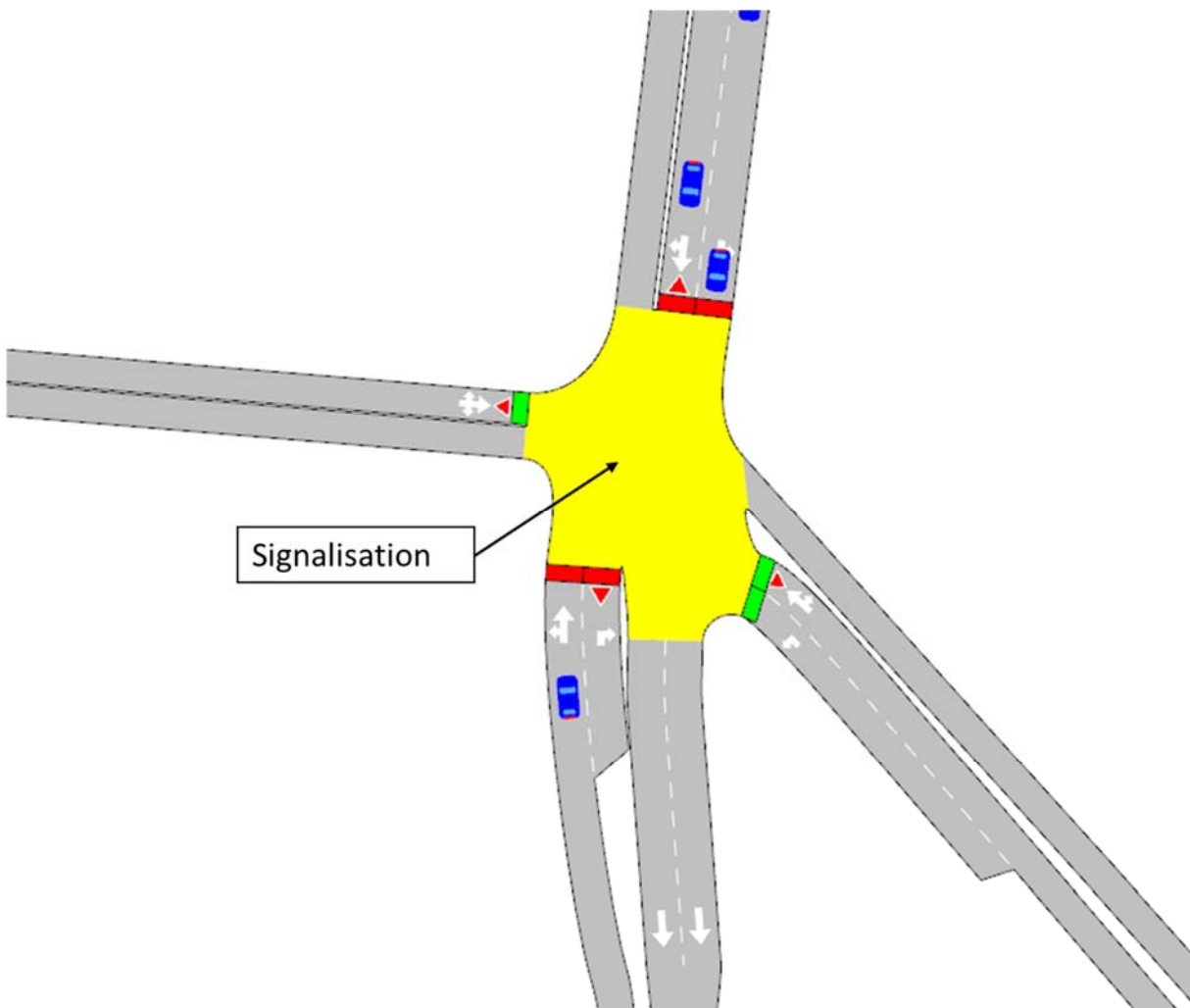


Table 2-9 presents the intersection performance results. The results indicate the proposed option maintains a good level of intersection performance with a **LOS A** in the AM and PM peaks when compared to the base case in 2026.

Table 2-9 Intersection Performance Argyle Street / Lumsdaine Street (Option 1)

	AM	PM
Future Year 2026 Base	LOS A	LOS A
Future Year 2026 Option 1	LOS A	LOS A

Given this intersection’s proximity to the Argyle Street / Barkers Lodge Road intersection, the impact on the northern intersection performance was also assessed.

Table 2-10 presents the intersection performance results. The implementation of Argyle Street / Lumsdaine Street Option 1 results in a minor improvement in the AM peak intersection performance at Argyle Street / Barkers Lodge Road, evidenced by **LOS D** compared to **LOS E** without Option 1. This is most likely due to the signalised pedestrian crossing on Argyle Street creating additional gaps in downstream traffic.

Table 2-10 Intersection Performance Argyle Street / Barkers Lodge Road (Option 1)

	AM	PM
Future Year 2026 “Cumulative Options”	LOS E	LOS B
Future Year 2026 “Cumulative Options” plus Option 1	LOS D	LOS B

2.2.3.6.2 SIDRA Assessment

Option 1 was modelled in SIDRA v7.0 to optimise the signal control plan and validate the results produced by the Aimsun model. The SIDRA layout of Option 1 is presented in Figure 2-18, the signal control plan in Figure 2-19 and the intersection results in Table 2-11. The SIDRA results indicate Option 1 has good intersection performance with a LOS A in the AM and PM peaks, which is consistent with the results from Aimsun. For detailed movement summaries please see Appendix E.

Figure 2-18 Argyle Street / Lumsdaine Street Option 1 SIDRA Layout

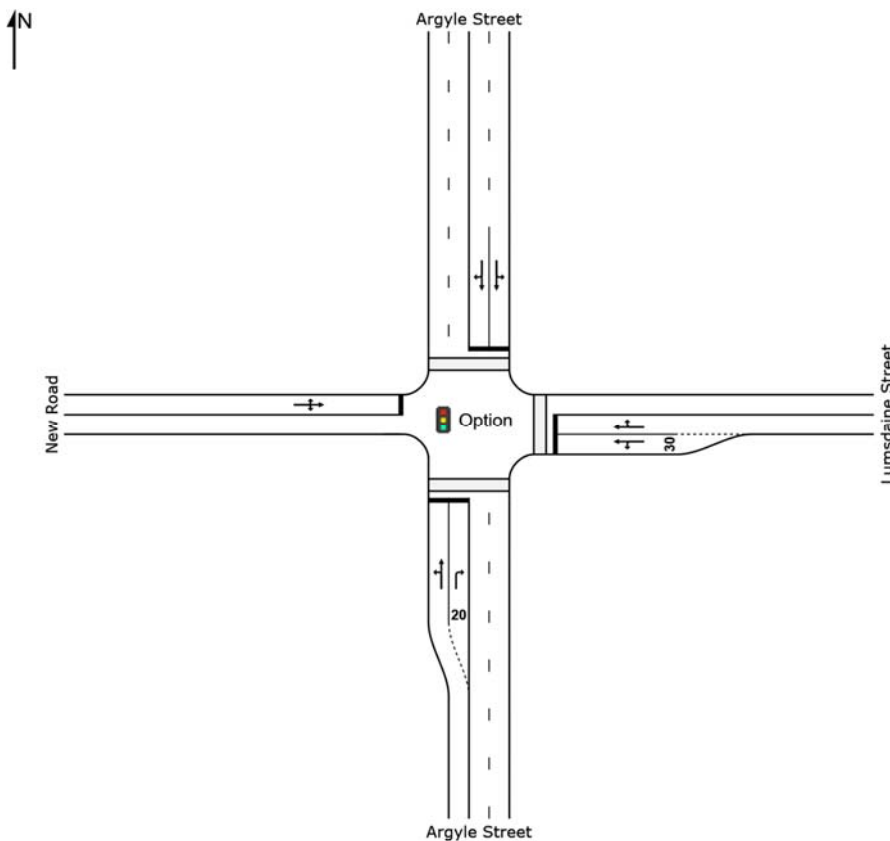




Figure 2-19 Argyle Street / Lumsdaine Street Proposed Signal Control Plan

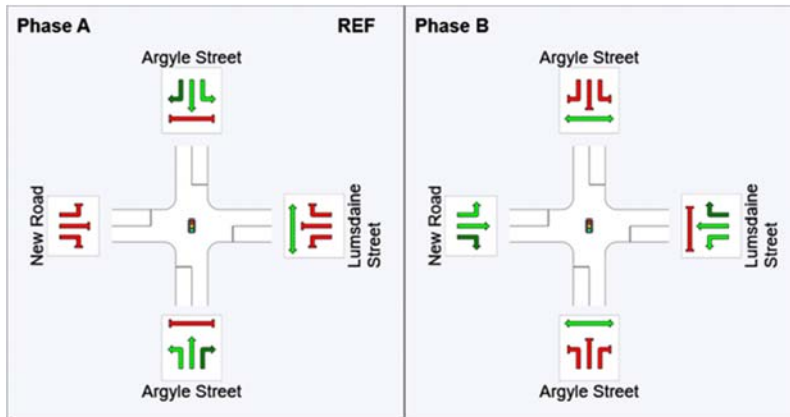


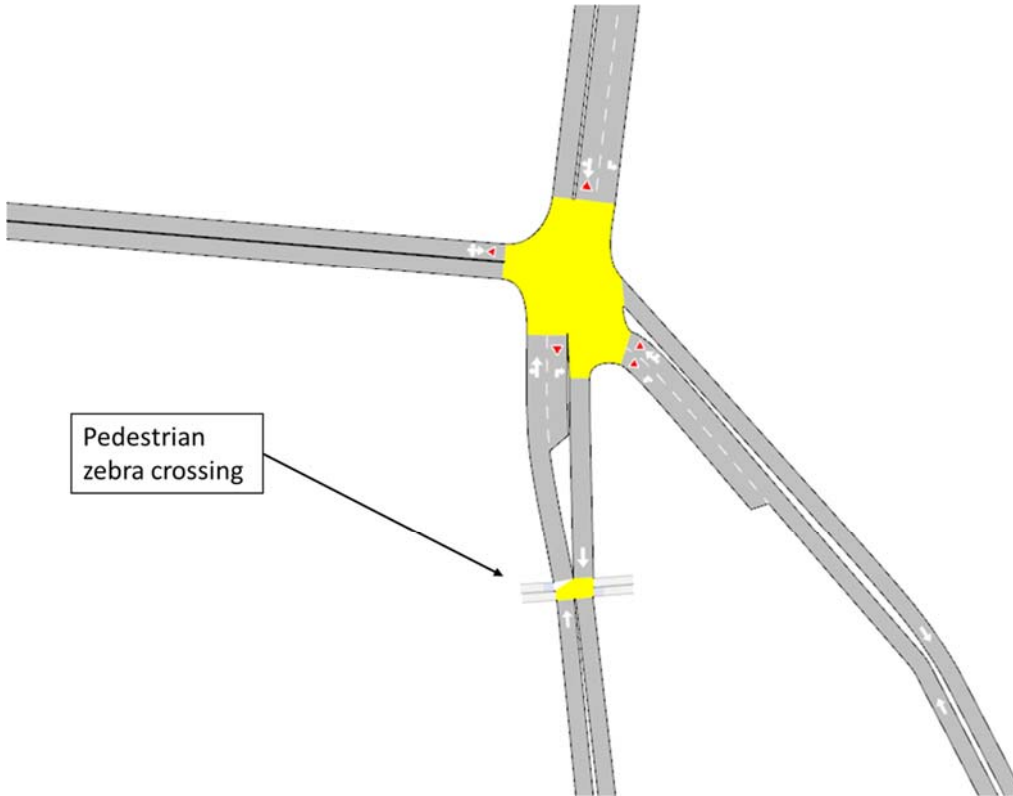
Table 2-11 Argyle Street / Lumsdaine Street – Intersection Performance

	AM	PM
Future Year 2026 Option 1 – Aimsun	LOS A	LOS A
Future Year 2026 Option 1 – SIDRA	LOS A	LOS A

### 2.2.3.6.3 Option 2

Option 2 proposes a pedestrian (zebra) crossing on Argyle Street just south of the Argyle Street / Lumsdaine Street intersection, as illustrated in Figure 2-20. To comply with Austroads requirements and reduce the overall speed environment, Argyle Street is proposed to be reduced to one lane southbound between Lumsdaine Street and Prince Street. This is consistent with the proposed option for Argyle Street / Prince Street intersection, which reduces Argyle Street to one lane southbound to facilitate the free flow left turn out of Prince Street.

Figure 2-20 Argyle Street / Lumsdaine Street – Option 2



It was assumed 100 pedestrians per hour would use this zebra crossing during peak hours. The impact on both Argyle Street / Lumsdaine Street and Argyle Street / Barkers Lodge Road intersections were assessed.

Table 2-12 presents the Argyle Street / Lumsdaine Street intersection performance results. The results indicate the proposed option maintains a good level of intersection performance with a **LOS B** in the AM and PM peaks.

Table 2-12 Intersection Performance Argyle Street / Lumsdaine Street (Option 2)

	AM	PM
Future Year 2026 Base	LOS A	LOS A
Future Year 2026 Option 2	LOS B	LOS B

Table 2-13 presents the Argyle Street / Barkers Lodge Road intersection performance results. The results show Option 2 gives a minor improvement to the intersection performance at Argyle Street / Barkers Lodge Road, with a **LOS D** compared to a **LOS E** without Option 2 during the AM peak.

Table 2-13 Intersection Performance Argyle Street / Barkers Lodge Road (Option 2)

	AM	PM
Future Year 2026 “Cumulative Options”	LOS E	LOS B
Future Year 2026 “Cumulative Options” plus Option 2	LOS D	LOS B

The modelling results discussed above show that the proposed pedestrian zebra crossing and reduction of capacity on Argyle Street southbound between Lumsdaine Street and Prince Street are not anticipated to have a significant negative impact on the road network in 2026.

It can be seen that both Option 1 and Option 2 result in improved pedestrian amenity and minor traffic performance benefits. The preferred option is subject to further design development and discussion with relevant stakeholders, in particular Roads and Maritime and Picton Public School.

### 2.3 Traffic modelling summary

Cardno estimated the future year 2026 road network conditions and established a future baseline scenario for comparative assessment of options, by developing Aimsun microsimulation traffic models for the study area. The traffic models indicated the impact of future development and traffic growth on the road network resulted in capacity issues at the following intersections by 2026:

- > Menangle Street / Argyle Street
- > Prince Street / Menangle Street
- > Prince Street / Argyle Street
- > Argyle Street / Barkers Lodge Road.

Preferred options were proposed to address the identified short term capacity issues, and their impact was comparatively assessed against the future baseline scenario. The proposed options are:

Intersection	Proposed Option
Menangle Street / Argyle Street	<ul style="list-style-type: none"> <li>▪ Right turn ban on the eastern approach (Menangle Street)</li> </ul>
Argyle Street / Margaret Street	<ul style="list-style-type: none"> <li>▪ Increase maximum green time of the signal control plan on the eastern approach from 15s to 20s</li> </ul>
Prince Street / Menangle Street	<ul style="list-style-type: none"> <li>▪ Upgrade the intersection to signals</li> </ul>
Prince Street / Argyle Street	<ul style="list-style-type: none"> <li>▪ Reduce northern approach (Argyle Street) to one lane southbound</li> <li>▪ Provide for a continuous left turn out of Prince Street</li> <li>▪ Formalise the 90m right turn bay on the southern approach (Argyle Street)</li> </ul>
Argyle Street / Barkers Lodge Road	<ul style="list-style-type: none"> <li>▪ No further upgrades required assuming the above options are in place</li> </ul>

The proposed options result in improved intersection performance as summarised below :

Intersection	AM		PM	
	2026 Base	Option	2026 Base	Option
Menangle Street / Argyle Street	LOS D	LOS C	LOS F	LOS D
Argyle Street / Margaret Street	LOS D	LOS D	LOS D	LOS D
Prince Street / Menangle Street *	LOS F	LOS B	LOS F	LOS B
Prince Street / Argyle Street	LOS B	LOS B	LOS E	LOS B
Argyle Street / Barkers Lodge Road **	LOS F	LOS E	LOS F	LOS B

\* Option 2 for this intersection is preferred and recommended

\*\* No upgrades are proposed for this intersection, "option" considers the cumulative impact of all the other proposed options, not including Argyle St / Lumsdaine St

Additionally, two options to improve pedestrian safety and connectivity at the Argyle Street / Lumsdaine Street intersection were proposed and assessed. Both options improve pedestrian safety and show minor improvement to the Argyle Street / Barkers Lodge Road intersection performance.

Argyle Street / Lumsdaine Street Intersection	AM		PM	
	2026 Base	Option	2026 Base	Option
Option 1 – install traffic lights	LOS A	LOS A	LOS A	LOS A
Option 2 – install pedestrian (zebra crossing) on the southern leg of the intersection	LOS A	LOS B	LOS A	LOS B

The proposed options are recommended because they address the short term capacity issues which are anticipated in the road network by 2026 and demonstrate cumulative network wide benefits for relatively low cost.

## 3 Strategic Design Development

### 3.1 Design Guides and References

The strategic intersection designs of Menangle Street / Prince Street, and Argyle Street / Prince Street have been based on the following guides and references:

- > Wollondilly Shire Council Design Specifications – Subdivision and Engineering Standards
- > Wollondilly Shire Council Standard Drawings – Subdivision and Engineering Standards
- > Austroads Part 3 Geometric Design
- > Austroads Part 4A Unsignalised and Signalised Intersections
- > Roads and Maritime Services Traffic Signal Design – Appendix D
- > Roads and Maritime Services Delineation Guide Section 4 – Longitudinal Markings
- > Roads and Maritime Services Delineation Guide Section 4 – Transverse Markings
- > Roads and Maritime Services Delineation Guide Section 4 – Pavement Arrows
- > Rawlinson's Australian Construction Handbook Edition 26 (2016)

### 3.2 Menangle Street / Prince Street

The design of the intersection layout for the Menangle Street and Prince Street is a signalised urban channelised T-junction, with a total of eight (8) new traffic lanterns. The intersection has been designed for a 5.2 m passenger vehicle, with an 8.8 m service vehicle as the check vehicle. These vehicles have been chosen for the design as the Prince Street Bridge enforces a load limit of 5 t gross and access to other streets from Prince Street are residential dwellings only.

The intersection consists of a channelised right turn movement for southbound traffic into Prince Street and a channelised left turn movement for northbound traffic into Prince Street. The channelising of these turn movements are implemented through the use of both chevron marked medians and a concrete median. The lane length of the right turn movement has been dictated by Austroad guidelines, whereas the left turn movement lane length has been determined through the Aimsun and SIDRA modelling outputs.

The kerb returns on Prince Street have been improved to allow for the design and check vehicles to manoeuvre safely through the turn movements which has resulted in pavement widening and installation of new kerb and gutter. Further pavement widening and new kerb and gutter has occurred on the eastern side of Argyle Street to allow for a 3.5 m through lane for the southbound traffic.

The traffic signal phasing for the proposed intersection upgrade has been matched to the SIDRA modelling inputs as per Section 2.2.3.3.

#### 3.2.1 Cost Estimation

A cost estimate for the construction of the proposed works at the intersection of Menangle Street / Prince Street was performed using material and volume take-offs from strategic design depicted on drawing 82018177-01 SK006 (refer to Appendix A). Cardno also utilised current industry costs for the relevant elements of the works based on Cardno's previous experience on similar projects, as well as Rawlinson's cost guide handbook.

The estimate includes the following costs:

- > Pre-construction or site preparation works
- > Construction of all elements as shown in the drawings, unless specifically excluded
- > Contingency allowance appropriate to the stage of the estimate

A summary of the cost estimate can be found in Table 3-1 below. For the detailed cost estimate please refer to Appendix B.

Table 3-1 Menangle Street / Prince Street Cost Estimate Summary

<b>General Items</b>	<b>\$42,500.00</b>
Earthworks	\$7,967.00
Roadworks	\$358,600.00
Erosion & Sedimentation Control	\$5,000.00
Total Excl. Contingency	\$414,067.00
Contingency 30%	\$124,220.10
<b>Total Incl. Contingency</b>	<b>\$538,287.10</b>

It should be noted no allowance has been made for any utility relocation or protection works as there is insufficient information to determine works at this stage. It should also be noted the cost estimate above has assumed the works for Menangle Street / Prince Street are constructed in isolation. If Council were to utilise a contractor to construct additional works at the same time, there would likely be cost savings in preliminaries and site establishment.

### 3.3 Argyle Street / Prince Street

The design of the intersection layout for the Argyle Street / Prince Street is an unsignalised urban channelised T-junction. The intersection has been designed for a 5.2 m passenger vehicle, with an 8.8 m service vehicle as the check vehicle. These vehicles have been chosen for the design as the Prince Street Bridge enforces a load limit of 5 t gross and access to other streets from Prince Street are residential dwellings only.

The intersection consists of a channelised right turn movement for northbound traffic into Prince Street, a dedicated left turn movement for southbound traffic into Prince Street and a channelised left turn movement for westbound traffic into Argyle Street. The channelising of these turn movements are implemented through the use of chevron marked medians. The lane length of the left turn movements into Argyle Street has been dictated by Austroad guidelines, whereas the right turn movement lane length has been determined through Aimsun modelling outputs.

Pavement widening is to be implemented for the channelised left turn movement into Argyle St and for the northbound through lane on Argyle Street. This shall also result in new kerb and gutter for these sections of pavement.

#### 3.3.1 Cost Estimation

A cost estimate for the construction of the proposed works at the intersection of Argyle Street and Prince Street was performed using material and volume take-offs from the strategic design depicted on drawing 82018177-01 SK009 (refer to Appendix A). Cardno also utilised current industry costs for the relevant elements of the works based on Cardno's previous experience on similar projects, as well as Rawlinson's cost guide handbook.

The estimate includes the following costs:

- > Pre-construction or site preparation works
- > Construction of all elements as shown in the drawings
- > Contingency allowance appropriate to the stage of the estimate

A summary of the cost estimate can be found in Table 3-2 below. For the detailed cost estimate please refer to Appendix B.

Table 3-2 Argyle Street / Prince Street Cost Estimate Summary

General Items	\$36,000.00
Earthworks	\$74,530.00
Roadworks	\$82,764.45
Erosion & Sedimentation Control	\$5,000.00
Total Excl. Contingency	\$198,294.45
Contingency 30%	\$59,488.33
Total Incl. Contingency	<b>\$257,782.78</b>

It should be noted no allowance has been made for any utility relocation or protection works as there is insufficient information to determine works at this stage. It should also be noted the cost estimate above has assumed the works for Argyle Street / Prince Street are constructed in isolation. If Council were to utilise a contractor to construct additional works at the same time, there would likely be cost savings in preliminaries and site establishment.

## 4 Conclusions

### 4.1 Overview

The Picton Town Centre Transport Master Plan (TDG, 2017) proposed numerous road upgrades, including the replacement of the Prince Street bridge, to improve traffic conditions in the town centre. The TDG proposals will require long term planning and funding arrangements in order to be implemented in full, due to the large extent of works and private property acquisition required. It is also likely the Picton Town Centre Transport Master Plan will be revised due to development re-zoning in the Greater Macarthur region.

In this revised 'Picton Town Centre Transport Plan 2026', Cardno has identified a number of short term network capacity improvements as interim measures and developed designs sufficient for strategic cost estimates and consultation with relevant stakeholders.

### 4.2 Proposed Intersection Improvements

The upgrades developed as part of this transport plan are short term, "quick win" measures can be implemented at relatively low cost and provide sufficient network capacity until at least 2026. Table 4-1 summarises the proposed upgrades.

Table 4-1 Summary of proposed intersection improvements

Intersection	Proposed Option
Menangle Street / Argyle Street	<ul style="list-style-type: none"> <li>Right turn ban on the eastern approach (Menangle Street)</li> </ul>
Argyle Street / Margaret Street / Cliffe Street	<ul style="list-style-type: none"> <li>Increase maximum green time of the signal control plan on the eastern approach from 15s to 20s</li> </ul>
Menangle Street / Prince Street	<ul style="list-style-type: none"> <li>Signalise the intersection</li> </ul>
Argyle Street / Prince Street	<ul style="list-style-type: none"> <li>Reduce the northern approach (Argyle Street) to one lane southbound</li> <li>Provide for a continuous left turn out of Prince Street</li> <li>Formalise the 90m right turn bay on the southern approach (Argyle Street)</li> </ul>
Argyle Street / Barkers Lodge Road	<ul style="list-style-type: none"> <li>No upgrades required assuming the above options are implemented</li> </ul>
Argyle Street / Lumsdaine Street	<ul style="list-style-type: none"> <li>Option 1 - signalise the intersection</li> <li>Option 2 - install pedestrian (zebra) crossing on Argyle Street south of the intersection</li> </ul>

### 4.3 Strategic Cost Estimates

Estimated costs for the main capital works are shown in Table 4-2.

