

## 1. Part 1 - Structural integrity of Richmond Bridge

The existing bridge is 212.63 metres long and it consists of 13 spans. The sequence of the spans is 15.85 metres, eleven spans of 16.45 metres and a further span of 15.85 metres. The bridge was built in 1905 and widened on the downstream for a railway in 1927. The widening was converted to road deck in 1966. The original superstructure consists of a concrete arch and the existing widening consists of two arch shaped steel beams and reinforced concrete deck. The substructure consists of concrete piers and concrete headstocks.

The carriageway between kerbs is 8.53 metres wide and carries two traffic lanes. There is a footway on the upstream side. In addition, there is an 800mm water main attached to the downstream side.

A Level 3 inspection was carried out in August 2011 and October 2011 by personnel from RMS' Bridge Engineering Branch supported by Sydney Road Services. This inspection concluded that the overall bridge is in fair to good condition for its age.

Some detailed analytical studies were carried out. Based on the analytical studies, the structural capacity of the bridge is adequate to carry two lanes of Higher Mass Limit (HML), General Access Vehicle and HML Restricted Access Vehicle in as good condition.

It is recommended that:

- The bridge is suitable to carry two lanes of HML vehicles provided that the bridge is maintained in a reasonably good condition by implementing the necessary repair and monitoring regime
- The bridge is suitable for widening on the downstream side as an independent structure to the existing structure.

The full report on the structural integrity of the existing Richmond Bridge is available on the RMS project website.

## 2. Part 2 - Short-term solutions study

### 2.1. Introduction

The Part 2 study was conducted by Hyder Consulting Pty Ltd. It assessed current traffic conditions in the study area, identified strategies and proposed solutions to address traffic congestion to 2021.

#### 2.1.1. Study area

The study area is shown at Figure 2 at page 4 of this report.

The short-term solutions study undertook traffic modelling to identify network operational issues at the following key intersections:

- Bells Line of Road / Grose Vale Road (traffic light controlled)
- Kurrajong Road / Yarramundi Lane / Old Kurrajong Road (sign controlled)
- Kurrajong Road / Bosworth Street (traffic light controlled).

### 2.2. Traffic analysis

Extensive traffic data collection and analysis involving key roads and intersections in the study area was undertaken to identify and quantify the traffic congestion problem.

### 2.2.1. Traffic surveys

Traffic surveys were undertaken to provide input to:

- Micro simulation (Paramics) model calibration and validation
- Intersection capacity analysis to determine levels of service, using SIDRA.

The following types of surveys were undertaken:

- Intersection turning movement counts for the critical peak periods
- Daily automatic traffic counts for a one week period
- Queue length surveys at critical intersections.

Traffic surveys were undertaken for three different situations:

1. A survey of 12 intersections in the study area was conducted on 17 June 2011. Traffic on Richmond Bridge was counted for one week
2. Traffic counts were undertaken during the Yarramundi Lane closure (Yarramundi Lane was closed for road resurfacing from 18 July 2011 to 15 August 2011). During the closure, traffic counts were undertaken at two intersections on 26 July 2011. This traffic data was used as a sensitivity check through the modelling process
3. HCC requested traffic counts for an additional three intersections. This was undertaken on 18 August 2011 after Yarramundi Lane was reopened to traffic.

### 2.2.2. Traffic issues in the study area

#### Richmond Bridge traffic

Figure 3 shows the hourly east bound and west bound traffic volumes for a typical weekday on Richmond Bridge as well as the indicative capacity thresholds, as provided in relevant Austroads Guidelines. This demonstrates that the current morning and evening peaks are close to saturation.

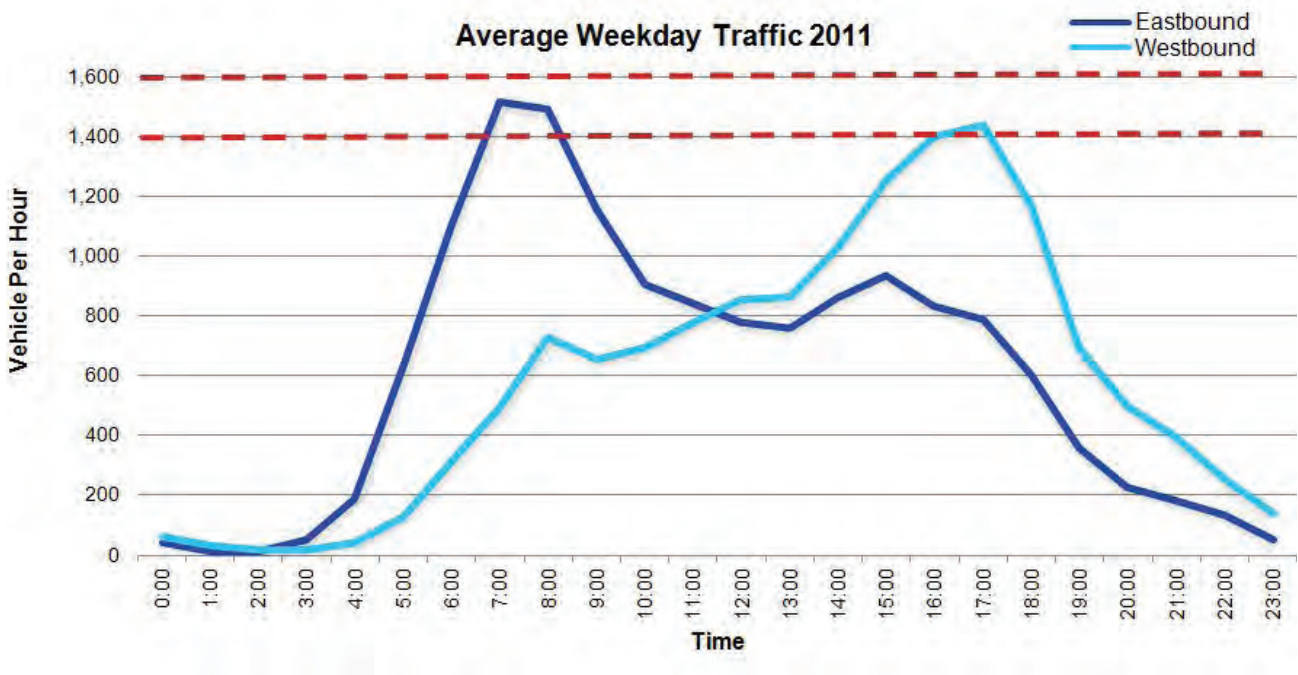


Figure 3 - Hourly traffic volumes on Richmond Bridge, June 2011

### Travel speeds

Figure 4 shows the 2011 travel time data for the three sections of the corridor. From this, it is apparent that:

- Speeds are generally low, indicative of moderately high levels of congestion
- The problem is particularly pronounced in the evening peak, in the westbound direction.

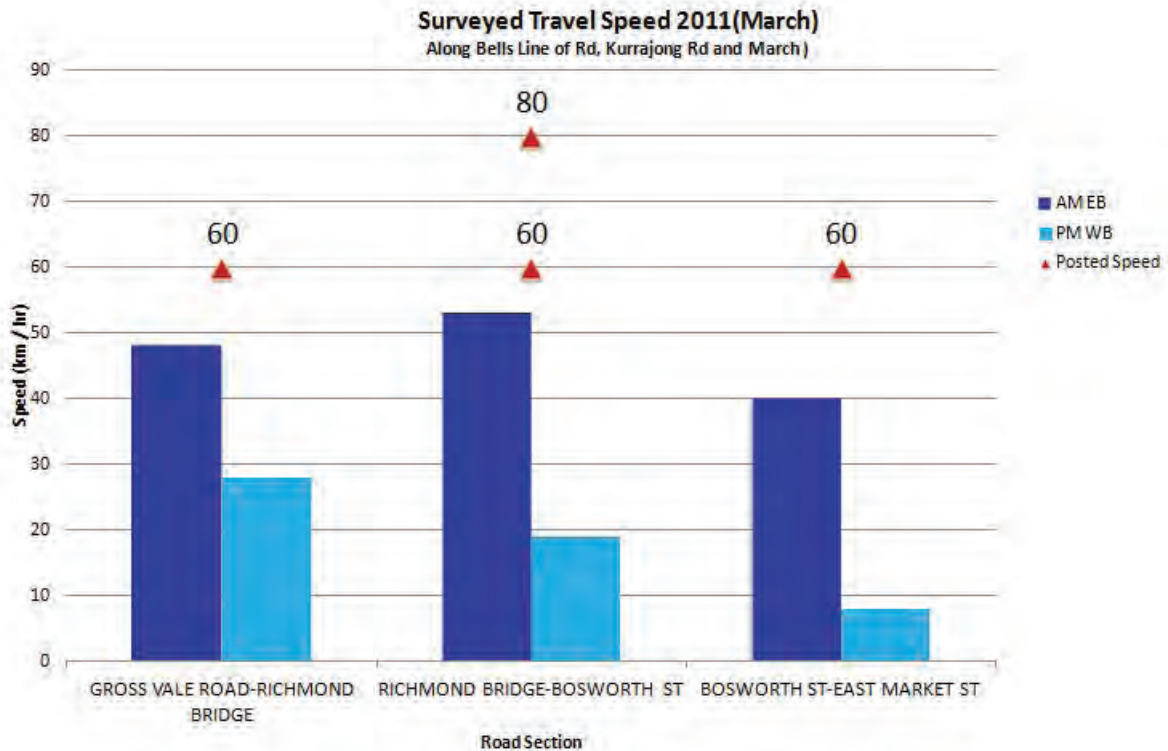


Figure 4 - Average travel speed on sections of Bells Line of Road / Kurrajong Road, March 2011

