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READYMIX

Proposed Readymix Regional Distribution Centre at Rooty Hill – Traffic Impact Study

Final Report – 23rd June 2005

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1. INTRODUCTION

READYMIX has commissioned Irwinconsult to conduct a traffic impact study for the proposed Regional Distribution Centre (RDC) on Kellogg Rd, Rooty Hill, NSW. This report has been produced for Readymix and describes the following:

- existing road infrastructure;
- existing traffic volumes and conditions;
- predicted traffic volumes and conditions as a result of operations at the RDC. In particular predictions substantially relate to the intersections of Kellogg Rd / Woodstock Ave, Glendenning Rd / Woodstock Ave and Power St / Glendenning Rd;
- traffic noise in the vicinity of the proposed Rooty Hill development site;
- site access points;
- capability of proposed routes; and
- cumulative traffic impacts.

The proposed Regional Distribution Centre would be developed to include:

- A regional office building, which incorporates a quarry materials and concrete testing laboratory;
- A rail siding with aggregate unloading facility;
- Storage Bin Area and Load out facilities;
- Ground storage and reclaim facilities;
- A Blending plant;
- A conveyor system linking the unloading station to the storage and truck load out facilities;
- Workshop, stores, and amenities facilities, truck washdown facilities, truck refuelling, weighbridges, truck and car parking;
- Concrete Batching Plant;
- Bridges at two locations over Angus Creek; and
- Realignment of North Parade.

The maximum operating capacity of the site will be 4 Mtpa (Million tonnes per annum).

Construction of the site, and in particular the construction related traffic and timings, are not assessed in this document. However they are described and analysed in a separate report titled '*Proposed Readymix Regional Distribution Centre – Construction Traffic Impact Study'*, which is to be read in conjunction with this Traffic Impact Study.

The suburb of Rooty Hill forms part of the Blacktown City LGA (Local Government Area).

This study has been prepared in accordance with the methodology outlined in the 'RTA's Guide to Traffic Generating Developments – Traffic Impact Studies'.

2. THE DEVELOPMENT

2.1 Site Locations and Accessibility

The proposed site development is located along the south-eastern boundary of Kellogg Road which is predominately an industrial area (see Figure 1).

The existing access point to the development is approximately:

- 3.6 kilometres north of the M4 motorway interchange
- 600m from the planned half diamond M7 interchange with Woodstock Ave (current Phillip Parkway / Woodstock Ave intersection); and
- 2 kilometres south of the proposed half diamond M7 interchange with Power St.

All vehicles (heavy and light) associated with the site will utilise parts of either Woodstock Ave, Glendenning Rd / Power St or the Westlink M7 (upon its completion) to access the site.

It should be noted that all heavy vehicle movements related to the RDC will utilise the M7 and will not encroach on residential streets. This includes the delivery of dangerous goods such as fuel to the site.

Table 2.1 outlines the average daily traffic generation from the RDC under maximum operating capacity (4Mtpa).

Table 2.1 Traffic Generation at the site (average Daily) – during maximum operating capacity

	Type of Vehicle	No. of vehicles entering site per day	No of vehicles exiting site per day
Staff	Car	**185**	**185**
Aggregate distribution	Heavy vehicle	**400**	**400**
Concrete deliveries	Agitator	**133**	**133**
General deliveries	Car / Van	**50**	**50**
Special deliveries	Heavy vehicle	**18**	**18**

A rail siding / aggregate unloading and storage area will be constructed as part of the development to receive aggregate deliveries to the site. As a result no aggregate deliveries to the site will be made by trucks under normal operating conditions when the rail siding is operational. However some products will be bought on-site via heavy vehicles, but these will be on a 'backload' basis therefore will not generate any additional vehicle movements.

The proposed RDC is not scheduled to become operational until 2008, and will open only after the M7 is commissioned. This report will analyse existing and predicted post development traffic for Kellogg Road, Woodstock Ave and Glendenning Road mainly, with some comments provided for Power St.

An assessment of the proposed M7 signalised interchanges with Woodstock Ave and Power St have been completed (Section 4.4), providing a preliminary estimate of the additional turning movements expected at the interchanges and its corresponding impact on performance.

The M7, upon completion, will be a high capacity motorway, able to accommodate around 6,000 - 8,000 vehicles per hour (two-way). The expected traffic generated from the RDC site (maximum of 295 total vehicle movements in the peak hour - of which not all will use the M7) will be minor in comparison and will therefore have negligible impacts on the performance of the motorway. The proposed on and off-ramps of the M7 will allow vehicles to accelerate and decelerate safely upon entering or exiting the motorway.

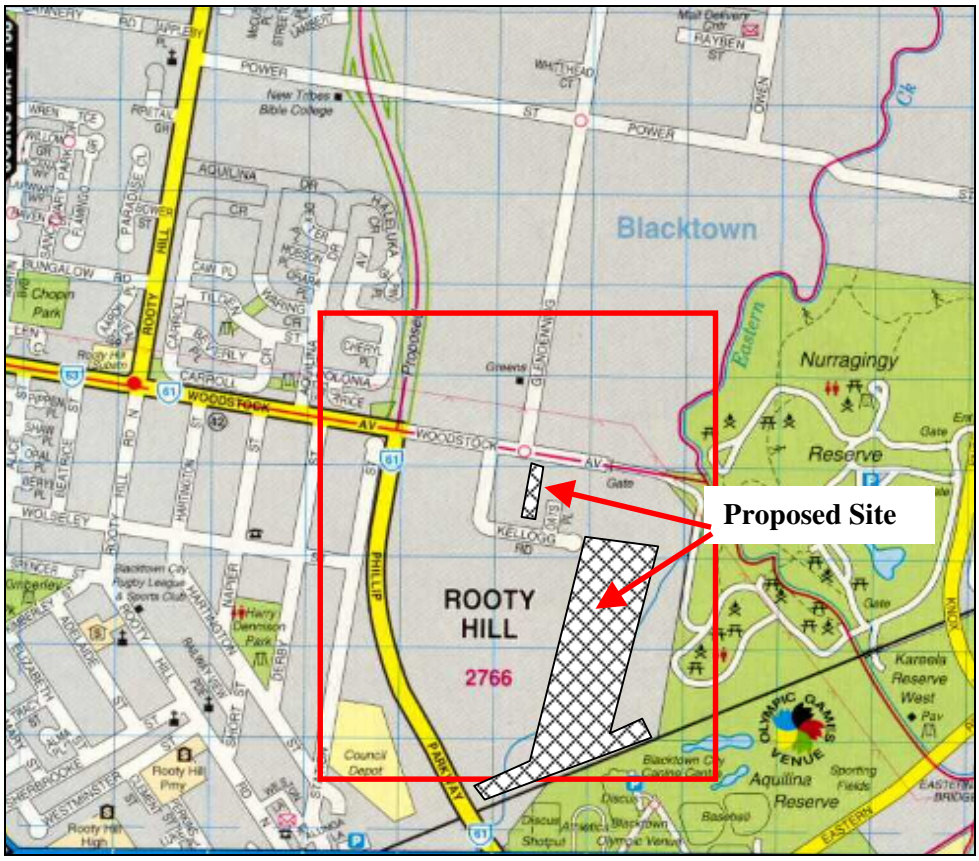


Figure 1: Development Location

2.2 Landuse

Land-use surrounding Kellogg Road comprises of:

- Nurragingy Reserve;
- One Steel Mini Mill;
- Humes Concrete Products; and the
- Western Rail Line.

North Parade, south of the site, is a Council Road reserve running parallel to the Main Western Railway from the riparian corridor of Eastern Creek to Phillip Parkway / M7 Motorway.

The Main Western Railway Corridor, within the vicinity of the site, runs between Eastern Creek and Rooty Hill Station.

2.3 The Westlink M7 motorway

The Westlink M7 motorway is a new 40km long tolled motorway currently under construction. The motorway has dual carriageways which will be constructed to link the M5/Hume Highway at Prestons and the M2 at West Baulkham Hills. This together with the Lane Cove Tunnel are the missing link to complete the Sydney Orbital Road.

The new motorway alignment firstly travels Northwest from the M5/Hume Highway and Camden Valley Way at Prestons to Elizabeth Drive at Cecil Park. From Cecil Park, the route travels north, with the road alignment running parallel and to the east of Wallgrove Road, and cross the M4 Motorway and the Great Western Highway at Eastern Creek. North of the Great Western Highway, at Rooty Hill, the road alignment follows the **Phillip Parkway** corridor to Richmond Road then turns east along the Castlereagh motorway corridor alignment linking onto the existing M2 motorway at West Baulkham Hills. The existing Phillip Parkway will form part of the overall 'orbital' network.

Work on the motorway began in late 2003 and is currently scheduled to open to traffic in late 2006, prior to the opening of the proposed Regional Distribution Centre.

The M7 design incorporates an interchange at Woodstock Ave which will allow northbound traffic to exit and southbound traffic to enter the motorway. This interchange will be 'grade separated' with the M7 passing over Woodstock Ave. The additional Power Street Interchange located approximately 1km north of the Woodstock Ave Interchange, permits access onto the M7 for northbound traffic and exit ramps will be provided for southbound traffic. The motorway will pass under Power St at this interchange. Figure 2 shows the location of the M7 interchanges in relation to the proposed RDC.

The proposed M7 interchanges at Woodstock Ave will consist of two co-ordinated signalised intersections (approx. 55m apart), one for each of the on and off ramps. The southbound on-ramp will be constructed approximately 215m west of Kellogg Rd.

The Power St interchanges will also include two co-ordinated signalised intersections of similar separation to the Woodstock interchange. These will be constructed approximately 500m west of Glendenning Rd.

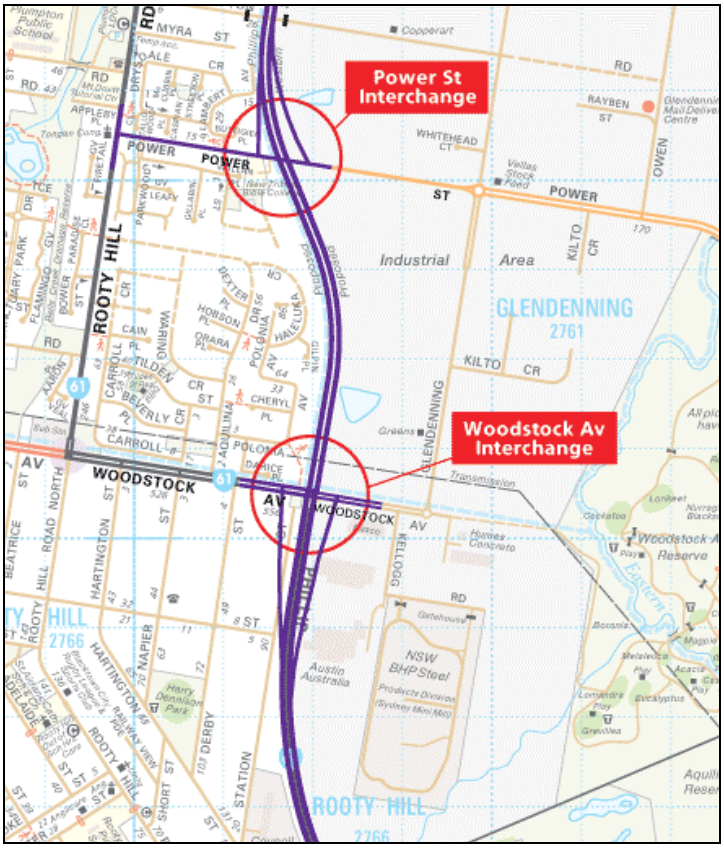


Figure 2 Location and configuration of M7 interchanges

As stated in RTA's modelling results for the proposed M7, the opening of the motorway will reduce traffic levels along the Rooty Hill Road South by approximately 58%. It is also estimated that a potential reduction in traffic of approximately 68% will be experienced along the Rooty Hill Road North.