Table 4-2 Strategic cost estimates for proposed intersection upgrades

Intersection	Strategic Cost Estimate (incl. contingency @ 30%)
Menangle St / Prince Street	<b>\$538,287.10</b>
Argyle Street / Prince Street	<b>\$257,782.78</b>

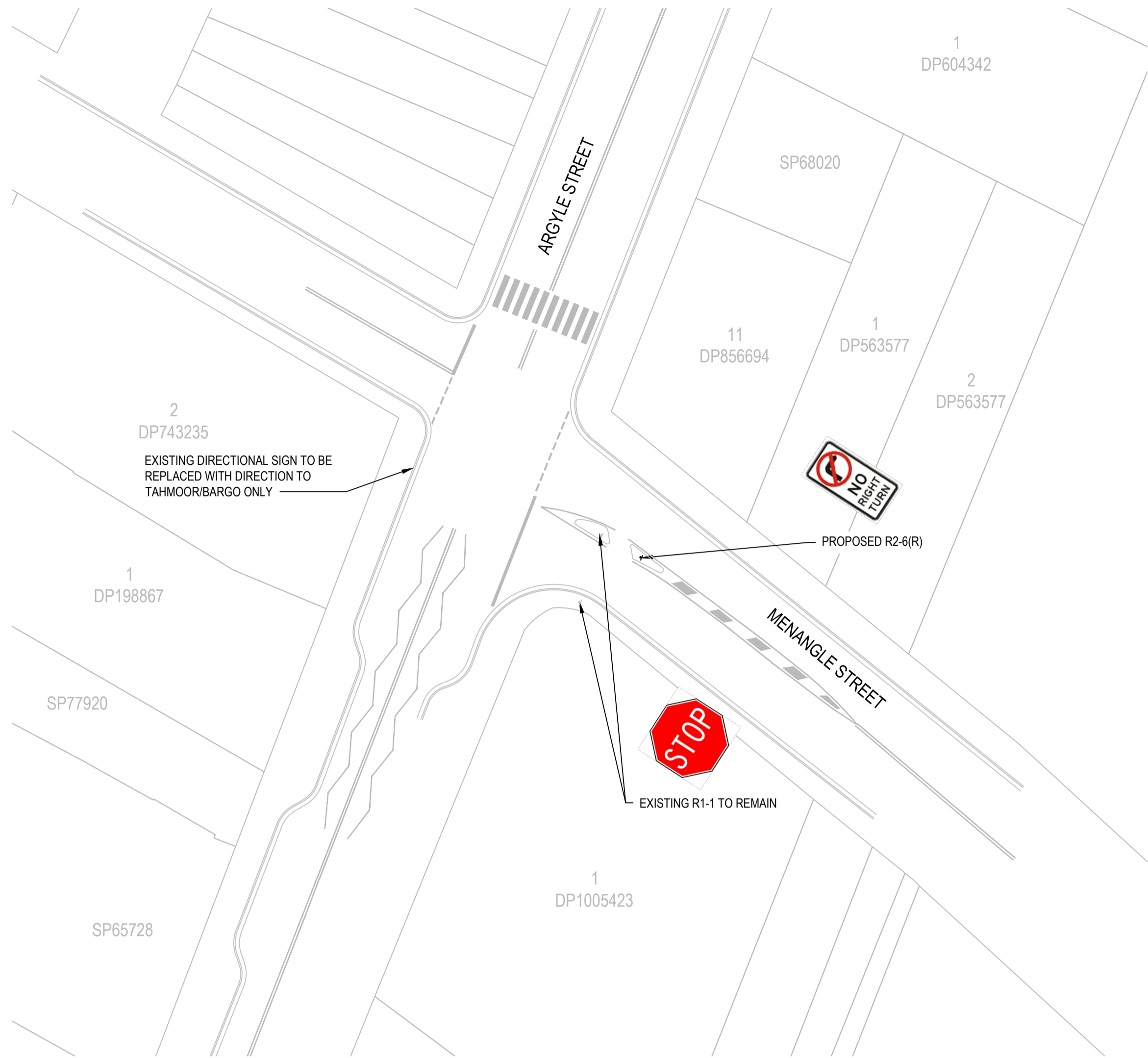
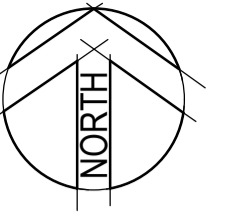


APPENDIX

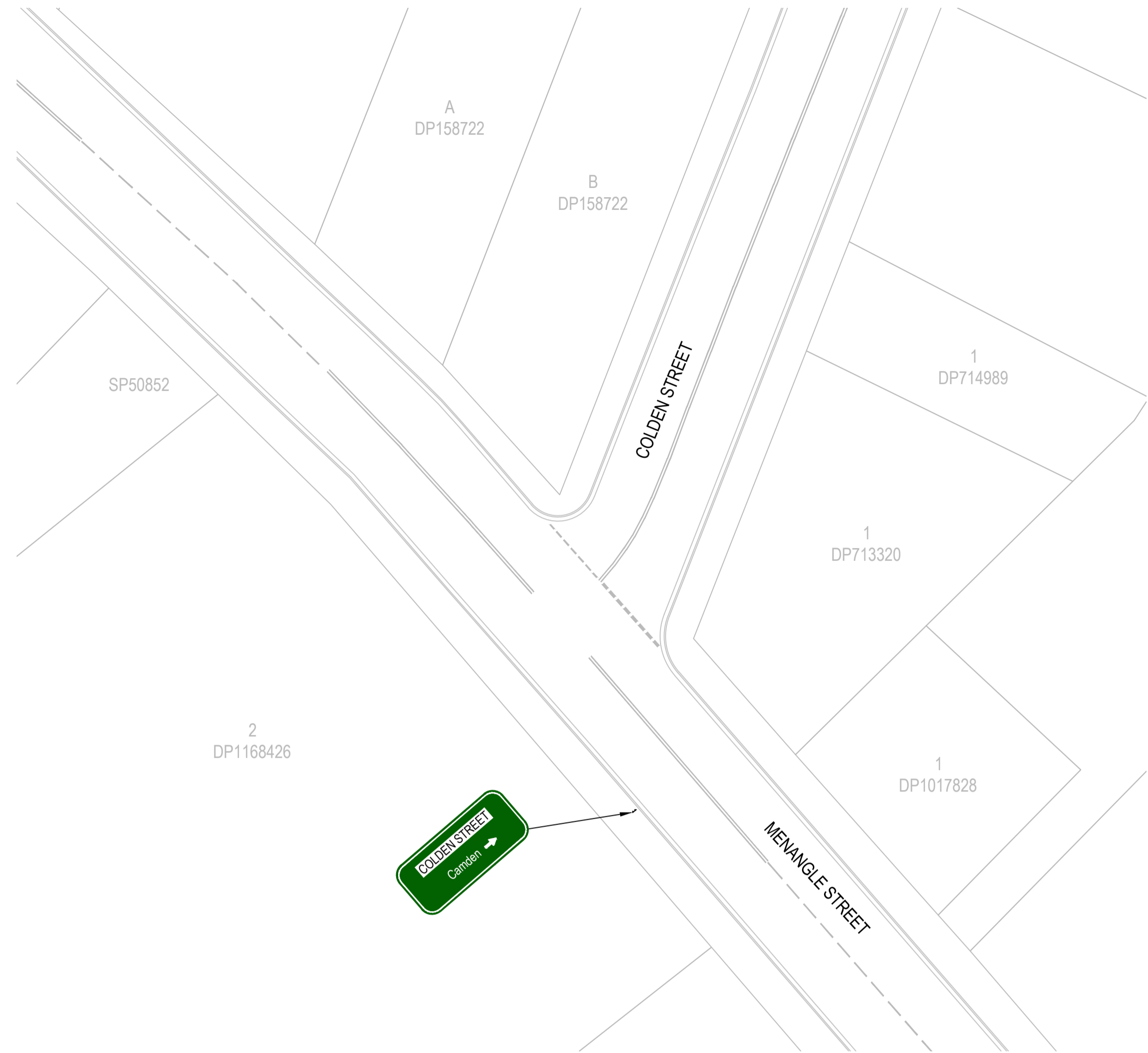
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STRATEGIC DESIGN DRAWINGS





**PRELIMINARY ARGYLE AND MENANGLE STREET INTERSECTION LAYOUT**  
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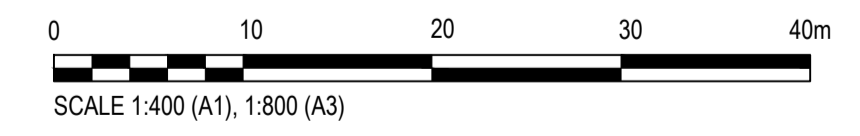


**PRELIMINARY MENANGLE AND COLDEN STREET INTERSECTION LAYOUT**  
SCALE 1:400

**NOTES**  
1. ALL EXISTING FEATURES ARE SHOWN INDICATIVELY. NO GROUND SURVEY HAS BEEN UNDERTAKEN FOR THIS DESIGN

**LEGEND**

	EXISTING LINEMARKING - CHEVRON
	EXISTING LINEMARKING - CONTINUITY LINE - C1
	EXISTING LINEMARKING - GIVE WAY LINE - TB
	EXISTING LINEMARKING - STOP LINE - TF
	EXISTING LINEMARKING - BARRIER LINE - BB
	EXISTING LINEMARKING - EDGE LINE - E1



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1	8/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	TS	TS



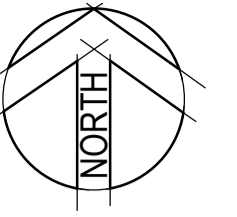
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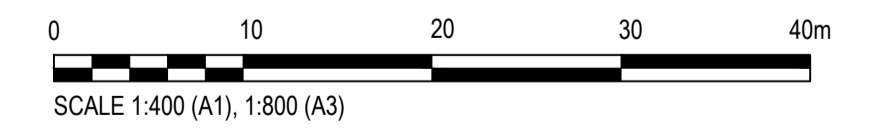
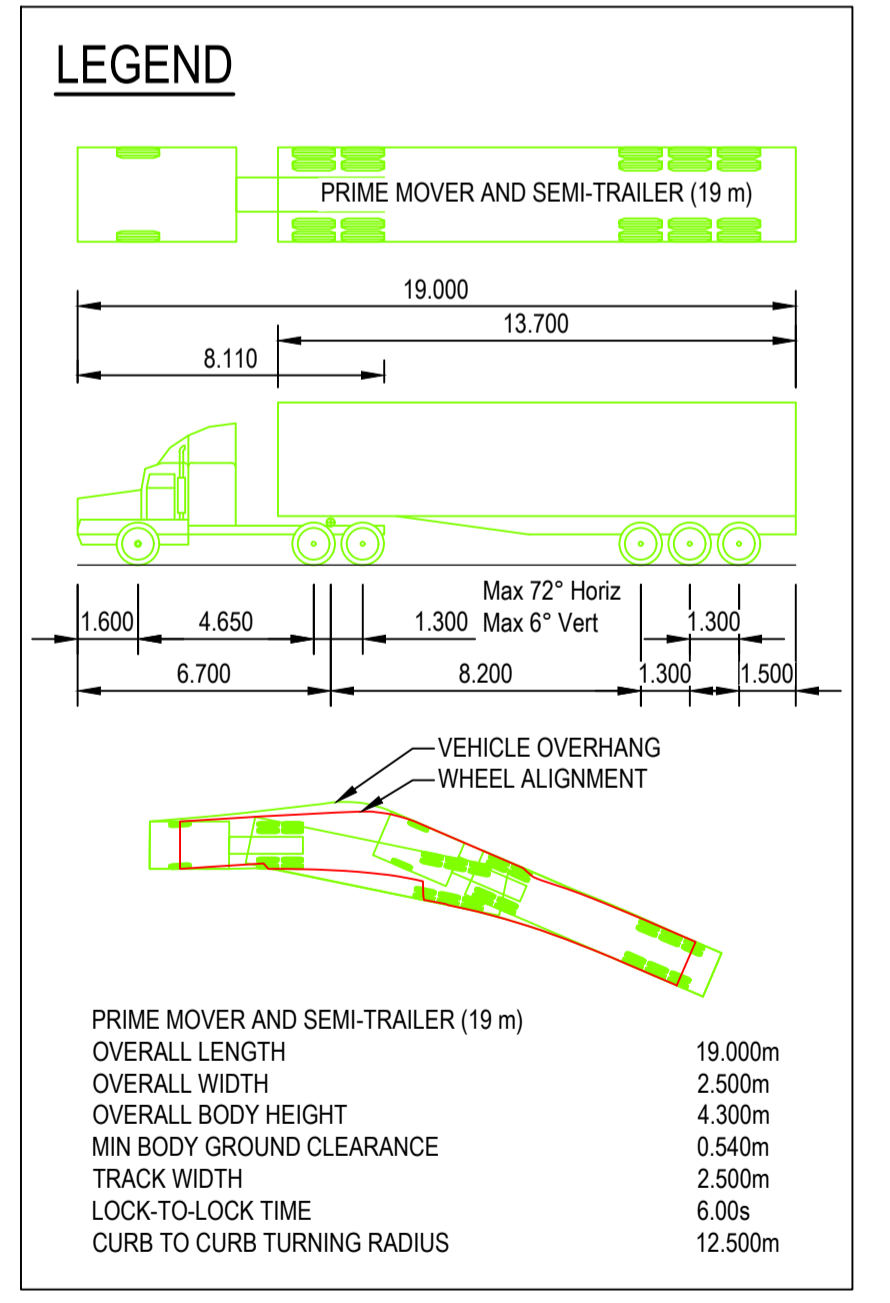
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Approved	TS	Date	8/06/2018

Client	WOLLONDILLY SHIRE COUNCIL
Project	PICTON CBD ROAD IMPROVEMENTS STRATEGIC INTERSECTION DESIGN
Title	PRELIMINARY ARGYLE AND MENANGLE STREET AND MENANGLE AND COLDEN STREET INTERSECTION LAYOUT PLAN

Status	<b>FOR CONCEPT APPROVAL</b> NOT TO BE USED FOR CONSTRUCTION PURPOSES		
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Size	A1		Revision
Drawing Number	82018177-01 SK001		2



PRELIMINARY ARGYLE AND MENANGLE STREET INTERSECTION VEHICLE PATHS  
SCALE 1:400



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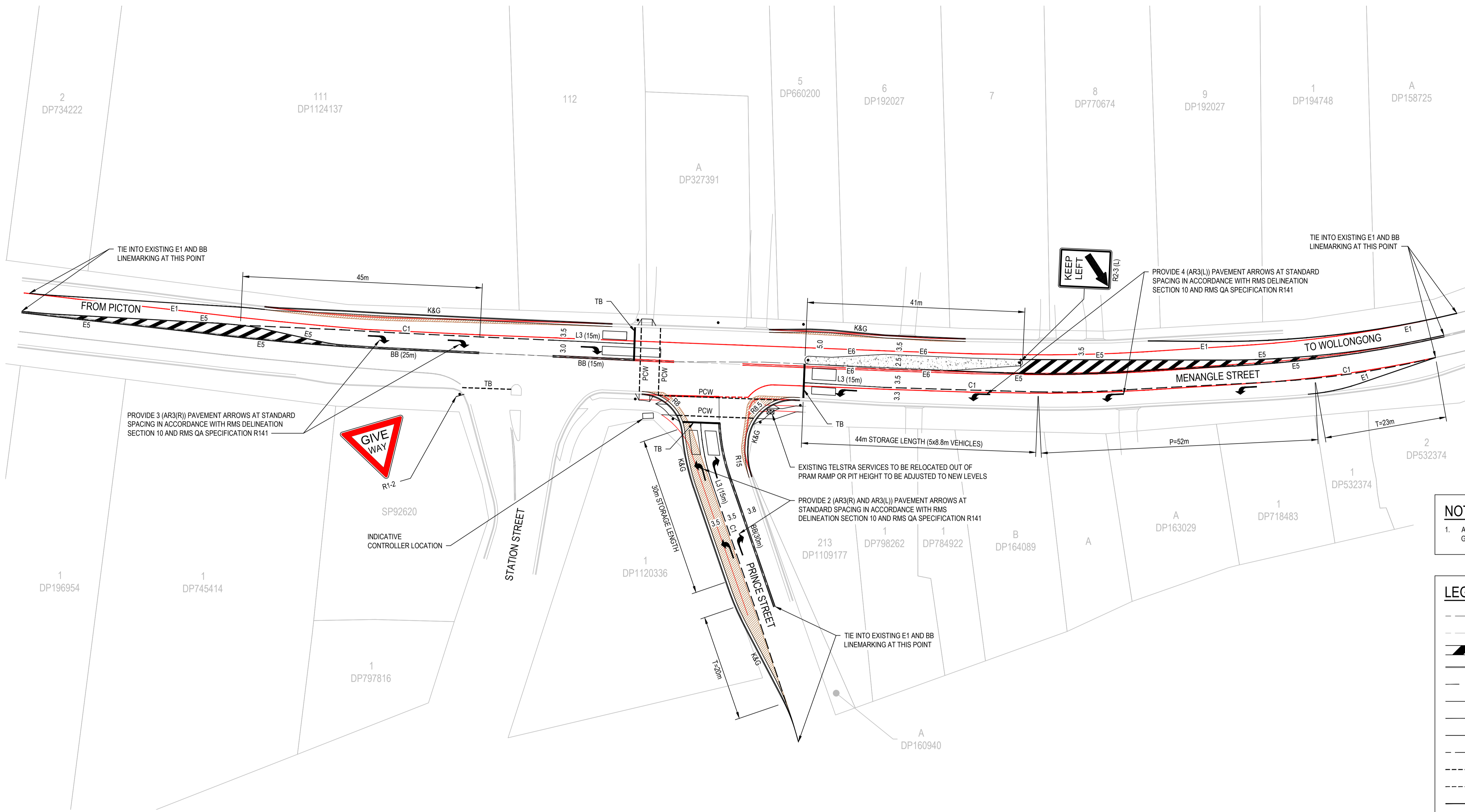
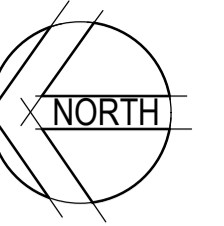
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Verified	TS	Date	5/06/2018
Approved	TS	Date	8/06/2018

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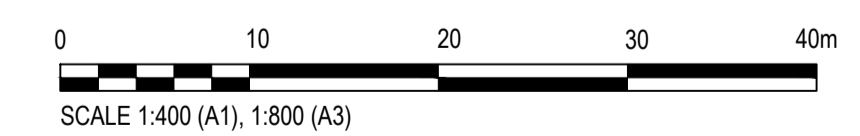
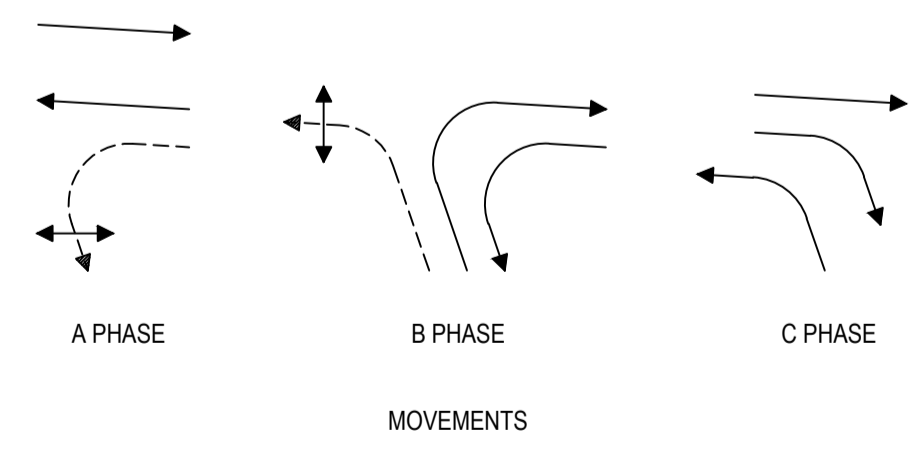


**NOTES**  
 1. ALL EXISTING FEATURES ARE SHOWN INDICATIVELY. NO GROUND SURVEY HAS BEEN UNDERTAKEN FOR THIS DESIGN

**LEGEND**

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- - - EXISTING ROAD CENTRELINE
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- ▬ LINEMARKING - BARRIER LINE - BB
- LINEMARKING - LANE LINE - L1
- LINEMARKING - LANE LINE - L3
- LINEMARKING - EDGE LINE - E1
- LINEMARKING - EDGE LINE - E5
- LINEMARKING - CONTINUITY LINE - C1
- LINEMARKING - GIVE WAY LINE - TB
- LINEMARKING - PEDESTRIAN CROSS WALK LINE - PCW
- LINEMARKING - STOP LINE - TF
- ← LINEMARKING - ARROWS
- ▨ PROPOSED RAISED CONCRETE MEDIAN
- ▨ INDICATIVE PROPOSED PAVEMENT
- ▲ INDICATIVE PROPOSED SIGN LOCATION
- INDICATIVE LANTERN LOCATION
- ▭ INDICATIVE PRAM RAMP LOCATION
- ▭ INDICATIVE PROPOSED KERB AND GUTTER
- EXISTING FEATURES TO BE REMOVED
- EXISTING LINEMARKING - BARRIER LINE - BB
- EXISTING LINEMARKING - EDGE LINE - E1

**PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION LAYOUT OPTION 1**  
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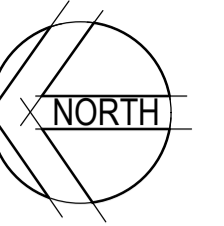
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Approved	TS	Date	8/06/2018

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**LEGEND**

SERVICE VEHICLE (8.8m)

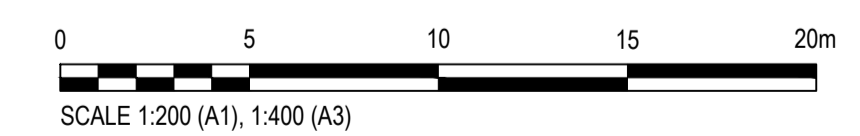
OVERALL LENGTH 8.800m  
 OVERALL WIDTH 2.500m  
 OVERALL BODY HEIGHT 4.300m  
 MIN BODY GROUND CLEARANCE 0.427m  
 TRACK WIDTH 2.500m  
 LOCK-TO-LOCK TIME 4.00s  
 CURB TO CURB TURNING RADIUS 12.500m

**LEGEND**

8.8m DESIGN VEHICLE

VEHICLE OVERHANG - WHEEL ALIGNMENT

- PROPOSED ROAD CENTRELINE
- ==== LINEMARKING - BARRIER LINE - BB
- LINEMARKING - LANE LINE - L1
- LINEMARKING - LANE LINE - L3
- LINEMARKING - CONTINUITY LINE - C1
- LINEMARKING - GIVE WAY LINE - TB
- LINEMARKING - PEDESTRIAN CROSS WALK LINE - PCW
- LINEMARKING - STOP LINE - TF
- LINEMARKING - ARROWS
- ==== LINEMARKING - CHEVRON



**PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 1 VEHICLE PATHS**  
 SCALE 1:200

Rev.	Date	Description	Des.	Verf.	Appd.
2	22/06/2018	RE-ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	SAS	TS
1	8/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	SAS	TS



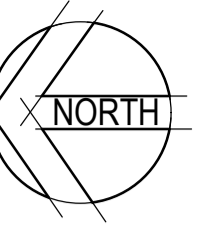
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Drawn	LAB	Date	5/06/2018
Checked	JMW	Date	8/06/2018
Designed	LAB	Date	5/06/2018
Verified	SAS	Date	5/06/2018
Approved	TS	Date	8/06/2018

Client	WOLLONDILLY SHIRE COUNCIL
Project	PICTON CBD ROAD IMPROVEMENTS STRATEGIC INTERSECTION DESIGN
Title	PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 1 VEHICLE PATHS SHEET 1 OF 2

Status	<b>FOR CONCEPT APPROVAL</b> NOT TO BE USED FOR CONSTRUCTION PURPOSES		
DATUM	AHD	Scale	1:200
Size	A1		
Drawing Number	82018177-01 SK004		Revision
			2