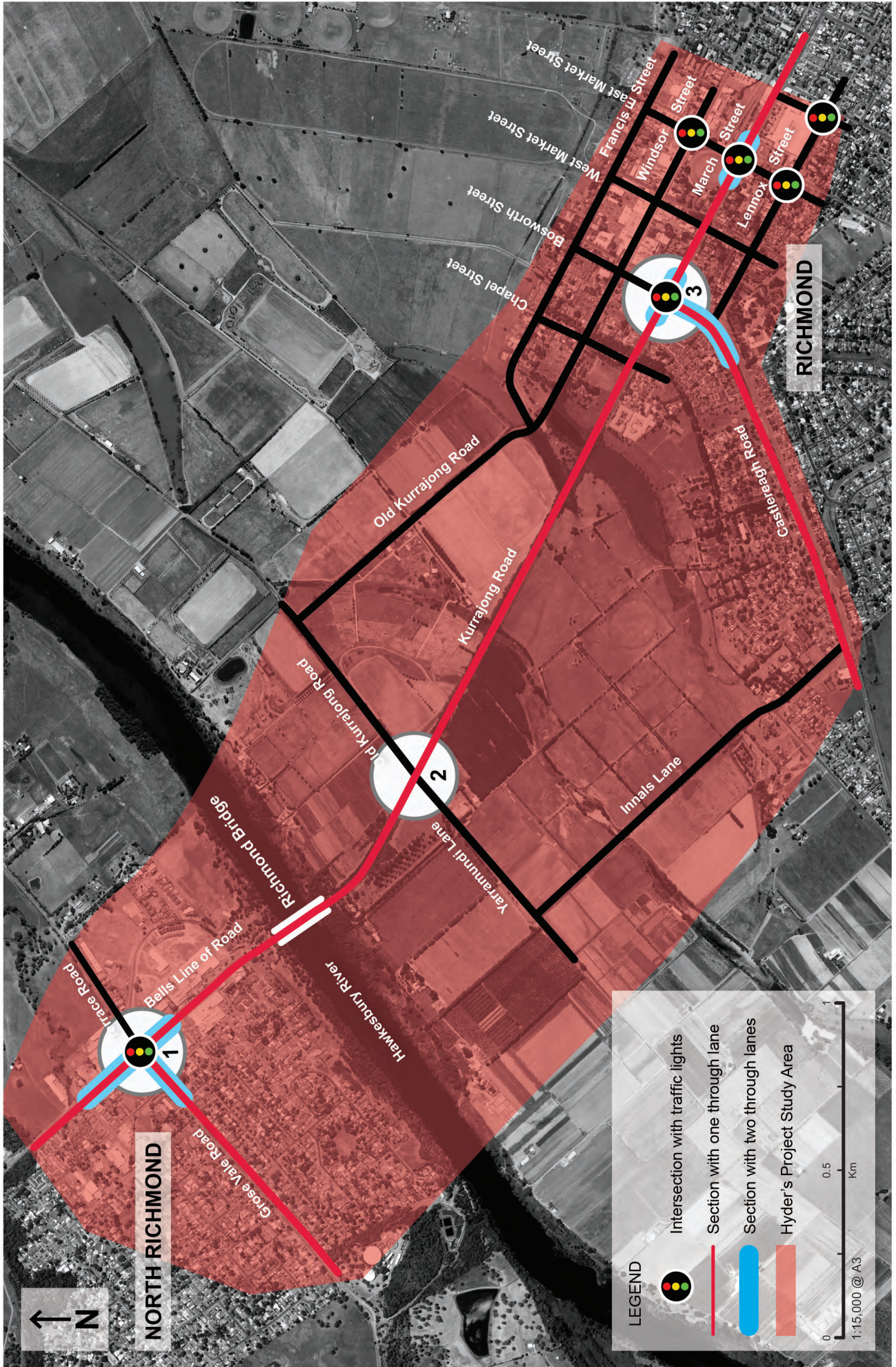
### Key intersections

Traffic modelling (using SIDRA) and site observations found that during the morning and evening peak periods, some turn movements at adjoining key intersections with Bells Line of Road / Kurrajong Road have an adverse impact on the operation of Richmond Bridge. The analysis identified network operational issues at the following key intersections:

1. Bells Line of Road / Grose Vale Road (traffic light controlled)
2. Kurrajong Road / Yarramundi Lane / Old Kurrajong Road (sign controlled)
3. Kurrajong Road / Bosworth Street (traffic light controlled).

Figure 5 on the following page shows the three key intersections





Source - Vector Backdrop Data © MDS 2012 Imagery - SKM provided by RMS Cross Section - Tract  
**Figure 5 - Key intersections**



The following tables provide a summary of the traffic issues identified at these intersections. These intersections also account for a high proportion of crashes on the overall regional network.

**Table 1 - Key network issues in the morning peak period**

<i><b>Id</b></i>	<i><b>Location</b></i>	<i><b>Issue</b></i>
1	Bells Line of Road / Grose Vale Road Intersection	<p>The high number of right turn movements (500 veh/h) from Grose Vale Road to Bells Line of Road. In line with current situation, the model predicts long queues (LoS F).</p> <p>Currently there is no separate bus bay for the bus stop on Bells Line of Road, immediately east of Grose Vale Road. Buses occasionally block the eastbound kerb side lane. Our site visit indicates occasional kerb side lane blockage due to buses, affecting signal operation. According to the available bus timetable about 10 buses use this bus stop between 7am and 9am.</p> <p>Two eastbound through lanes on Bells Line of Road merge to one-lane east of Grose Vale Road. The potential merge impedes eastbound through traffic and affects signal operation.</p>
2	Kurrajong Road / Yarramundi Lane intersection	<p>Currently there is no exclusive right turn bay on the Kurrajong Road western approach to accommodate traffic turning into Yarramundi Lane. The high number of vehicles (350 veh/h) turning right from Kurrajong Road to Yarramundi Lane blocks eastbound through traffic. Once interrupted, eastbound through traffic needs additional time to accelerate, causing a potential knock-on effect from Yarramundi Lane upstream to the bridge.</p>
3	Kurrajong Road / Bosworth Street intersection	<p>Currently there is no exclusive right turn bay on the Kurrajong Road western approach. The eastbound right turning traffic (370 veh/h) shares one-lane with through traffic. There are occasional long queues (west of Chapel Street) along the western intersection approach.</p>

**Table 2 - Key network issues in the afternoon peak period**

<i><b>Id</b></i>	<i><b>Location</b></i>	<i><b>Issue</b></i>
1	Bells Line of Road / Grose Vale Road intersection	<p>There is only one through lane on Bells Line of Road in the westbound direction. Westbound through traffic experiences long queues and long delays. The model suggests that occasionally the queue extends upstream to the bridge.</p> <p>Westbound traffic turning left from North Richmond Shopping Centre also causes delays to westbound through traffic on Bells Line of Road.</p>
2	Kurrajong Road / Yarramundi Lane intersection	<p>The large amount of traffic (380 veh/h) turning left from Yarramundi Lane tends to force its way out before it merges with Kurrajong Road mainstream westbound traffic. The site visit indicated that potentially aggressive left turning vehicles frequently impede westbound through traffic, causing a knock-on effect from Yarramundi Lane upstream to Richmond township.</p> <p>The model predicts long queues on Kurrajong Road in the westbound direction (LoS F) and on Yarramundi Lane (LoS F).</p>
3	Kurrajong Road / Bosworth Street intersection	<p>Long queues were observed along March Street in the westbound direction (LoS F). These are residual queues predominantly due to the interruption of westbound traffic by Yarramundi Lane turning traffic.</p>

### Traffic growth

The increased levels of congestion due to projected traffic growth will compound the current traffic issues on the road network.

Analysis of the historic traffic growth on Richmond Bridge suggests that average annual growth in the order of 0.7 per cent per annum and there is evidence that the rate of growth is accelerating (the last three years have had an annual growth rate of 1.6 per cent).

Table 3 shows the modelled peak hour traffic volumes at a number of key locations in the surrounding network.

**Table 3 - Forecast of traffic at key locations from 2011 to 2021**

<i>Mid-block section</i>			<i>Peak hour traffic volumes</i>		
			<i>2011</i>	<i>2016</i>	<i>2021</i>
Bells Line of Road from Grose Vale Road to Richmond Bridge	AM	Eastbound	1,513	1,661	1,780
		Westbound	651	713	806
	PM	Eastbound	874	979	1,044
		Westbound	1,305	1,458	1,585
Richmond Bridge	AM	Eastbound	1,513	1,661	1,780
		Westbound	651	713	806
	PM	Eastbound	874	979	1,044
		Westbound	1,305	1,458	1,585
Kurrajong Road from Richmond Bridge to Yarramundi Lane	AM	Eastbound	1,513	1,661	1,780
		Westbound	651	713	806
	PM	Eastbound	874	979	1,044
		Westbound	1,305	1,458	1,585
Kurrajong Road from Yarramundi Lane to Bosworth Street	AM	Eastbound	1,070	1,161	1,255
		Westbound	517	565	613
	PM	Eastbound	709	765	822
		Westbound	858	964	1,040

**Note:** this forecast is generated by using future Paramics model. In Paramics, future demand was sourced from RMS Sydney Strategic Model (EMME/2).

These rates of growth suggest that the traffic will result in both an increase in the volume of traffic and the impact of peak traffic issues to a wider area over time.

## 2.3. Traffic solutions and options

### Options considered

Based on the existing network performance assessment and traffic modelling, 10 preliminary short-term improvement options were identified. These have the potential to improve traffic flow in the section of Bells Line of Road / Kurrajong Road / March Street between Grose Vale Road and East Market Street. These options include a range of localised changes to the three key intersections previously identified.

The short-term options specify minor improvements to road lengths and intersections to maintain an acceptable level of traffic operation. They include intersection widening, clearway restrictions during peak periods and other minor works.

Through the refinement process and in consultation with key stakeholders, some initial options were combined. Eight options (Options A to H) were short listed for detailed assessment. The following options were rejected:

- Full closure of Yarramundi Lane
- A new sign to formalise Pitt Lane as established traffic route for left turning traffic.