According to the RTA's M7 modelling, *the commissioning of the M7 is not expected to increase traffic along Woodstock Ave (east of the Phillip Parkway - M7) or Power St.* However general background growth in the region is envisaged to continue. Historical trends suggest this will be in the order of 1.5 to 2.5% per annum.

As well as the interchanges identified above, the M7 project will incorporate some other infrastructure upgrades deemed necessary to meet the change in traffic patterns in the Rooty Hill area. These include:

- The upgrading of the Rooty Hill Rd North / Woodstock Avenue intersection to provide improved traffic flow and safety for vehicles, pedestrians and cyclists; and
- An additional two traffic lanes (total of four) on Power St near the proposed M7 interchange to improve capacity and traffic flow.

These additional infrastructure upgrades will help further improve vehicle and pedestrian efficiency and safety in the area.

3. EXISTING TRAFFIC CONDITIONS

3.1 Existing Road and Intersection Inventory

Visual reconnaissance surveys were conducted at the main intersections in the vicinity of the site. The characteristics of each intersection such as the traffic control devices, layout, queue length, potential vehicular conflicts etc., were recorded and assessed. These observations were useful in determining the existing performance of the intersections.

From the surveys it was identified, that the AM peak period had higher traffic volumes compared to the PM peak period. This is probably related to 'through' traffic volumes and shift work at the industrial developments surrounding Intersection 1 and 2. Figure 3 shows the location of the main intersections whilst Figure 4 provides the existing intersection layout of the following intersections;

Intersection 1 – Woodstock Avenue / Phillip Parkway

Prior to the construction of the M7, this intersection was under give-way control, with priority given to Woodstock Ave. However, at the time of the 'existing' conditions surveys this intersection was beginning to be upgraded as part of the M7 interchange at Woodstock Ave, hence had become signalised.

A significant amount of traffic was observed to pass between the Woodstock Ave (West) and Phillip Parkway during the AM peak period. This intersection also serves as a main link to Glendenning Road and to the Industrial developments along east of Woodstock Avenue. 'Through' traffic movements at the intersection consist of mainly cars and light vehicles and low percentages of heavy vehicles. Whilst the right turn movement from Phillip Parkway has relatively low traffic volumes it consists of 26% heavy vehicles.

At the time of the Regional Distribution Centre's completion this intersection will be fully grade separated and signalised as part of the M7 project.

Intersection 2 – Woodstock Ave / Kellogg Road

This is a traditional T-intersection under give-way control. Traffic levels at this intersection are mainly associated with Industrial developments in Kellogg Road. The highest traffic volume occurs during the AM peak period. During the survey, it was observed that the intersection had a high percentage of heavy vehicles compared to the other intersections in this area, due to the existing industrial sites serviced by Kellogg Rd.

Intersection 3 – Woodstock Ave / Glendenning Road

This is a three-leg roundabout. The main traffic movements are those associated with travel between Phillip Parkway and Glendenning Road, ie. left turn from Woodstock Ave into Glendenning Rd and the right turn from Glendenning Rd into Woodstock Ave. The eastern intersection arm serves an Industrial development and carries low traffic volumes. The highest traffic flows occur during the morning peak period during shift changes and deliveries. The eastern leg of the intersection now provides access to the Nurragingy Reserve during the day, which is closed (via a gate) in the evenings.

Intersection 4 – Power St / Glendenning Road

This is a four-leg roundabout with two circulating lanes. The western leg of Power St has one approach lane, whilst all other approaches have two. This intersection provides for most of the industrial traffic movements in the area and will become increasingly important as the M7 interchange at Power St becomes operational.

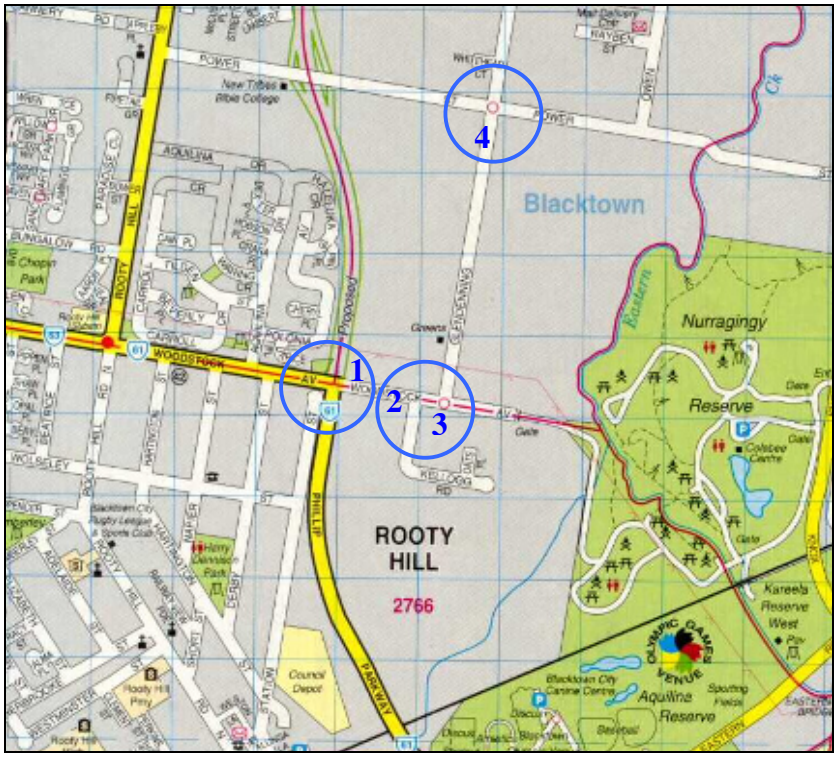
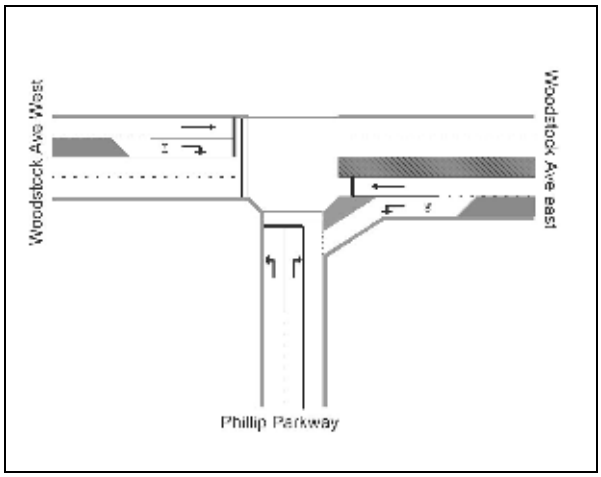
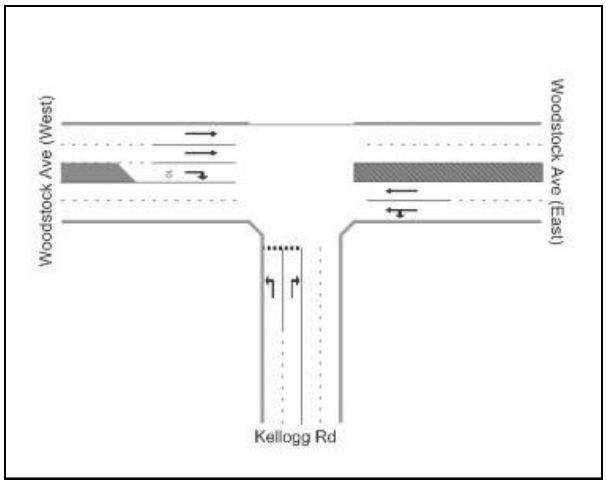


Figure 3: Location of Intersections

Pedestrian paths are provided on the southern side of Woodstock Ave near Kellogg Rd and along parts of Glendenning Rd. There are no designated on-street cyclist facilities in the region apart from those proposed for the M7 Motorway and North Parade.

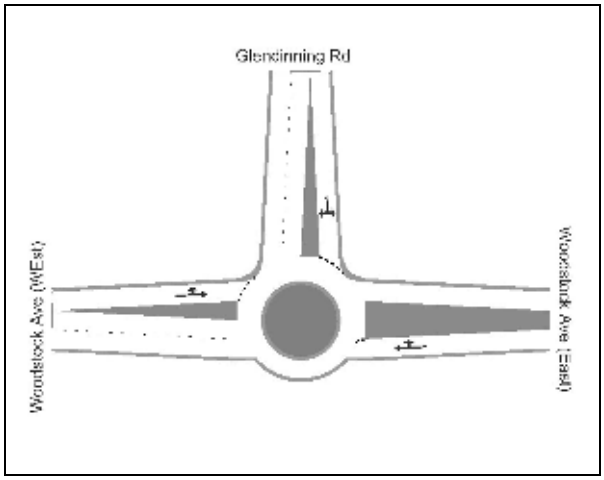


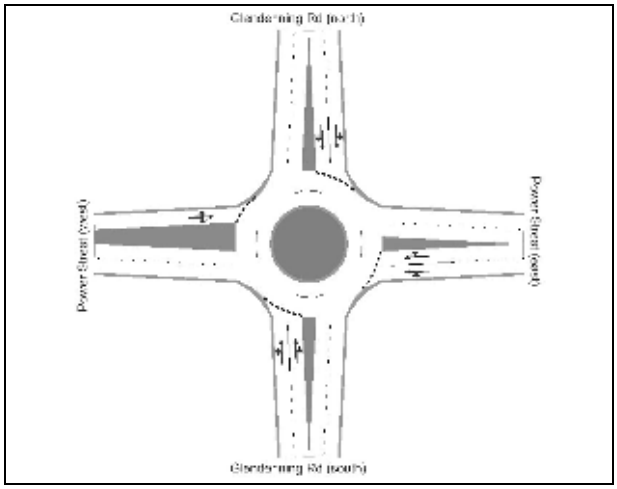


Note: this not the original layout of the intersection as it has since been transformed to signalisation as part of the M7 interchange construction.

INTERSECTION 1: PHILLIP PARKWAY / WOODSTOCK AVE

INTERSECTION 2: KELLOGG ROAD / WOODSTOCK AVE





INTERSECTION 3: GLENDENNING ROAD / WOODSTOCK AVE

INTERSECTION 4: GLENDENNING ROAD / POWER ST

Figure 4: Existing Intersection Layouts

General traffic movement in the area

Within the vicinity of the RDC site, the most trafficked roads are currently Phillip Parkway, Woodstock Ave (west of Phillip Parkway) and Rooty Hill Rd Nth, as vehicles utilise these routes to gain access to the wider arterial network of the area, such as the M4.

This was identified in the high proportion of turning movements surveyed at the Phillip Parkway / Woodstock Ave intersection, particularly turning right into and left out-of the Phillip Parkway (as seen in Figure 5). It would be expected that the majority of the vehicles using this main route would be 'through' traffic, aiming to access other roads.

However, traffic on Woodstock Ave (east of Phillip Parkway) and Glendenning Rd would be more 'localised', required to use these road sections to directly gain access from their origin or to their destination.

Traffic utilising Kellogg Rd is purpose-based, providing access to businesses on this road, with no 'through' traffic.

Access to the nearby Nurragingy Reserve can now be obtained (during daylight hours) from Woodstock Ave, east of the Glendenning Rd intersection and provides an alternative to the other access point on Knox Rd. Entry into the Reserve will be restricted via a gate, opened approximately 8.00am and closed around 4.30 – 6.00pm, depending on the time of year. This is expected to slightly increase traffic volumes along Woodstock Ave as visitors use this access point, however the impacts are expected to be minimal.