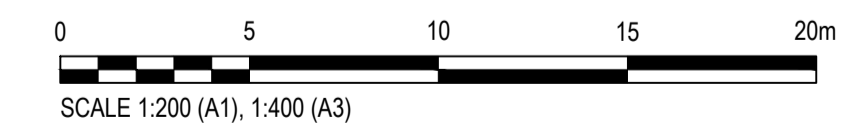
**LEGEND**

SERVICE VEHICLE (8.8m)  
 OVERALL LENGTH 8.800m  
 OVERALL WIDTH 2.500m  
 OVERALL BODY HEIGHT 4.300m  
 MIN BODY GROUND CLEARANCE 0.427m  
 TRACK WIDTH 2.500m  
 LOCK-TO-LOCK TIME 4.00s  
 CURB TO CURB TURNING RADIUS 12.500m

**LEGEND**

- 8.8m DESIGN VEHICLE
- VEHICLE OVERHANG - WHEEL ALIGNMENT
- PROPOSED ROAD CENTRELINE
- LINEMARKING - BARRIER LINE - BB
- LINEMARKING - LANE LINE - L1
- LINEMARKING - LANE LINE - L3
- LINEMARKING - CONTINUITY LINE - C1
- LINEMARKING - GIVE WAY LINE - TB
- LINEMARKING - PEDESTRIAN CROSS WALK LINE - PCW
- LINEMARKING - STOP LINE - TF
- LINEMARKING - ARROWS
- LINEMARKING - CHEVRON

PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 1 VEHICLE PATHS  
 SCALE 1:200



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Rev.	Date	Description	Des.	Verf.	Appd.
2	22/06/2018	RE-ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	SAS	TS
1	8/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	SAS	TS



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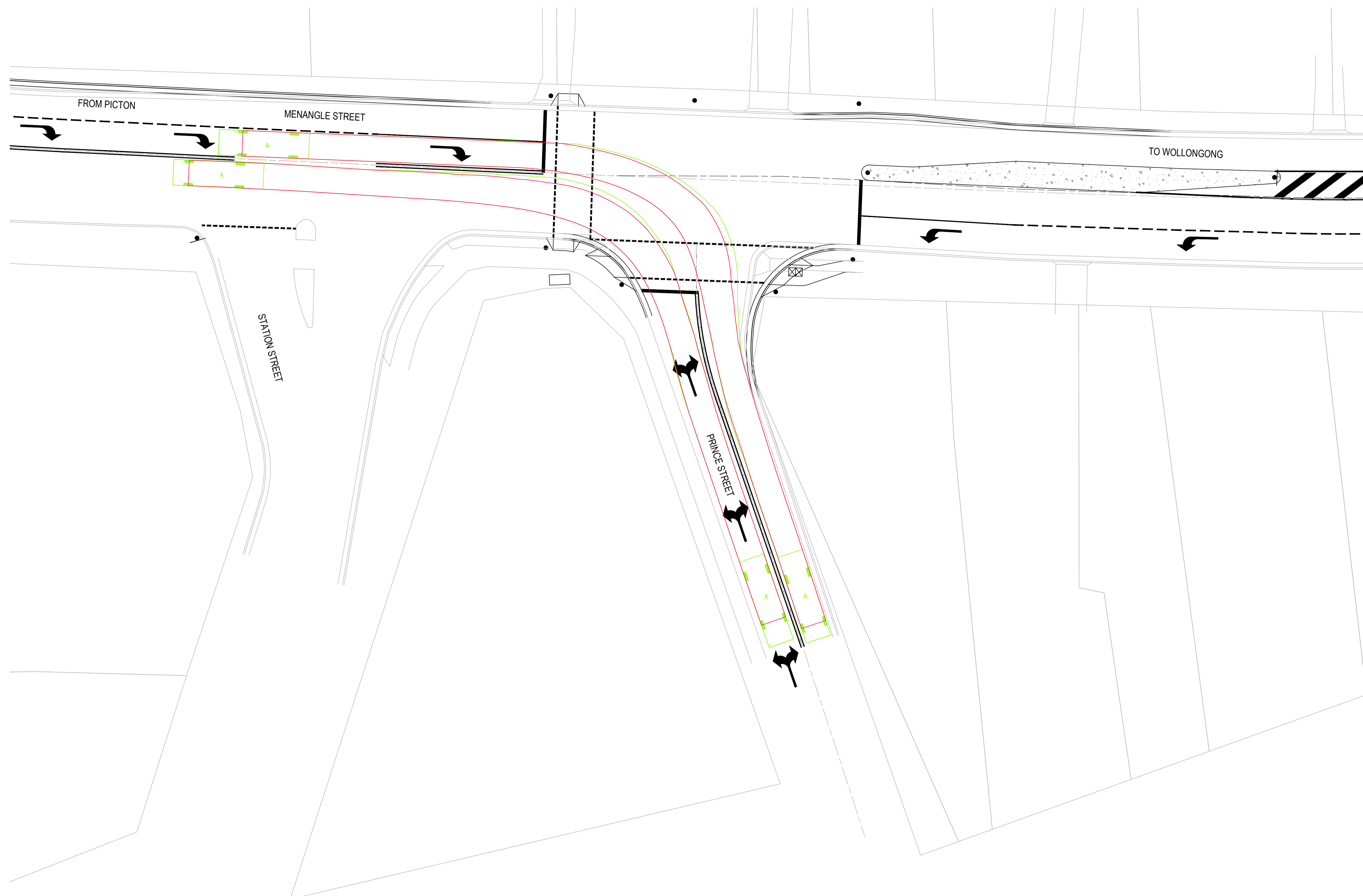
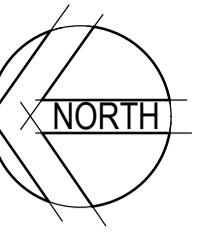
Drawn	LAB	Date	5/06/2018
Checked	JMW	Date	8/06/2018
Designed	LAB	Date	5/06/2018
Verified	SAS	Date	5/06/2018
Approved	TS	Date	8/06/2018

Client	WOLLONDILLY SHIRE COUNCIL
Project	PICTON CBD ROAD IMPROVEMENTS STRATEGIC INTERSECTION DESIGN
Title	PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 1 VEHICLE PATHS SHEET 2 OF 2

Status	FOR CONCEPT APPROVAL NOT TO BE USED FOR CONSTRUCTION PURPOSES		
DATUM	AHD	Scale	1:200
Size	A1		
Drawing Number	82018177-01 SK005		Revision
			2







**LEGEND**

SERVICE VEHICLE (8.8m)

OVERALL LENGTH 8.800m

OVERALL WIDTH 2.500m

OVERALL BODY HEIGHT 4.300m

MIN BODY GROUND CLEARANCE 0.427m

TRACK WIDTH 2.500m

LOCK-TO-LOCK TIME 4.00s

CURB TO CURB TURNING RADIUS 12.500m

**LEGEND**

8.8m DESIGN VEHICLE

VEHICLE OVERHANG - WHEEL ALIGNMENT

--- PROPOSED ROAD CENTRELINE

— LINEMARKING - BARRIER LINE - BB

- - - LINEMARKING - LANE LINE - L1

- - - LINEMARKING - LANE LINE - L3

- - - LINEMARKING - CONTINUITY LINE - C1

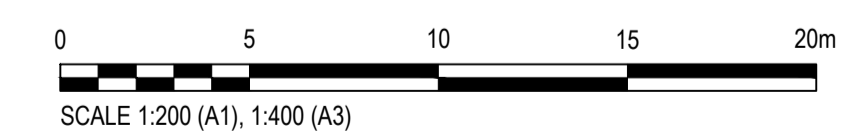
- - - LINEMARKING - GIVE WAY LINE - TB

- - - LINEMARKING - PEDESTRIAN CROSS WALK LINE - PCW

— LINEMARKING - STOP LINE - TF

↩ LINEMARKING - ARROWS

▩ LINEMARKING - CHEVRON



**PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 2 VEHICLE PATHS**  
SCALE 1:200

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Rev.	Date	Description	Des.	Verf.	Appd.
1	22/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	SAS	TS



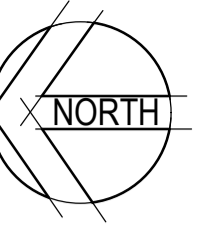
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Checked	MPR	Date	21/06/2018
Designed	LAB	Date	21/06/2018
Verified	SAS	Date	21/06/2018
Approved	TS	Date	21/06/2018

Client	WOLLONDILLY SHIRE COUNCIL
Project	PICTON CBD ROAD IMPROVEMENTS STRATEGIC INTERSECTION DESIGN
Title	PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 2 VEHICLE PATHS SHEET 1 OF 2

Status	<b>FOR CONCEPT APPROVAL</b> NOT TO BE USED FOR CONSTRUCTION PURPOSES		
DATUM	AHD	Scale	1:200
Size	A1		
Drawing Number	82018177-01 SK007		Revision
			1



**LEGEND**

SERVICE VEHICLE (8.8m)

8.800

1.500 5.000

VEHICLE OVERHANG  
WHEEL ALIGNMENT

SERVICE VEHICLE (8.8m)	8.800m
OVERALL LENGTH	8.800m
OVERALL WIDTH	2.500m
OVERALL BODY HEIGHT	4.300m
MIN BODY GROUND CLEARANCE	0.427m
TRACK WIDTH	2.500m
LOCK-TO-LOCK TIME	4.00s
CURB TO CURB TURNING RADIUS	12.500m

**LEGEND**

8.8m DESIGN VEHICLE

VEHICLE OVERHANG  
WHEEL ALIGNMENT

- PROPOSED ROAD CENTRELINE
- LINEMARKING - BARRIER LINE - BB
- - - LINEMARKING - LANE LINE - L1
- - - LINEMARKING - LANE LINE - L3
- - - LINEMARKING - CONTINUITY LINE - C1
- - - LINEMARKING - GIVE WAY LINE - TB
- - - LINEMARKING - PEDESTRIAN CROSS WALK LINE - PCW
- - - LINEMARKING - STOP LINE - TF
- ↔ LINEMARKING - ARROWS
- ▨ LINEMARKING - CHEVRON

**PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 2 VEHICLE PATHS**  
SCALE 1:200

XREFs: 82018417701-E-BASE: 82018417701-E-CADASTHE: 82018417701-G-LEGEND: 82018417701-D2-VECH: PAIH: 82018417701-D2-BASE  
CAD File: U:\FY18\177 - Picton CBD Road Improvements\Drawings\Build\Sketches\820184177-01 SK008.dwg

Rev.	Date	Description	Des.	Verf.	Appd.
1	22/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	SAS	TS



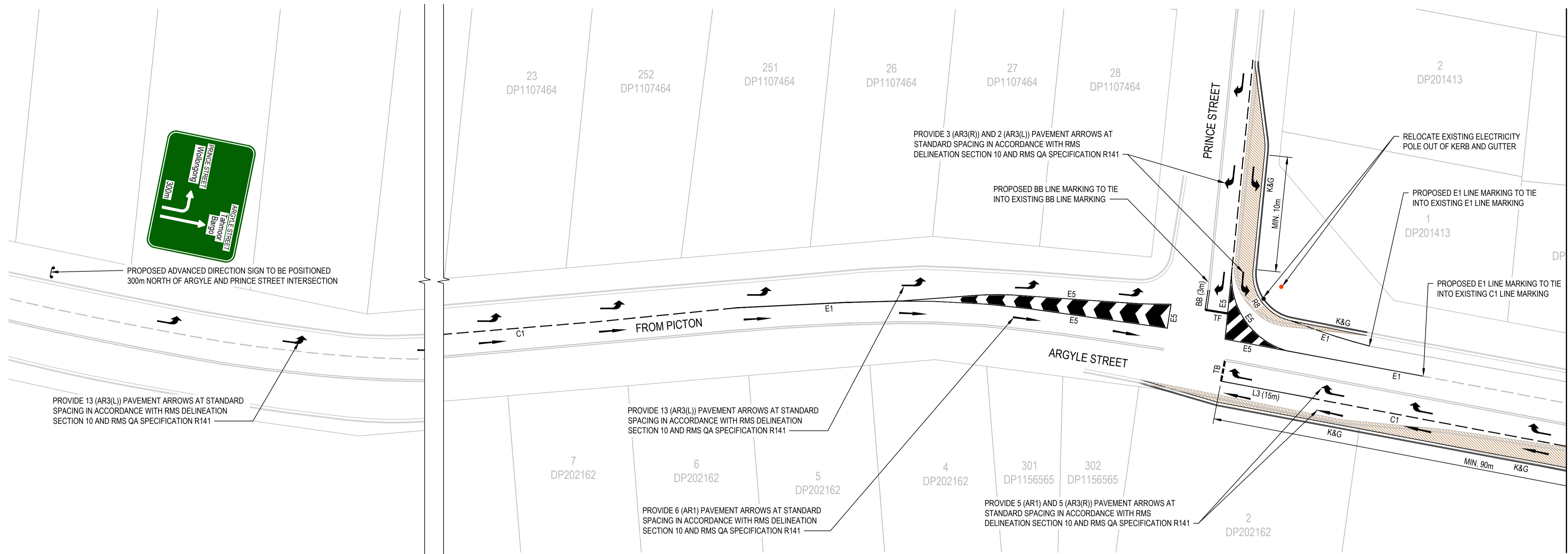
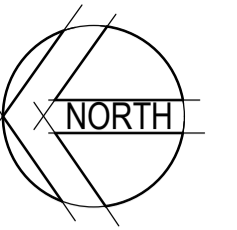
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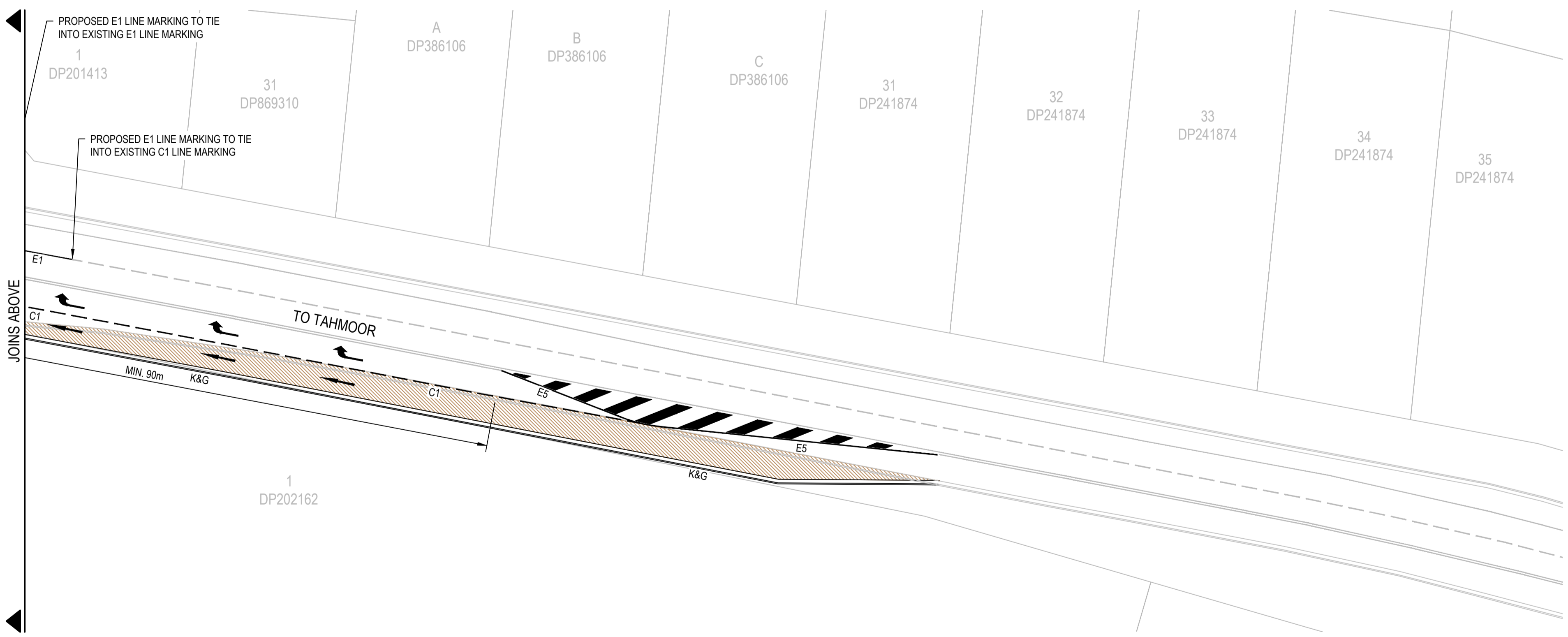
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Checked	MPR	Date	21/06/2018
Designed	LAB	Date	21/06/2018
Verified	SAS	Date	21/06/2018
Approved	TS	Date	21/06/2018

Client	WOLLONDILLY SHIRE COUNCIL
Project	PICTON CBD ROAD IMPROVEMENTS STRATEGIC INTERSECTION DESIGN
Title	PRELIMINARY MENANGLE AND PRINCE STREET INTERSECTION OPTION 2 VEHICLE PATHS SHEET 2 OF 2

Status	<b>FOR CONCEPT APPROVAL</b> NOT TO BE USED FOR CONSTRUCTION PURPOSES			
DATUM	AHD	Scale	1:200	
Size	A1			
Drawing Number	82018177-01 SK008		Revision	1



PRELIMINARY ARGYLE AND PRINCE STREET INTERSECTION LAYOUT  
SCALE 1:400

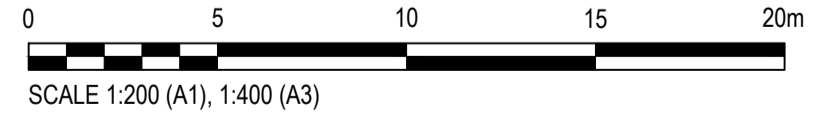


PRELIMINARY ARGYLE AND PRINCE STREET INTERSECTION LAYOUT - CONTINUED  
SCALE 1:400

**NOTES**  
1. ALL EXISTING FEATURES ARE SHOWN INDICATIVELY. NO GROUND SURVEY HAS BEEN UNDERTAKEN FOR THIS DESIGN

**LEGEND**

	PROPOSED ROAD CENTRELINE
	EXISTING ROAD CENTRELINE
	LINEMARKING - CHEVRON
	LINEMARKING - BARRIER LINE - BB
	LINEMARKING - LANE LINE - L3
	LINEMARKING - EDGE LINE - E1
	LINEMARKING - EDGE LINE - E5
	LINEMARKING - CONTINUITY LINE - C1
	LINEMARKING - GIVE WAY LINE - TB
	LINEMARKING - STOP LINE - TF
	LINEMARKING - ARROWS
	INDICATIVE PROPOSED PAVEMENT
	INDICATIVE PROPOSED SIGN LOCATION
	INDICATIVE EXISTING ELECTRICITY POLE
	RELOCATED EXISTING ELECTRICITY POLE
	INDICATIVE PROPOSED KERB AND GUTTER
	EXISTING LINEMARKING - BARRIER LINE - BB
	EXISTING LINEMARKING - EDGE LINE - E1



XREFs: 82018417701-D-BASE: 82018417701-E-BASE: 82018417701-G-TITLE: 82018417701-G-LEGEND  
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Rev.	Date	Description	Des.	Verf.	Appd.
2	22/06/2018	RE-ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	TS	TS
1	8/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	TS	TS



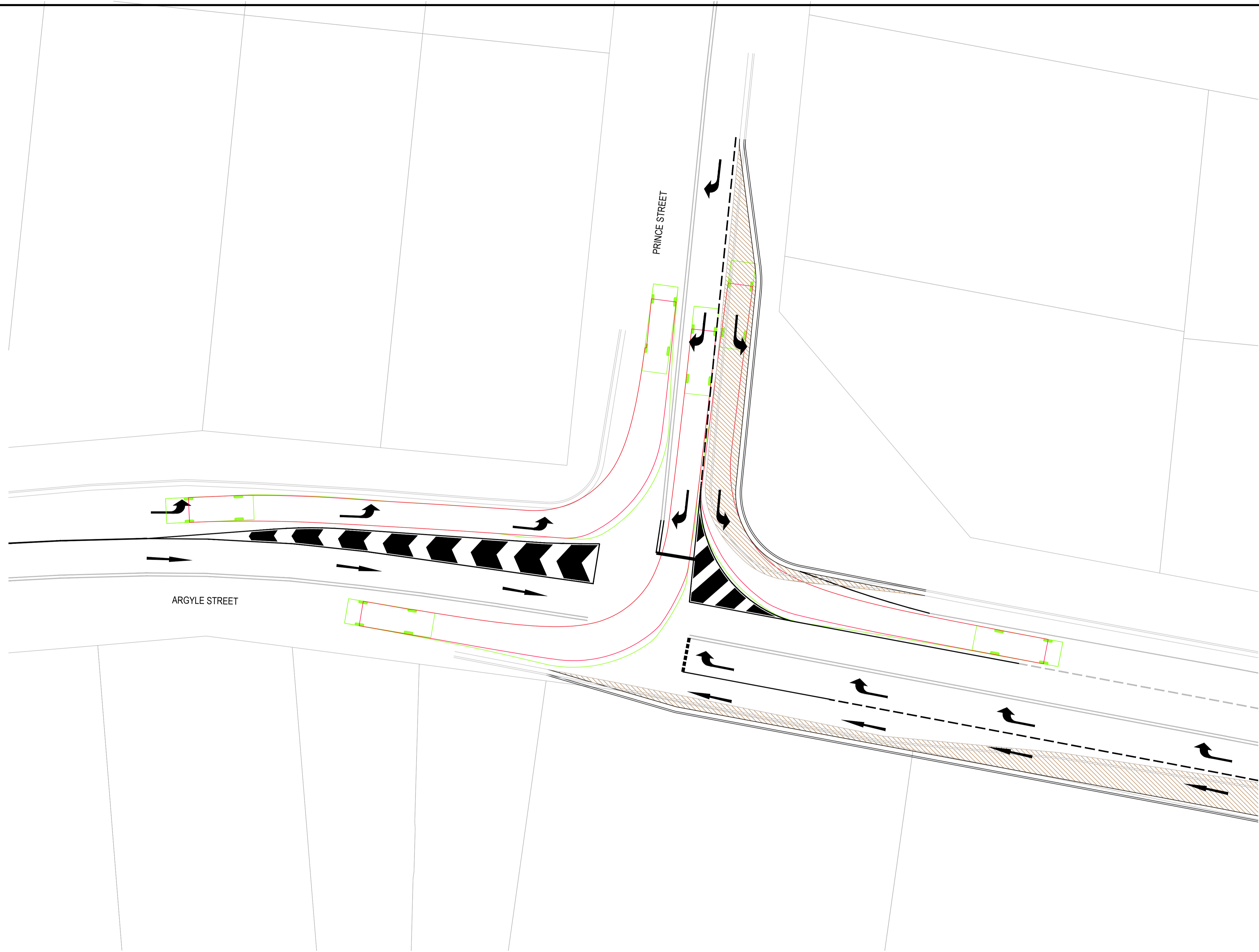
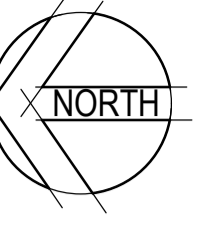
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Checked	JMW	Date	8/06/2018
Designed	SCA	Date	5/06/2018
Verified	TS	Date	5/06/2018
Approved	TS	Date	8/06/2018

Client **WOLLONDILLY SHIRE COUNCIL**  
Project **PICTON CBD ROAD IMPROVEMENTS  
STRATEGIC INTERSECTION DESIGN**  
Title **PRELIMINARY ARGYLE AND PRINCE STREET  
INTERSECTION LAYOUT PLAN  
SHEET 1 OF 2**

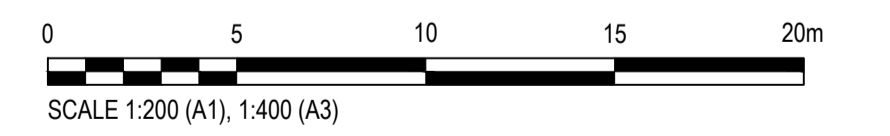
Status	<b>FOR CONCEPT APPROVAL</b>		
	NOT TO BE USED FOR CONSTRUCTION PURPOSES		
DATUM	AHD	Scale	1:400
Size			A1
Drawing Number	82018177-01 SK009		Revision
			2