Table 4 provides a summary of the proposed changes to key intersections for Options A to H.

**Table 4 - Intersection changes for Options A to H**

<i>Option</i>	<i>Key intersections</i>	<i>Proposed changes</i>
Option A	Kurrajong Rd / Yarramundi Lane / Old Kurrajong Road	Ban eastbound right turns to Yarramundi Lane during the morning and afternoon peak periods.
Option B	Kurrajong Road / Yarramundi Lane / Old Kurrajong Road	Ban eastbound right turns to Yarramundi Lane during the morning and afternoon peak periods.  Ban eastbound left turns to Old Kurrajong Road during peak periods.
Option C (modification of Option A)	Kurrajong Road / Yarramundi Lane / Old Kurrajong Road	Same as option A.
	Kurrajong Road / Bosworth Street	Provide an eastbound exclusive right turn bay from Kurrajong Road to Bosworth Street.  Ban westbound right turns from March Street to Bosworth Street.
Option D	Bells Line of Road / Grose Vale Road	Provide: <ul style="list-style-type: none"> <li>• A shared through / left turn lane on Bells Line of Road to replace the existing left turn lane on the eastern approach</li> <li>• An additional westbound short through lane on Bells Line of Road, west of Grose Vale Road.</li> </ul> <p>This option allows for all movements at the intersection and may require some widening work.</p>

<i>Option</i>	<i>Key intersections</i>	<i>Proposed changes</i>
Option E (modification of Option D)	Bells Line of Road / Grose Vale Road	<p>Provide:</p> <ul style="list-style-type: none"> <li>• A shared through / left turn lane on Bells Line of Road to replace the existing left turn lane on the eastern approach</li> <li>• An additional westbound short through lane on Bells Line of Road, west of Grose Vale Road</li> <li>• Prohibit on-street parking during peak periods on the southern side of Bells Line of Road between Pitt Lane and Grose Vale Road</li> <li>• Ban eastbound right turns from Bells Line of Road into Grose Vale Road</li> <li>• Convert the existing eastbound right-turn bay to a second westbound through lane.</li> </ul> <p>This option avoids the need for widening at the intersection by banning the eastbound right turn movement.</p>
Option F (modification of Option E)	Bells Line of Road / Grose Vale Road	Same as Option E.
	Kurrajong Road / Yarramundi Lane / Old Kurrajong Road	An eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane.
Option G (combination of Options C and E with modification)	Kurrajong Road / Yarramundi Lane / Old Kurrajong Road	<p>Ban eastbound right turns to Yarramundi Lane during peak periods.</p> <p>Provide a left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road (westbound direction).</p>
	Kurrajong Road / Bosworth Street	Same as Option C.
	Bells Line of Road / Grose Vale Road	<p>Same as Option E.</p> <p>Extend the eastbound merge kerb side lane east of the Grose Vale Road intersection.</p>
Option H	Kurrajong Road / Yarramundi Lane / Old Kurrajong Road	<p>Provide:</p> <ul style="list-style-type: none"> <li>• An eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane</li> <li>• A left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road (westbound direction).</li> </ul>
	Bells Line of Road / Grose Vale Road	Same as Option G.



## 2.4. Performance modelling against criteria

Using Paramics or SIDRA modelling where relevant, each option was tested against the criteria. Table 5 shows the criteria and results.

Table 5 - Performance of considered upgrade options compared to base case

Id	Traffic Criteria	Time	Options							
			A	B	C	D	E	F	G	H
1	Improve Bells Line of Road eastbound traffic flows	AM	●	●	●			●	●	●
2	Improve Bells Line of Road westbound traffic flows	PM		●		●	●	●	●	●
3	Vehicle Kilometres Travelled (VKT) in the study area network	AM	●	●	●				●	
		PM	●	●	●				●	
4	Vehicle Hours Travelled (VHT) in the study area network	AM	●	●	●		●	●	●	●
		PM	●	●	●	●	●	●	●	●
5	Improve Grose Vale Road traffic flows	AM / PM							●	●
<b>Improve key intersection Level of Service with:</b>										
6	• Bells Line of Road / Grose Vale Road (Signal)	AM / PM				●	●	●	●	●
	• Kurrajong Road / Yarramundi Lane (Priority)	AM / PM	●	●	●			●	●	●
	• Kurrajong Road / Bosworth Street (Signal)	AM / PM	●	●						
<b>Impact on adjacent intersections</b>										
7	• Area A, Richmond	AM / PM								
	• Area B, Castlereagh Road	AM / PM	●	●	●				●	
	• Area C, North Richmond	AM / PM					●	●	●	●

<i>Performance compared to base case</i>	
Improvement	●
Slight improvement	●
No change / minor change	
Slightly worse	●
Worse	●

### *Impacts of Option H*

On the basis of this analysis, Option H performed well as a short-term solution. It displayed the following performance characteristics:

- It would improve both eastbound and westbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peak
- The model forecasts significant improvement in travel speed (about 171 per cent) for westbound traffic from 17 km/h (base case) to 46 km/h. The improved traffic flows are triggered by the combined effect of a left turn slip lane out of Yarramundi Lane and an acceleration lane on Kurrajong Road (westbound direction)
- The model forecasts improvements in travel speeds (about 4 per cent) for eastbound traffic from 48 km/h (base case) to 50 km/h in the morning peak
- The extension of the eastbound merge (east of Grose Vale Road) is forecast to improve Grose Vale Road traffic, particularly in the morning peak
- In line with predicted travel speed improvements for westbound traffic, Option H would improve (up to 31 per cent) vehicle hours of travel (VHT) during the afternoon peak in the study area network. There will be no change in vehicle kilometres of travel (VKT)
- It is unlikely to change traffic volumes and associated LoS at other adjacent intersections in the Richmond and Castlereagh Road areas. The model forecasts minor impacts to the adjacent intersection in North Richmond.

### *Option H modification*

In consultation with stakeholders, Option H was slightly modified and reassessed with a clearway scenario on Kurrajong Road between Chapel Street and Bosworth Street. Traffic analysis suggested that the proposed clearway on Kurrajong Road would also improve the performance of the Kurrajong Road / Bosworth Street intersection. The kerbside lane would provide additional capacity for through traffic during peak periods. Currently, eastbound right turn traffic shares one-lane with through traffic. With clearway scenario, the model shows increased use of the kerbside lane for eastbound through traffic, leaving more available capacity for the right turning vehicles.

### *Future traffic conditions*

The Option H improvements were assessed for traffic conditions in 2016 and 2021. As for the previous assessment, future network operational issues for Option H were reassessed at three key intersections and Richmond Bridge. The key findings are:

- The 2016 model predicts satisfactory operation of the Kurrajong Road / Bosworth Street intersection. For the western approach traffic, the LoS is predicted to be between C and D during peak hour. In 2021, the model predicts a lower LoS (F) for western approach traffic
- The analysis suggests the need for an additional eastbound exclusive right turn lane on Kurrajong Road at the Kurrajong Road / Bosworth Street intersection after 2016. The proposed upgrade is forecast to provide a good level of service (A and B) to western approach traffic up to 2021
- In the future, a lower LoS (F) is forecast for Grose Vale Road approach traffic.

Table 6 on the following page shows the modelled future traffic performance of the proposed improvements at the key intersections.

In general, the analysis found that the proposed improvements would maintain an acceptable LoS for key intersections and Richmond Bridge, over the short-term (0-10 years).

**Table 6 - Assessment of performance of proposed improvements at key intersections**

Intersection	Approach	Time	Level of Service (LoS)			
			2011 Existing	Option H		Option H with exclusive right turn bay on Kurrajong Rd at Bosworth St
				2016	2021	2021
Kurrajong Road / Bosworth Street (traffic light controlled)	Kurrajong Road western approach	AM	LoS B	LoS C	LoS C	LoS A
		PM	LoS C	LoS D	LoS F	LoS B
Bells Line of Road / Grose Vale Road (traffic light controlled)	Bells Line of Road eastern approach	AM	LoS B	LoS C	LoS D	LoS D
		PM	LoS D	LoS C	LoS C	LoS C
	Grose Vale Road approach	AM	LoS F	LoS F	LoS F	LoS F
		PM	LoS D	LoS D	LoS E	LoS E
Kurrajong Road / Yarramundi Lane (sign controlled)	Kurrajong Road western approach	AM	LoS B	LoS A	LoS A	LoS A
	Kurrajong Road eastern approach	PM	LoS F	LoS A	LoS A	LoS A

**Source:** SIDRA model was used for existing 2011 LoS results, except for Kurrajong Road / Yarramundi Lane. Paramics model was used for existing 2011 LoS results for Kurrajong Road / Yarramundi Lane and Future 2016 and 2021 LoS results.

## 2.5. Community involvement and feedback

In July 2012 RMS produced a Community Involvement Plan (CIP) for Richmond Bridge and approaches congestion study.

In accordance with the CIP RMS:

- Conducted a community workshop on 24 July 2012
- Conducted stakeholder interviews throughout July 2012
- Received written submissions from 56 sources between 24 July and 15 August 2012.

### 2.5.1. Community consultation

This section provides a summary of the community responses related to the short-term options. Full details of the community responses is at the Community issues report (Part 2 short-term study) – September 2012 (Appendix 1).

The following broad themes emerged from the consultation:

1. There was significant community support for banning right turns out of Old Kurrajong Road into Kurrajong Road, at least during peak hours. There was also support for preventing motorists crossing Kurrajong Road from Yarramundi Lane to Old Kurrajong Road
2. A number of submissions noted improvements following recent changes to light phases but noted the potential for further adjustment to prevent delays



3. A number of submissions suggested clearway conditions on both sides of Bells Line of Road
4. A roundabout was suggested for the intersection of Grose Vale Road and Bells Line of Road
5. There was general support for Option H, with some modifications suggested.