Public Transport in the area

Two public transport (on-street buses) routes run along Woodstock Ave and Glendenning Rd, but only provided outside of the assessed peak hour periods.

Route 756G runs between Mt Druitt and the Glendenning industrial area approximately 4 times a day (each way), with most services operating prior to 7am.

Route 757 operates between Rooty Hill Rd North and Mt Druitt, but only utilises Woodstock Ave and Glendenning Rd on five of its services throughout the day. All other services on this route skip this area and act as an 'express' between origin and destination.

Bus stops for these bus services , within the vicinity of the RDC, are located on:

- Woodstock Ave – near Kellogg Rd;
- Glendenning Rd – near Woodstock Ave; and
- Glendenning Rd – near Power St.

Busways Blacktown are the service provider for these routes and their bus depot is located on Glendenning Rd, north of Power St.

Road pavement condition

Current pavement condition along Woodstock Ave, Kellogg Rd and Glendenning Rd is of an acceptable standard, with no obvious pot-holes or cracking. Kerbing is located on all sections of these roads within the vicinity of the site.

Continued maintenance of these roads is a Council responsibility, as they are not under RTA control.

3.2 Total Traffic Volumes

Annual Average Daily Traffic (AADT) along Phillip Parkway (was obtained from RTA permanent count site located near to the Rooty Hill train line) for both 1999 and 2002. The two way traffic volumes are 12,565 and 13,708 respectively. This shows an annual growth of approximately 2.5%.

The two-way AADT along Woodstock Ave between Phillip Parkway and Kellogg Rd (obtained from RTA permanent count site 71.168) for 1999 and 2002 are 9,638 and 10,549 respectively. This shows an annual growth of around 3%.

During the week, Phillip Parkway traffic peaks between 0600 and 0900 hours in the morning and between 1500 and 1800 hours in the afternoon. During both these periods, two-way traffic volumes increase to over 1,100 vehicles per hour. During the weekend, traffic levels are lower with approximately 700 vehicles per hour (two-way) between 0900 and 1900 hours.

3.3 Traffic Surveys

Irwinconsult conducted a traffic survey of the development area 1st December 2004, which was deemed to be a representative day. The traffic counts included light and heavy vehicle turning movements throughout the period and were conducted at the following intersections:

- Woodstock Ave / Phillip Parkway;
- Woodstock Ave / Kellogg Road;
- Woodstock Ave / Glendenning Road and;
- Glendenning Road / Power St

Total daily and hourly traffic volumes recorded along Woodstock Ave were similar to the published RTA counts data. The hourly traffic profiles of the area, supplied by RTA, indicated that the AM peak was the most severe (ie. largest hourly traffic volume). Additionally, as the RDC will create more vehicular activity during the morning peak hour, this period was deemed the most critical.

As a result traffic counts were conducted between 7.00am-9.00am and the AM peak hour was found to be between 7.30am –8.30am.

Counts along Woodstock Ave and Glendenning Rd during the surveyed peak period are summarised in Figure 5. Heavy vehicles for the morning peak traffic travelling on Woodstock Ave vary between 10%-15%.

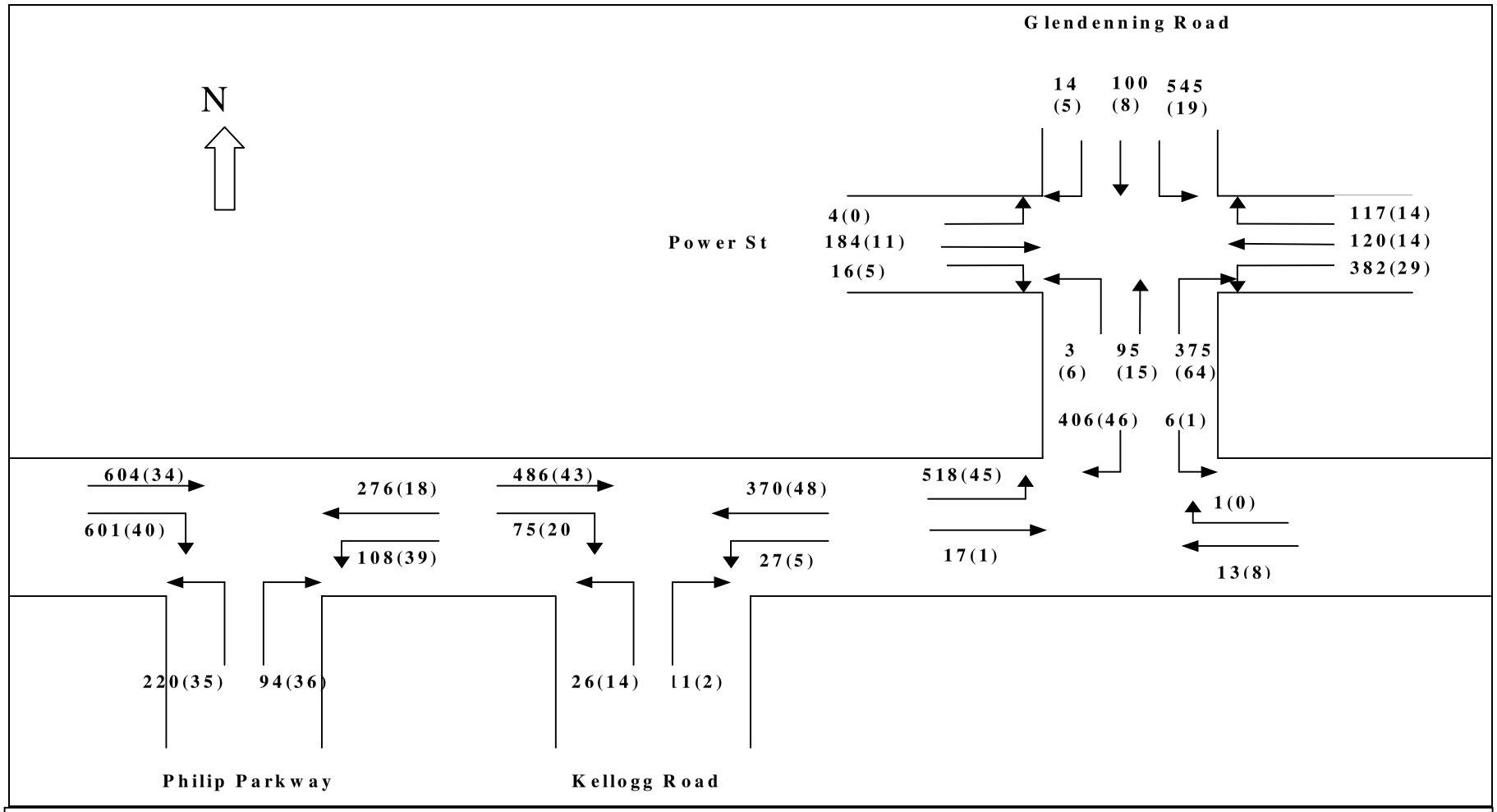


Figure 5: **Peak Hour Traffic Flows on Woodstock Avenue (7.30am – 8.30am)**

Legend 300 Light Vehicles
(20) Heavy Vehicles

3.4 Existing Intersection Performance

The operational performances of the existing intersections were analysed using aaSIDRA Version 2 (Signalised & Unsignalised Intersection Design and Research Aid), which is an advanced intersection analysis software developed by Akcelik and Associates Pty Ltd (Research and Software for Transport).

The performance of an intersection is usually measured in terms of the delay, queue length and the degree of saturation. The delay for each movement includes deceleration and acceleration delays for the major stop experienced by queue vehicles, as well as the geometric delays experienced by all vehicles negotiating the intersection.

The queue length is the 95th percentile back of the queue length for a movement. The 95th percentile back of queue length is the value below 95% of all observed cycle queue lengths fall.

The degree of saturation is defined as the ratio of demand flow to roadway capacity.

The Level of Service assessment of these intersections were based on the New South Wales RTA's 'delay method', which is ma inly associated with the delay encountered by vehicles at an intersection. Intersection performance is ranked as a Level of Service as follows:

LoS	Description
A or B	Very Good
C	Good
D	Acceptable
E or F	Bad

Analyses were carried out for the four intersections mentioned in section 3.1 using the 1st December 2004 traffic counts. Only the AM peak period intersection performances were analysed, as it was observed to be the most critical peak period for vehicular movement around the site. The PM peak period experienced lower traffic volumes than the corresponding morning peak.

Results of the analyses are shown below in Tables 3.1, 3.2, 3.3 and 3.4.

Table 3.1 Existing Performance of Intersection 1 – Woodstock Ave / Phillip Parkway (AM peak)

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Phillip Parkway – south of intersection (NB)					
Left	13	37	0.193	A	≤D
Right	62	76	0.659	E	≤D
Woodstock Ave – west of intersection (EB)					
Through	5	119	0.515	A	≤D
Right	19	93	1.000	B	≤D
Woodstock Ave – east of intersection (WB)					
Left	9	3	0.126	A	≤D
Through	54	88	0.880	D	≤D

Source: aaSIDRA analysis

Table 3.2 Existing Performance of Intersection 2 – Woodstock Ave / Kellogg Road (AM peak)

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Kellogg Rd – south of intersection (NB)					
Left	16	3	0.098	B	≤D
Right	33	2	0.095	C	≤D
Woodstock Ave – west of intersection (EB)					
Through	0	0	0.143	A	≤D
Right	15	6	0.271	B	≤D
Woodstock Ave – east of intersection (WB)					
Left	10	0	0.125	A	≤D
Through	0	0	0.125	A	≤D

Source: aaSIDRA analysis

Table 3.3 Existing Performance of Intersection 3 – Woodstock Ave / Glendenning Road (AM peak)

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Glendenning Rd – north of intersection (SB)					
Left	13	12	0.275	A	≤D
Right	13	12	0.275	A	≤D
Woodstock Ave – west of intersection (EB)					
Left	7	16	0.358	A	≤D
Through	7	16	0.358	A	≤D
Woodstock Ave – east of intersection (WB)					
Through	9	1	0.032	A	≤D
Right	9	1	0.032	A	≤D

Source: aaSIDRA analysis

Table 3.4 Existing Performance of Intersection 4 – Glendenning Rd / Power St (AM peak)

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Glendenning Rd – south of intersection (NB)					
Left	14	9	0.220	A	≤D
Through	11	9	0.217	A	≤D
Right	15	22	0.419	A	≤D
Power St – east of intersection (WB)					
Left	9	13	0.277	A	≤D
Through	8	11	0.245	A	≤D
Right	14	11	0.246	A	≤D
Glendenning Rd – north of intersection (SB)					
Left	23	81	0.762	B	≤D
Through	18	16	0.366	B	≤D
Right	24	16	0.365	B	≤D
Power St – west of intersection (EB)					

Left	13	17	0.373	A	≤D
Through	13	17	0.373	A	≤D
Right	13	17	0.373	A	≤D

Source: aaSIDRA analysis

It should be noted that Power Street is *not* currently a defined B-Double route. This should be upgraded to allow for such heavy vehicle movements, particularly considering the industrial nature of the area and its future interchange with the M7.

The results of the intersection analysis show that both Intersection 2 and 3 are operating below capacity i.e. at LoS 'A' during the AM peak period. The Power St / Glendenning Rd roundabout (intersection 4) is operating an overall LoS 'B'. Each has spare operating capacity to accommodate additional traffic movements.