**LEGEND**

SERVICE VEHICLE (8.8m)	8.800m
OVERALL LENGTH	8.800m
OVERALL WIDTH	2.500m
OVERALL BODY HEIGHT	4.300m
MIN BODY GROUND CLEARANCE	0.427m
TRACK WIDTH	2.500m
LOCK-TO-LOCK TIME	4.00s
CURB TO CURB TURNING RADIUS	12.500m

PRELIMINARY ARGYLE AND PRINCE STREET INTERSECTION SWEEP PATHS  
SCALE 1:200



Rev.	Date	Description	Des.	Verif.	Appd.
2	22/06/2018	RE-ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	TS	TS
1	8/06/2018	ISSUED FOR STRATEGIC DESIGN APPROVAL	LAB	TS	TS



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Checked	JMW	Date	8/06/2018
Designed	SCA	Date	5/06/2018
Verified	TS	Date	5/06/2018
Approved	TS	Date	8/06/2018

Client	WOLLONDILLY SHIRE COUNCIL
Project	PICTON CBD ROAD IMPROVEMENTS STRATEGIC INTERSECTION DESIGN
Title	PRELIMINARY ARGYLE AND PRINCE STREET INTERSECTION VEHICLE PATHS SHEET 2 OF 2

Status	<b>PRELIMINARY</b> NOT TO BE USED FOR CONSTRUCTION PURPOSES		
DATUM	AHD	Scale	1:200
Size			A1
Drawing Number	82018177-01 SK010		Revision
			2

APPENDIX

# B

STRATEGIC COST ESTIMATES

**PICTON CBD INTERSECTION DESIGN**  
**INTERSECTION OF ARGYLE AND PRINCE STREET**



Revision 0  
 Date 21/06/2018

**1.0 GENERAL ITEMS**

Item	Details	Quantity	Unit	Rate	Total
<b>1.1 Preliminaries</b>					
1.1.1	Site establishment including site office, site facilities, signage, compliance with OH&S Act and Regulations, construction and maintenance of site access tracks, site supervision and removal on completion.	1	item	\$5,000.00	\$5,000.00
1.1.2	Provision for traffic including preparation and implementation of traffic management plan for all site access, including all application fees for Council S138, drawings, revisions, Council liaison as required, installation & maintenance of all traffic management devices for road closures, shoulder closures, detours etc. for the duration of construction.	1	item	\$16,000.00	\$16,000.00
1.1.3	Survey - including services locations, services connection points, set out works and the provision of engineering survey control for all aspects of the Works (incl WAE survey for utilities) and review of DBYD plans	1	item	\$5,000.00	\$5,000.00
1.1.4	Prepare and implement site management plan, environmental management plan WHS management plan and quality plan.	1	item	\$2,000.00	\$2,000.00
1.1.5	Supply, install & maintenance of ATF fencing for any areas the Contractor deems required. Maintain fencing for the duration of the civil contract and remove upon construction completion. .	200	m	\$30.00	\$6,000.00
<b>1.2 Clearing &amp; Site Preparation</b>					
1.2.1	Clearing of site, remove & dispose of all rubbish, fences and debris as instructed by the superintendent, & dispose off-site (including tip fees).	1	item	\$2,000.00	\$2,000.00
<b>Sub Total for General Items</b>					<b>\$36,000.00</b>
<b>2.0 BULK EARTHWORKS</b>					
Item	Details	Quantity	Unit	Rate	Total
<b>2.1 Bulk Earthworks and Materials Management</b>					
2.1.1	Cut to Stockpile for new pavement area (all classes of material, solid measurement, no allowance for bulking factors)	290	cu.m	\$7.00	\$2,030.00
2.1.2	Cart and stockpile excess fill to nearest waste management facility	290	cu.m	\$250.00	\$72,500.00
<b>Sub Total for Bulk Earthworks</b>					<b>\$74,530.00</b>
<b>3.0 ROADWORKS</b>					
Item	Details	Quantity	Unit	Rate	Total
<b>3.1 Road Pavement for Collector Road</b>					
3.1.1	Trim and compact subgrade material to subgrade design level	522	sq.m	\$2.50	\$1,304.90
3.1.2	Supply, place, compact and trim sub-base material DGS40, 300mm minimum consolidated thickness compacted in accordance with Council's Construction Specification	522	sq.m	\$35.00	\$18,268.57
3.1.3	Supply, place, compact and trim base material DGB20, 200mm minimum consolidated thickness compacted in accordance with Council's Construction Specification	522	sq.m	\$25.00	\$13,048.98
3.1.4	Supply and place AC14 in 50mm compacted thickness including primer seal	750	sq.m	\$30.00	\$22,500.00
<b>3.2 Kerbing</b>					
3.2.1	Construct Council's standard kerb & gutter including transition to pits & other kerb types, joints & drainage outlets	221	m	\$55.00	\$12,133.83
<b>3.3 Road Signs</b>					
3.3.1	Supply and install 'advanced turn' sign only (R1-2) as per AS1742.2	1	ea.	\$500.00	\$500.00
<b>3.4 Road Delineation</b>					
3.4.1	Install 'BB' type line marking as per RMS QA Specification R141	3.4	m	\$5.00	\$16.75
3.4.2	Install 'E1' type line marking as per RMS QA Specification R141	41.8	m	\$4.00	\$167.20
3.4.3	Install 'E5' type line marking as per RMS QA Specification R141	192.5	m	\$4.00	\$770.00
3.4.4	Install 'L3' type line marking as per RMS QA Specification R141	15.0	m	\$2.00	\$30.00
3.4.5	Install 'C1' type line marking as per RMS QA Specification R141	230.6	m	\$4.50	\$1,037.75
3.4.6	Install 'TB' type line marking as per RMS QA Specification R141	4.0	m	\$15.00	\$60.00
3.4.7	Install 'TF' type line marking as per RMS QA Specification R141	4.0	m	\$15.00	\$59.49
3.4.8	Install Chevron markings as per RMS QA Specification R141	96.2	sq.m	\$35.00	\$3,367.00

3.4.9	Install "AR3(R)" type pavement arrow as per RMS QA Specification R141	11.0	ea.	\$100.00	\$1,100.00
3.4.10	Install "AR3(L)" type pavement arrow as per RMS QA Specification R141	12.0	ea.	\$100.00	\$1,200.00
3.4.11	Install "ARR5" type pavement arrow as per RMS QA Specification R141	11.0	ea.	\$100.00	\$1,100.00
3.4.12	Install "AR1" type pavement arrow as per RMS QA Specification R141	11.0	ea.	\$100.00	\$1,100.00
<b>3.5 Geotechnical Assessment</b>					
3.5.1	Geotechnical investigation and testing of road pavements onsite	1	item	\$5,000.00	\$5,000.00
<b>Sub Total for Roadworks</b>					<b>\$82,764.45</b>
<b>4.0 EROSION &amp; SEDIMENTATION CONTROL</b>					
<b>Item</b>	<b>Details</b>	<b>Quantity</b>	<b>Unit</b>		<b>Total</b>
<b>4.1 Soil &amp; Water Management</b>					
4.1.1	Erosion and sediment control measures	1	item	\$5,000.00	\$5,000.00
<b>Sub Total for Erosion and Sediment Control</b>					<b>\$5,000.00</b>
<b>TOTAL EXCL. CONTINGENCY</b>					<b>\$198,294.45</b>
<b>Contingency</b>					<b>\$59,488.33</b>
Application of 30% Contingency					
<b>TOTAL INCL. CONTINGENCY</b>					<b>\$257,782.78</b>
<b>Notes:</b>					
1 These preliminary quantities and budget estimates are an indicative preliminary engineering estimate only, based upon a preliminary design and does not include detailed design, tendering, construction management/superintendent or land acquisition fees. Rates are based on Cordell's and Rawlinson's and Cardno's engineering experience on similar civil projects and quantities are estimated based on the preliminary level of design to date. Cardno is not a Quantity Surveyor and these are not Quantity Surveyor estimates and as such should not be relied upon for final budgeting purposes.					
2 Pavement has been assumed to incorporate 300mm layer DGS40, 200mm layer DGB20 and 50mm layer AC14					
3 Asphaltic Concrete layer assumed to overlap existing pavement by 1m					
4 No allowance has been made for any utility relocation or protection works as there is not enough information to determine works at this stage					
5 Works assumed to be completed in a 2 week program					

**PICTON CBD INTERSECTION DESIGN**  
**INTERSECTION OF MENANGLE AND PRINCE STREET**



Revision 0

Date 21/06/2018

**1.0 GENERAL ITEMS**

Item	Details	Quantity	Unit	Rate	Total
<b>1.1 Preliminaries</b>					
1.1.1	Site establishment including site office, site facilities, signage, compliance with OH&S Act and Regulations, construction and maintenance of site access tracks, site supervision and removal on completion.	1	item	\$5,000.00	\$5,000.00
1.1.2	Provision for traffic including preparation and implementation of traffic management plan for all site access, including all application fees for Council S138, drawings, revisions, Council liaison as required, installation & maintenance of all traffic management devices for road closures, shoulder closures, detours etc. for the duration of construction.	1	item	\$24,000.00	\$24,000.00
1.1.3	Survey - including services locations, services connection points, set out works and the provision of engineering survey control for all aspects of the Works (incl WAE survey for utilities) and review of DBYD plans	1	item	\$5,000.00	\$5,000.00
1.1.4	Prepare and implement site management plan, environmental management plan WHS management plan and quality plan.	1	item	\$2,000.00	\$2,000.00
1.1.5	Supply, install & maintenance of ATF fencing for any areas the Contractor deems required. Maintain fencing for the duration of the civil contract and remove upon construction completion. .	150	m	\$30.00	\$4,500.00
<b>1.2 Clearing &amp; Site Preparation</b>					
1.2.1	Clearing of site, remove & dispose of all rubbish, fences and debris as instructed by the superintendent, & dispose off-site (including tip fees).	1	item	\$2,000.00	\$2,000.00
<b>Sub Total for General Items</b>					<b>\$42,500.00</b>
<b>2.0 BULK EARTHWORKS</b>					
Item	Details	Quantity	Unit	Rate	Total
<b>2.1 Bulk Earthworks and Materials Management</b>					
2.1.1	Cut to Stockpile for new pavement area (all classes of material, solid measurement, no allowance for bulking factors)	31	cu.m	\$7.00	\$217.00
2.1.2	Cart and stockpile excess fill to nearest waste management facility	31	cu.m	\$250.00	\$7,750.00
<b>Sub Total for Bulk Earthworks</b>					<b>\$7,967.00</b>
<b>3.0 ROADWORKS</b>					
Item	Details	Quantity	Unit	Rate	Total
<b>3.1 Road Pavement for Collector Road</b>					
3.1.1	Trim and compact subgrade material to subgrade design level	60	sq.m	\$2.50	\$150.00
3.1.2	Supply, place, compact and trim sub-base material DGS40, 300mm minimum consolidated thickness compacted in accordance with Council's Construction Specification	60	sq.m	\$35.00	\$2,100.00
3.1.3	Supply, place, compact and trim base material DGB20, 200mm minimum consolidated thickness compacted in accordance with Council's Construction Specification	60	sq.m	\$25.00	\$1,500.00
3.1.4	Supply and place AC14 in 50mm compacted thickness including primer seal	200	sq.m	\$30.00	\$6,000.00
<b>3.2 Kerbing</b>					
3.2.1	Construct Council's standard kerb & gutter including transition to pits & other kerb types, joints & drainage outlets	140	m	\$55.00	\$7,700.00
3.2.2	Concrete median island 100mm with SL82 mesh	85	sq.m	\$70.00	\$5,950.00
3.2.3	Pedestrian pram ramp	3	ea.	\$700.00	\$2,100.00
<b>3.3 Road Signs</b>					
3.3.1	Supply and install 'give way' sign only (R1-2) as per AS1742.2	1	ea.	\$315.00	\$315.00
3.3.2	Supply and install 'keep left' sign (R2-3) as per AS1742.2	1	ea.	\$315.00	\$315.00
<b>3.4 Road Delineation</b>					
3.4.1	Install 'BB' type line marking as per RMS QA Specification R141	78	m	\$5.00	\$390.00
3.4.2	Install "PCW" type line markings as per RMS QA Specification R141	61	m	\$5.00	\$305.00
3.4.3	Install 'E1' type line marking as per RMS QA Specification R141	130	m	\$4.00	\$520.00
3.4.4	Install 'E5' type line marking as per RMS QA Specification R141	300	m	\$4.00	\$1,200.00
3.4.5	Install 'E6' type line marking as per RMS QA Specification R141	90	m	\$4.00	\$360.00



3.4.6	Install 'L3' type line marking as per RMS QA Specification R141	35	m	\$2.00	\$70.00
3.4.7	Install 'C1' type line marking as per RMS QA Specification R141	90	m	\$4.50	\$405.00
3.4.8	Install 'TB' type line marking as per RMS QA Specification R141	30	m	\$14.00	\$420.00
3.4.9	Install Chevron markings as per RMS QA Specification R141	80	sq.m	\$35.00	\$2,800.00
3.4.10	Install "AR3(R)" type pavement arrow as per RMS QA Specification R141	3	ea.	\$100.00	\$300.00
3.4.11	Install "AR3(L)" type pavement arrow as per RMS QA Specification R141	4	ea.	\$100.00	\$400.00
3.4.12	Install "AR2" type pavement arrow as per RMS QA Specification R141	3	ea.	\$100.00	\$300.00
<b>3.5 Traffic Signals</b>					
3.5.1	Installation, and supply of Traffic lanterns as per relevant standards	8	ea.	\$40,000.00	\$320,000.00
<b>3.6 Geotechnical Assessment</b>					
3.6.1	Geotechnical investigation and testing of road pavements onsite	1	item	\$5,000.00	\$5,000.00
<b>Sub Total for Roadworks</b>					<b>\$358,600.00</b>
<b>4.0 EROSION &amp; SEDIMENTATION CONTROL</b>					
<b>Item</b>	<b>Details</b>	<b>Quantity</b>	<b>Unit</b>		<b>Total</b>
<b>4.1 Soil &amp; Water Management</b>					
4.1.1	Erosion and sediment control measures	1	item	\$5,000.00	\$5,000.00
<b>Sub Total for Erosion and Sediment Control</b>					<b>\$5,000.00</b>
<b>TOTAL EXCL. CONTINGENCY</b>					<b>\$414,067.00</b>
<b>Contingency</b>					<b>\$124,220.10</b>
Application of 30% Contingency					
<b>TOTAL INCL. CONTINGENCY</b>					<b>\$538,287.10</b>

**Notes:**

- These preliminary quantities and budget estimates are an indicative preliminary engineering estimate only, based upon a preliminary design and does not include detailed design, tendering, construction management/superintendent or land acquisition fees. Rates are based on Cordell's and Rawlinson's and Cardno's engineering experience on similar civil projects and quantities are estimated based on the preliminary level of design to date. Cardno is not a Quantity Surveyor and these are not Quantity Surveyor estimates and as such should not be relied upon for final budgeting purposes.
- 2 Pavement has been assumed to incorporate 300mm layer DGS40, 200mm layer DGB20 and 50mm layer AC14
  - 3 Asphaltic Concrete layer assumed to overlap existing pavement by 1m
  - 4 No allowance has been made for any utility relocation or protection works as there is not enough information to determine works at this stage
  - 5 Works assumed to be completed in a 3 week program

APPENDIX

C

RSA – EXISTING CONDITIONS

# Road Safety Audit

Picton Town Centre – Various  
Locations – Existing Conditions

8201817701



Prepared for  
Cardno NSW/ACT Pty Ltd

May 2018

## Contact Information

**Cardno South Coast**  
**Trading as Cardno (NSW/ACT) Pty Ltd**  
ABN 95 001 145 035

Ground Floor, 16 Burelli Street  
PO Box 1285  
Wollongong NSW 2500

Telephone: 02 4228 4133  
Facsimile: 02 4228 6811  
International: +61 2 4228 4133

[southcoast@cardno.com.au](mailto:southcoast@cardno.com.au)  
[www.cardno.com.au](http://www.cardno.com.au)

Author(s): Antonio Villacorta  
Level 3 – Team Leader  
  
Michael Renko  
Level 2 – Team Member

Approved By: Michael Renko  
Level 2 – Team Member

## Document Information

Prepared for Cardno NSW/ACT Pty Ltd  
Project Name Picton Town Centre –  
Various Locations –  
Existing Conditions

File Reference RSA – Picton Town Centre  
– Various Locations –  
Existing Conditions

Job Reference 82018177-01

Date May 2018

Version Number Ver 0

Effective Date 28/05/2018

Date Approved: 28/05/2018

## Document History

Version	Date	Description of Revision	Prepared by:	Reviewed by:
0	28/05/2018	DRAFT for internal Comment	Michael Renko	Antonio Villacorta
1	28/05/2018	Issue for Client Comment	Michael Renko	Tim Sullivan
2		Issue FINAL	TBC	TBC

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## Project Summary

<b>Project Number:</b>	82018177-01
<b>Final Report Date:</b>	1/06/2018
<b>Draft Report Date:</b>	28/05/2018
<b>Title of Audit:</b>	Picton Town Centre – Various Locations – Existing Conditions
<b>Location of Audit:</b>	Picton Town Centre – Various Locations
<b>Project Description:</b>	The aim of this project is to assess several sites throughout the Picton Town Centre for potential road improvements.
<b>Purpose of Audit:</b>	The aim of this Road Safety Audit (RSA) is to assess the existing conditions.
<b>State:</b>	NSW
<b>Stage of Audit:</b>	Existing Conditions
<b>Client Company:</b>	Cardno NSW/ACT Pty Ltd
<b>Client Contact:</b>	Tim Sullivan
<b>Client Phone:</b>	9024 7055
<b>Client Email:</b>	<a href="mailto:Tim.Sullivan@Cardno.com.au">Tim.Sullivan@Cardno.com.au</a>
<b>Audit Date:</b>	21/05/2018
<b>Audit Team:</b>	Antonio Villacorta (Team Leader) Michael Renko (Team Member)

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# 1 Project Description

The aim of this project is to assess the existing conditions of several sites throughout the Picton Town Centre for potential road improvements.

These sites include Colden Street/Margaret Street (Site 1), Argyle Street/Menangle Street (Site 2), Argyle Street/Barkers Lodge Road (Site 3) and Prince Street from Argyle Street to Menangle Street (Site 4).

# 2 Audit Stage

An Existing Conditions Stage Audit was carried out during a site visit of the various sites highlighted above during day and night time conditions on the 21<sup>st</sup> May 2018. At the time of the site visit weather was clear and traffic was moderate.

The audit was generally undertaken in accordance with 'TNSW Guidelines for Road Safety Audit Practices (2011)' and 'Austroads: Guide to Road Safety Part 6: Road Safety Audit (2009)'.

Findings of the audit are listed in Section 9, Tables 9.1 to Table 9.4.

# 3 Study Area

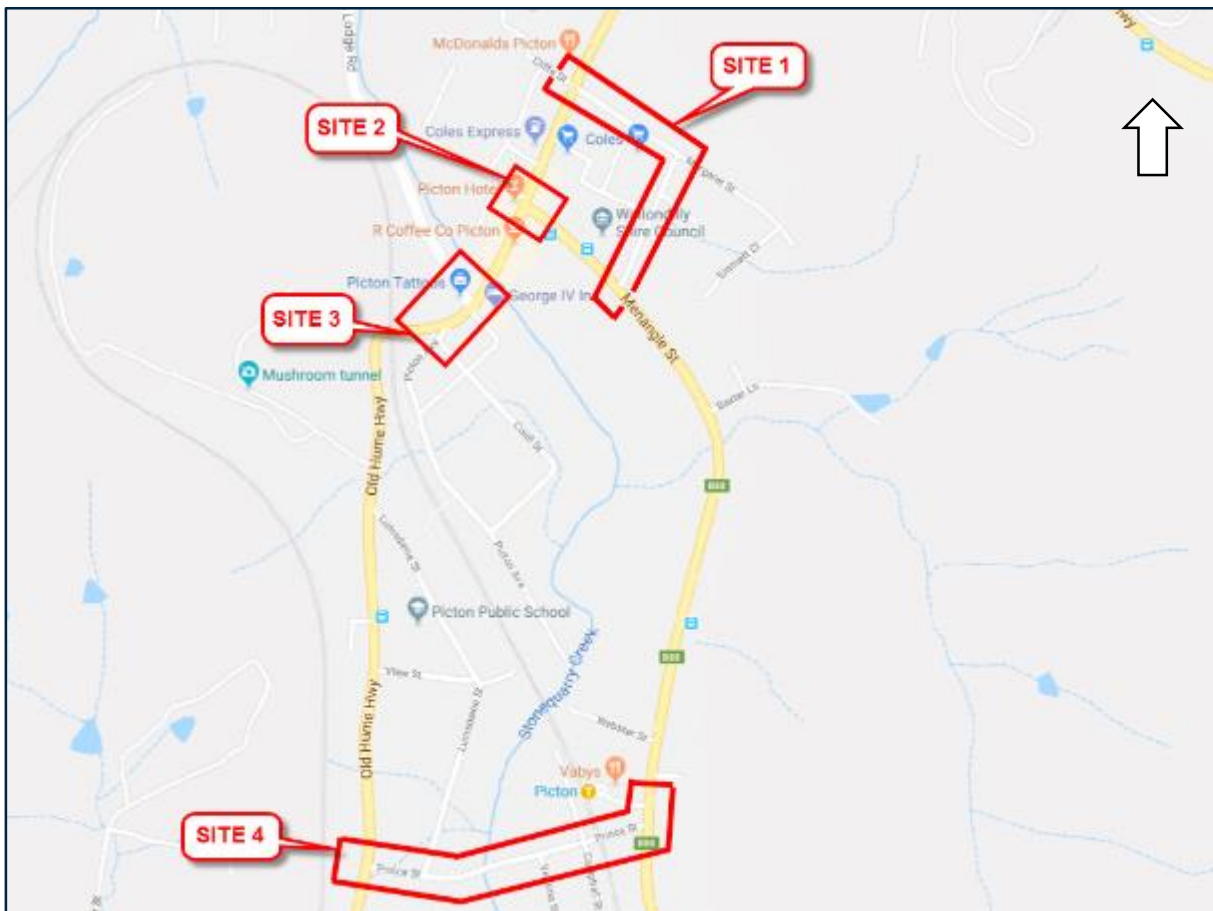


Figure 3-1 Locality Plan

Image sourced from Google Maps

## 4 Audit Team

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The audit team and client details are shown in **Table 4-1**.

**Table 4-1 Audit Team & Client Details**

Role		
<b>Client (Sponsor)</b>	Cardno (NSW/ACT) Pty Ltd	
<b>Client Contact</b>	Tim Sullivan	Manager – Traffic and Transport
<b>Client Email</b>	<a href="mailto:Tim.Sullivan@Cardno.com.au">Tim.Sullivan@Cardno.com.au</a>	
<b>Lead Auditor</b>	Antonio Villacorta	Level 3 Auditor (RSA-02-0805)
<b>Lead Auditor Email</b>	<a href="mailto:Antonio.Arrollave@Kier.co.uk">Antonio.Arrollave@Kier.co.uk</a>	
<b>Team member</b>	Michael Renko	Level 2 Auditor (RSA-02-1134)

## 5 Audit Program

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The audit program details are shown in **Table 5-1**.

**Table 5-1 Audit Program**

Activity	Date	Attendees
<b>Opening Meeting</b>	14/05/2018	Michael Renko, Tim Sullivan
<b>Site Inspection</b>	21/05/2018	Michael Renko, Antonio Villacorta
<b>Draft Report</b>	29/05/2018	RSA Report (DRAFT for comment)
<b>Completion Meeting</b>	31/05/2018	Michael Renko, Tim Sullivan
<b>Final Report</b>	1/06/2018	RSA Report (Final for issue)

## 6 Background Information

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As the time of the audit the sites highlighted in Figure 3-1 were observed as per existing conditions, no further background information was supplied to the audit team.

## 7 Exclusions

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The existing bridge along Prince Street was excluded from the road safety audit, as such any safety hazard findings in this area have not been included.

The existing pedestrian crossing and school zone on Colden Street were excluded from the road safety audit, as such any safety hazard findings in this area have not been included.



## 8 Audit Risk Assessment Technique

For each of the safety issues identified, the level of risk with each has been determined. **Tables 8-1, 8-2 & 8-3** are extracted from Austroads: Guide to Road Safety Part 6: Road Safety Audit (2009) and have been used in the assessment of risk for this audit.