### 2.5.2. Community comments

This section provides a summary of the community comments on the short-term strategy to reduce traffic congestion in the Richmond and North Richmond area.

Community comments and suggestions for solutions are grouped according to the key intersection and related streets to which they relate. This section also includes many general comments that refer to specific issues or solutions related to these intersections.

The key intersections are:

1. Bells Line of Road and Grose Vale Road
2. Kurrajong Road, Yarramundi Lane and Old Kurrajong Road
3. Kurrajong Road and Bosworth Street

#### *Bells Line of Road / Grose Vale Road / Terrace Road intersection*

The main issues raised in relation to this signal-controlled intersection were :

- Relocating the existing bus stop for eastbound buses
- Introducing clearway conditions on Bells Line of Road between Pitt Lane and Grose Vale Road
- Improving right-hand turn movements, such as extending the right turn lane from Bells Line of Road to Terrace Road to improve traffic flow
- Improving left-hand turn movements, such as creating a left-turn anytime lane from Grose Vale Road into Bells Line of Road
- Introducing multiple turning lanes
- Improving merging lanes
- Improving traffic light phasing and sequences
- Replacing traffic lights with a new roundabout.

#### *Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection*

The issues raised in relation to this sign-controlled intersection were:

Preventing right-hand turns out of Old Kurrajong Road into Kurrajong Road (near the Windsor Polo Club). This received strong support and moderate support was expressed for a ban during peak times only

- Banning eastbound right turns from Kurrajong Road into Yarramundi Lane in weekday peak periods
- Providing an eastbound exclusive right turn bay from Kurrajong Road into Yarramundi Lane
- Banning eastbound right turns from Yarramundi Lane into Kurrajong Road in weekday peak periods
- Banning westbound left turns from Yarramundi Lane into Kurrajong Road in weekday afternoon peak only
- Banning north bound and southbound through movements between Yarramundi Lane and Old Kurrajong Road
- Closing Yarramundi Lane
- Improving merging lanes
- Installing a roundabout
- Reducing the current speed limit on Kurrajong Road.

### ***Kurrajong Road / Bosworth Street intersection***

The main issues raised in relation to this signal-controlled intersection were:

- Providing an eastbound right turn bay from Kurrajong Road into Castlereagh Road
- Imposing clearway conditions on Kurrajong Road between Chapel Street and Bosworth Street.

### ***General comments on options***

**Table 7 - Comments on options**

<b><i>Option</i></b>	<b><i>Comments</i></b>
A	<p>Would add a lot of time to the journey for those travelling to Penrith. This was evident during the closure of Yarramundi Lane during road resurfacing work.</p> <p>Not supported as it moves the problem elsewhere.</p>
B	<p>Would add a lot of time to the journey for those travelling to Penrith. This was evident during the closure of Yarramundi Lane during road resurfacing work.</p> <p>Not supported as it moves the problem elsewhere.</p>
C	<p>Would add a lot of time to the journey for those travelling to Penrith. This was evident during the closure of Yarramundi Lane during road resurfacing work.</p> <p>Not supported as it moves the problem elsewhere.</p>
D	<p>This option was in place a few years ago and caused traffic merging issues and traffic cutting up the inside lane.</p>
E	<p>This option is not safe as it would increase the traffic around the Richmond North Public School, although the risks may be reduced outside of school hours.</p> <p>The safest route is to turn into Grose Vale Road.</p> <p>This option was in place a few years ago and caused traffic merging issues and traffic cutting up the inside lane.</p>
F	<p>No general comments were made. Specific comments on right turns are included in the comments about the relevant intersection.</p>
G	<p>No general comments were made. Specific comments on the left turn slip lane, bus stop and parking are included in the comments about the relevant intersection.</p>
H	<p>Of the written submissions that made specific reference to the options, Option H received more support than the other short-term options presented. However, at the community workshop and in the written submissions received there was strong support for modifications to Option H.</p> <p>General comments about Option H included:</p> <ul style="list-style-type: none"> <li>• Consider a road safety audit to ascertain the viability of Option H</li> <li>• Support for Option H as outlined in the presentation</li> <li>• Uncertain how an acceleration lane would help</li> <li>• Option H provides improvement to all three of the main choke points at Grose Vale Road / Bells Line of Road, Yarramundi Lane / Kurrajong Road and Bosworth Street / Kurrajong Road</li> <li>• Option H could be implemented now and eventually an overpass at the Grose Vale Road intersection and duplication of the bridge would cater for future traffic volumes</li> <li>• Implement Option H if the modelling shows it is the best, but stop any further housing development until a long-term solution, such as a bypass is implemented.</li> </ul>

Specific comments by HCC were as follows:

- The improvement works outlined in Option H could see traffic numbers increase to more than double. Traffic should be contained within the State road network of Kurrajong Road, Bosworth Street and Castlereagh Road
- Yarramundi Lane (Old Kurrajong Road) is similar to a local road with a maximum environmental capacity in the order of 300 vehicles an hour and is currently beyond capacity. The road reserve for the majority of this section is only 10 metres wide and should not be considered as a de-facto State road. Consider widening and upgrading this road with funding provided to further maintain it. A road safety audit would need to be undertaken for Yarramundi Lane to ascertain its viability for continued use as an alternative to Kurrajong Road
- No improvement in the LoS for traffic on Grose Vale Road in the mornings is predicted in the congestion study at any stage. The doubling in size of North Richmond (due to proposed developments) would feed the increased traffic into Grose Vale Road presenting a critical problem
- While the outcome of Option H relating to the intersection of Kurrajong Road / Yarramundi Lane / Old Kurrajong Road would potentially improve capacity and safety on Kurrajong Road, it does so at the expense of the physical, environmental and safety of Yarramundi Lane and the feeder local road network. If this option is pursued, then these issues must be addressed.

### 2.5.3. Conclusion

The Richmond and North Richmond communities provided broad ranging feedback, however community comment to date provides strong support for the implementation of traffic improvements to the three key intersections and surrounding streets:

- Bells Line of Road and Grose Vale Road
- Kurrajong Road, Yarramundi Lane, and Old Kurrajong Road
- Kurrajong Road and Bosworth Street.

## 2.6. Response to issues and proposed short-term improvements

This section provides a summary of the issues raised by the community in relation to the proposed short-term improvements and proposed responses.

Responses to the issues raised are detailed below, which further explain the proposed short-term improvements. Table 8, Table 9 and Table 10 on the following pages provide details of the issues responded for the three key intersections.

### 2.6.1 Bells Line of Road / Grose Vale Road intersection

Table 8 - Issues and responses relating to the Bells Line of Road / Grose Vale Road intersection

<i>Issue</i>	<i>Response</i>
Extend the right turn lane from Bells Line of Road into Terrace Road.	The proposed changes in Option H would provide two westbound lanes for through traffic. Option H would improve traffic performance at this intersection. Traffic analysis does not support the need for longer right-hand turn lane from Bells Line of Road into Terrace Road.



<i>Issue</i>	<i>Response</i>
Allow right-hand turn from Bells Line of Road into Grose Vale Road. One submission added that the small right-hand turn lane into Charles Street must also stay and others were generally concerned that a ban would see an increase in traffic use of alternate routes, such as Charles Street, Pitt Lane and other streets.	Option H would be modified permitting an eastbound right turn from Bells Line of Road into Grose Vale Road. RMS is currently investigating potential widening works required to accommodate changes from a modified Option H.
Ban right-hand turn eastbound from Bells Line of Road into Gross Vale Road	Following the community workshop, Option H has been modified to permit eastbound right turns from Bells Line of Road into Grose Vale Road.
Implement a raised centre line, of kerb height or greater, on the westbound right lane into Terrace Road to prevent vehicles crossing to the wrong side of the road to access the turn right lane.	Option H would improve traffic performance at the Grose Vale Road intersection by providing two westbound lanes for through traffic. The changes proposed in Option H would improve right turn lane capacity.
Close the Bells Line of Road entrance to the shopping centre. Close the service road to Bells Line of Road from the post office.	From the perspective of traffic operation and network efficiency, there is no requirement to close the Bells Line of Road entrance to the shopping centre and service road.
Review the proposed no right turn from Bells Line of Road into Grose Vale Road at Charles Street as this will create another rat run and will shift congestion.	Option H would be modified to permit eastbound right turns from Bells Line of Road into Grose Vale Road. RMS is currently investigating potential widening works required to accommodate changes from modified Option H.
Remove the right turn lane into Grose Vale Road from Bells Line of Road (eastbound) during peak hours to allow room for two westbound lanes. Close the right-hand turn into Grose Vale Road.	Following the community workshop, Option H was modified to permit eastbound right turns from Bells Line of Road into Grose Vale Road.
Allow for a right-hand turn lane westbound along Bells Line of Road into Crooked Lane.	The study undertook extensive data collection involving some 15 key regional and local intersections in the study area. Traffic analysis was undertaken for Charles Street / Bells Line of Road. Traffic was not counted for minor intersections with Redbank Road / Bells Line of Road and Crooked Lane / Bells Line of Road. These intersections are considered to be outside the scope of the current study.
Implement a no right-hand turn from Charles Street into Bells Line of Road during the morning and afternoon peak periods and allow left-hand turns to occur more easily from Charles Street (to local high school).	There is no requirement to ban turns into and out of Charles Street.
A right turn at Pitt Lane would hold up traffic on Bells Line of Road where the traffic is currently more congested.	Option H proposes key changes to the Bells Line of Road / Grose Vale intersection to improve the current congestion.