The Woodstock Ave / Phillip Parkway Intersection (Intersection 1) is also operating at an acceptable overall level of service i.e. LOS 'B', even though it has LoS 'D' for the westbound through movement on Woodstock Ave and LoS 'E' for the right turn out of Phillip Parkway. These delays are primarily as a result of the increased 'green time' given to the high volume of traffic approaching the intersection from Woodstock Ave west (through and right turn). This intersection serves as the main intersection for through traffic from Phillip Parkway to Glendenning Road and to the Industrial developments on Kellogg Road.

With the construction of the M7, and subsequent 'grade separation' and signalisation of this interchange, vehicle interaction will be minimised and therefore intersection performance will improve.

3.5 Road Accidents

Irwinconsult has reviewed the last five years accident data for Woodstock Ave between Phillip Parkway and Glendenning Road. The latest statistics on reported accidents were obtained from RTA's Crash Analysis Department for a five-year period from March 1999 to March 2004.

A summary of the reported accidents at these points can be seen below in Tables 3.5, 3.6, 3.7 and 3.8.

Over the last five years, 33 accidents occurred in the immediate vicinity of Phillip Parkway / Woodstock Ave intersection. Table 3.5 summarises the total recorded accidents at this priority junction.

Table 3.5 Reported Accident Statistics from March 1999 to March 2004 – intersection of Phillip Parkway / Woodstock Ave

Accident Type	RUM Code	Number of accidents involving property damage only	Number of accidents involving an injury	Number of accidents involving a fatality
Vehicles striking from adjacent directions	100	1	Nil	Nil
Vehicles striking from adjacent directions – cross traffic	101	1	1	Nil
Vehicles striking from adjacent directions – right thru from left	102	1	Nil	Nil
Vehicles striking from adjacent directions – right thru from right	104	5	3	Nil
Vehicles striking from adjacent directions – left thru from right	107	1	2	Nil
Vehicles striking from opposing directions – right thru	202	6	7	Nil
Rear end collision into left turning vehicle	302	1	3	Nil
Left turn side swipe	309	1	Nil	Nil
TOTAL		***17***	***16***	***NIL***

Source: NSW RTA's Crash Analysis Department

During this period 33 accidents occurred, 17 involving property damage only, 16 involving an injury and none resulting in a fatality. 18% of the accidents included one or more heavy vehicles.

The analysis shows that 80% of the accidents took place on weekdays, with 33% of the total accidents occurring during the weekday peak periods (between 6am – 9am and 3pm-6pm). The calendar year of 2002 included the highest number of accidents in the analysis period, as shown in Table 3.6.

Table 3.6 Yearly summary of accidents at Phillip Parkway / Woodstock Ave intersection

Year	Total number of Accidents
1999	1
2000	5
2001	8
2002	10
2003	9
***2004**	0
Total	**33**

** 25 percent completed in analysis period*

With the imminent completion of the M7 motorway and subsequent grade-separated interchange at this location (including signalisation), the risk of accident will be greatly diminished.

The nearby intersection of Kellogg Rd with Woodstock Ave is currently utilised by local traffic not only for the existing developments in Kellogg Rd, but also industrial businesses on Glendenning Rd. A summary of the reported accidents this intersection can be seen below in Table 3.7.

Table 3.7 Reported Accident Statistics from March 1999 to March 2004 – intersection of Kellogg Rd / Woodstock Ave

Accident Type	RUM Code	Number of accidents involving property damage only	Number of accidents involving an injury	Number of accidents involving a fatality
Lane side swipe	305	1	Nil	Nil
Left turn side swipe	309	1	Nil	Nil
TOTAL		***2***	***Nil***	***NIL***

Source: NSW RTA's Crash Analysis Department

During the last five years only 2 accidents have occurred at this intersection, both involving property damage only. One of the accidents involved a heavy vehicle, while the other included passenger cars only. Each of these incidents occurred in 2001 and 2002 respectively.

The final intersection assessed was the Kellogg Rd / Glendenning Rd roundabout. The accident statistics are outlined in Table 3.8.

Table 3.8 Reported Accident Statistics from March 1999 to March 2004 – intersection of Woodstock Ave / Glendenning Rd

Accident Type	RUM Code	Number of accidents involving property damage only	Number of accidents involving an injury	Number of accidents involving a fatality
Vehicle left of carriageway into object	703	1	Nil	Nil
Vehicle leaves carriageway during right turning manoeuvre	707	1	Nil	Nil
TOTAL		***2***	***Nil***	***NIL***

Source: NSW RTA's Crash Analysis Department

Both of the recorded accidents at this intersection resulted in property damage only, with no heavy vehicles involved. One of the incidents occurred in 1999, while the other was in 2001.

Even though there have been 37 accidents along this stretch of Woodstock Ave (between Phillip Parkway and Glendenning Rd) during the last five years, the accident rate is not considered 'critical'. There is no obvious pattern associated with the accident statistics in this area.

The Phillip Parkway / Woodstock Ave intersection has been the largest source of these accidents and its upgrading to a grade-separated signalised interchange for the M7 motorway project will reduce its accident rate and improve the overall road safety of the Woodstock Ave environment.

4. EXPECTED TRAFFIC IMPACTS OF THE PROPOSED READYMIX SITE

This section examines the expected traffic impacts of the proposed Readymix Regional Distribution Centre upon the existing surrounding road network, in particular the intersections of Kellogg Rd / Woodstock Ave, Glendenning Rd / Woodstock Ave and Glendenning Rd / Power St.

The existing Woodstock Ave / Phillip Parkway intersection will not be examined as it will be updated as part of the M7 project.

4.1 The Proposed Development

The proposed development of the Readymix site will involve the construction of a Regional Distribution Centre. It is expected to become operational around 2008.

The RDC includes the construction of a rail unloading area, from which aggregate supplies will be delivered to the site. Concrete distribution will be via concrete agitators out of Kellogg St, as part of the Concrete Batching Plant. Aggregates will be distributed from the site to the Sydney market by road.

This development will generate traffic due to the employee movements and the distribution of aggregates and concrete from the site. All heavy vehicle access to the facility will be via Kellogg Road and the M7.

On completion of the office and laboratory some Humes and laboratory staff will enter the site through the Humes entrance on Woodstock Avenue, while the remaining staff and laboratory staff will enter via Kellogg Road and park in the new carpark under the office and laboratory buildings.

The remaining RDC staff will use the new main carpark at the end of Kellogg Rd.

The centre is to operate twenty-four hours a day, seven days a week.

4.1.1 Aggregate Distribution routes

Aggregate deliveries to the proposed site will be from the new rail siding area. Aggregate distribution will still be made from the site to the Sydney market by road via the M7.

All of these heavy vehicle distribution routes will utilise the Westlink M7.

Therefore the trucks will either access the southbound lanes of the motorway directly from Woodstock Ave, or travel via Glendenning Rd and Power St to access the northbound lanes. The opposite will occur for distribution trucks returning to the site.

4.2 Vehicle Trip Generation and Distribution

The four most predominant vehicle movements at the site will be:

- Employee's cars;
- Laboratory and other deliveries (light vehicles);
- Concrete delivery trucks (agitators); and
- Trucks distributing aggregate to other Readymix sites and customers (heavy vehicle).

The following is an estimate of the expected 'average daily' traffic movements at the Regional Distribution Centre under *maximum* operating capacity.

RDC related traffic (average daily movements – maximum operating capacity)

- Employee's cars – 370 total for the day (185 into the site and 185 out). These vehicles will utilise both the existing Humes carpark and the proposed RDC site carpark. All will utilise Kellogg Rd to gain access to these parking areas;

(note: some existing Humes employees will enter directly off Woodstock Ave, but these form part of the 'existing conditions' and will not change as a result of the RDC development)

- Laboratory and other deliveries – 100 total for the day (50 in and 50 out);
- Concrete agitators – 266 total for the day (133 in and 133 out);
- Tanker deliveries via the M7 (cement / flyash) – 36 per day (18 in and 18 out)
- The distribution of aggregates (via trucks on the M7) – 800 total for the day (400 in and 400 out)

The origin and destination of future employee vehicles to and from the site is difficult to predict. As such a directional split was estimated based on the land use around the site.

The usage of concrete agitators for deliveries is also difficult to quantify, as these are required to be accessible to all markets in the area and delivery locations would change from day to day.

The distribution of aggregates from the site is to be made by heavy vehicles to the Sydney market. These vehicles will all utilise the M7 and are assumed to be split **40/60** between northbound and southbound traffic lanes. However this will vary to suit the market demand.

4.2.1 Traffic Generation in the critical AM peak hour

For this site the AM peak hour will be the most critical, as this will be the busiest time in terms of concrete and aggregate distribution and also exhibits the highest levels of background traffic throughout the day. As a result, more delivery trucks will leave and return to the site in this period compared to the 'average hour' during the day.

RDC staff shifts will be staggered, with the first of the day shift employees arriving at 5.00am. The majority of the employees (mainly concrete agitator drivers and the laboratory staff) will be on-site prior to 7.00am, therefore outside of the defined 'peak hour' for the surrounding network. *As such, these movements will not be included in the AM peak analysis.*

However, some of the RDC are expected to arrive during this peak period (and park in either the Humes carpark or main site carpark via Kellogg Rd).

The critical extra traffic volumes are those associated with the heavy vehicles, as they exhibit much slower acceleration and deceleration characteristics than cars and their movements will correspond with the AM traffic peak in the area.

In order to assess a 'worst case' scenario for all intersections, the *maximum* peak hour vehicle output under maximum operating conditions was used.

The maximum vehicle trip generation to be produced in the defined AM Peak Hour by the facility is estimated at:

Table 4.1 Traffic Generation at the site (AM Peak hour) – maximum output

	Type of Vehicle	No. of vehicles entering site in AM Peak hour	No of vehicles exiting site in AM Peak hour
Staff (into Humes carpark)	Car	**55** (all via Kellogg Rd)	**0**
Aggregate distribution	Heavy vehicle	**80**	**80**
Concrete deliveries	Agitator	**28**	**28**
Special product deliveries	Heavy vehicle	**2**	**2**
General deliveries	Car / Van	**10**	**10**

Source: Readymix

4.2.2 Traffic Distribution in the AM peak hour

The anticipated directional breakdown of these AM peak vehicles movements are listed below.

Employees cars (RDC) – expecting 185 in and 185 out, average per day

- estimated 55 cars entering the existing Humes carpark in the AM Peak hour via Kellogg Rd
  - ♣ 28 coming from Glendenning Rd and Power St (mainly from southbound M7 lanes)
  - ♣ 27 along Woodstock Ave and the northbound M7 lanes then turning right into Kellogg Rd

General deliveries to RDC and Laboratory – expecting 50 in and 50 out, average per day

- estimated 10 vehicles entering site during AM Peak hour
  - ♣ 5 coming in from Glendenning Rd (mainly from southbound M7 lanes)
  - ♣ 5 coming in from Woodstock Ave west and northbound M7 lanes

- estimated 10 vehicles exiting the site in the AM Peak hour
  - ♣ 5 turning right and then heading up Glendenning Rd towards northbound lanes of M7
  - ♣ 5 turning left onto Woodstock Ave.

Special product deliveries to the site (expecting 18 in and 18 out, average per day)

- estimated 2 heavy vehicles entering the site during the AM Peak hour
  - 1 coming from Glendenning Rd and Power St (from southbound M7 lanes)
  - 1 coming from Woodstock Ave west and M7 northbound lanes.

- estimated 2 heavy vehicles exiting the site during the AM Peak hour
  - 1 turning right and then heading up Glendenning Rd towards northbound lanes of M7
  - 1 turning left onto Woodstock Ave towards southbound M7 lanes.