**Table 8-1 Incident Frequency**

Frequency	Description
<b>Frequent</b>	Once or more per week
<b>Probable</b>	Once or more per month
<b>Occasional</b>	Once or more per year
<b>Improbable</b>	Less often than once every year

**Table 8-2 Incident Severity**


Severity	Description	Examples
<b>Catastrophic</b>	Likely multiple deaths	<ul style="list-style-type: none"> <li>&gt; High-speed, multi-vehicle crash on freeway.</li> <li>&gt; Car runs into crowded bus stop.</li> <li>&gt; Bus and petrol tanker collide.</li> <li>&gt; Collapse of bridge or tunnel.</li> </ul>
<b>Serious</b>	Likely death or serious injury	<ul style="list-style-type: none"> <li>&gt; High or medium-speed vehicle/vehicle collision.</li> <li>&gt; High or medium-speed collision with a fixed roadside object.</li> <li>&gt; Pedestrian or cyclist struck by a car</li> </ul>
<b>Minor</b>	Likely minor injury	<ul style="list-style-type: none"> <li>&gt; Some low-speed vehicle collisions.</li> <li>&gt; Cyclist falls from bicycle at low speed.</li> <li>&gt; Left-turn rear-end crash in a slip lane.</li> </ul>
<b>Limited</b>	Likely trivial injury or property damage only	<ul style="list-style-type: none"> <li>&gt; Some low-speed vehicle collisions.</li> <li>&gt; Pedestrian walks into object (no head injury).</li> <li>&gt; Car reverses into post.</li> </ul>


**Table 8-3 Resulting Level of Risk Matrix**

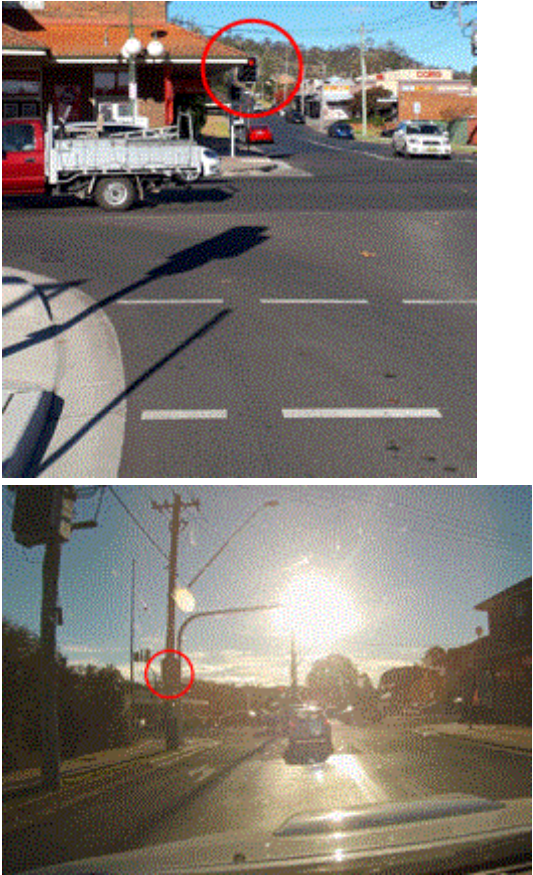
	Frequent	Probable	Occasional	Improbable
<b>Catastrophic</b>	Intolerable	Intolerable	Intolerable	High
<b>Serious</b>	Intolerable	Intolerable	High	Medium
<b>Minor</b>	Intolerable	High	Medium	Low
<b>Limited</b>	High	Medium	Low	Low


## 9 Audit Findings

**Table 9-1 Colden Street / Margaret Street – Site 1**


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.1 Crossing Point – Limited Sight</b> Margaret St/Argyle St Intersection</p> 	<p>There is a crossing point on Margaret Street that has limited sight as it is obstructed by vegetation.</p> <p>There is a risk that a motorist turning onto Margaret Street from Argyle Street may fail to see a pedestrian crossing the road at this location resulting in a pedestrian-vehicle collision.</p> <p>The frequency of this hazard is increased when a child or wheel chair user are crossing in this vicinity.</p>	Occasional	Serious	High	Council to check crash history in this location and determine appropriate mitigation, if required.


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.2 Pedestrian Connectivity</b> Menangle St/Colden St Intersection</p>	<p>There is inadequate connectivity for pedestrians commuting along Menangle St wishing to cross the road to Colden St.</p> <p>There is a risk that pedestrians may travel along this desire line, crossing the road at an unsafe location resulting in a pedestrian-vehicle collision.</p> <p>The frequency of the hazard is increased by the likelihood of pedestrians looking to access the Colden St shopping facilities.</p> 	Occasional	Serious	High	Council to consider opportunities to improve pedestrian crossings in this location as part of capital works program.

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.3 Existing Traffic Lanterns</b> Intersection of Cliffe St/Argyle St/Margaret St</p>	<p>There are two existing traffic lanterns that are obstructed, one by an existing awning and the other by an existing power pole.</p> <p>There is a risk a motorist may fail to see the red arrow lights when in phase and enter the intersection when not having right of way resulting in a collision with through traffic or injuring pedestrians.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Council / RMS to check crash history in this location and determine appropriate mitigation, if required.</p>


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.4 Merge Lane</b> Argyle St Southbound</p>	<p>There is a short merge lane southbound of the Argyle St/Cliffe St/Margaret St intersection.</p> <p>There is a risk motorists may fail to merge with adjacent traffic, resulting in a side-swipe or rear end collision.</p> <p>The frequency of the hazard is also increased as the existing sign 'Form One Lane' is obstructed by the large directory sign on approach of the merging lane.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>This is a fairly recent intersection upgrade. Presumably any design non-conformances relating to the departure merge lane were approved by RMS as part of the TCS sign-off process.</p> <p>Council / RMS to review TCS layout and placement of signs in this location and determine appropriate mitigation, if required.</p>

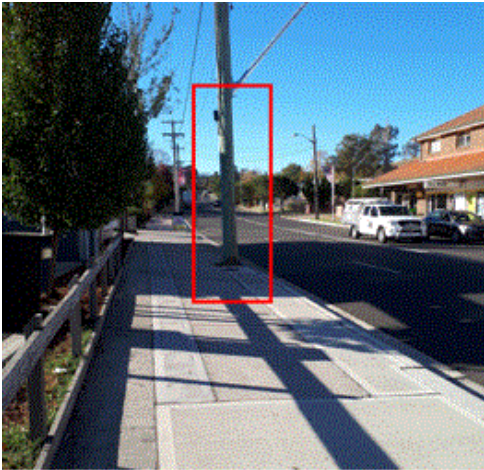
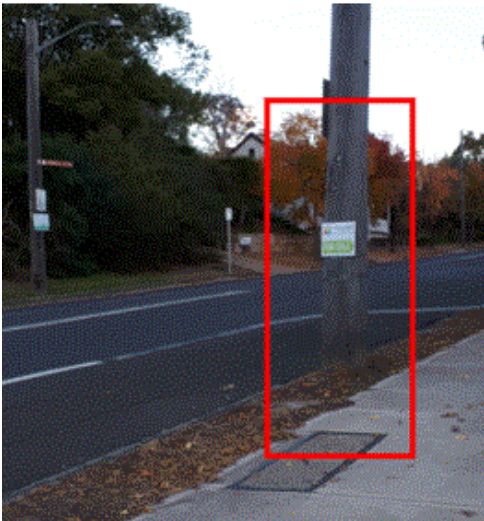
CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.5</b> <b>Crossing Point – Desire Line</b> Margaret St/Argyle St Intersection</p>	<p>There is a crossing point on Margaret Street that does not match the desire line of pedestrians travelling along Argyle Street.</p> <p>There is a risk that pedestrians may fail to walk the further distance required to cross at the formalised crossing point and cross at an unsafe location, resulting in a pedestrian-vehicle collision.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Council / RMS to review TCS layout and road geometry in this location and determine appropriate mitigation, if required.</p>

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.6</b> <b>Pedestrian Crossing</b> Margaret St/Colden St Intersection</p>	<p>There is a small gap created between the edge of the existing retaining wall and the existing landscaped area on Colden St.</p> <p>There is a risk that this gap will entice pedestrians to cross the road at an unsafe location rather than walking further to the formalised crossing point, resulting in a pedestrian-vehicle collision. It was observed on site that this was a frequent occurrence.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Council to review landscaping, street furniture in this location and determine appropriate mitigation, if required.</p>


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.7</b> <b>Intersection Angle</b> Menangle St/Colden St Intersection</p>	<p>There is an undesired intersection angle at the intersection of Menangle St and Colden St.</p> <p>There is a risk that motorists turning from Colden St to Menangle St may endeavour to make the turn in an untimely manner or pass the holding line before making the turn due to limited sight of traffic on Menangle St resulting in a collision with through traffic.</p> <p>On site it was observed that vehicles frequently crossed the holding line to gain a better line of sight of through vehicles.</p>	Occasional	Minor	Low	<p>Council / RMS to review intersection layout and road geometry in this location and determine appropriate mitigation, if required.</p>
					
<p><i>Image sourced from Google Maps</i></p>					





CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.8</b> <b>Turning Movements</b> Cliffe St/Argyle St/Margaret St Intersection</p>	<p>It was observed on site that large vehicles turning onto Cliffe St from Argyle St frequently require a larger turning radius passing over the opposite traffic lane.</p> <p>There is a risk that large vehicles at this intersection may not have sufficient turning clearance resulting in a side-swipe or head-on collision with holding opposite traffic at the signalised intersection.</p>	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>This is a fairly recent intersection upgrade. Presumably any design non-conformances relating to large vehicle swept paths were approved by RMS as part of the TCS sign-off process.</p> <p>Council / RMS to review TCS layout in this location and determine appropriate mitigation, if required.</p>
<p><b>1.9</b> <b>Existing Signage</b> Margaret St/Colden St Intersection</p>	<p>There is an existing Give way sign that is obstructed by vegetation.</p> <p>There is a risk a motorist may fail to appreciate the Give Way arrangement and enter the intersection in an untimely manner resulting in a collision with through traffic.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council to review landscaping, street tree maintenance schedule in this location and determine appropriate mitigation, if required.</p>


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>1.10</b> <b>Power Poles</b> Site Extents</p>	<p>It appears at numerous locations along the site extends that the clearance from the street power poles to the edge of the kerb is insufficient.</p> <p>There is a risk errant vehicles may impact a street pole.</p> <div style="display: flex; flex-direction: column; align-items: center;">   </div>	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council / Utility Authority to review placement of power poles in this location and determine appropriate mitigation, if required.</p>


**Table 9-2 Argyle Street/Menangle – Site 2**

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>2.1</b> <b>Wide Crossing</b> Argyle St/Menangle St Intersection</p>	<p>There is a wide crossing on Argyle Street fitting up to 4 lanes of traffic simultaneously.</p> <p>There is a risk that pedestrians crossing the road will be exposed to high volumes of traffic with minimal visibility to the formalised pedestrian crossing resulting in a pedestrian-vehicle collision.</p> <p>On site it was observed that motorists on Argyle Street looking to turn onto Menangle Street often queued over the crossing, obstructing other motorists of being able to see pedestrians crossing the road with right of way behind the queued vehicles.</p> <p>The frequency of the hazards above are also increased by the observed high traffic volumes and different turning manoeuvres occurring simultaneously at this intersection.</p>	Probable	Serious	Intolerable	Council / RMS to check crash history in this location and determine appropriate mitigation, if required.
					


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>2.2</b> <b>Kerb Ramp Alignment</b> Site Extents</p>	<p>There are a number of kerb ramps at various intersections within the audit extents that are directing pedestrians to the centre of the intersection.</p> <p>There is a risk for vulnerable pedestrians, such as the visually impaired, may be directed into the travel lanes resulting in a pedestrian-vehicle collision.</p>	Occasional	Serious	High	<p>Council to consider opportunities to improve pedestrian crossings / accessibility improvements in this location as part of capital works program.</p>
					

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>2.3</b> <b>Concrete median</b> Menangle Street</p>	<p>There is a concrete median on Menangle Street approaching Argyle Street with a flush gap for pedestrians.</p> <p>The angle of the gap interferes with the desired line for pedestrians to cross the street perpendicularly.</p> <p>There is a trip hazard for visual impaired and users of wheelchairs.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Council to consider opportunities to improve pedestrian crossings / accessibility improvements in this location as part of capital works program.</p>


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>2.4</b> <b>Crossing Point – Desire Line</b> Argyle St/Menangle St Intersection</p>	<p>There is a crossing point on Menangle Street that does not match the desire line of pedestrians travelling along Argyle Street.</p> <p>There is a risk that pedestrians may fail to walk the further distance required to cross at the formalised crossing point and cross at an unsafe location, resulting in a pedestrian-vehicle collision.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Council to consider opportunities to improve pedestrian crossings / accessibility improvements in this location as part of capital works program.</p>

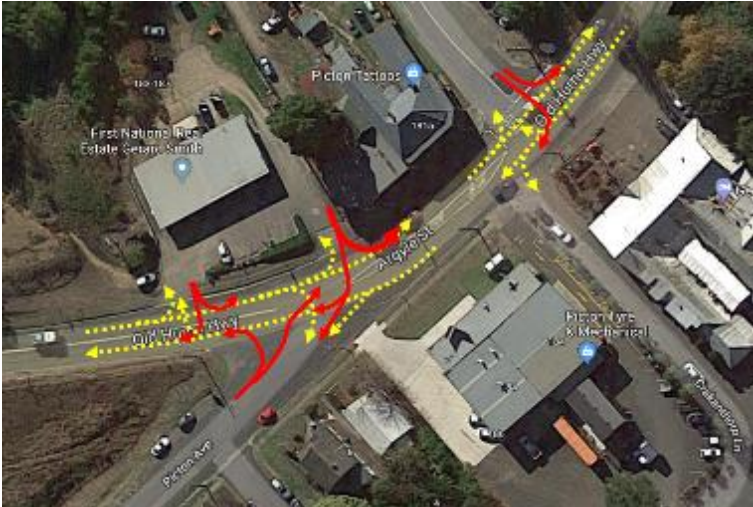
CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>2.5</b> <b>Turning Configurations</b> Argyle St/Menangle St Intersection</p>	<p>There is insufficient delineation on Menangle Street heading into Argyle Street to identify right/left turning movements.</p> <p>There is a risk that a vehicle intending to turn left and another turning right may simultaneously queue in the lane with insufficient guidance/delineation and obstruct sight of traffic on Argyle Street resulting in a side-swipe incident, or collision with through traffic.</p> <p>The frequency of the hazards above are also increased by the high traffic volumes observed at this intersection.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>


**Table 9-3 Argyle Street/Barkers Lodge Road.– Site 3**


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>3.1 Limited Sight Distance</b> Argyle St/Barkers Lodge Road</p>	<p>There is limited sight distance in and out of Barkers Lodge Road/Argyle St intersection.</p> <p>It was noted during the site inspection on Barkers Lodge Road that there were long waiting periods for vehicles holding until finding a safe gap to enter Argyle Street.</p> <p>There is a risk that vehicles may attempt to turn in or out of Barkers Lodge Road with an insufficient safe gap in traffic resulting in a collision with oncoming or through traffic on Argyle Street.</p>	Occasional	Serious	High	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>
					




CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>3.2</b> <b>Commercial Property Access in Intersection</b> Argyle St/Picton Ave</p>	<p>There is an existing commercial property access point located within the intersection of Argyle Street and Picton Avenue with limited sight distance and poor delineation.</p> <p>There is a risk that a motorist may proceed into the intersection with limited sight distance resulting in a collision with through or turning traffic.</p> <p>The frequency of the hazard is increased in peak traffic hours. On site it was observed that a motorist exiting this location was awaiting a gap for some time, before impatiently entering Argyle Street into oncoming traffic to navigate around a turning vehicle from the left side.</p> 	Occasional	Minor	Medium	Council to check crash history in this location and determine appropriate mitigation, if required.


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>3.3 Insufficient Intersection Treatments</b> Argyle Street, Picton Avenue, Barkers Lodge Road</p>	<p>It is noted that Argyle Street / Picton Avenue / Barkers Lodge Road / Crakanthorp Lane intersections present a numerous amount of turning manoeuvres within a short distance and limited sight distance of the through traffic on Argyle Street. .</p> <p>There is insufficient delineation, linemarking and inadequate intersection traffic control off Picton Avenue to hold traffic before entering Argyle Street</p> <p>There is a risk of long waiting queues, traffic conflicts and collisions for traffic at the unsignalised intersection of Picton Avenue and Argyle Street</p> 	Occasional	Minor	Medium	Council to check crash history in this location and determine appropriate mitigation, if required.


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>3.4</b> <b>Lack of Delineation</b> Picton Ave</p>	<p>There is insufficient delineation along Picton Avenue and its adjoining intersections Argyle Street and Coull Street. Picton Avenue also has deteriorated pavement conditions. There is a risk that motorists may get confused navigating through these intersections or park in inappropriate locations resulting in limiting sight and rear-end collision or collision with through traffic.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council to check crash history in this location and determine appropriate mitigation, if required. Council to review site in respect of road maintenance priorities.</p>


CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>3.5</b> <b>Damaged Shoulder</b> In Vicinity of Coull Street/Picton Ave Intersection</p>	<p>Coull Street shoulder northbound is damaged and in poor condition. There is a risk that during rainy days storm water may flush and wash debris into the Argyle Street intersection increasing the risk of slippery conditions. This could potentially increase the likelihood of vehicles losing control and collisions with opposite traffic.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council to review site in respect of road maintenance priorities.</p>

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>3.6</b> <b>Poor Delineation</b> Argyle Street</p>	<p>Linemarking and delineation on Argyle Street north of Prince Street is not clear. Linemarking is faded.</p> <p>There is a risk that vehicles may confuse the lane configuration increasing the risk of head on collision with opposite traffic.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council to review site in respect of road maintenance priorities.</p>


**Table 9-4 Prince Street from Argyle Street to Menangle Street.– Site 4**

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>4.1</b> <b>Old Hume Highway / Prince Street Right Turn</b> Old Hume Highway / Prince Street</p>	<p>There is inadequate linemarking and delineation for vehicles on Old Hume Highway to turn right into Prince Street.</p> <p>There is a risk that traffic queues may be recorded turning right into Prince Street. This may block Old Hume Highway northbound through traffic or increase the risk of rear end collisions for vehicles trying to find a gap on the left side to overtake holding traffic near the existing on-street parking area and property accesses.</p>	Probable	Minor	High	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>
					

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>4.2</b> <b>Property Access Locations</b> Argyle St/Prince St Intersection</p>	<p>There are a number of property access points located close to or within the Argyle Street/Prince Street intersection.</p> <p>There is a risk that motorists entering these property access points will suddenly brake and reveal their intentions to turn without sufficient notice, resulting in a rear-end collision.</p> <p>The frequency of the hazard is increased as driveway warning signage is currently located after the first driveway and not on approach of it.</p> 	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>4.3 Short Stagger Distance Between Intersections</b> Prince St/Menangle St/Station St</p>	<p>There is a short stagger distance between Station Street and Prince Street.</p> <p>There is a risk that a motorist heading north on Menangle Street, indicating to turn into Station Street may be mistaken by another motorist for turning onto Prince Street, resulting in a collision with oncoming traffic.</p> <p>The frequency of the hazard is also increased given that Station Street is used to access the train station.</p> 	Occasional	Minor	Medium	Council to check crash history in this location and determine appropriate mitigation, if required.



CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>4.4</b> <b>Menangle St Shoulder</b> Prince St/Menangle St/Station St</p>	<p>There is a shoulder on the northbound side of Menangle Street between Prince Street and Station Street without signage or on-street parking restrictions.</p> <p>There is a risk that vehicles may be parked in this location blocking sight to vehicles off Prince Street and Station Street resulting in a collision with through traffic on Menangle Street.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Medium</p>	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>
<p><b>4.5</b> <b>Property Access Locations</b> Prince St/Menangle St/Station St</p>	<p>There are a number of property access points located close to or within the Prince Street/Station St/Menangle Street intersections.</p> <p>There is a risk that motorists entering these property access points will suddenly brake and reveal their intentions to turn without sufficient notice, resulting in a rear-end collision.</p>	<p>Occasional</p>	<p>Minor</p>	<p>Medium</p>	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>

CAR Reference/Location	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Managers Response
<p><b>4.6</b> <b>Widened Area Within Intersection</b> Argyle St/Prince St Intersection</p>	<p>There is an existing widened area at the intersection of Argyle Street and Prince Street with inadequate delineation, its purpose is unclear.</p> <p>There is a risk that motorists may use it as a slip lane to turn into Prince Street with insufficient width resulting in side-swipe with adjacent traffic on Argyle Street.</p> 	<p>Improbable</p>	<p>Minor</p>	<p>Low</p>	<p>Council to check crash history in this location and determine appropriate mitigation, if required.</p>

## 10 Responding to the Audit Report

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A project manager is under no obligation to accept the findings outlined in this audit report. This report simply provides the opportunity for the project manager to review potential problems highlighted by the auditors.

A formal road safety audit report should be responded to in writing.

It should be noted that this audit will be recorded on the NSW Register of Road Safety Auditors and the project manager should expect email notification from the register to confirm the audit has been carried out.

## 11 Formal Statement

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We, the undersigned, declare that we have reviewed the material and data listed in this report and identified the safety and operational deficiencies above.

It should be noted that while every effort has been made to identify potential safety hazards, no guarantee could be made that every deficiency has been identified.

We recommend that points of concern be investigated and necessary corrective actions are undertaken.

**Antonio Villacorta**

*Level 3 Road Safety Auditor  
Auditor ID (RSA-02-0805)  
Team Leader*

**Michael Renko**

*Level 2 Road Safety Auditor  
Auditor ID (RSA-02-1134)  
Team Member*

APPENDIX

# D

RSA – STRATEGIC DESIGN

# Road Safety Audit Report

Picton Town Centre – Pre-Construction  
Strategic Design Stage Road Safety  
Audit

8201817701



Prepared for  
Cardno NSW / ACT Pty Ltd

22 June 2018

## Contact Information

### Cardno (NSW/ACT) Pty Ltd

ABN 95 001 145 035

Level 9 - The Forum  
203 Pacific Highway  
St Leonards NSW 2065  
Australia

[www.cardno.com](http://www.cardno.com)

Phone +61 2 9496 7700

Fax +61 2 9496 7748

## Document Information

Prepared for	Cardno NSW / ACT Pty Ltd
Project Name	Picton Town Centre – Pre-Construction Strategic Design Stage Road Safety Audit
File Reference	82018177_Picton RSA Strategic v02.docx
Job Reference	8201817701
Date	22 June 2018
Version Number	2

## Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
0	22/06/2018	Draft (internal review)	Hayden Calvey	Antonio Villacorta
1	22/06/2018	Draft (client issue)	Hayden Calvey	Antonio Villacorta
2	22/06/2018	Final (client issue)	Hayden Calvey	Antonio Villacorta

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# 1 Project Summary

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<b>Project Number:</b>	8201817701
<b>Final Report Date:</b>	22/06/2018
<b>Draft Report Date:</b>	22/062018
<b>Title of Audit:</b>	Picton Town Centre – Pre-Construction Strategic Design Stage Road Safety Audit
<b>Location of Audit:</b>	Argyle Street, Menangle Street, Prince Street – Picton NSW
<b>Project Description:</b>	The aim of this project is to assess a number of locations and proposed intersection treatments within the Picton town centre.
<b>Purpose of Audit:</b>	The aim of this Road Safety Audit (RSA) is to assess the proposed strategic design drawings against vehicle and pedestrian safety
<b>State:</b>	NSW
<b>Stage of Audit:</b>	Pre-Construction Strategic Design Stage Road Safety Audit
<b>Client Company:</b>	Cardno NSW / ACT Pty Ltd
<b>Client Contact:</b>	Tim Sullivan
<b>Client Phone:</b>	9024 7055
<b>Client Email:</b>	Tim.sullivan@cardno.com.au
<b>Audit Date:</b>	20/06/2018
<b>Audit Team:</b>	Antonio Villacorta (Auditor Level 3) Hayden Calvey (Auditor Level 2)

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## 2 Project Description

The aim of this project is to assess a number of locations and proposed intersection treatments within the Picton town centre.

These sites include Argyle Street/Menangle Street (Site 1), Argyle Street/Prince Street (Site 2) and Menangle Street / Prince Street (Site 3).

## 3 Audit Stage

A pre-construction strategic design stage audit was carried out through desktop review of plans (as detailed in **Section 7**) on 20 June 2018. An existing stage audit was previously carried out on 21 May 2018.

The audit was generally undertaken in accordance with 'TNSW Guidelines for Road Safety Audit Practices (2011)' and 'Austroads: Guide to Road Safety Part 6: Road Safety Audit (2009)'.