<i>Issue</i>	<i>Response</i>
Make the left turn only lane on Bells Line of Road into Grose Vale Road a straight through lane to allow vehicles to bypass right turn traffic.	Option H proposes to replace the existing left-turn lane with a shared through / left-turn lane.
<p>Create a left turn anytime lane from Grose Vale Road into Bells Line of Road.</p> <p>Install a Left turn permitted on red after stopping sign on Bells Line of Road facing Terrace Road.</p> <p>Implement a left turn lane from Bells Line of Road into Terrace Road. Implement a left turn lane from Terrace Road into Bells Line of Road.</p>	Option H proposes key changes to the Bells Line of Road / Grose Vale intersection to improve current congestion. A separate left turn lane is not required from Bells Line of Road to Terrace Road or from Terrace Road to Bells Line of Road.
Implement a two-lane turn at the lights at Grose Vale Road and Bells Line of Road.	Option H proposes key changes to the Bells Line of Road / Grose Vale intersection to improve current congestion. A two-lane turn is not required.
<p>For the evening peak, make Bells Line of Road two lanes westbound directly after the North Richmond Bridge all the way to the traffic lights at Grose Vale Road. Make this a 3pm to 7pm clearway. The existing westbound lane can continue through the lights. The left lane can turn left into Grose Vale Road as well as continuing west through the traffic lights and merging back into one-lane prior to the United Service Station, as it did prior to the intersection upgrade some years ago.</p> <p>From the traffic island adjacent to Coles car park exit on Bells Line of Road (westbound), use contraflow traffic dividers to make a third lane west linking to the existing right turn lane into Terrace Road. Use this in conjunction with a 3pm to 7pm peak clearway to increase the right turn capacity into Terrace Road by approximately 150 metres.</p>	<p>Option H proposes to provide a westbound shared through / left turn lane on Bells Line of Road, east of Grose Vale Road replacing the existing left turn lane. It will also provide an additional westbound short through lane on Bells Line of Road, west of Grose Vale Road for a total of two lanes westbound. A clearway is proposed on the southern side of Bells Line Road between Pitt Lane and Grose Vale Road during peak periods.</p> <p>Option H would improve both eastbound and westbound traffic flows along Bells Line of Road and Kurrajong Road in both morning and afternoon peak periods.</p> <p>Following the community workshop, Option H has been modified to permit eastbound right turns from Bells Line of Road into Grose Vale Road.</p>
Widen Bells Line of Road between Richmond Bridge and Yarramundi Road to create a bypass lane for right turn traffic into Yarramundi Road.	Option H provides an eastbound exclusive right-turn bay from Kurrajong Road to Yarramundi Lane. This will provide adequate capacity for right turn traffic into Yarramundi Lane.
West of Grose Vale Road should be widened to four lanes at least up to Redbank Creek through to the narrow bridge.	Bells Line of Road, west of Grose Vale Road carries substantially lower traffic volumes than east of Grose Vale Road. RMS is investigating a Long-term Strategic Corridor Plan for the Bells Line of Road corridor. Traffic issues on Bells Line of Road between Grose Vale Road and Redbank Creek are outside the scope of the current study.

<i>Issue</i>	<i>Response</i>
<p>Provide three lanes from Grose Vale Road and Terrace Road intersection, all the way to Richmond Bridge.</p> <p>Use the service road as an extra lane after Terrace Road.</p>	<p>The Part 2 long-term options study will investigate the need for three lanes on Bells Line of Road and Kurrajong Road between Grose Vale Road and Richmond Bridge.</p>
<p>A left merging lane up to Richmond would keep traffic moving, but may not solve the problem.</p>	<p>The Part 2 long-term options study will investigate the need to widen Bells Line of Road and Kurrajong Road between Grose Vale Road and Richmond Bridge.</p>
<p>Introduce a longer merge lane turning out of Grose Vale Road eastbound.</p>	<p>The proposed changes to Option H would improve traffic performance at Grose Vale intersection.</p>
<p>Relocate both bus stops near the intersection of Grose Vale Road and Bells Line of Road.</p> <p>Allow the school bus to stop outside shopping centre, but not cars.</p> <p>Removal of the bus stop opposite the Post Office at North Richmond poses a problem. Bus services to and from Richmond should be supported so it is important to find an alternative site. If it is relocated in the service road in front of the post office this will remove parking.</p> <p>Install a clearway between Richmond Bridge and Grose Vale Road in peak traffic periods. One comment added buses excepted.</p> <p>Implement no parking on Bells Line of Road, particularly between Pitt Lane and Grose Vale Road during morning and afternoon peak periods.</p>	<p>Currently three bus routes (Routes, 668, 680, 682) service two bus stops located near the Grose Vale / Bells Line of Road intersection. Eastbound, the bus stop is located on Bells Line of Road about 80 metres east of the intersection. Westbound, the bus stop is also located on the Bells Line of Road but about 200 metres east of the intersection.</p> <p>In the morning one hour peak about seven buses serve the eastbound stop, ie one bus in every eight minutes. In the afternoon one hour peak about four buses service the eastbound stop, ie one bus in every 15 minutes.</p> <p>Two bus stops and their existing locations are critical in serving passengers to and from North Richmond. The proposed changes in Option H would improve traffic performance at Grose Vale intersection, including buses. There is no requirement to relocate the existing bus stop.</p> <p>Option H provides a clearway on the southern side of Bells Line Road between Pitt Lane and Grose Vale Road during peak periods. The clearway will ban parking during peak periods.</p>
<p>Remove traffic lights at Bells Line of Road and Grose Vale Road and create a roundabout.</p> <p>A large scale roundabout at North Richmond looks like a very good option.</p>	<p>Option H proposes key changes to the Bells Line of Road / Grose Vale traffic lights to improve the current congestion. A new roundabout to replace the traffic lights is not required.</p>



<i>Issue</i>	<i>Response</i>
Construct a roundabout at Terrace Road and Beaumont Avenue.	The capacity of Terrace Road is influenced by the capacity of the traffic lights at the intersection with Bells Line of Road. Option H proposes key changes to the Bells Line of Road / Grose Vale Road traffic lights to improve the current congestion. A new roundabout on Terrace Road at Beaumont Avenue is not required.
A Liquid Flow Free Flow Turnabout in North Richmond with modifications to local roads to achieve free flow traffic.	The long-term option study considered a grade separation at the Bells Line of Road / Grose Vale Road intersection and concluded that grade separation is not required.

### 2.6.2 Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection

**Table 9 - Issues and responses relating to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road Intersection**

<i>Issue</i>	<i>Response</i>
<p>Ban right-hand turns from Old Kurrajong Road into Kurrajong Road (near Windsor Polo Club). One submission noted in the evening only. HCC also supports this recommendation.</p> <p>Prevent right-hand turn from Old Kurrajong Road to Kurrajong Road at peak times.</p>	<p>In the morning and afternoon peak there is a small volume of traffic (between four and 34 vehicles) turning out of Old Kurrajong Road. A Road Safety Audit was undertaken to ascertain the safety implications of right hand turn out of Old Kurrajong Road into Kurrajong Road. The results of the audit are presented in Appendix 2.</p>
<p>Implement a right-hand turn lane, for traffic coming from North Richmond to Richmond, to be able to turn into Old Kurrajong Road heading towards Yarramundi Lane.</p> <p>One comment noted that immediate implementation is needed. Others noted that this would also relieve right-hand turning traffic closer to Bosworth Street.</p>	<p>Option H provides for the following improvements to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection:</p> <ul style="list-style-type: none"> <li>• An eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane; and</li> <li>• A left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road (in the westbound direction).</li> </ul>
<p>Install a dedicated right turn lane into Yarramundi Lane (Old Kurrajong Road west) off Bells Line of Road (Kurrajong Road</p>	<p>Option H provides for the following improvements to Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection:</p> <ul style="list-style-type: none"> <li>• An eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane; and</li> <li>• A left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road (in the westbound direction).</li> </ul>

<i>Issue</i>	<i>Response</i>
<p>Consider no right hand turn from Bells Line of Road (Kurrajong Road) into Yarramundi Lane (Old Kurrajong Road) in peak times.</p> <p>One comment suggests an evening ban only.</p>	<p>The option of banning right turns from Bells Line of Road into Yarramundi Lane in peak hours was investigated as part of Options A to C. The ban would increase journey time for some motorists. Traffic analysis shows that banning right turns into Yarramundi Lane would have a significant adverse impact on the performance of the Bosworth Street traffic light.</p> <p>Option H proposes one eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane.</p>
<p>Close the intersection.</p>	<p>Closing the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection would have a significant adverse impact on the Bosworth Street / Kurrajong Road traffic lights.</p>
<p>Improve the right-hand turn from Old Kurrajong Road (Yarramundi Lane) into Inalls Lane (eastbound).</p>	<p>From a traffic operation perspective, there is no requirement to improve the right hand turn from Old Kurrajong Road (Yarramundi Lane) into Inalls Lane (eastbound).</p> <p>A road safety audit was undertaken to ascertain the safety implication on Yarramundi Lane and associated intersections including Inalls Lane. Refer to the Road Safety Audit Report for details.</p>
<p>Ban the left-hand turn out of Yarramundi Lane (Old Kurrajong Road) into Kurrajong Road during the afternoon peak (Hawkesbury City Council).</p>	<p>Banning left turns out of Yarramundi Lane (Old Kurrajong Road) into Kurrajong Road would have an adverse impact on the Bosworth Street / Kurrajong Road traffic lights.</p> <p>Option H proposes a left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road westbound. This would improve traffic conditions for left-hand turns out of Yarramundi Lane (Old Kurrajong Road) into Kurrajong Road during the afternoon peak.</p>
<p>Close Yarramundi Lane.</p>	<p>This option was investigated. Any closure of Yarramundi Lane would have a significant adverse impact on the Bosworth Street traffic lights. In consultation with key study stakeholders this option was rejected.</p>
<p>Make Old Kurrajong Road up to Yarramundi Lane (Colo Soccer Football Club) one way only. Would still be able to turn right off Kurrajong Road, from North Richmond, but no exit onto Kurrajong Road.</p>	<p>Option H proposes key improvements to this intersection to improve congestion. The one way proposition would adversely impact the accessibility of this area.</p>