Distribution of aggregates to the other sites (expected to be 400 in and 400 out, average per 24hr day)

- estimated 80 heavy vehicles entering site during AM Peak hour
  - 32 coming in from Glendenning Rd (All from southbound M7 lanes)
  - 48 coming in from Woodstock Ave west (from northbound M7 lanes)

- estimated 80 heavy vehicles exiting the site in the AM Peak hour
  - 32 turning right and then heading up Glendenning Rd towards northbound lanes of M7
  - 48 turning left onto Woodstock and then left onto southbound lanes of M7.

Concrete Agitators (customer deliveries) – expecting 133 in and 133 out, average per day

- estimated 28 trucks leaving the site in the AM Peak hour
  - 14 turning right and heading up Glendenning Rd
  - 14 turning left onto Woodstock Ave

- estimated 28 trucks returning to the site in the AM Peak hour
  - 14 coming from Glendenning Rd
  - 14 coming from Woodstock Ave west and M7 northbound lanes

Under normal operating conditions the concrete delivery trucks will be parked on-site overnight and will begin deliveries in the first hour of the next day. However it is expected that some will make their delivery and return to the site within the peak hour.

Table 4.2 shows a comparison of AM peak midblock traffic volumes along Woodstock Ave, Kellogg Rd and Glendenning Rd under existing and estimated future conditions (2008 with and without RDC)

Table 4.2 Midblock traffic volumes on surrounding roads – existing and estimated future conditions (AM peak hour)

	Existing Conditions (Dec 2004)		Estimated 2008 'base' (natural growth)		Future 2008 conditions (including RDC)	
Road section	Traffic Volume	% trucks	Traffic Volume	% trucks	Traffic Volume	% trucks
Woodstock Ave (b/w Phillip Parkway/M7 and Kellogg Rd	EB – 624 WB - 441	10% 13%	EB – 697 WB – 505	10% 14%	EB – 792 WB - 573	17% 23%
Woodstock Ave (b/w Kellogg Rd and Glendenning Rd)	EB – 542 WB - 450	8% 12%	EB – 597 WB – 496	8% 12%	EB – 649 WB - 576	15% 18%
Kellogg Rd (south of Woodstock Ave intersection)	NB – 53 SB - 127	30% 20%	NB – 60 SB - 151	32% 20%	NB – 180 SB - 326	72% 42%
Glendenning Rd (north of Woodstock Ave intersection)	NB – 564 SB - 459	8% 10%	NB – 621 SB - 504	8% 10%	NB – 673 SB - 584	14% 17%

Note: NB = northbound, SB = southbound, EB = eastbound, WB = westbound
'Traffic Volume' includes light and heavy vehicle totals.

Figure 6 shows the estimated traffic generation and distribution of RDC related traffic in the AM peak hour in graphical form, while Figure 7 identifies the expected turning volumes along Woodstock Ave upon completion on the RDC. The underlined values are movements impacted upon by the development.

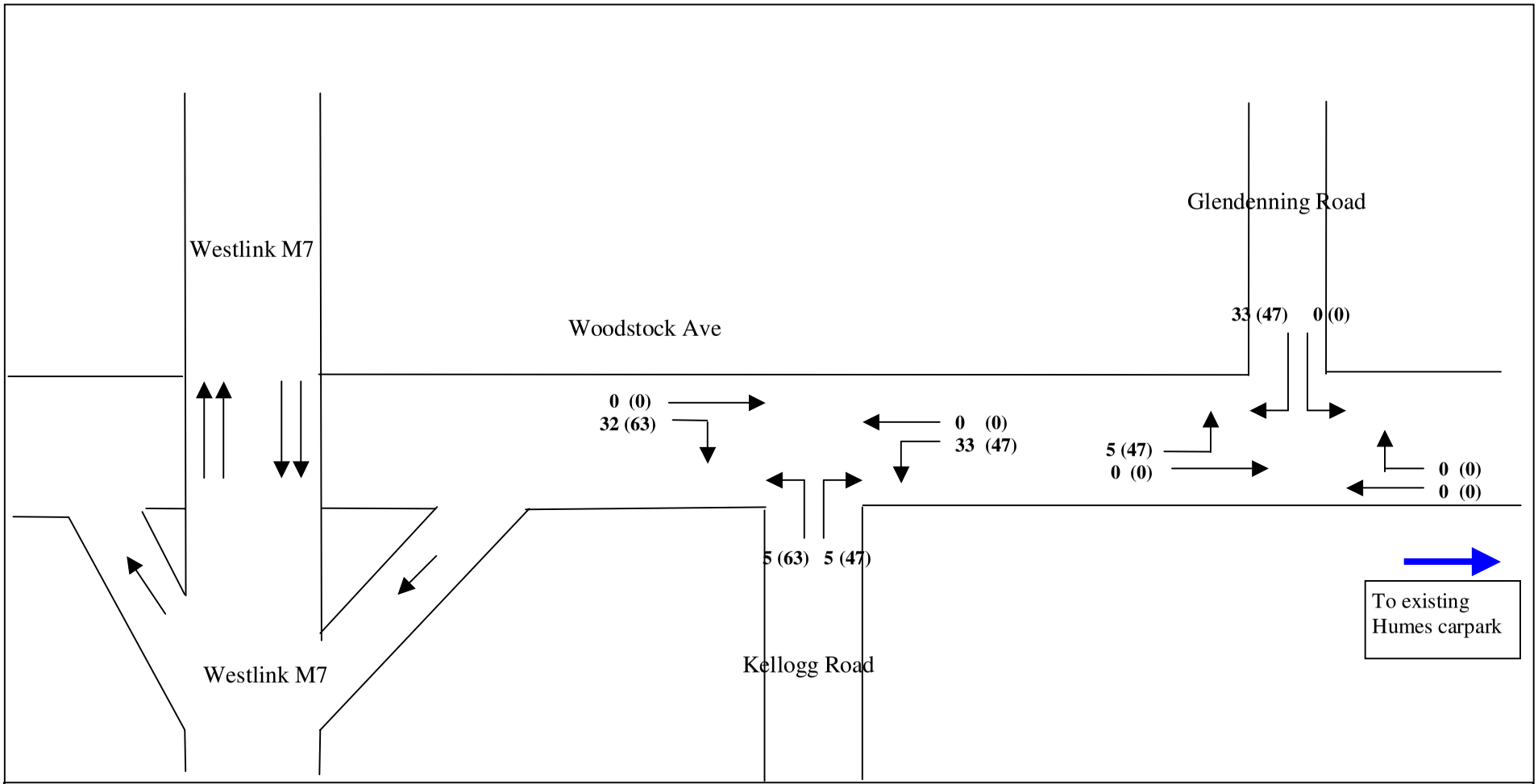


FIGURE 6: TRAFFIC GENERATION AND DISTRIBUTION OF RDC VEHICLES (AM PEAK HOUR)
(7.30am – 8.30am)

LEGEND 300 Light Vehicles
(20) Heavy Vehicles

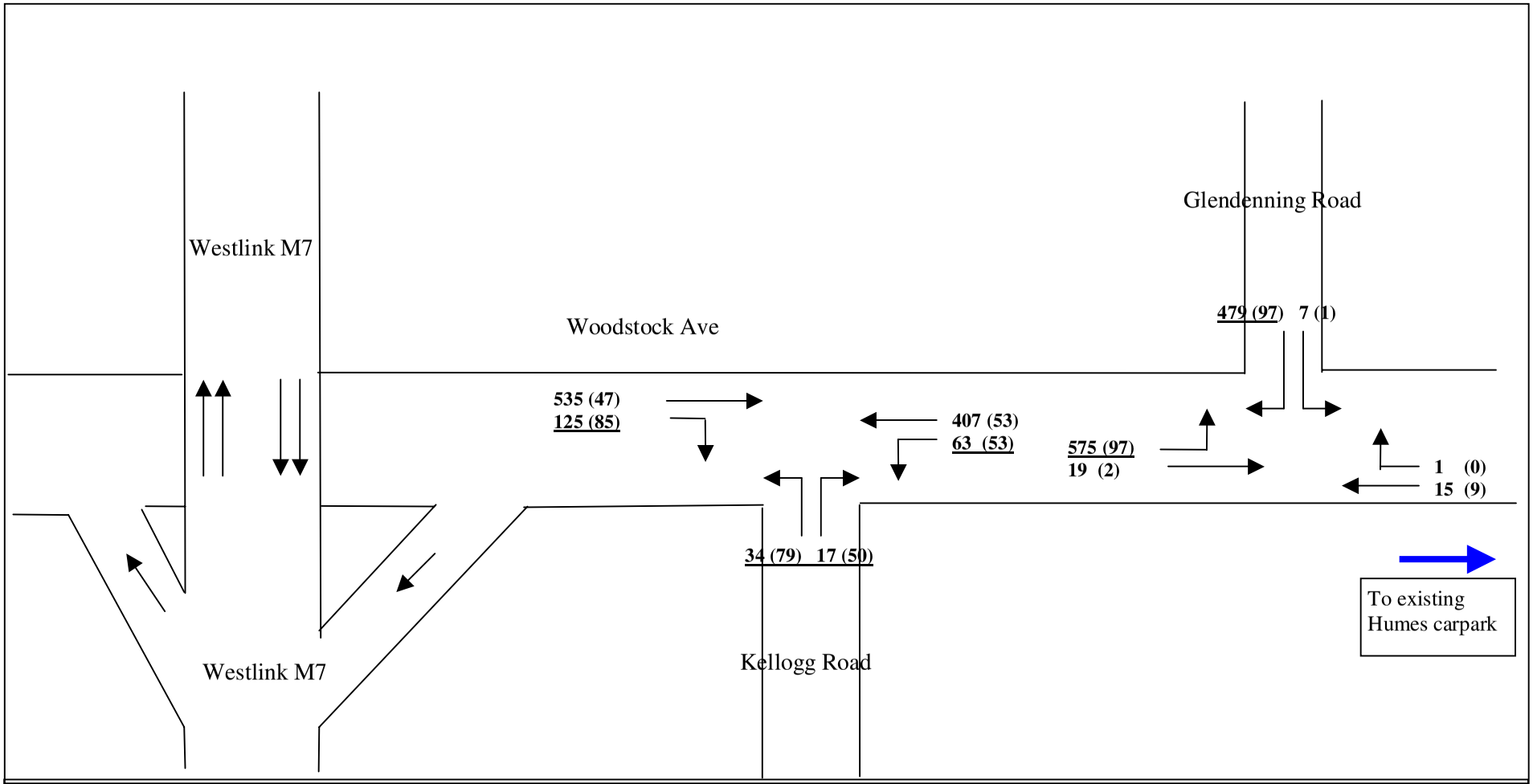
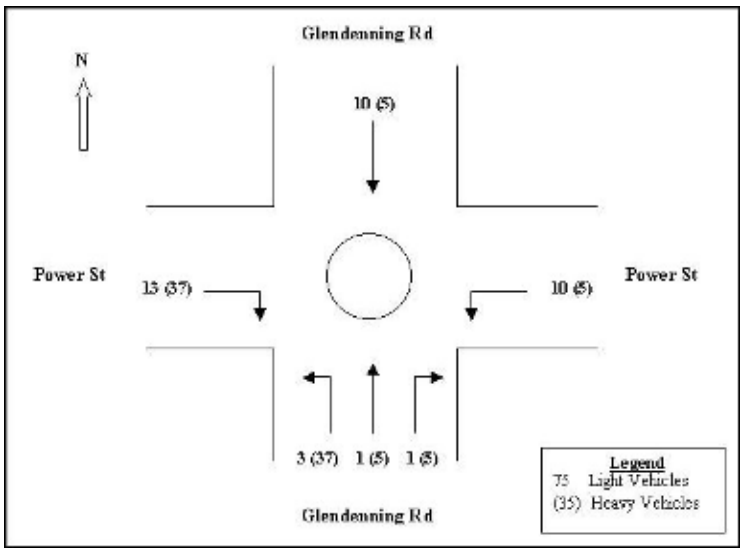


FIGURE 7: AM PEAK HOUR TRAFFIC FLOWS ON WOODSTOCK AVE (POST RDC DEVELOPMENT) (7.30am – 8.30am)

LEGEND 300 Light Vehicles
(20) Heavy Vehicles

According to the scope of the M7 construction, Power St will be upgraded to 4 lanes (2 each way) near the interchange, but no improvements are scheduled for the Power St / Glendenning Rd roundabout.