## 4 Study Area

The focus of the study is limited to the three study sites as shown in Figure 4-1.

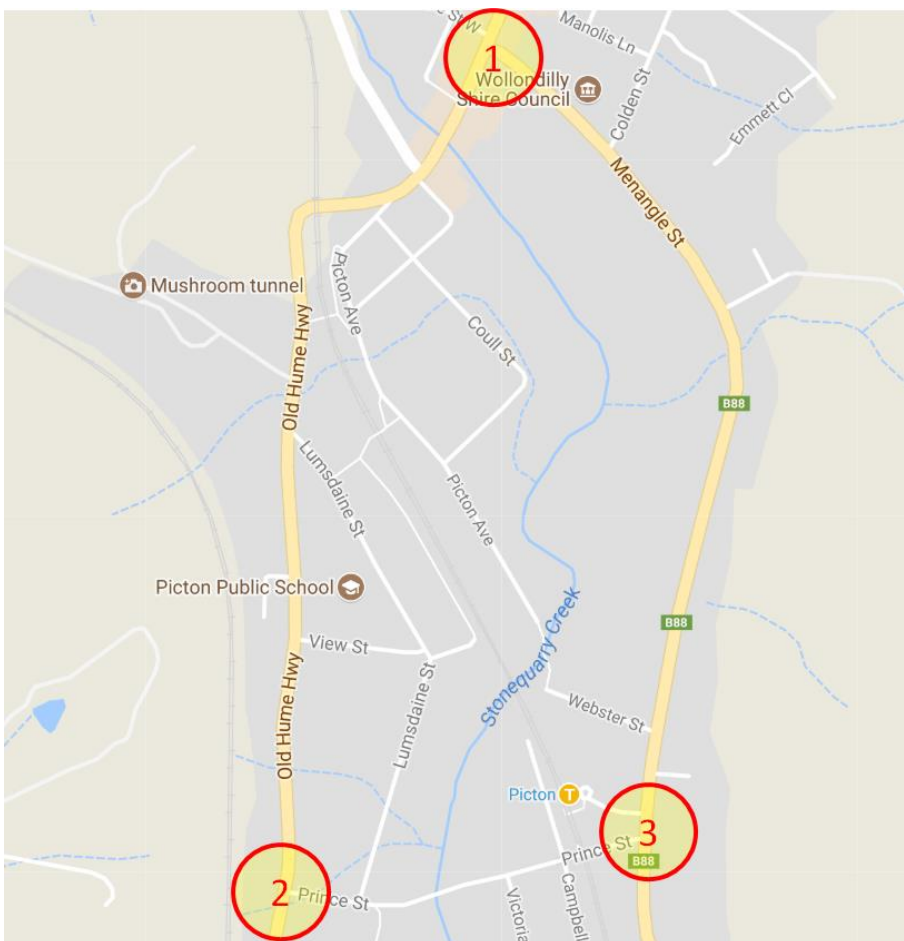


Figure 4-1 Areas of Audit

## 5 Audit Team

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The audit team and client details are shown in **Table 5-1**.

Table 5-1 Audit Team & Client Details

Role	
<b>Client</b>	Cardno NSW / ACT Pty Ltd
<b>Client Email</b>	Tim.sullivan@cardno.com.au
<b>Lead Auditor</b>	Antonio Villacorta (RSA-02-0805)
<b>Team Members</b>	Hayden Calvey (RSA-02-0754)
<b>Contact for enquiries</b>	Hayden.calvey@cardno.com.au

## 6 Audit Program

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The audit program details are shown in **Table 6-1**.

Table 6-1 Audit Program

Activity	Date	
<b>Desktop Audit</b>	20/06/2018	Antonio Villacorta, Hayden Calvey
<b>Draft Report issued</b>	22/06/2018	Draft Report
<b>Review/Closing Meeting</b>	22/06/2018	Project Manager Comments
<b>Final Report Issued</b>	22/06/2018	Final Report

## 7 Exclusions

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The following list identifies items excluded from the audit process:

- > Street lighting was not part of the audit
- > Pavement and drainage design were not part of this audit
- > Cross and longitudinal sections were not provided to the audit team
- > Swept paths for large vehicles over 8.8m length were not provided
- > Underground and overhead utilities were not provided

## 8 Reference Documents

The following reference documentation are the focus of the audit.

Table 8-1 List of Plans

Name	Reference	Date
Road Safety Audit Existing Conditions, Picton Town Centre – Various Locations – Existing Conditions	8201817701 Cardno Report	June 2018
Preliminary Argyle and Menangle Street and Menangle and Colden Street Intersection Layout Plan	82018177-01-SK001	08/06/2018
Preliminary Argyle and Menangle Street Intersection Vehicle Paths	82018177-01-SK002	08/06/2018
Preliminary Menangle and Prince Street Intersection Plan	82018177-01-SK003	08/06/2018
Preliminary Menangle and Prince Street Intersection Vehicle Paths Sheet 1 of 2	82018177-01-SK004	08/06/2018
Preliminary Menangle and Prince Street Intersection Vehicle Paths Sheet 2 of 2	82018177-01-SK005	08/06/2018
Preliminary Argyle and Prince Street Intersection Layout Plan	82018177-01-SK006	08/06/2018
Preliminary Argyle and Prince Street Intersection Vehicle Paths	82018177-01-SK007	08/06/2018

## 9 Audit Risk Assessment Technique

For each of the safety issues identified, the level of risk with each has been determined. **Table 9-1**, **Table 9-2** and **Table 9-3** are extracted from Austroads: Guide to Road Safety Part 6: Road Safety Audit (2009) and have been used in the assessment of risk for this audit.

Table 9-1 Incident Frequency

Frequency	Description
<b>Frequent</b>	Once or more per week
<b>Probable</b>	Once or more per month
<b>Occasional</b>	Once or more per year
<b>Improbable</b>	Less often than once every year

Table 9-2 Incident Severity

Severity	Description	Examples
<b>Catastrophic</b>	Likely multiple deaths	<ul style="list-style-type: none"> <li>&gt; High-speed, multi-vehicle crash on freeway.</li> <li>&gt; Car runs into crowded bus stop.</li> <li>&gt; Bus and petrol tanker collide.</li> <li>&gt; Collapse of bridge or tunnel.</li> </ul>
<b>Serious</b>	Likely death or serious injury	<ul style="list-style-type: none"> <li>&gt; High or medium-speed vehicle/vehicle collision.</li> <li>&gt; High or medium-speed collision with a fixed roadside object.</li> <li>&gt; Pedestrian or cyclist struck by a car</li> </ul>
<b>Minor</b>	Likely minor injury	<ul style="list-style-type: none"> <li>&gt; Some low-speed vehicle collisions.</li> <li>&gt; Cyclist falls from bicycle at low speed.</li> <li>&gt; Left-turn rear-end crash in a slip lane.</li> </ul>
<b>Limited</b>	Likely trivial injury or property damage only	<ul style="list-style-type: none"> <li>&gt; Some low-speed vehicle collisions.</li> <li>&gt; Pedestrian walks into object (no head injury).</li> <li>&gt; Car reverses into post.</li> </ul>

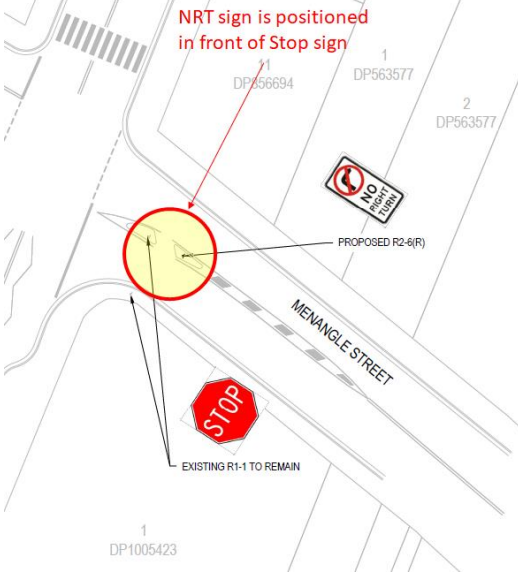
Table 9-3 Resulting Level of Risk Matrix

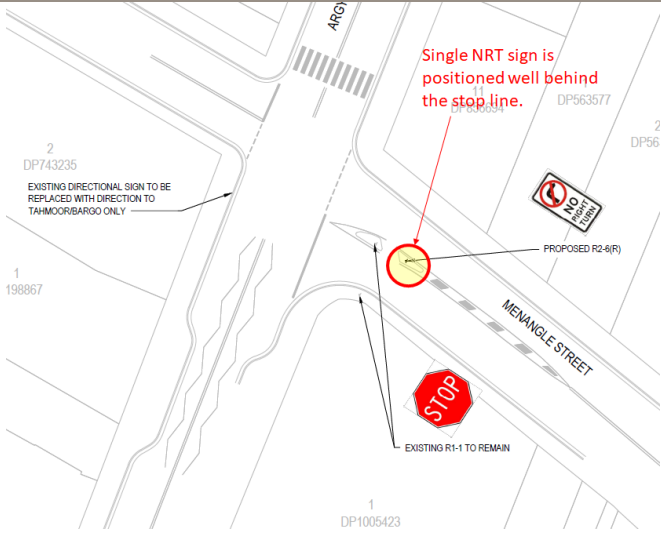
	Frequent	Probable	Occasional	Improbable
<b>Catastrophic</b>	Intolerable	Intolerable	Intolerable	High
<b>Serious</b>	Intolerable	Intolerable	High	Medium
<b>Minor</b>	Intolerable	High	Medium	Low
<b>Limited</b>	High	Medium	Low	Low

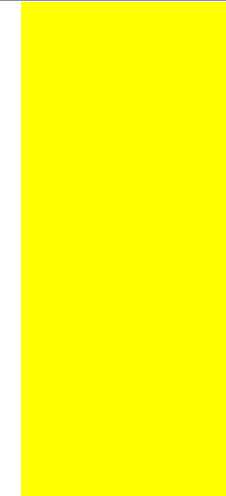
## 10 Audit Findings

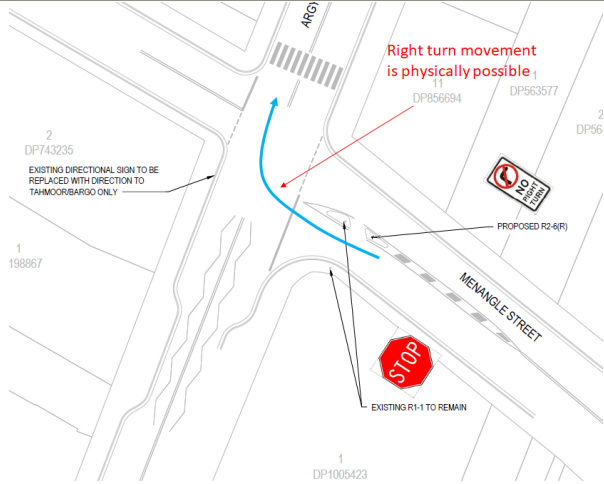
Table 10-1 Audit Findings – Menangle Street / Argyle Street Site 1

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
1.01	<p>There is a wide crossing on Argyle Street fitting up to 4 lanes of traffic simultaneously.</p> <p>There is a risk that pedestrians crossing the road will be exposed to high volumes of traffic with minimal visibility to the formalised pedestrian crossing resulting in a pedestrian-vehicle collision.</p>	Occasional	Serious	High	Outside of project scope. Zebra crossing relocation to be addressed by Council as a separate project.
1.02	<p>The proposed “No Right Turn” regulatory sign appears to be positioned on the concrete median in front of the existing “Stop” sign. There is a risk of signage blockage.</p> <p>Location of sign far from the intersection may not be suitable to inform drivers of the movement restrictions. Vehicles could potentially continue turning right into Argyle Street increasing the risk of traffic conflicts and the already identify issues with pedestrians at the pedestrian crossing.</p>	Improbable	Serious	Medium	Comment to be passed to design team. No Right Turn signage placement to be finalised at concept design stage.

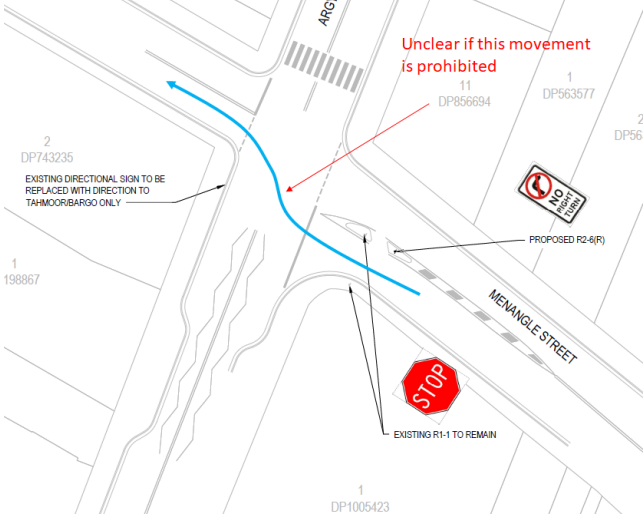
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
1.03	 <p>There is only one “No Right Turn” sign provided, approximately 14m (2 car lengths) back from the existing stop line.</p> <p>There is a risk that the limited number of signs and inappropriate location may result in approach vehicles not adequately observe the movement restriction and proceed to undertake a prohibit manoeuvre, resulting in a potential crash at the intersection.</p>	Improbable	Serious	Medium	<p>Comment to be passed to design team. No Right Turn signage to be finalised at concept design stage. It should be noted that the proposal includes additional signage at Colden St to give right turners early warning.</p>

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
					
<p><b>1.04</b></p>	<p>The proposed “No Right Turn” is enforced by signage only, with no physical treatment.</p> <p>There is a risk that approach vehicles may undertake this prohibited manoeuvre resulting in a potential crash at the intersection.</p>	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Physical medians to prohibit the right turn are not feasible due to the need to facilitate straight ahead movements and the offset geometry of the intersection. It is expected that the proportion of right turners ignoring the right turn ban will diminish over time as drivers get used to the changed traffic conditions.</p>

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
1.05	<p>Due to the existing alignment of the intersection, it is unclear if access from Menangle Street (eastern approach) to Menangle Street West is intended to be prohibited as a result of the proposed “No Right Turn”</p> <p>The ‘through’ movement may be confused for drivers at the intersections as may appears to conflict with the proposed banned right turn movement.</p>	Note Only			<p>Comment to be passed to design team. Additional signage to be considered at concept design stage.</p>

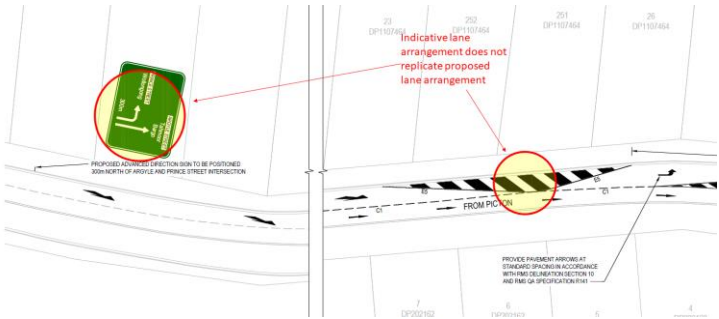


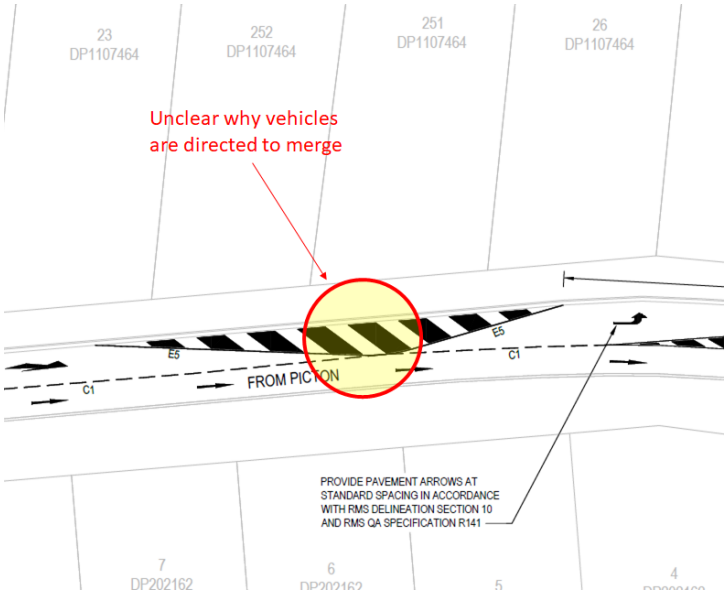


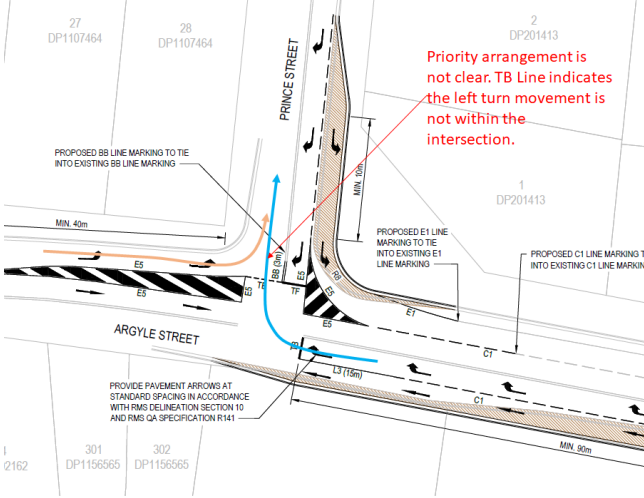
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
1.06	 <p>The swept path assessment adopts an 8.8m Medium Rigid Vehicle (MRV) however it is likely the intersection caters for general access vehicles (vehicles up to and including 19m semi-trailers) for turning movements.</p>	Note Only			<p>Comment to be passed to design team. Swept paths to be updated using 12.5m service vehicle as design vehicle and 19.5m semi-trailer as check vehicle. It should be noted that no physical changes are proposed to the road geometry in this location.</p>
1.07	<p>The displaced right turn traffic volume may result in capacity issues at other intersection locations (e.g. Argyle Street / Cliff Street), warrant the need to review existing pedestrian facilities (e.g. Colden Street) or review access to commercial properties on the north-western side of Argyle Street</p>	Note Only			<p>An Aimsun model has been used to confirm acceptable impacts at adjacent intersections up to 2026. Council to consider opportunities to improve pedestrian crossings as part of capital works program. Deliveries to commercial premises on the west side of Argyle St could potentially be done via Walton Street, with precise arrangements to be determined as part of stakeholder consultation prior</p>

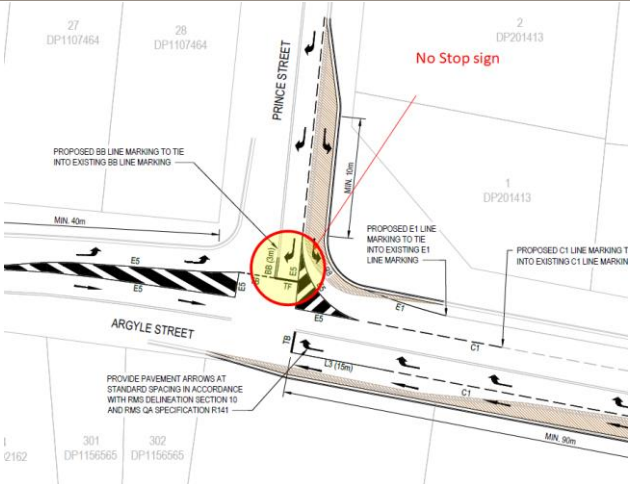
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
					to implementation of the changed traffic conditions.

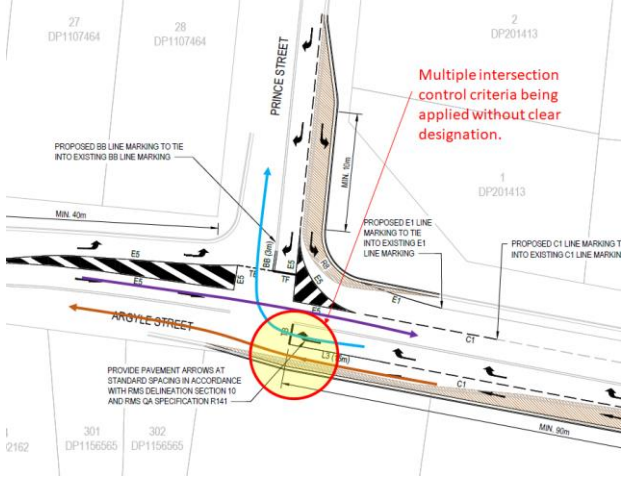
Table 10-2 Audit Findings – Argyle Street / Prince Street Site 2

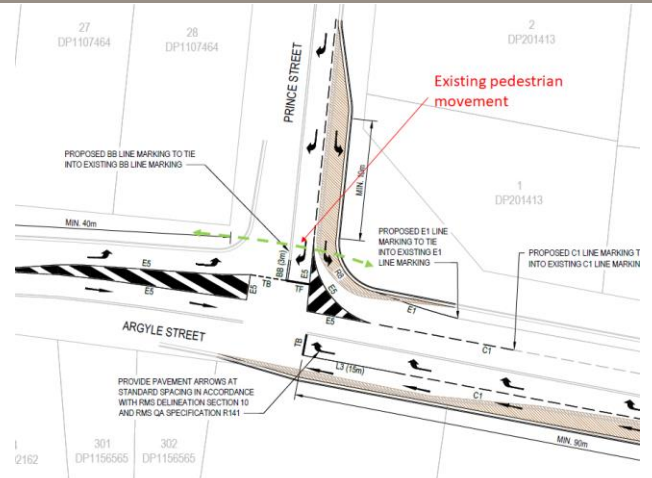
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
<b>2.01</b>	<p>The advance direction sign indicates two approach lanes on the southbound traffic lanes starting from the sign itself however does not display the requirement to merge before the intersection and then performing the fork diverge</p> <p>There is a risk that approach vehicles may disregard the merge requirement resulting in vehicle to vehicle conflict and potential side-swipe crash types.</p> <p>In addition, it is not clear to the audit team the purpose of the linemarking treatments.</p> 	Probable	Minor	High	<p>The merge from two lanes to one lane SB is to facilitate an acceleration lane further south for left turners exiting Prince St. The microsimulation modelling showed that this free flow left turn from Prince St was required to maintain acceptable network performance in the future.</p> <p>The intent is for left turners into Prince St to stay in the kerbside lane. The only vehicles required to merge are those wishing to continue straight (towards Tahmoor).</p> <p>Chevrons in the kerbside lane have been removed and merge arrows replaced with left turn arrows for final issue.</p> <p>Exact linemarking and signage to be resolved at concept design.</p>
<b>2.02</b>	<p>The requirement for the merge area on the northern approach is unclear to the audit team.</p>	Probable	Minor	High	See response to 2.01 above.

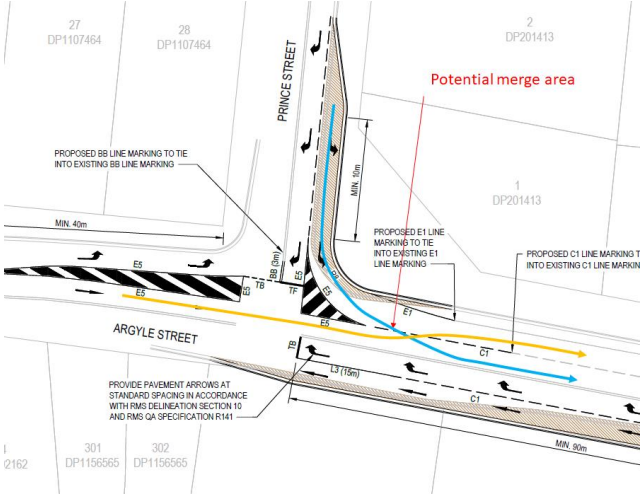
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
	<p>There is a risk that approach vehicles may disregard the merge requirement resulting in vehicle to vehicle conflict and potential side-swipe crash types.</p> 				
<p><b>2.03</b></p>	<p>The priority and purpose of the proposed intersection is unclear to the audit team. The right turn movement into Prince Street is proposed as a “Stop” control according to the proposed linemarking however the left turn into Prince Street presents as a continuous movement although is somewhat separated from the intersection.</p> <p>There is a risk that the confusing priorities at the intersection may result in potential near-side crashes.</p>	<p>Occasional</p>	<p>Serious</p>	<p>High</p>	<p>Give way and stop line marking corrected for final issue of drawings.</p>

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
2.04	 <p>The right turn to Argyle Street from Prince Street is proposed to be under “Stop” control based on the proposed linemarking however no “Stop” sign is proposed. I</p> <p>There is a risk that due to the inadequate signage an approaching vehicle may disregard the intersection control resulting in near and / or far-side crashes.</p>	Improbable	Serious	Medium	The drawings only show new signage. The existing stop sign will be retained.