<i>Issue</i>	<i>Response</i>
<p>Build slip / filter lanes for Yarramundi Lane (Old Kurrajong Road) into Kurrajong Road.</p> <p>One comment specified left-hand turn lane.</p> <p>Add a merging lane on Kurrajong Road, of sufficient length, to allow vehicles to merge smoothly.</p>	<p>Option H proposes a left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road (westbound). This would improve traffic condition for left-hand turns out of Yarramundi Lane (Old Kurrajong Road) into Kurrajong Road during the afternoon peak.</p>
<p>Widen Kurrajong Road for a dedicated right turn lane at Old Kurrajong Road, to make through traffic to Richmond flow uninterrupted</p> <p>Kurrajong Road should have four lanes on the western side of the intersection of Kurrajong Road and Old Kurrajong Road to allow west bound vehicles from Old Kurrajong Road to merge onto Kurrajong Road and also allow east bound vehicles to turn right from Kurrajong Road onto Old Kurrajong Road.</p>	<p>Option H would provide an eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane.</p> <p>Option H provides the following improvements to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection:</p> <ul style="list-style-type: none"> <li>• An eastbound exclusive right turn bay from Kurrajong Road to Yarramundi Lane</li> <li>• A left turn slip lane out of Yarramundi Lane with an acceleration lane on Kurrajong Road (in the westbound direction).</li> </ul> <p>The above traffic works would improve traffic congestion at this intersection.</p>
<p>Consider widening the roads from Yarramundi Lane to Richmond Bridge to create two lanes in order to allow traffic merge onto Bells Line of Road (Kurrajong Road) from Yarramundi Lane (Old Kurrajong Road) in peak traffic times.</p>	<p>Option H proposes a range of localised changes to all three key intersections that favour the major east west movement of traffic on Bells Line of Road and Kurrajong Road.</p> <p>Option H would improve both eastbound and westbound traffic flows in the morning and afternoon peak periods.</p>
<p>Installation of a roundabout at the junction of Yarramundi Lane (Kurrajong Road) and Old Kurrajong Road. This would enable traffic to move freely.</p>	<p>The traffic data indicates an imbalance of flow at four approaches to the intersection. A new roundabout at the junction of Yarramundi Lane (Kurrajong Road) and Old Kurrajong Road may not be appropriate given this imbalance and low traffic volumes at particular approaches, eg old Kurrajong Road (northern approach).</p>
<p>Reduce the speed on Kurrajong Road to 60 km/h during peak times.</p> <p>Keep the speed limit at 80 km/h until the current 60 km/h sign appears just after the crossing at Kurrajong and Old Kurrajong Road</p>	<p>The posted travel speeds on Richmond Bridge and that section of Bells Line of Road / Kurrajong Road are between 60 km/h and 80 km/h. There is no requirement to amend the current posted speed limits. The existing posted speed limit is consistent with the road hierarchy.</p>

### 2.6.3 Kurrajong Road / Bosworth Street intersection

Table 10 - Issues and responses relating to the Kurrajong Road / Bosworth Street intersection

<i>Issue</i>	<i>Response</i>
Traffic lights at the intersections of Lennox Street / Page Street and Bourke Street and Lennox Street / Blacktown Road should be replaced with standard mini roundabouts.	There is no requirement to replace traffic lights with standard mini roundabouts. The study indicates a satisfactory level of service at both intersections.
Consider providing a no right-hand turn at the intersection of March Street and East Market Street.  HCC noted that there are currently turning manoeuvre issues at the intersection of East Market Street and March Street (extension of Kurrajong Road). Traffic flow could be improved at this intersection by allowing the kerb lane to be left turn and through, providing a green right turn arrow from March Street into East Market Street or banning the right turn from March Street into East Market Street.	The Congestion Study analysed the March Street / East Market Street traffic lights. The results show a satisfactory level of service in both morning and afternoon peak period.
(Coming from North Richmond along Kurrajong Road) a right turn bay is suggested at Bosworth and March Street into Castlereagh Road.	Option H proposes an eastbound exclusive right turn bay from Kurrajong Road into Castlereagh Road.
Introduce a right-hand turn restriction west bound at the corner of Chapel Street and Kurrajong Road. Timed or permanent.  Close Chapel Street access to March Street.	Option H proposes clearways on both sides of Kurrajong Road from Chapel Street to Bosworth Street during peak periods.  There is no requirement to impose a ban on right hand turns at the corner of Chapel Street and Kurrajong Road.  The analysis does not suggest a need to close Chapel Lane.
Consider a Road Safety Audit to ascertain the viability of Option H.	Option H has been modified permitting an eastbound right turn from Bells Line of Road into Grose Vale Road. No other changes are proposed to the original Option H. A Road Safety Audit has been conducted to assess the safety implications of the proposed changes to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection. Refer to the Road Safety Audit Report for details.



<i>Issue</i>	<i>Response</i>
<p>HCC commented that the study refers to Penrith bound traffic turning into Yarramundi Lane and not travelling further to the intersection of Kurrajong Road and Bosworth Street. There is anecdotal evidence that some of the traffic turning right at Yarramundi Lane has a destination of either Richmond or is travelling towards Windsor / Blacktown, using Yarramundi Lane / Inalls Lane / Southee Road as a rat-run. The Study data could be further enhanced by undertaking an Origin / Destination Study for some of these critical movements.</p>	<p>Option H proposes an eastbound exclusive right-turn bay from Kurrajong Road to Yarramundi Lane. This will provide adequate capacity for right turn traffic into Yarramundi Lane. A further origin / destination study is not required.</p> <p>A Road Safety Audit has been undertaken to assess the safety implications of the proposed changes to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection.</p>
<p>The peak hour traffic volumes outlined in the study clearly demonstrate that the State road traffic is not following the State road network. State road traffic should be contained within its own road network and not diverted into the Local road network.</p>	<p>Subject to the road safety outcome, should there be an impact on council assets or roads, it will be assessed appropriately.</p>
<p>The Congestion Study report is deficient in not examining the impact of proposed changes on the local road network. Documenting the increase in vehicle numbers without studying the suitability of roads to cope and identifying possible changes, road signage, one way traffic possibilities or pedestrian safety is a serious deficiency.</p>	<p>The study involved an extensive data collection exercise involving key local roads and intersections in the study area. Traffic impacts have been assessed at key local roads and intersections for all eight identified options. Chapter 7 of the Congestion Study reported details impact assessment.</p>
<p>The Congestion Study report on Traffic Growth is totally incorrect in that it has failed to take into account three points:</p> <ul style="list-style-type: none"> <li>• The accelerated rate of increase in traffic volumes over the last three years. The manipulating of the numbers by a smoothing exercise involving averaging the increase over different periods is invalid and does not eliminate the fact that traffic is increasing at a rate eight times that of earlier years. Nothing has happened to slow the increase in rate and much has happened to accelerate it further</li> <li>• No allowance has been made for the nursing home and aged care facility currently under construction. These alone could provide traffic flows which exceed bridge capacity within five years</li> <li>• No allowance has been made for the rezoning and development applications already lodged with Council and forwarded to Gateway.</li> </ul>	<p>Future traffic growth in the traffic analysis was based on data provided by the Bureau of Transport Statistics. The relative merits and demerits of each option was assessed based on existing traffic count data in 2011. The long-term traffic assessment will include potential larger developments being planned in North Richmond.</p>

<i>Issue</i>	<i>Response</i>
<p>It is questioned if the congestion study took into account all the traffic merging at Richmond from Blacktown Road, Windsor Road and Castlereagh Road onto Kurrajong Road and then Bells Line of Road.</p>	<p>The Congestion Study undertook an extensive data collection exercise involving 15 key intersections that provide various forms of network connectivity to Bells Line of Road / Kurrajong Road. A road based micro-simulation traffic model was developed that included key roads and intersections in the study area. The traffic model also included Blacktown Road, Windsor Street, Castlereagh Road and Bells Line of Road. Figure 9 shows the extent of road network considered in the traffic assessment.</p>
<p>No observations appear to have been made of the length of the queue along Bells Line of Road west of the lights. In the morning this often extends to Colo High School and beyond.</p>	<p>The study undertook a queue length survey at critical intersections within the study area. Relevant to Bells Line of Road west of the traffic lights a queue length survey was undertaken at intersections with:</p> <ul style="list-style-type: none"> <li>• Grose Vale Road / Bells Line of Road</li> <li>• Charles Street / Bells Line of Road.</li> </ul> <p>Table 9 of the study documents details of traffic survey and data used in the traffic assessment.</p>
<p>Traffic figures need to consider other side streets such as Windsor Street, March Street, Market Place (shopping centre) and Bourke Street (at McDonalds).</p>	<p>The Congestion Study undertook an extensive data collection exercise involving 15 key intersections that provide various forms of network connectivity to Bells Line of Road / Kurrajong Road. A road based micro-simulation traffic model was developed that included key roads and intersections in the study area. The traffic model also included key roads in Richmond, including Windsor Street, March Street, Bourke Street. Figure 9 shows the extent of road network considered in the traffic assessment.</p>
<p>No detailed analysis of traffic movement in the local roads appears to have been done by the Congestion Study. The study seems to have only concentrated on one stretch of main road and has not taken into account - Charles Street / Bells Line of Road, Redbank Road / Bells Line of Road and Crooked Lane / Bells Line of Road.</p>	<p>The Congestion Study undertook an extensive data collection exercise involving 15 key intersections in the study area. Traffic analysis was undertaken for the Charles Street / Bells Line of Road intersection. Traffic was not counted at two minor intersections with Redbank Road / Bells Line of Road and Crooked Lane / Bells Line of Road. These intersections are outside of the current scope of study.</p>