Figure 8 identifies the expected AM peak hour traffic movements at the Power St / Glendenning Rd roundabout as a result of the RDC development.



Note: the heavy vehicles identified for the Power St eastern approach and Glendenning Rd northern approach are concrete agitators used for concrete deliveries, not heavy vehicle aggregate distributions.

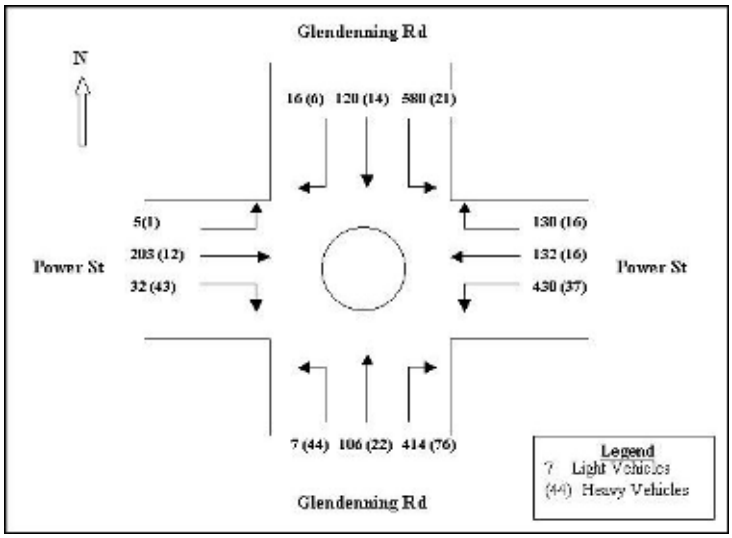
Figure 8 Expected AM peak traffic at Power St roundabout related to RDC development

The future performance of the Power St / Glendenning Rd intersection is difficult to accurately assess without knowledge or results from any area wide traffic models that may have been undertaken as part of the motorway's planning. These were unable to be obtained from either RTA or Westlink.

Even so, the development of the RDC is expected to contribute only a minor increase in traffic volumes at this intersection (as seen in Figure 8). Although a lot of these RDC traffic movements will be heavy vehicles, it is not expected to impact greatly on the performance of the intersection as a whole during the AM peak period due to the configuration of the junction and its high capacity.

For this analysis an assumption of 2.5% annum growth was applied to the existing background traffic, then the expected RDC traffic was added to the movements at the intersection.

Figure 9 shows the expected movements at the intersection upon completion of the RDC, based on general background growth.



Note: these are estimated future movements at the intersection based on general traffic growth

Figure 9 Expected AM peak traffic at Power St roundabout with the RDC developed (2008)

Based on these future forecasts the Regional Distribution Centre will contribute only 5% of the total traffic movements at the intersection during the AM peak hour.

4.3 Intersection Performance at existing intersections

Performance analysis was undertaken for the two key intersections with the inclusion of the development traffic for the proposed Readymix Regional Distribution Centre using aaSIDRA version 2.

The intersections analysed in this section are the same geometry as in the existing traffic conditions (unless stated otherwise), but with the addition of the extra traffic generated from completion of the proposed development.

An assumed 2.5% per annum traffic growth factor was applied to the base (surveyed movements on Woodstock Ave and Glendenning Rd), so as to simulate estimated 2008 volumes.

4.3.1 Intersection of Woodstock Ave and Kellogg Rd – existing layout

Table 4.3 presents the results of aaSIDRA analysis of the existing intersection of Woodstock Ave and Kellogg Rd with the inclusion of the extra traffic volumes expected from the proposed development.

Table 4.3 Forecast performance for the intersection of Woodstock Ave and Kellogg Rd under future AM peak conditions – Existing Layout 2008

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Kellogg Rd – south of intersection (NB)					
Left	23	19	0.422	B	≤D
Right	240 +	160	1.117	**F**	≤D
Woodstock Ave – west of intersection (EB)					
Through	0	0	0.157	A	≤D
Right	24	31	0.755	B	≤D
Woodstock Ave – east of intersection (WB)					
Left	11	0	0.169	A	≤D
Through	0	0	0.169	A	≤D

Source: aaSIDRA analysis

The aaSIDRA analysis shows that this intersection, under its existing configuration, would operate at an overall Level of Service 'B' in post-development conditions, with spare traffic carrying capacity.

However, the right turn out of Kellogg Rd is expected to experience a delay of more than 4 minutes and a LoS of 'F', as a result of the high volume of opposing flow along Woodstock Ave.

Additionally, the majority of these turning vehicles will be trucks and therefore, via their acceleration constraints, can increase the risk of accident to all vehicles at the intersection, particularly due to the need to cross two directions of traffic to complete the manoeuvre.

In order to limit delays for all vehicle movements and reduce the need to cross two traffic directions whilst turning right out of Kellogg Rd, a two-lane roundabout configuration may be best suited for the intersection. This option is outlined in Section 4.3.2.

4.3.2 Intersection of Woodstock Ave and Kellogg Rd – roundabout option

As outlined in the previous section, the current configuration for the Woodstock Ave / Kellogg Rd intersection may not be the best option for the expected post development AM peak conditions. Hence the analysis of a two-lane roundabout has been conducted.

Table 4.4 presents the results of aaSIDRA analysis of the roundabout option for the Woodstock Ave / Kellogg Rd intersection, with the inclusion of the extra traffic volumes expected from the proposed development.

Table 4.4 Forecast performance for the intersection of Woodstock Ave and Kellogg Rd under future AM peak conditions – 2 lane roundabout 2008

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Kellogg Rd – south of intersection (NB)					
Left	13	7	0.213	A	≤D
Right	18	5	0.154	B	≤D
Woodstock Ave – west of intersection (EB)					
Through	8	12	0.289	A	≤D
Right	14	11	0.289	A	≤D
Woodstock Ave – east of intersection (WB)					
Left	12	13	0.307	A	≤D
Through	9	13	0.307	A	≤D

Source: aaSIDRA analysis

As can be seen in Table 4.4, the implementation of a two-lane roundabout at the Kellogg Rd / Woodstock Ave intersection would dramatically improve the performance of the right turn out of Kellogg Rd, with a LoS of 'B' and an average delay of 18 seconds. The 'overall' intersection performance would also improve to LoS 'A'.

Although a two-lane roundabout would improve the right turning movements in and out of Kellogg Rd, it will slightly worsen the performance of the through movements along Woodstock Ave, which are currently unrestrained and a priority movement. This however, is not expected to be a significant impact (queuing of around 13 metres on both approaches) considering the gain in amenity and safety overall for heavy and light vehicles entering and exiting Kellogg Rd.

Statistically roundabouts provide far greater management of conflicts over 'give-way' controlled intersections, as they are able to channel vehicles into one course (clockwise around the roundabout) and limit the number of opposing vehicle directions (ie. opposing vehicles should only be entering from the right). This coupled with the need for right turning vehicles to only cross one direction of traffic at a time, provide a roundabout configuration with a road safety advantage over priority controlled intersections.

The assessment shows that excessive queuing will not occur with the roundabout option, thus will not interfere with the nearby Woodstock Ave / Glendenning Rd intersection (roundabout), which lies approximately 70 metres to the east, or the M7 on-ramp (215m to the west).

A 2-lane roundabout will aim to minimise impacts to the surrounding road network, particularly the nearby Glendenning Rd / Woodstock Ave intersection. It should be designed in accordance with relevant Council, RTA and Australian Standards.

Although not formally tested the option of a signalised intersection is deemed unnecessary as it would further increase delays to the major traffic movement at the intersection (eastbound and westbound along Woodstock Ave), without providing substantial amenity and safety improvements over the roundabout option. Traffic volumes at this intersection are not expected to be excessive, even with the development of the RDC and the opening of the M7.

4.3.3 Intersection of Woodstock Ave and Glendenning Rd

Table 4.5 presents the results of aaSIDRA analysis of the intersection of Woodstock Ave and Glendenning Rd with the inclusion of the extra traffic volumes expected from the proposed development.

Table 4.5 Forecast performance characteristics of the intersection of Woodstock Ave and Glendenning Rd – AM peak 2008

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Glendenning Rd – north of intersection (SB)					
Left	13	15	0.335	A	≤D
Right	13	15	0.335	A	≤D
Woodstock Ave – west of intersection (EB)					
Left	7	18	0.391	A	≤D
Through	7	18	0.391	A	≤D
Woodstock Ave – east of intersection (WB)					
Through	11	2	0.040	A	≤D
Right	11	2	0.040	A	≤D

Source: aaSIDRA analysis

The aaSIDRA analysis shows that this intersection is influenced little by the facility's development.

The only movements that are expected to be altered in the AM peak hour due to the new development are: those approaching from the west (through and left) and traffic turning out of Glendenning (right and left). All other movements are expected to remain unchanged from the existing conditions.

During post development conditions it is anticipated that the majority of vehicles (heavy and light) wishing to head north of the site via the newly constructed M7 will utilise this intersection.

All other movements are predicted to operate under similar conditions to the existing conditions, however the 'overall' intersection performance is predicted to operate at LoS 'A' during the AM peak hour.

4.3.4 Intersection of Glendenning Rd and Power St (with and without RDC)

The future performance of the Power St / Glendenning Rd intersection is difficult to accurately assess without knowledge or results from any area wide traffic models that may have been undertaken as part of the motorway's planning. Although data for the midblock volumes along Power St and its interchange with the M7 were obtained, the expected turning movements at this intersection were unable to be gathered either from RTA or Westlink.

Therefore for this analysis an assumption of 2.5% annum growth was applied to the existing background traffic (see Table 4.6), then the expected RDC traffic was added to the movements at the intersection (see Table 4.7).

Table 4.6 presents the results of aaSIDRA analysis of the Power St / Glendenning Rd intersection under expected future conditions without the development of the RDC (ie. based purely on growth in background traffic).

Table 4.6 Forecast performance characteristics of the intersection of Power St and Glendenning Rd – AM peak 2008 (without RDC)

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Glendenning Rd – south of intersection (NB)					
Left	15	11	0.250	B	≤D
Through	11	11	0.251	A	≤D
Right	15	26	0.480	B	≤D
Power St – east of intersection (WB)					
Left	9	15	0.315	A	≤D
Through	8	13	0.279	A	≤D
Right	14	13	0.279	A	≤D
Glendenning Rd – north of intersection (SB)					
Left	25	93	0.877	B	≤D
Through	21	21	0.436	B	≤D
Right	27	21	0.440	B	≤D
Power St – west of intersection (EB)					
Left	15	22	0.446	B	≤D
Through	15	22	0.446	B	≤D
Right	15	22	0.446	B	≤D

Source: aaSIDRA analysis

The aaSIDRA analysis shows that this intersection, with its existing configuration, would operate at an overall Level of Service 'B' under future conditions without the development of the RDC, with spare traffic carrying capacity.