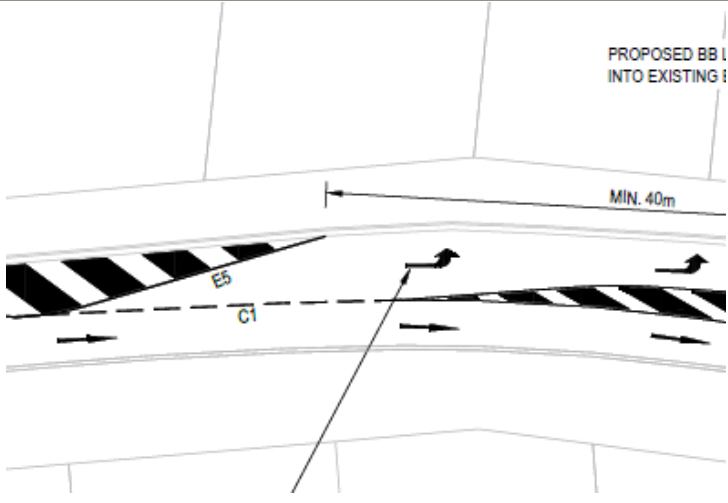
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
2.05	 <p>The intersection control applicable to the southern approach on Argyle Street is unclear to the audit team. The southern approach has a “Stop” control proposed for the right turn movement only, with the through (northbound) movement appearing to be a continuous movement. There is inadequate signage / warning of this intersection control and may result in confusion as to who is to stop and giveaway.</p> <p>There is a risk that this atypical intersection control may result in abrupt braking resulting in rear-end crashes.</p>	Occasional	Serious	High	Give way and stop line marking corrected for final issue of drawings.

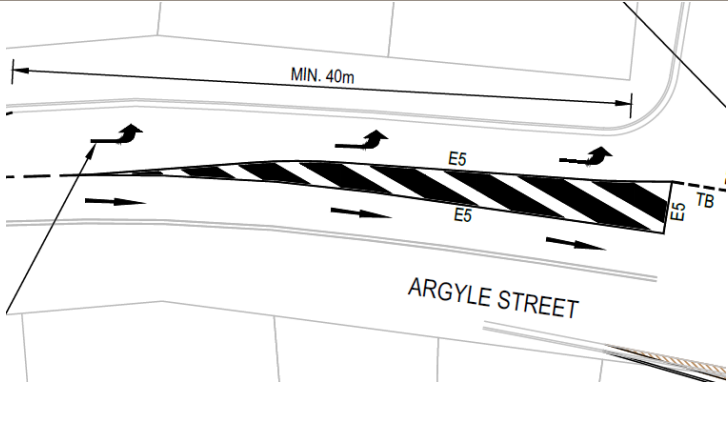
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
2.06	 <p>It is unclear how pedestrians are catered to cross Prince Street. Design drawings do not provide details of any pedestrian treatment or consideration in the design for the existing kerb ramps on Prince Street</p> <p>There is a risk that pedestrians may store within the chevron pavement marking area to cross Prince Street. This may result in vehicle to pedestrian conflict and result in a pedestrian related crash type.</p>	Improbable	Serious	Medium	Comment referred to design team. Location of dropped kerbs to be addressed at concept design.

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
					
2.07	<p>It appears that the proposed widening of the intersection would require property boundary adjustments, residential driveway demolitions and potentially construction of retaining walls.</p> <p>There is risk that adjusted driveways will be steep to cater for the existing road level resulting in emerging from driveway crash type.</p> <p>In addition it is not clear how the access to the two new property driveways would be retained</p>	Improbable	Minor	Low	Comment referred to design team. Private driveway adjustments to be considered at concept design.
2.08	<p>There is on-street parking permitted along Argyle Street. There are no proposed parking restrictions within the proposed northbound through lane or the southbound lanes</p> <p>There is a risk that parking may hinder / obstruct the intersection capacity and traffic flow which can lead to congestion, resulting in rear-end crash types.</p>	Improbable	Minor	Low	Comment referred to design team. Parking restrictions to be considered at concept design. It should be noted that the proposed scheme does not exacerbate the likelihood or severity of the identified risk.
2.09	<p>The continuous left turn slip lane from Prince Street into Argyle Street south proposes a C1 linemarking treatment. It is not clear to the audit team the purposes of the crossing</p>	Improbable	Minor	Low	C1 line marking corrected for final issue of drawings.

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
	<p>merging linemarking as the two southbound lanes are not merging at any location nearby</p> <p>There is a risk that southbound vehicles along Argyle Street may merge into the kerbside lane which is interpreted as the continuous lane for left turn traffic. This may result in side swipe crash types.</p> 				
2.10	<p>The taper to divert vehicles to the left turn lane after the merge to the right painted chevron appears too short to allow vehicles for a smooth transition to the left turn lane.</p> <p>Vehicles may not have adequate time and space to merge back to the left lane increasing the risk of side and read end collisions.</p>	Improbable	Serious	Medium	See response to 2.01 above.

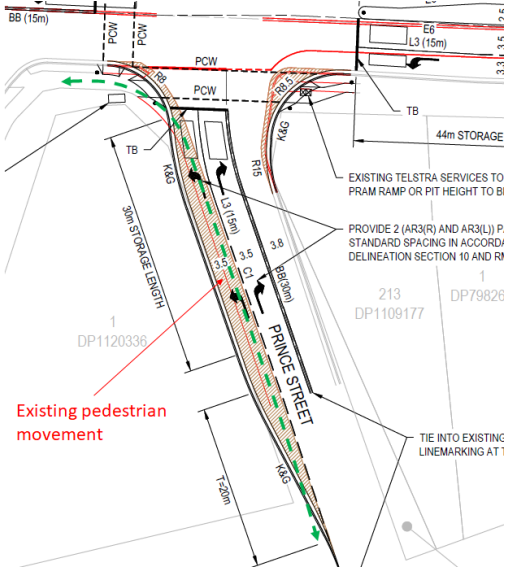


CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
	 <p>PROPOSED BB L INTO EXISTING I</p> <p>MIN. 40m</p> <p>E5</p> <p>C1</p>				
<p><b>2.11</b></p>	<p>There is an existing power pole at the southeast corner of Prince Street and Argyle Street. It appears that the proposed left turn lane would clash with the existing utility pole.</p> <p>There is a risk that clearance to the power pole may not be achieved increasing the risk of vehicles hitting the pole</p>	<p>Improbable</p>	<p>Serious</p>	<p>Medium</p>	<p>Power pole relocation to be addressed at concept design.</p>
<p><b>2.12</b></p>	<p>It is not clear to the audit team the purpose of the proposed bi-directional painted chevron for traffic travelling in the same direction. It appears an incorrect chevron pavement marking has been adopted to split the left and through lane movements on the northern approach.</p> <p>There is a risk that drivers may be confused with the painted marking increasing the risk of side collisions when attempting to navigate back to the through traffic lane</p>	<p>Occasional</p>	<p>Minor</p>	<p>Medium</p>	<p>Chevron line marking corrected for final issue of drawings.</p>

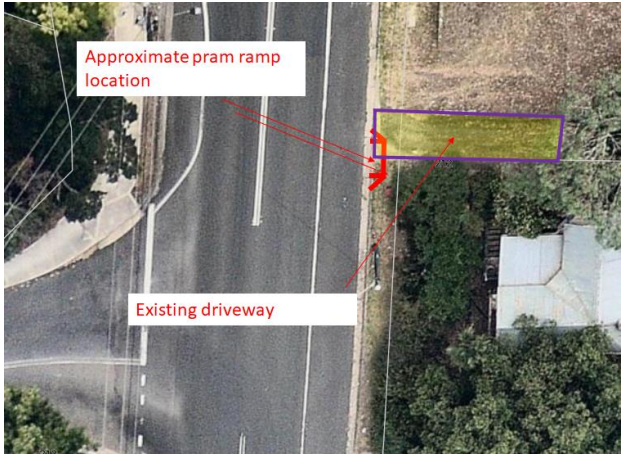
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
					
<p><b>2.13</b></p>	<p>The existing intersection arrangement is noted to encourage vehicles on Prince Street to reduce speed and give way to the through traffic on Argyle Street.</p> <p>The proposed arrangement may encourage vehicles to maintain the travel speed entering the intersections</p> <p>The left turn lane from Prince Street into Argyle Street south appears to have inadequate geometry for the travel speed that may be performed when entering Argyle Street.</p> <p>The may increase the risk of vehicles losing control and crossing over the through traffic lane. This issue is reinforce with the proposed crossing linemarking C1 line off the left turn</p>	Occasional	Minor	Medium	Precise kerb geometry to be addressed at concept design.
<p><b>2.14</b></p>	<p>Design drawings do not provide details of any pavement treatment on Argyle Street for the proposed left turn lane into Prince Street.</p> <p>Typical or detailed cross sections were not provided to the audit team.</p> <p>The pavement conditions of the proposed slip left turn on Argyle Street present severe damages and differences in levels to the existing through lanes.</p>	Occasional	Minor	Medium	Pavement and cross section details not required at strategic design stage. To be addressed at concept design.


CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
	<p>There is a risk that usage of this lane may continue deteriorating the already damaged conditions of the lane.</p> <p>In additional the difference of road levels may increasing the risk of losing control and mounting the kerb</p>				
2.15	<p>Design drawings provide details of swept path for vehicles up to 8.8m length.</p> <p>It is not clear to the audit team is larger vehicles are allowed to enter Prince Street.</p> <p>There are no regulatory signs to inform drivers of the low bridge clearance and maximum loading (5t) on Argyle Street. There is a risk that large vehicle may attempt to use the Prince Street used the proposed dedicated turning lanes.</p>	Improbable	Minor	Low	This is an existing issue and it not within the scope of work for this project.
2.16	<p>It is not clear to the audit team the purpose of the through traffic painted arrows. It is not a common practice in New South Wales nor adopted by Roads and Maritime</p>	Note Only			This linemarking was adopted to help delineate the traffic movements on the northern approach. Linemarking to be finalised at concept design.
2.17	<p>No swept paths have been provided for the right turn bay on the southern approach</p>	Note Only			This right turn movement is unaffected by the proposed design, therefore the swept path is not included.
2.18	<p>Cross sections were not provided to the audit team.</p> <p>It is unclear to the audit team propose road levels, location of the crown and storm water management at the intersection</p>	Note Only			Cross section details not required at strategic design stage. To be addressed at concept design.
2.19	<p>The complexity of the proposed intersection may require suitable and sufficient directional and regulatory signage to advice drivers of the traffic conditions and facilitate navigation through the intersection.</p> <p>The information provided to the audit team was limited. A complete assessment of the intersection cannot be undertaken at this stage.</p>	Note Only			Given the non-standard nature of the intersection, it is recommended that a further road safety audit is undertaken at concept design stage.

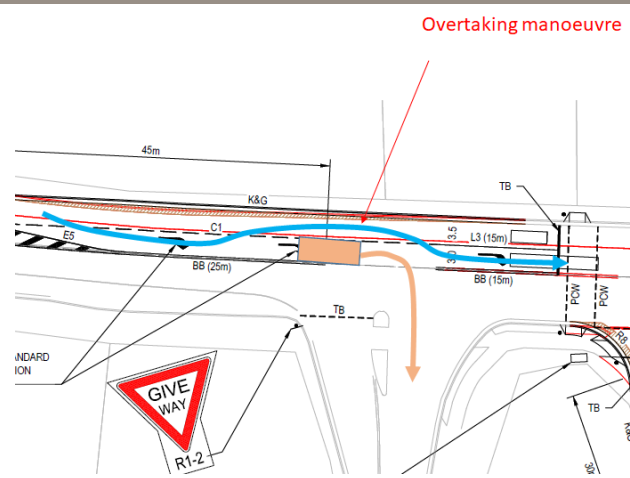
Table 10-3 Audit Findings – Menangle Street / Prince Street Site 3

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
3.01	<p>It is unclear to the audit team if the existing footpath will be reinstated.</p> <p>There is a risk that pedestrians are forced to use the road as access resulting in vehicle to pedestrian conflict and pedestrian crash types</p> 	Occasional	Serious	High	Design amended for final issue, allowing footpath to be retained.
3.02	<p>Menangle Street, northbound and southbound, currently have priority as the major road. The introduction of traffic signals will require these movements to stop and give way to others resulting in changed traffic conditions.</p> <p>There is a risk that motorists will be unfamiliar with the new intersection control type resulting in crashes at the intersection</p>	Improbable	Serious	Medium	This is no different to any other new set of traffic signals in NSW. Appropriate advance warning signage, lighting etc to be provided prior to the traffic signals being commissioned.

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
3.03	<p>The active traffic lane is now positioned closer to the kerbside and existing utility poles. These utility poles are within the clearzone for the posted speed limit of 60km/h.</p> <p>There is a risk that vehicles may collide with the fixed roadside hazard resulting in injury.</p>	Improbable	Serious	Medium	Power pole locations to be reviewed during concept design.
<p>Approximate location of existing utility poles</p> <p>Labels: K&amp;G, E6, E5, E8, C1, MENAN, TB, 44m STORAGE LENGTH (5x8.8m VEHICLES), P=52m, EXISTING TFI STRA SERVICES TO BE RELOCATED OUT OF</p>					
3.04	<p>Alignment / width of the proposed kerb ramps appear inadequate for the pedestrian crossing.</p> <p>There is a risk that pedestrians, including mobility impaired, are misdirected at the crossing point resulting in slip / trip falls.</p>	Improbable	Limited	Low	Dropped kerbs are 2.0m wide, as per RMS Traffic Signal Design Guide Appendix D Section 1.5.
<p>Difference between prop ramp width and crossing width</p> <p>Labels: PCW, R2, R3, K&amp;G</p>					

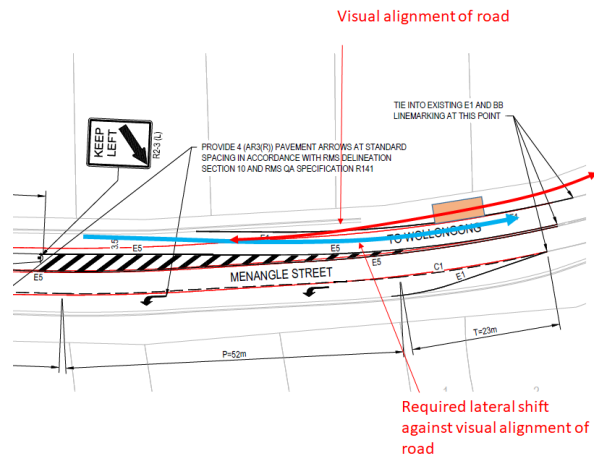
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
3.05	<p>The western kerb ramp appears to align with the residential driveway of 212 Menangle Street.</p> <p>There is a risk that entering / exiting vehicles conflict with pedestrians within the verge storage area resulting in pedestrian related crashes.</p> 	Improbable	Serious	Medium	<p>There are no footpath facilities on the east side of Menangle St. Recommend discussing with RMS the removal of this pedestrian crossing at concept design.</p>
3.06	<p>The existing driveway access for property 212 Menangle Street is within the uncontrolled area of the intersection.</p> <p>There is risk that entering / exiting vehicles may undertake manoeuvring (forward or reverse) that conflicts with the signal phasing and other vehicles travelling through the intersection resulting in crashes at the intersection</p>	Occasional	Minor	Medium	<p>Comment referred to design team. Private driveway adjustments to be considered at concept design.</p>

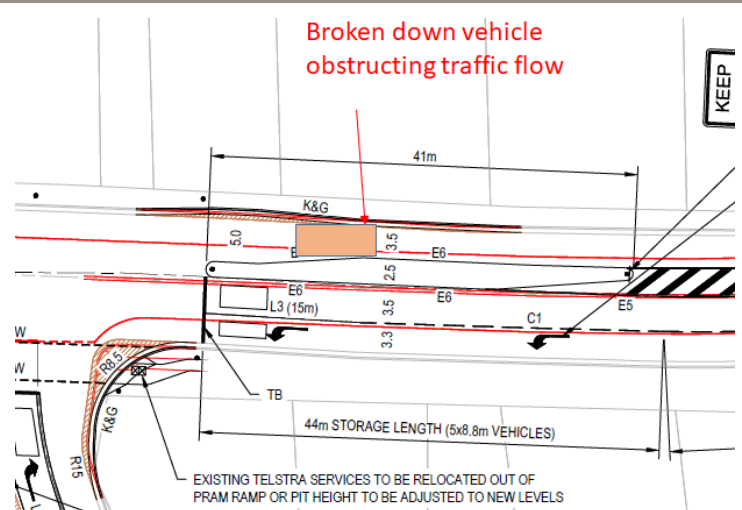
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
					
<p><b>3.07</b></p>	<p>The turn arrow pavement marking spacing appears to be atypical and indicates that two right turn bays are functioning.</p> <p>Vehicles awaiting to turn into Station Street may be overtaken by vehicle seeking to turn into Prince Street resulting in potential side swipe and rear end crash types.</p>	Occasional	Minor	Medium	Comment referred to design team. To be resolved at concept design.

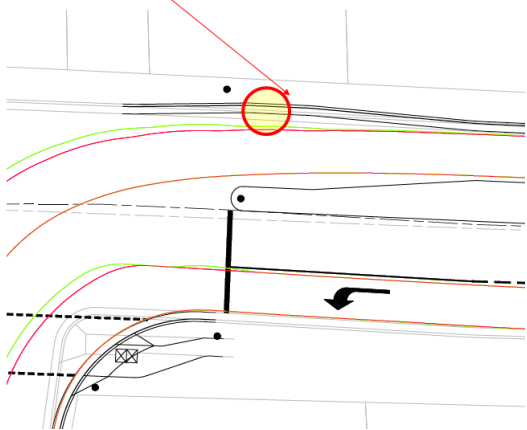
CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
					
3.08	<p>There are no parking regulations around the intersection.</p> <p>There is a risk that parking may hinder / obstruct the intersection capacity and traffic flow that can lead to congestion, resulting in rear-end crash types.</p>	Improbable	Minor	Low	Parking restrictions to be added at concept design.
3.09	<p>There is likely to parked vehicles on the inside corner (left hand bend) where vehicles are required to shift laterally to the right.</p> <p>There is a risk that the conflicting road geometry and vehicle movement in conjunction with kerbside parking may result in crashes with parked vehicles.</p>	Improbable	Minor	Low	Referred to design team. Linemarking, design extents and parking restrictions to be resolved at concept design.



CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
3.10	<p>There is inadequate width between the proposed central median and the kerb in the southbound direction to accommodate broken down vehicles based on the proposed length of the concrete median.</p> <p>There is a risk that a broken down vehicle may obstruct traffic flow resulting in congestion and potential rear end crash types.</p>	Improbable	Minor	Low	Referred to design team.



CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
	 <p>Broken down vehicle obstructing traffic flow</p>				
3.11	<p>It is unclear to the audit team if appropriate sight lines to the signal lanterns has been achieved.</p> <p>There is a risk that vehicles with the unfamiliar new intersection treatment may not have clear visibility of the traffic signals increasing the risk to enter the intersection and collide with opposite traffic.</p>	Improbable	Serious	Medium	Lantern sight distance assessment to be done at concept design stage.
3.12	<p>There is an existing street pole at the southwest corner of Prince Street and Menangle Street. It appears that the proposed left turn lane widening into Prince Street would clash with the existing utility pole.</p> <p>There is a risk that clearance to the power pole may not be achieved increasing the risk of vehicles hitting the pole</p>	Improbable	Serious	Medium	Power pole relocation to be resolved at concept design.
3.13	<p>Design drawings provide details of swept path for vehicles up to 8.8m length.</p> <p>It is not clear to the audit team if larger vehicles are allowed to enter Prince Street.</p>	Improbable	Minor	Low	This is an existing issue and it not within the scope of work for this project.

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
	There are no regulatory signs to inform drivers of the low bridge clearance and maximum loading (5t) on Menangle Street. There is a risk that large vehicle may attempt to use the Prince Street used the proposed signalised intersection.				
3.14	It is unclear what the lantern type and arrangements are proposed.	Note Only			To be addressed at concept design.
3.15	The swept path assessment adopts an 8.8m Medium Rigid Vehicle (MRV) however it is likely the intersection caters for general access vehicles (vehicles up to and including 19m semi-trailers) for turn movements	Note Only			The weight restriction on the bridge prevents large vehicles turning at this intersection.
3.16	It is unclear the purpose of a a “kink” in the proposed kerb alignment on the eastern side of Menangle Street.  Irregular kerb alignment	Note Only			This kerb adjustment is to maintain a 5.0m carriageway width on the departure lane.
					
3.17	Design drawings do not provide details for the propose usage of the traffic lanes. It appears a significant number of on-street parking spaces would be removed.  There are no details of proposed parking restriction or parking operations along Menangle Street	Note Only			Parking restrictions to be resolved at concept design.

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
3.18	It is unclear to the audit team any treatment to the storm water management at the intersection. There is an existing drainage pit at the south west corner of Prince Street and Menangle Street that appears to clash with the proposed left turn lane widenings	Note Only			Stormwater adjustments to be resolved at concept design.

Table 10-4 General Notes

CAR Reference	Safety Hazard Findings	Frequency	Severity	Level Of Risk	Project Manager Response
4.01	It is not clear to the audit team proposed or retained road levels. Cross sectional detail has not been provided	Note Only			To be resolved at concept design.
4.02	Pavement type details has not been provided.	Note Only			To be resolved at concept design.
4.03	Vertical and horizontal long sections have not been provided	Note Only			To be resolved at concept design.
4.04	Geometry details (e.g. median types, kerb types) have not been provided	Note Only			To be resolved at concept design.
4.05	Underground and overhead utility planes were not provided. There is a risk of utility clashes at the intersection with the introduction of the Roads and Maritime underground cabling and pavement widening.	Note Only			To be resolved at concept design.
4.06	Drainage plans have not been provided	Note Only			To be resolved at concept design.
4.07	Traffic Control Signal (TCS) design plans have not been provided	Note Only			To be resolved at concept design.

## 11 Responding to the Audit Report

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A project manager is under no obligation to accept the findings outlined in this audit report. This report simply provides the opportunity for the project manager to review potential problems highlighted by the auditors.

A formal road safety audit report should be responded to in writing.

It should be noted that this audit will be recorded on the NSW Register of Road Safety Auditors and the project manager should expect email notification from the register to confirm the audit has been carried out.

## 12 Formal Statement

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We, the undersigned, declare that we have reviewed the design drawings listed in Section 8 Reference Documents in this report and identified the safety and operational deficiencies above.

It should be noted that while every effort has been made to identify potential safety hazards, no guarantee could be made that every deficiency has been identified.

We recommend that points of concern be investigated and necessary corrective actions are undertaken.