<i>Issue</i>	<i>Response</i>
A one day visit over the prolonged study period was inadequate to observe all traffic flow issues and led to some inaccurate assumptions. Further visit sites are required.	The study undertook a comprehensive data collection program. It was supplemented by multiple site visits when required. After traffic model validation, additional site visits were undertaken confirming that observed traffic matched with actual behaviour in the study area.
The traffic survey SIDRA results are strange as they show a current delay of 39 seconds at the Grose Vale Road / Bells Lind of Road junction reducing to 36 seconds after proposed improvement. A 39 second delay bears no relation to real life experiences.	SIDRA is a tool used in assessing intersection capacity. The performance of an intersection is measured by the intersection average delay per vehicle which in turns leads to a level of service measure for the intersection.
Modification of traffic light phasing has strong support with around a third of written submissions seeking consideration of changes to phasing. At the community workshop, community members raised this as a solution to improve traffic flow. Some respondents suggested removing traffic lights or altering the priority given to particular traffic in peak times.	Comment acknowledged.
Respondents identified scope for educating drivers to avoid poor driver behaviour with a resulting impact on traffic flow.	Comment acknowledged.
Some respondents expressed concern that short-term options would have limited or no benefit. Others wanted the improvements brought forward. Short-term options are not future proof. Short-term options are a waste - stop development then investigate. Recommended Action – apart from the Yarramundi Lane intersection we believe the 0 to-5 year items on should be completed within one year or less. We believe the 5 to 10 year option for Bosworth Street will need to be brought forward to 0 to 5 years because of the underestimate of the rate of increase in traffic growth.	Option H, comprises improvements at Grose Vale Road, Yarramundi Lane and Bosworth Street intersections. Together with the prohibition of on-street parking during peak periods on Bells Line of Road / Kurrajong Road this would ease current traffic congestion. The future year analysis suggested that Option H improvements would provide satisfactory level of service to year 2021.

#### **2.6.4 Consideration of community comment**

After considering the community feedback, Option H was modified permitting eastbound right turns from Bells Line of Road into Grose Vale Road.

#### **2.7. Road safety audit**

A Road Safety Audit was conducted to assess the safety implications of changes being proposed to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection. As part of this study both day and night inspections were performed in July and September 2012 to determine road safety issues at the study area intersections.

This included a walkover and drive through inspection of each of the intersections as well as the Richmond-Agnes Banks local road precinct. A follow up site inspection was also carried out on 13 September 2012.

The inspection and subsequent reporting was carried out in accordance with TfNSW's Centre for Road Safety's Guidelines for Road Safety Audit Practices (2011). The Road Safety Audit Report is attached in Appendix 2.

The full report includes a completed checklist as provided in the Austroads Guide to Road Safety Part 6. The audit findings will be taken into account in developing the detailed plans.

#### **2.8. Preferred short-term solution**

The preferred short-term solution to address demand to 2021 is to upgrade the intersections at Grose Vale Road, Old Kurrajong Road and Bosworth Street.

The long-term strategic option study identified the following further improvements to the Bells Line of Road / Grose Vale Road intersection. They are the provision of:

- Two dedicated right turning lanes from Grose Vale Road into Bells Line of Road
- A dedicated left turning lane from Bells Line of Road into Grose Vale Road.

As these improvements would also be beneficial in the short-term, though not essential, they have been incorporated into the preferred short-term improvements.

##### **2.8.1. Bells Line of Road / Grose Vale Road / Terrace Road intersection**

The improvements described below will be provided at this intersection. Figure 6 on page 33 shows an indicative illustration of the improvements.

###### ***Traffic travelling east along Bells Line of Road***

- One through traffic lane to the east
- A shared through and left turn lane into Terrace Road
- A right-turn lane into Grose Vale Road (this was not provided for in the original Option H but has been included following public comment).

###### ***Traffic travelling west along Bells Line of Road***

- Two through traffic lanes to the west
- A dedicated left-turn lane from Bells Line of Road into Grose Vale Road
- A dedicated right-turn lane into Terrace Road and an additional through lane west of Grose Vale Road
- Parking bans on Bells Line of Road during peak periods.

###### ***Traffic travelling north along Grose Vale Road***

- Two dedicated right-turn lanes eastbound into Bells Line of Road
- A shared through and left turn lane.



### ***Traffic travelling south along Terrace Road***

- A through lane
- A shared through and left turn lane with improved left turn facilities including lengthened egress eastbound along Bells Line of Road
- A right-turn lane.

In general, the above arrangements should provide for improved traffic conditions and safety. The Road Safety Audit noted that the dual right turn lanes from Grose Vale Road into Bells Line of Road appear to clash with the right-turn from Terrace Road. This comment will be taken into account when the detailed design is developed.

### ***2.8.2. Kurrajong Road / Old Kurrajong Road / Yarramundi Lane intersection***

The improvements described below will be provided at this intersection. Figure 7 on page 35 shows an indicative illustration of the improvements.

### ***Traffic travelling eastbound along Kurrajong Road***

- A dedicated right turn bay
- A shared through and left turn (north into Kurrajong Road) lane. The left turn movement will have improved egress northbound.

### ***Traffic travelling north along Old Kurrajong Road***

- A left turn lane with a 125 metre acceleration lane on Kurrajong Road
- A combined through and right turn lane.

During detailed design development consideration will be given to banning right turn movements from Old Kurrajong Road into Kurrajong Road East during peak periods, to lower road safety risk.

### ***Traffic travelling south along Old Kurrajong Road***

- A shared through and right and left turn lane.

During detailed design development consideration will be given to banning right turn movements from Old Kurrajong Road into Kurrajong Road West during peak periods, to lower road safety risk.

There should be significant improvements in traffic flow and road safety. The proposed acceleration lane on Kurrajong Road for left-turning vehicles from Old Kurrajong Road South will improve the ability of cars to enter Kurrajong road in heavy traffic conditions (ie reduced gap acceptance requirement from five seconds to three seconds). Though this acceleration lane may still have medium-level crash risks of low angled impacts, it would eliminate the high-level risk of more severe high angled impacts.

### **2.8.3. Kurrajong Road / March Street / Bosworth Street intersection**

The improvements described below will be provided at this intersection. Figure 8 on page 37 shows an indicative illustration of the improvements.

#### ***Traffic travelling east along Kurrajong Road***

- One through traffic lane to the east
- One shared left turn and through traffic lane to the east
- A right-turn lane into Bosworth Street (southbound)
- Ban parking on Kurrajong Road during peak hours.

#### ***Traffic travelling west along March Street***

- One through traffic lane to the west
- A shared left turn (to Bosworth Street south) and through traffic lane
- A shared right turn and through traffic lane
- A shared through and left turn lane
- Ban parking on March Street during peak hours.

#### ***Traffic travelling north along Bosworth Street***

- A shared right turn and through traffic lane
- A shared through and left turn lane.

#### ***Traffic travelling south along Bosworth Street***

- A shared right turn and through traffic lane
- A shared through and left turn lane.

## **2.9. Estimated cost and Benefit to Cost Ratio (BCR)**

The implementation of the short-term solutions at the three key intersections (Bosworth Street, Old Kurrajong Road / Yarramundi Lane and Grose Vale Road) is estimated to cost \$28 million (in 2012 dollars at P90). It will provide a Benefit to Cost Ratio (BCR) of 9.

## **2.10. Next steps**

Subject to the availability of funding, future activities for the implementation of the short-term improvements involve:

- Assessment of environmental impacts
- Further community consultation
- Planning approval
- Development of detailed designs
- Construction.

### **2.10.1. Design development**

The designs provided in this document are indicative strategic designs for each of the intersections studied. Further investigation and design development is required to produce detailed designs that can be considered for approval.

### **2.10.2. Review of Environmental Factors (REF)**

An REF will be carried out on the proposed intersection upgrades in accordance with Part 5 of the Environmental Planning and Assessment Act (1979). Community consultation will be part of the environmental assessment process.



NOT FOR CONSTRUCTION - 22/10/12

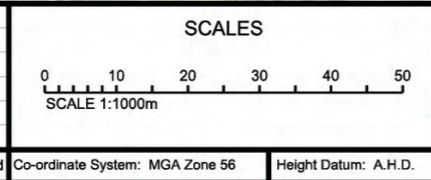


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**LEGEND**  
 - - - PROPOSED BOUNDARY

PRODUCED: 22/10/2012 AT 2:26:58 PM USER: wassellp  
 FILE PATH: K:\Design\pds\Bells\_Line\_of\_Rd\_Nth\_Richmond\Drawings\01\_Grose\_Vale\_Rd.dgn  
 PLOT DRIVER: c:\data\Bentley\WorkSpace\Standards\plotdrv\PDF-Full.plt  
 PEN TABLE: c:\data\Bentley\WorkSpace\Standards\table\PenTEXT\_SUBSTITUTIONS\_FOR\_COLOUR.tbl

No.	Amendment Description	Initials	Date
A3 original	This sheet may be prepared using colour and may be incomplete if copied		



**NSW** Transport  
 Roads & Maritime  
 Services

DESIGNED: .....

REVIEWED: .....