The most significant movement is expected to be the left turn from Glendenning north into Power St, which is expected to experience an average delay of 25 seconds and a LoS of 'B'. The 95% back of queue length (or length which is exceeded only 5% of the time) for these movements will be just under 100m long.

It is the future high volume of opposing traffic, turning right from Glendenning Rd south and 'through' eastbound movements along Power St which causes the increased delay and extension of queuing for this left turning movement.

All movements at this intersection are predicted to operate at LoS 'B' or better during the future AM peak hour without the development of the RDC.

Table 4.7 presents the results of aaSIDRA analysis of the Power St / Glendenning Rd intersection under expected future conditions with the inclusion of the RDC development.

Table 4.7 Forecast performance characteristics of the intersection of Power St and Glendenning Rd – AM peak 2008 (with RDC)

Movement	Average Delay (sec)	95% back of Queue Length (m)	Degree of Saturation	LoS	Acceptable LoS
Glendenning Rd – south of intersection (NB)					
Left	15	14	0.329	B	≤D
Through	10	14	0.328	A	≤D
Right	15	26	0.489	B	≤D
Power St – east of intersection (WB)					
Left	10	21	0.399	A	≤D
Through	9	15	0.324	A	≤D
Right	15	15	0.324	A	≤D
Glendenning Rd – north of intersection (SB)					
Left	37	137	0.929	C	≤D
Through	24	25	0.487	B	≤D
Right	30	25	0.489	C	≤D
Power St – west of intersection (EB)					
Left	20	35	0.601	B	≤D
Through	20	35	0.601	B	≤D
Right	20	35	0.601	B	≤D

Source: aaSIDRA analysis

The aaSIDRA analysis shows that this intersection, under its existing configuration, would operate at an overall Level of Service 'B' in post-development conditions, with spare traffic carrying capacity.

The development of the RDC will have the most influence on the Glendenning Rd north approach, with the queue for left turning vehicles expected to increase from 93m to 137m with a LoS 'C'. The right turning movement from this approach is also expected to operate at LoS 'C', compared to the LoS 'B' predicted for the scenario with general future background traffic only. Other movements at the intersection are only impacted marginally by the RDC related traffic. It should be noted that this intersection will provide direct access to the M7 interchange on Power St (upon its commission) and is expected to experience an increase in general traffic movements, even without the development of the RDC.

Even though the forecast RDC-related traffic will impose some additional delays and queuing to vehicles approaching the intersection from the north, the 'overall' performance analysis (LoS 'B') suggests spare capacity is available even after the development of the RDC. It should be noted that the RDC is predicted to only contribute approximately 5% (132 out of 2483 – as shown in Figures 8 and 9) of the total turning movements at the intersection during the AM peak hour.

All other movements at the intersection of Power St and Glendenning Rd are predicted to operate at LoS 'B' or better during the future AM peak hour.

This intersection will experience more obvious increases in heavy vehicle traffic outside of the peak periods under the proposed RDC's 24hr operational schedule. However, the industrial nature of the area and the capacity and configuration of Glendenning Rd, Power St and their junction will allow for such an increase.

Readymix based heavy vehicles will not utilise Power Street west of the M7, only the stretch from the motorway to the Glendenning Road roundabout.

4.4 Intersection Analysis of M7 interchanges

The two M7 interchanges at Woodstock Ave and Power St were also assessed for their capacity and ability to accommodate the RDC related traffic.

4.4.1 M7 interchange on Woodstock Ave

As detailed earlier the M7 interchange at Woodstock Ave will provide access to the southbound lanes of the motorway and provide an exit for northbound traffic. The design of the interchange includes:

Off ramp

- Two lanes which turn left onto Woodstock Ave (signalised control); and
- One right turning lane onto Woodstock Ave -approx. 100m long (signalised control)

On ramp

- Two lanes merging onto southbound lanes of M7

Woodstock Ave west approach

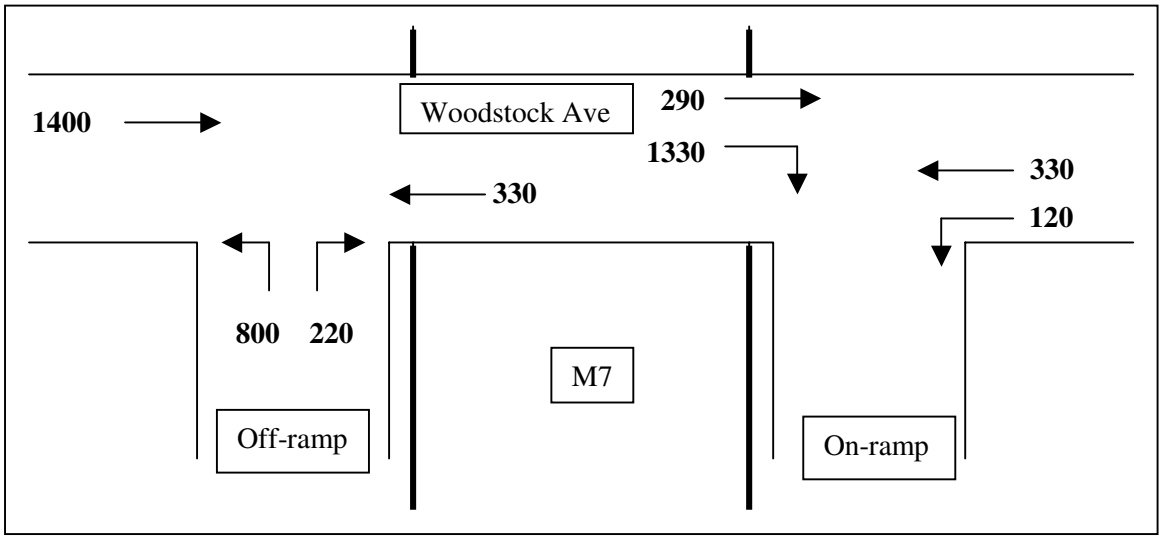
- Two through lanes eastbound along Woodstock Ave (signalised control); and
- Two right turning lanes onto the on-ramp - approx. 80m long (signalised control).

Woodstock Ave east approach

- Two through lanes westbound along Woodstock Ave (signalised control); and
- One left turn slip lane onto the on ramp (give-way controlled)

This interchange configuration will have a high capacity, with lanes and signal timings able to accommodate large volumes of traffic.

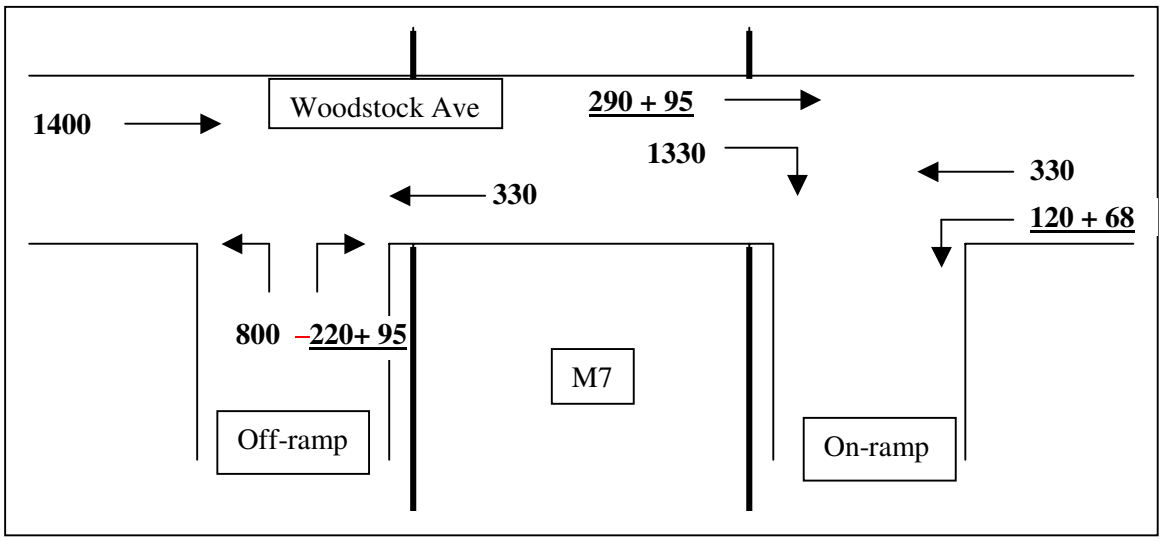
RTA's modelling of the M7 makes estimates for the traffic turning volumes at the signalised intersections of Woodstock Ave and the M7 on and off ramps for 2006 and 2016. If we interpolate between the two time periods, the following estimates for 2008 AM peak turning movements can be derived, as seen in Figure 10.



Note: these volumes were interpolated between RTA's 2006 and 2016 estimates

Figure 10 RTA's estimated traffic volumes at the Woodstock Ave M7 interchange – 2008 AM peak hour (RDC not developed)

If the expected turning movements generated by the RDC at the interchange in the AM peak hour are applied to the junction the following turning volumes are identified (Figure 11). During this period 68 vehicle movements are expected to exit the site and head southbound on the M7, while 95 vehicles (as identified earlier in Figure 6) are expected to exit the M7 northbound lanes and turn right towards the RDC site.



Note: the underlined figures are those expected to change as a result of the RDC development

Figure 11 Estimated traffic volumes at the Woodstock Ave M7 interchange – 2008 AM peak hour (RDC developed)

Based on these RTA volumes, the signalised off-ramp intersection (including Woodstock Ave movements) is estimated to experience a total of 2750 movements in the AM peak without the RDC, and 2845 when the RDC becomes operational. This is an overall increase of 3% to the total movements at the intersection.

The signalised on-ramp will be slightly more affected, with RTA predicting 2070 movements prior to RDC, but increasing to 2233 upon the RDC becoming operational. This corresponds with a 7% increase in total traffic movements at the intersection in the AM peak.

It should be noted that all turning movements to which the RDC contributes additional traffic are actually quite low volume turning movements. None of the high volume turns are impacted.

A preliminary investigation of the interchange performance was conducted, based on the volumes and layouts provided by RTA. It identified that the RDC traffic will impose only minor impacts on the Woodstock Ave interchange, namely:

- An increase in queue length for left turners from Woodstock Ave onto the on-ramp of 8m (20m with RDC and 12m without the development);
- An increase in queue length for right turners out of the off-ramp of 16m (52m with RDC and 36m without the development);

This interchange will be able to accommodate the comparatively small volumes of RDC traffic easily, without altering the 'overall' performance of the interchange (LoS and average delay). Analysis suggests that the intersection will operate with an overall LoS 'B' or better, with or without the RDC operational.

4.4.2 M7 interchange on Power St

The M7 interchange at Power St will provide access to the northbound lanes of the motorway and provide an exit for southbound traffic. The design of the interchange includes:

Off ramp
- One lane which turns left onto Power St (signalised control); and
- One right turning lane onto Power St (signalised control).

On ramp
- Two lanes merging onto northbound lanes of M7

Power St west approach
- Two through lanes eastbound along Power St (signalised control); and
- One left turn slip lane onto the on ramp – approx 50m long (give-way controlled)

Power St east approach
- Two through lanes westbound along Power St (signalised control); and
- One right turning lanes onto the on-ramp - approx. 80m long (signalised control).

This interchange configuration will have a high capacity, with lanes and signal timings able to accommodate large volumes of traffic.

The RTA also modelled the proposed traffic volumes at the Power St interchange, similar to Woodstock Ave, for the years 2006 and 2016. If we interpolate between the two time periods, the following estimates for 2008 AM peak turning movements can be derived, as seen in Figure 12.