**Antonio Villacorta**  
*Level 3 Road Safety Auditor*  
*Team Leader*



**Hayden Calvey**  
*Level 2 Road Safety Auditor*  
*Team Member*

APPENDIX

E

SIDRA MOVEMENT SUMMARIES

# MOVEMENT SUMMARY

 **Site: [Menangle St / Prince St AM 2 lane W]**

Option 1

Signals - Fixed Time Isolated Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Menangle St											
1	L2	340	0.3	0.237	8.2	LOS A	3.6	25.3	0.29	0.66	51.6
2	T1	405	7.3	0.810	27.7	LOS B	14.7	109.3	0.85	0.85	41.2
Approach		745	4.1	0.810	18.8	LOS B	14.7	109.3	0.60	0.77	45.4
North: Menangle St											
8	T1	717	8.2	0.776	17.5	LOS B	22.8	170.8	0.84	0.78	46.6
9	R2	60	1.8	0.436	46.7	LOS D	2.4	17.2	0.99	0.75	33.3
Approach		777	7.7	0.776	19.8	LOS B	22.8	170.8	0.85	0.78	45.2
West: Prince St											
10	L2	45	2.3	0.052	17.6	LOS B	0.9	6.7	0.56	0.68	45.5
12	R2	474	0.2	0.829	38.1	LOS C	19.2	134.8	0.97	0.93	36.1
Approach		519	0.4	0.829	36.3	LOS C	19.2	134.8	0.93	0.91	36.8
All Vehicles		2041	4.5	0.829	23.6	LOS B	22.8	170.8	0.78	0.81	42.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P3	North Full Crossing	11	23.3	LOS C	0.0	0.0	0.76	0.76	
P4	West Full Crossing	11	20.3	LOS C	0.0	0.0	0.71	0.71	
All Pedestrians		21	21.8	LOS C			0.74	0.74	

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

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Organisation: CARDNO (QLD) PTY LTD | Processed: Thursday, 5 July 2018 9:38:26 AM

Project: N:\Projects\820\FY18\177\_Picton CBD Road Improvements\Des-An\Traffic\Aimsun\Prince St Testing\Project1.sip7

# PHASING SUMMARY

 **Site: [Menangle St / Prince St AM 2 lane W]**

Option 1

Signals - Fixed Time Isolated Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

**Phase Times determined by the program**

**Phase Sequence: Two-Phase**

**Reference Phase: Phase A**

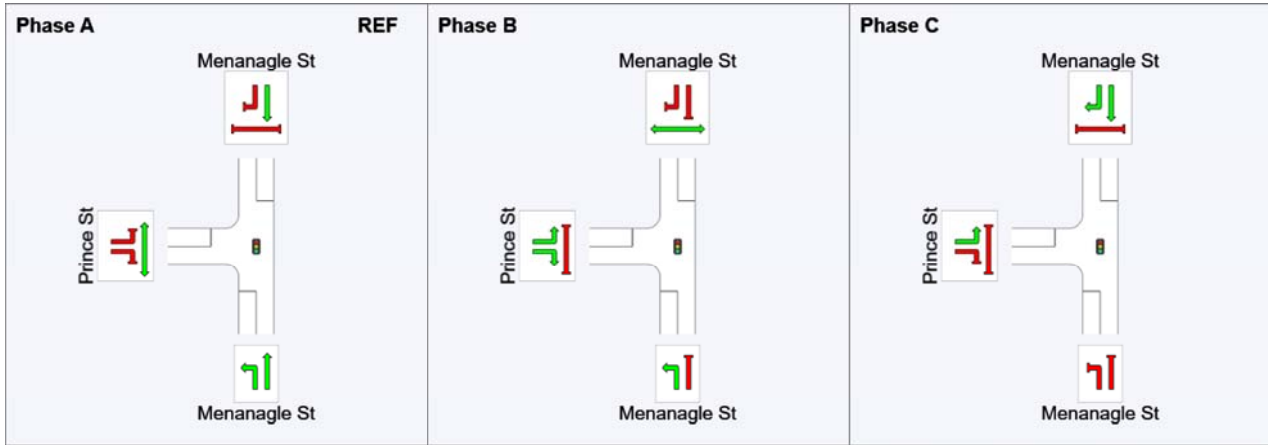
**Input Phase Sequence: A, B, C**

**Output Phase Sequence: A, B, C**

## Phase Timing Results

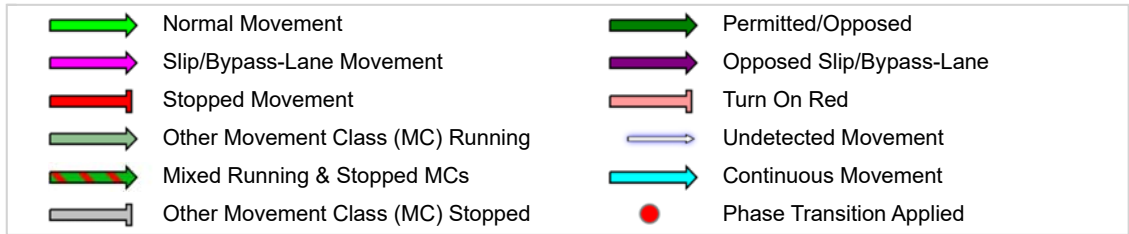
Phase	A	B	C
Phase Change Time (sec)	0	36	68
Green Time (sec)	30	26	6
Phase Time (sec)	36	32	12
Phase Split	45%	40%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase

VAR: Variable Phase





# MOVEMENT SUMMARY

 Site: [Menangle St / Prince St PM 2 lane W]

Option 1

Signals - Fixed Time Isolated Cycle Time = 84 seconds (User-Given Phase Times)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: Menangle St												
1	L2	561	0.2	0.353	6.8	LOS A	4.6	32.5	0.22	0.65	52.6	
2	T1	622	8.6	0.971	58.9	LOS E	34.0	255.8	0.73	1.11	30.5	
Approach		1183	4.6	0.971	34.2	LOS C	34.0	255.8	0.49	0.89	38.1	
North: Menangle St												
8	T1	399	10.3	0.333	6.8	LOS A	7.1	54.4	0.47	0.42	53.9	
9	R2	65	1.6	0.995	80.6	LOS F	3.8	27.2	1.00	1.08	25.4	
Approach		464	9.1	0.995	17.2	LOS B	7.1	54.4	0.55	0.51	46.6	
West: Prince St												
10	L2	21	5.0	0.034	25.0	LOS B	0.6	4.1	0.69	0.68	41.6	
12	R2	405	0.3	0.945	62.7	LOS E	22.4	156.8	1.00	1.08	29.1	
Approach		426	0.5	0.945	60.8	LOS E	22.4	156.8	0.98	1.06	29.5	
All Vehicles		2074	4.8	0.995	35.9	LOS C	34.0	255.8	0.61	0.84	37.4	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P3	North Full Crossing	11	30.0	LOS D	0.0	0.0	0.85	0.85	
P4	West Full Crossing	11	12.1	LOS B	0.0	0.0	0.54	0.54	
All Pedestrians		21	21.0	LOS C			0.69	0.69	

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

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Project: N:\Projects\820\FY18\177\_Picton CBD Road Improvements\Des-An\Traffic\Aimsun\Prince St Testing\Project1.sip7

# PHASING SUMMARY

 **Site:** [Menangle St / Prince St PM 2 lane W]

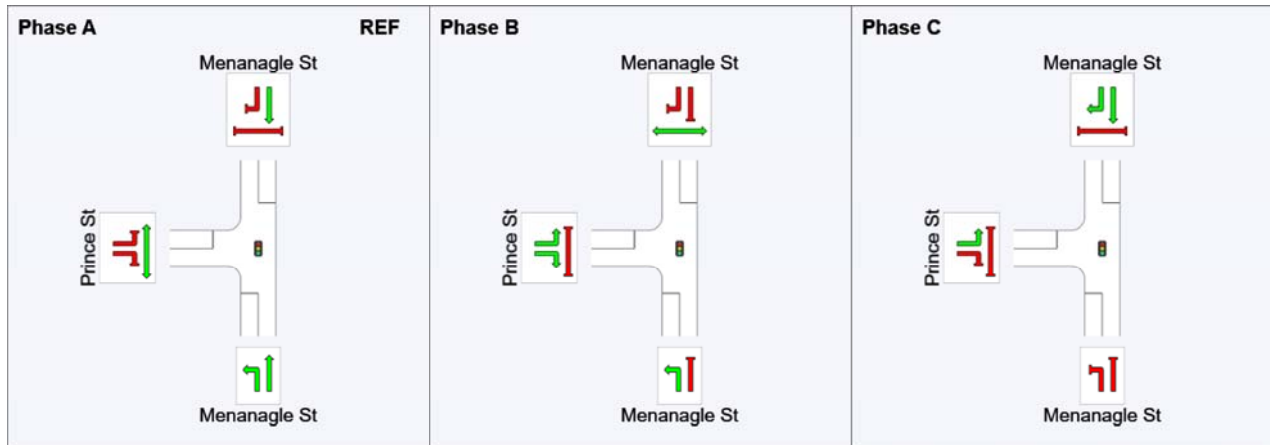
Option 1  
 Signals - Fixed Time Isolated Cycle Time = 84 seconds (User-Given Phase Times)

**Phase Times specified by the user**  
**Phase Sequence: Two-Phase**  
**Reference Phase: Phase A**  
**Input Phase Sequence: A, B, C**  
**Output Phase Sequence: A, B, C**

### Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	49	75
Green Time (sec)	46	20	3
Phase Time (sec)	52	26	6
Phase Split	62%	31%	7%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase  
 VAR: Variable Phase



# MOVEMENT SUMMARY

 **Site: [Menangle St / Prince St AM 1 lane W]**

Option 2

Signals - Fixed Time Isolated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Menangle St											
1	L2	339	0.3	0.232	8.0	LOS A	3.6	25.1	0.28	0.66	51.7
2	T1	407	7.2	0.827	30.4	LOS C	16.0	118.7	0.85	0.87	39.9
Approach		746	4.1	0.827	20.3	LOS B	16.0	118.7	0.59	0.77	44.6
North: Menangle St											
8	T1	687	8.6	0.757	17.6	LOS B	22.3	167.8	0.83	0.76	46.5
9	R2	58	1.8	0.447	49.5	LOS D	2.5	17.7	1.00	0.75	32.3
Approach		745	8.1	0.757	20.1	LOS B	22.3	167.8	0.84	0.76	45.0
West: Prince St											
10	L2	68	1.5	0.845	40.0	LOS C	23.8	167.1	0.99	0.95	35.6
12	R2	471	0.2	0.845	40.0	LOS C	23.8	167.1	0.99	0.95	35.5
Approach		539	0.4	0.845	40.0	LOS C	23.8	167.1	0.99	0.95	35.5
All Vehicles		2031	4.6	0.845	25.4	LOS B	23.8	167.8	0.79	0.81	41.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P3	North Full Crossing	11	23.4	LOS C	0.0	0.0	0.74	0.74	
P4	West Full Crossing	11	19.8	LOS B	0.0	0.0	0.68	0.68	
All Pedestrians		21	21.6	LOS C			0.71	0.71	

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

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Project: N:\Projects\820\FY18\177\_Picton CBD Road Improvements\Des-An\Traffic\Aimsun\Prince St Testing\Project1.sip7

# PHASING SUMMARY

 **Site: [Menangle St / Prince St AM 1 lane W]**

Option 2

Signals - Fixed Time Isolated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)

Phase Times determined by the program

Phase Sequence: Two-Phase

Reference Phase: Phase A

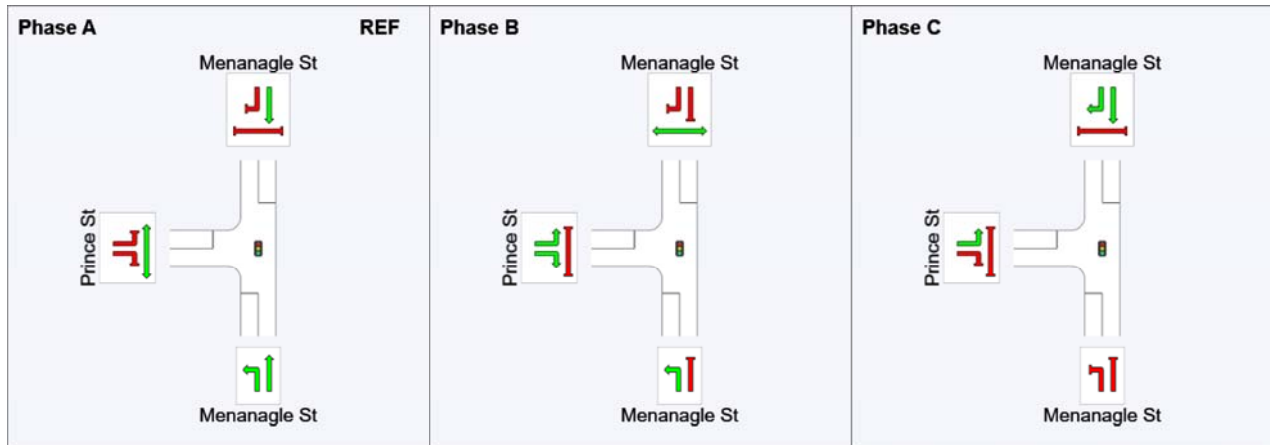
Input Phase Sequence: A, B, C

Output Phase Sequence: A, B, C

## Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	38	73
Green Time (sec)	32	29	6
Phase Time (sec)	38	35	12
Phase Split	45%	41%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase

VAR: Variable Phase



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Project: N:\Projects\820\FY18\177\_Picton CBD Road Improvements\Des-An\Traffic\Aimsun\Prince St Testing\Project1.sip7

# MOVEMENT SUMMARY

 Site: [Menangle St / Prince St PM 1 lane W]

Option 2

Signals - Fixed Time Isolated Cycle Time = 84 seconds (User-Given Phase Times)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Menangle St											
1	L2	555	0.2	0.349	6.8	LOS A	4.6	31.9	0.22	0.65	52.6
2	T1	626	8.6	0.972	59.3	LOS E	34.4	258.6	0.74	1.12	30.3
Approach		1181	4.6	0.972	34.6	LOS C	34.4	258.6	0.49	0.90	37.9
North: Menangle St											
8	T1	414	9.9	0.345	6.9	LOS A	7.5	56.8	0.48	0.42	53.9
9	R2	66	1.6	1.011	88.1	LOS F	4.1	29.3	1.00	1.11	24.0
Approach		480	8.8	1.011	18.1	LOS B	7.5	56.8	0.55	0.52	46.0
West: Prince St											
10	L2	24	4.3	0.907	53.8	LOS D	20.4	143.1	1.00	1.02	31.3
12	R2	378	0.3	0.907	53.8	LOS D	20.4	143.1	1.00	1.02	31.3
Approach		402	0.5	0.907	53.8	LOS D	20.4	143.1	1.00	1.02	31.3
All Vehicles		2063	4.8	1.011	34.5	LOS C	34.4	258.6	0.61	0.83	37.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Pedestrian	Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P3	North Full Crossing	11	30.0	LOS D	0.0	0.0	0.85	0.85	
P4	West Full Crossing	11	11.0	LOS B	0.0	0.0	0.51	0.51	
All Pedestrians		21	20.5	LOS C			0.68	0.68	

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

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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# PHASING SUMMARY

 **Site: [Menangle St / Prince St PM 1 lane W]**

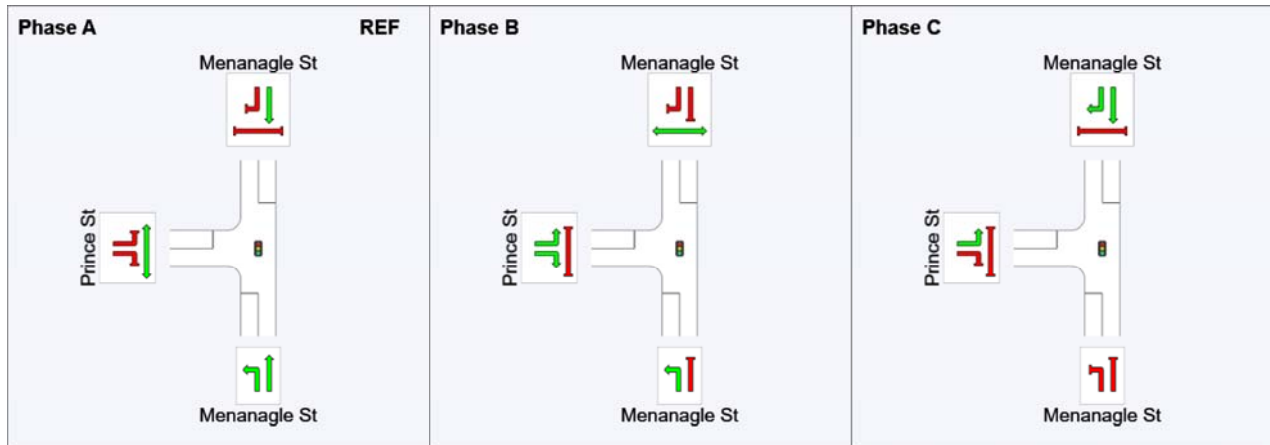
Option 2  
 Signals - Fixed Time Isolated Cycle Time = 84 seconds (User-Given Phase Times)

**Phase Times specified by the user**  
**Phase Sequence: Two-Phase**  
**Reference Phase: Phase A**  
**Input Phase Sequence: A, B, C**  
**Output Phase Sequence: A, B, C**

### Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	49	75
Green Time (sec)	46	20	3
Phase Time (sec)	52	26	6
Phase Split	62%	31%	7%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase  
 VAR: Variable Phase



# MOVEMENT SUMMARY

 Site: Option [Argyle Street / Lumsdaine Street AM]

2026 AM

Signals - Fixed Time Isolated Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Argyle Street											
1	L2	6	5.0	0.844	22.3	LOS B	29.7	216.7	0.87	0.89	45.9
2	T1	973	5.0	0.844	16.7	LOS B	29.7	216.7	0.87	0.89	47.1
3	R2	1	5.0	0.002	14.1	LOS A	0.0	0.1	0.50	0.60	47.5
Approach		980	5.0	0.844	16.7	LOS B	29.7	216.7	0.86	0.89	47.1
East: Lumsdaine Street											
4	L2	1	5.0	0.007	29.1	LOS C	0.1	0.4	0.83	0.57	41.0
5	T1	1	5.0	0.007	23.5	LOS B	0.1	0.4	0.83	0.57	41.9
6	R2	14	5.0	0.049	30.7	LOS C	0.4	2.7	0.86	0.68	38.9
Approach		16	5.0	0.049	30.1	LOS C	0.4	2.7	0.86	0.67	39.2
North: Argyle Street											
7	L2	42	5.0	0.285	11.9	LOS A	4.8	35.0	0.50	0.47	52.3
8	T1	569	5.0	0.285	7.0	LOS A	4.8	35.0	0.52	0.47	53.5
9	R2	6	5.0	0.285	13.3	LOS A	4.8	34.9	0.55	0.47	51.4
Approach		618	5.0	0.285	7.4	LOS A	4.8	35.0	0.52	0.47	53.4
West: New Road											
10	L2	13	5.0	0.071	30.9	LOS C	0.6	4.0	0.87	0.69	39.1
11	T1	1	5.0	0.071	25.3	LOS B	0.6	4.0	0.87	0.69	40.0
12	R2	6	5.0	0.071	30.9	LOS C	0.6	4.0	0.87	0.69	39.0
Approach		20	5.0	0.071	30.6	LOS C	0.6	4.0	0.87	0.69	39.1
All Vehicles		1634	5.0	0.844	13.5	LOS A	29.7	216.7	0.73	0.73	49.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	105	26.9	LOS C	0.2	0.2	0.91	0.91	
P2	East Full Crossing	105	7.9	LOS A	0.1	0.1	0.49	0.49	
P3	North Full Crossing	53	26.8	LOS C	0.1	0.1	0.91	0.91	
All Pedestrians		263	19.3	LOS B			0.74	0.74	

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

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# PHASING SUMMARY

 **Site: Option [Argyle Street / Lumsdaine Street AM]**

2026 AM

Signals - Fixed Time Isolated Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

**Phase Times determined by the program**

**Phase Sequence: Two-Phase**

**Reference Phase: Phase A**

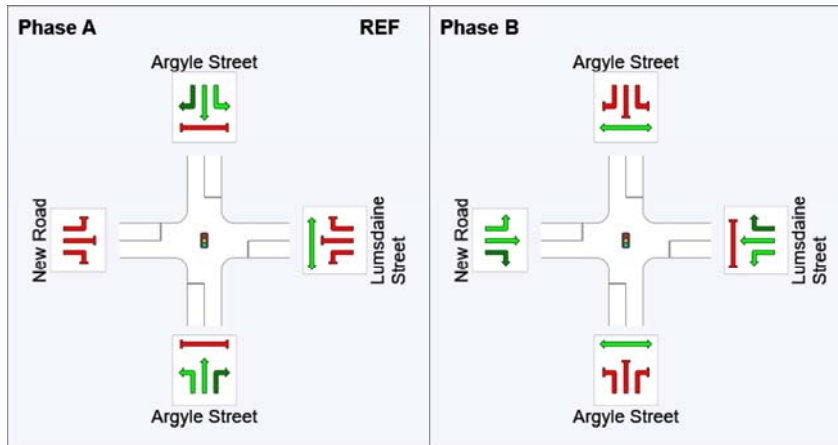
**Input Phase Sequence: A, B**

**Output Phase Sequence: A, B**

## Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	46
Green Time (sec)	40	13
Phase Time (sec)	46	19
Phase Split	71%	29%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase

VAR: Variable Phase



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# MOVEMENT SUMMARY

 Site: Option [Argyle Street / Lumsdaine Street PM]

2026 AM

Signals - Fixed Time Isolated Cycle Time = 65 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Argyle Street											
1	L2	11	5.0	0.580	13.7	LOS A	12.7	93.1	0.64	0.58	51.4
2	T1	661	5.0	0.580	8.1	LOS A	12.7	93.1	0.64	0.58	52.9
3	R2	1	5.0	0.003	14.1	LOS A	0.0	0.1	0.50	0.60	47.5
Approach		673	5.0	0.580	8.1	LOS A	12.7	93.1	0.64	0.58	52.9
East: Lumsdaine Street											
4	L2	1	5.0	0.004	30.9	LOS C	0.0	0.2	0.86	0.59	39.0
5	T1	1	5.0	0.018	23.8	LOS B	0.1	1.0	0.84	0.63	41.0
6	R2	4	5.0	0.018	29.4	LOS C	0.1	1.0	0.84	0.63	40.0
Approach		6	5.0	0.018	28.7	LOS C	0.1	1.0	0.84	0.62	40.0
North: Argyle Street											
7	L2	29	5.0	0.371	12.3	LOS A	6.7	49.2	0.53	0.49	52.2
8	T1	808	5.0	0.371	6.7	LOS A	6.7	49.2	0.53	0.48	53.9
9	R2	5	5.0	0.371	12.3	LOS A	6.6	48.1	0.53	0.47	52.2
Approach		843	5.0	0.371	6.9	LOS A	6.7	49.2	0.53	0.48	53.8
West: New Road											
10	L2	2	5.0	0.031	30.5	LOS C	0.2	1.7	0.86	0.65	39.4
11	T1	1	5.0	0.031	24.9	LOS B	0.2	1.7	0.86	0.65	40.3
12	R2	5	5.0	0.031	30.5	LOS C	0.2	1.7	0.86	0.65	39.3
Approach		8	5.0	0.031	29.8	LOS C	0.2	1.7	0.86	0.65	39.5
All Vehicles		1531	5.0	0.580	7.7	LOS A	12.7	93.1	0.58	0.53	53.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	105	26.9	LOS C	0.2	0.2	0.91	0.91	
P2	East Full Crossing	105	7.9	LOS A	0.1	0.1	0.49	0.49	
P3	North Full Crossing	53	26.8	LOS C	0.1	0.1	0.91	0.91	
All Pedestrians		263	19.3	LOS B			0.74	0.74	

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

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# PHASING SUMMARY

 **Site: Option [Argyle Street / Lumsdaine Street PM]**

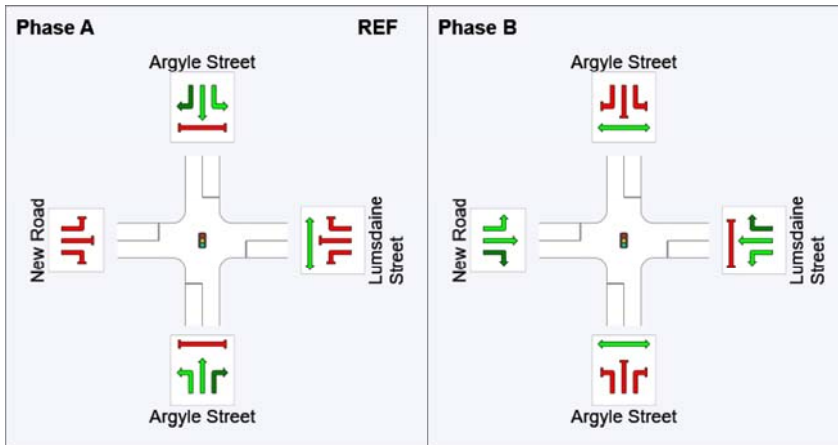
2026 AM  
 Signals - Fixed Time Isolated Cycle Time = 65 seconds (User-Given Cycle Time)

**Phase Times determined by the program**  
**Phase Sequence: Two-Phase**  
**Reference Phase: Phase A**  
**Input Phase Sequence: A, B**  
**Output Phase Sequence: A, B**

### Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	46
Green Time (sec)	40	13
Phase Time (sec)	46	19
Phase Split	71%	29%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase  
 VAR: Variable Phase

	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class (MC) Running		Undetected Movement
	Mixed Running & Stopped MCs		Continuous Movement
	Other Movement Class (MC) Stopped		Phase Transition Applied

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