**ROADS AND MARITIME SERVICES**

HAWKESBURY COUNCIL  
 MR184 BELLS LINE OF ROAD, NORTH RICHMOND  
 INTERSECTION WITH GROSE VALE ROAD AND TERRACE ROAD  
 STRATEGIC DESIGN - INTERSECTION UPGRADE  
 DESIGN LAYOUT

FILE No. SF2012/040309_01_Grose_Vale_Rd.dgn	DRAWING	PRINTED DATE 22/10/2012	SHEET No. <b>01</b>
REGISTRATION NUMBER <b>DS2012/001118</b>			

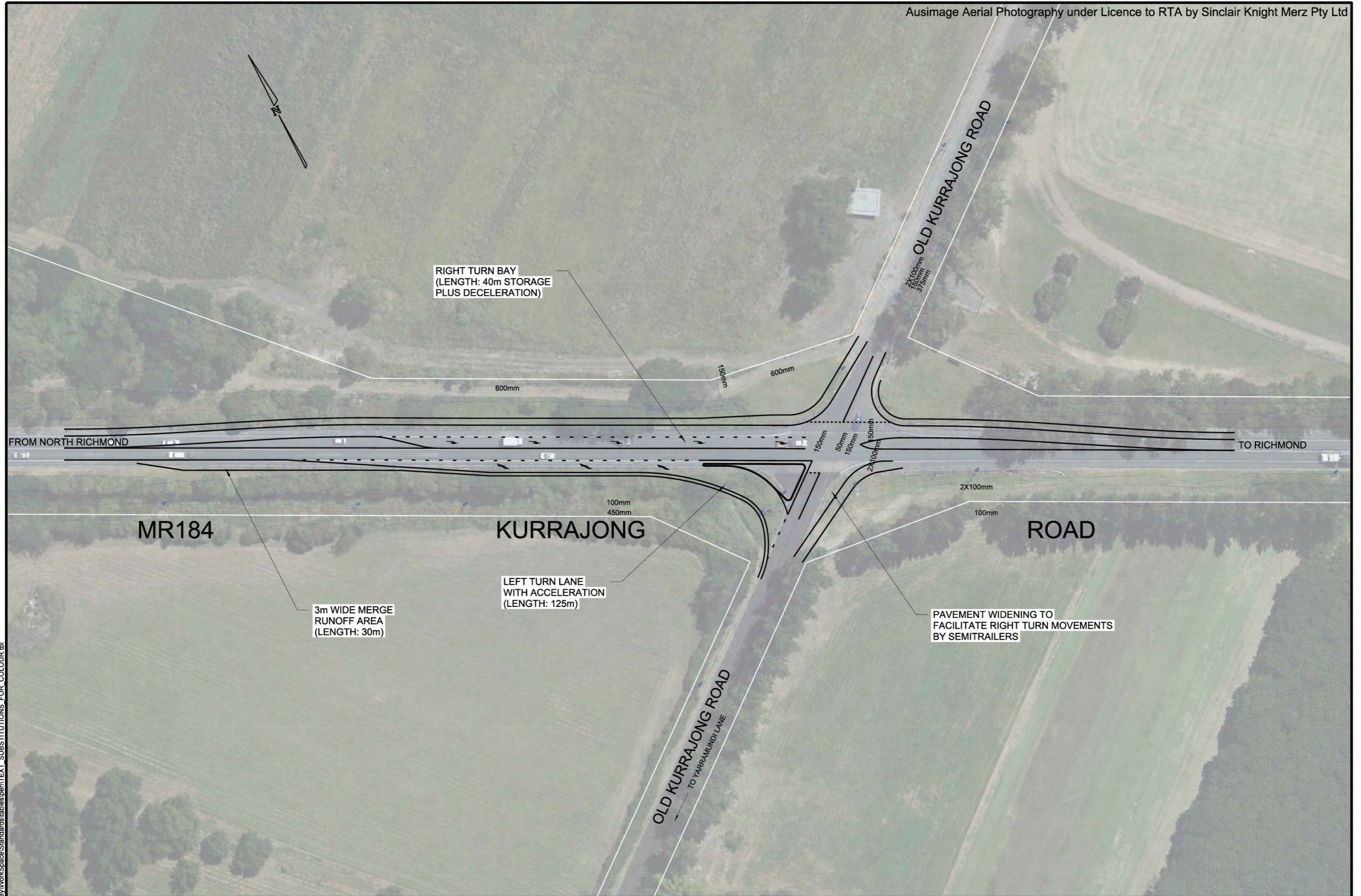
Figure 6 - Proposed improvements to the Bells Line of Road / Grose Vale Road / Terrace Road intersection



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NOT FOR CONSTRUCTION - 22/10/12



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PRODUCED: 22/10/2012 AT 2:29:07 PM USER: wasselp  
 FILE PATH: K:\Design\pds8\Beils\_Line\_of\_Rd\_Nth\_Richmond\Drawings\01\_Yarramundi\_Ln.dgn  
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No.	Amendment Description	Initials	Date
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**SCALES**

SCALE 1:1000m

Co-ordinate System: MGA Zone 56    Height Datum: A.H.D.

**NSW** Government  
**Transport**  
 Roads & Maritime  
 Services

DESIGNED.....  
 REVIEWED.....

**ROADS AND MARITIME SERVICES**

HAWKESBURY COUNCIL  
 MR184 KURRAJONG ROAD  
 INTERSECTION WITH OLD KURRAJONG ROAD, RICHMOND  
 STRATEGIC DESIGN - INTERIM INTERSECTION UPGRADE  
 DESIGN LAYOUT

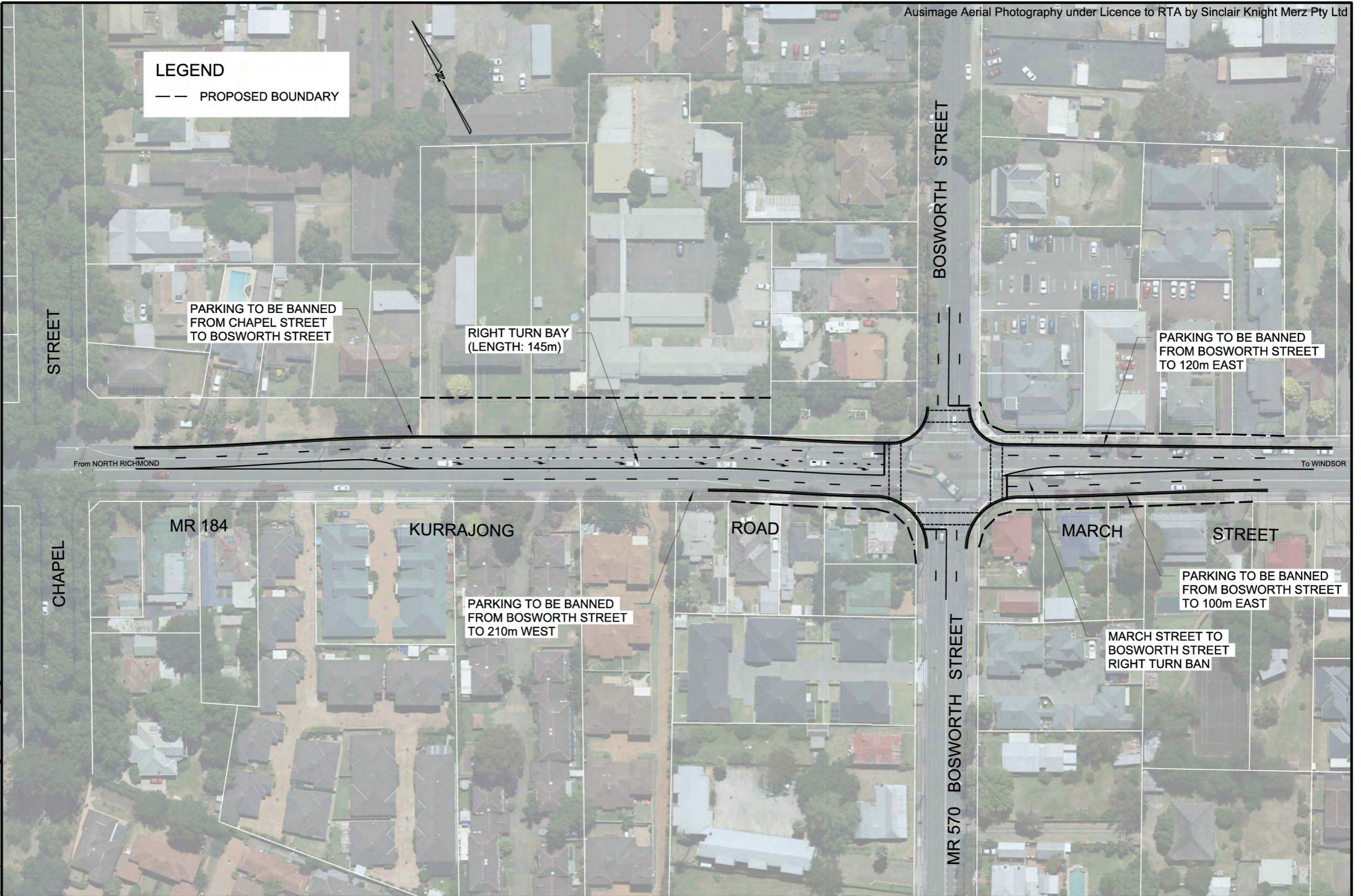
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REGISTRATION NUMBER <b>DS2012/001119</b>			

Figure 7 - Proposed improvements to the Kurrajong Road / Yarramundi Lane / Old Kurrajong Road intersection



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PRODUCED: 22/10/2012 AT 2:28:17 PM USER: wassellp  
 FILE PATH: K:\Design\88\Basis Line of Rd Nth Richmond\Drawings\01\_Bosworth\_St.dgn  
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 PEN TABLE: d:\data\Bentley\WorkSpace\Standards\table\PenTEXT.SUBSTITUTIONS\_FOR\_COLOUR.tbl

No.	Amendment Description	Initials	Date
A3 original	This sheet may be prepared using colour and may be incomplete if copied		

SCALES	
0	10 20 30 40 50
SCALE 1:1000m	
Co-ordinate System: MGA Zone 56	Height Datum: A.H.D.

**Transport**  
 Roads & Maritime  
 Services

DESIGNED: .....  
 REVIEWED: .....

**ROADS AND MARITIME SERVICES**

HAWKESBURY COUNCIL  
 MR184 KURRAJONG ROAD AND MARCH STREET  
 INTERSECTION WITH MR570 BOSWORTH STREET, RICHMOND  
 STRATEGIC DESIGN - INTERSECTION UPGRADE  
 DESIGN LAYOUT

FILE No.	DRAWING	PRINTED DATE	SHEET No.
SF2012/040309	01_Bosworth_St.dgn	22/10/2012	01
REGISTRATION NUMBER			
DS2012/001120			

Figure 8 - Proposed improvements to the Kurrajong Road / Bosworth Street / March Street intersection



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