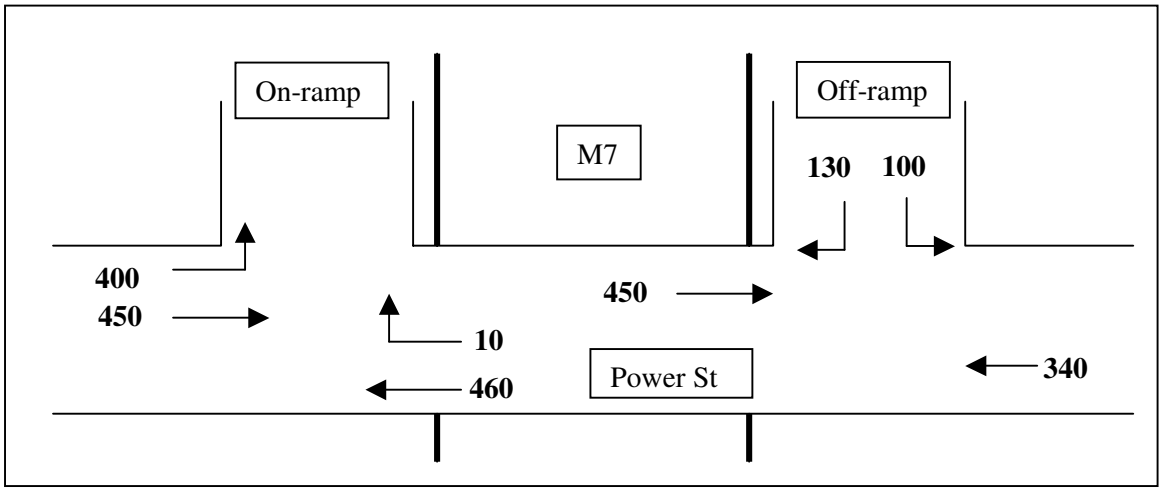
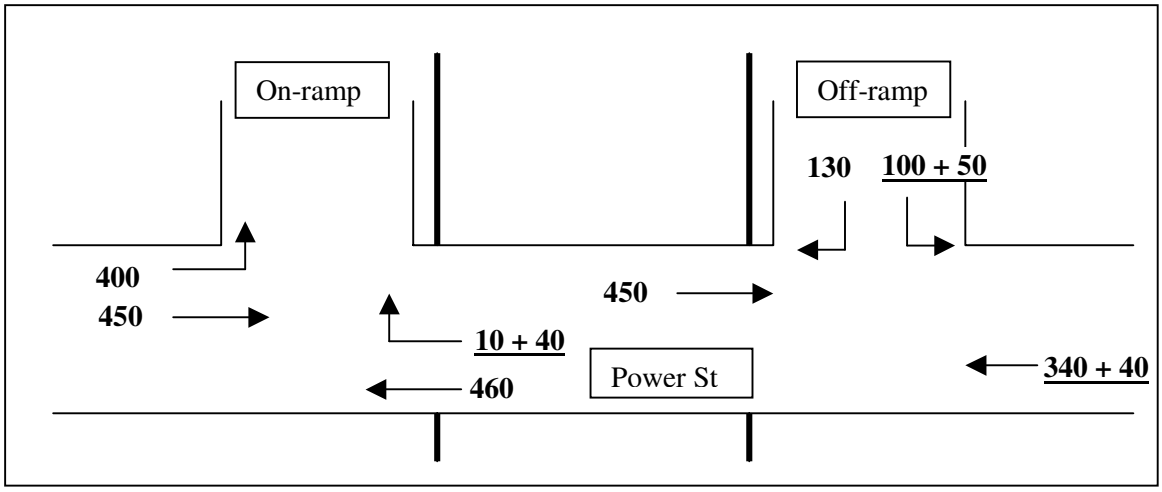


Figure 12 RTA's estimated traffic volumes at the Power St M7 interchange – 2008 AM peak hour (RDC not developed)

If the expected turning movements generated by the Regional Distribution Centre at the interchange in the AM peak hour are applied to the junction the following turning volumes are identified (Figure 13). During this period 40 vehicle movements (light and heavy) are expected to exit the site and head northbound on the M7, while 50 vehicles are expected to exit the M7 southbound lanes an continue down Power St towards the RDC site.



Note: the underlined figures are those expected to change as a result of the RDC development

Figure 13 Estimated traffic volumes at the Power St M7 interchange – 2008 AM peak hour (RDC developed)

Based on these RTA volumes, the signalised on-ramp intersection (including Power St Ave movements) is estimated to experience a total of 1320 movements in the AM peak without the RDC, and 1360 when the RDC becomes operational. This is an overall increase of 3% to the total movements at the intersection.

The signalised off-ramp will be slightly more affected, with RTA predicting 1020 movements prior to RDC, but increasing to 1110 upon the RDC becoming operational. This corresponds with a 9% increase in total traffic movements at the intersection in the AM peak.

It should be noted that all turning movements to which the RDC contributes additional traffic are expected to have low volumes.

A preliminary investigation of the interchange performance was conducted, based on the volumes and layouts provided by RTA. It identified that the RDC traffic will impose only minor impacts on the Power St interchange, namely:

- An increase in queue length for right turners from Power St onto the on-ramp of 19m (22m with RDC and 3m without the development);
- An increase in queue length for left turners out of the off-ramp of 15m (37m with RDC and 22m without the development);

This interchange will be able to accommodate the comparatively small volumes of RDC traffic easily, without significantly deteriorating the 'overall' performance of the interchange. Analysis suggests that the intersection will operate with an overall LoS 'B' or better, with or without the RDC operational.

5. GENERAL INFRASTRUCTURE IMPROVEMENTS TO THE AREA

The proposed RDC development will not only impact on key intersections in the area, it will also impact on some external road lengths, with Kellogg Rd being most affected.

In order to facilitate the development of the site it is recommended that the following additional infrastructure improvements be incorporated into the overall design:

- The realignment of North Parade (as proposed) should be of a sufficient standard to accommodate vehicles;
- Linemarking and signage within the RDC site should be clear and concise; and
- Centreline and parking linemarking should be implemented on Kellogg Rd.

These proposals are discussed in further detail in the following sections.

5.1 Realignment of North Parade

As part of the proposed overall RDC project the existing North Parade will be realigned to accommodate the rail siding on the southern boundary of the site.

North Parade services the Council works depot and gives access to Knox Rd. It runs parallel to the main west rail line.

As this is not a highly trafficked area the impact of the realignment will be minimal. It should at the very least be re-constructed to the same standard as the current road.

5.2 Linemarking within the site

It is recommended that linemarking and signage be implemented within the RDC site boundary to identify specific traffic routes (heavy and light). These should be clear and concise and provide drivers with no doubts as to the direction they should be travelling.

The current proposed plan identifies 'truck only' areas in which only heavy vehicles are allowed to circulate in a one-way system. These should be linemarked and signed accordingly, so that light vehicles do not inadvertently enter this area, potentially increasing the risk of an accident.

5.3 Linemarking on Kellogg Rd

Under its existing configuration Kellogg Rd is geometrically capable of accommodating one traffic lane in each direction and informal kerbside parking. No linemarking is currently in place on Kellogg Rd.

It is recommended that centreline road markings be implemented on Kellogg Rd to identify trafficable lanes, particularly due to the current and expected heavy vehicle volumes on this road. Formal kerbside parking 'lanes' should also be constructed to identify the possible presence of parked vehicles along Kellogg Rd. These should be made wide enough to accommodate truck parking (as currently occurs) and will provide the secondary benefit of a perceived narrowing of the road.

On-site truck parking areas have been provided for in the proposed RDC plans. The site is designed to run on an automated basis and not all trucks will be required to use the incoming weighbridge. This will limit overall truck queuing and prevent queuing back onto Kellogg Rd.

6. ROAD SAFETY

The number of accidents on any intersection or road section is related to traffic volumes and to specific geometric characteristics. The accident rate is a measure of the likely occurrence of an accident related to given traffic volumes, and is also influenced by factors such as gradient, sight distance, intersection layout, etc. Accident rates vary for any particular traffic volume depending on road characteristics.

A new development or redevelopment generally alters volumes and patterns, and may require changes to road and intersection layouts. Accident numbers can also change approximately in proportion to the traffic volume changes.

The additional traffic generated by the proposed Regional Distribution Centre will increase the traffic volumes in the area. However, it is not expected to have any substantial impact on accidents along Woodstock Ave or the intersections of Woodstock Ave / Kellogg Rd or Woodstock Ave / Glendenning Rd due to the recommended improvements to the surrounding road network.

These improvements aim to enhance vehicle priority at intersections and promote a reduced speed environment. These accident opportunities should be reduced as a result of:

- the signalised M7 interchanges on both Woodstock Ave and Power St; and
- the recommended 2-lane roundabout at the intersection of Kellogg Rd and Woodstock Ave;

Even so it is recommended that monitoring of road capacity and accidents statistics be undertaken to ensure that the extra traffic generated by the development does not unexpectedly affect the surrounding road network in an adverse manner.

7. TRAFFIC NOISE

The noise impact assessment completed by Richard Heggie Associates, includes details on operational noise levels, as well as traffic noise levels under existing and post development conditions.

The noise study aims to assess the existing and expected post development noise levels against the relevant NSW EPA standards and recommend ameliorative works where necessary.

The results and findings of the study can be viewed in Richard Heggie Associates' report; '*Noise Impact Assessment – Proposed Readymix Regional Distribution Centre, Rooty Hill'*.

8. CONCLUSION

8.1 Existing Conditions

Analysis of RTA traffic data for the region identified that the AM peak was the most severe, with the highest hourly traffic volumes.

The existing condition analysis indicates that the intersections of Woodstock Ave / Kellogg Road and Woodstock Ave / Glendenning Road are operating at LoS 'A' during the AM peak hour. This indicated that both intersections have additional capacity to accommodate an increase in traffic.

The Phillip Parkway and Woodstock Ave intersection accommodates cross regional north south through movements. This intersection carries high traffic volumes between Glendenning Road and Phillip Parkway and vice versa during the AM peak hour. Short delays are currently experienced for right turning movements onto Woodstock Ave from Phillip Parkway and for westbound through movements along Woodstock Ave. This intersection has recently been signalised as part of the future M7 interchange.

The Power St / Glendenning Rd roundabout is currently operating at an overall LoS 'B', with average delays to all vehicles of 15 seconds in the AM peak. Heavy volumes of traffic were observed heading eastbound along Power St (east of the roundabout), with the majority turning left from Glendenning Rd north, and right from Glendenning Rd south. Two-way traffic along Power St, west of the roundabout, was comparatively low.

The current number of accidents along Kellogg and Glendenning Road is relatively low. A total of four accidents have occurred at their respective intersections with Woodstock Ave in the last five years. All four of these incidents resulted in property damage only, with one involving a heavy vehicle.

Over the last five years, 33 accidents were recorded at the Phillip Parkway and Woodstock Ave intersection. 17 of the 33 accidents involved property damage only, while the remaining 16 included at least one injury. No fatalities have occurred at the intersection within the analysis period. 80% of the accidents took place on weekdays, with 33% of the total accidents occurring during the weekday peak periods (between 6am – 9am and 3pm-6pm). With the completion of the M7 / Woodstock Ave 'grade separated' interchange, accidents should dramatically improve at this point.

There is no obvious pattern or cause for the accidents analysed in the Woodstock Ave area.

Pedestrian paths are currently provided on the southern side of Woodstock Ave near Kellogg Rd and along parts of Glendenning Rd. There are no designated on-street cyclists facilities in the region.

Two public transport (on-street buses) routes run along Woodstock Ave and Glendenning Rd, but only provided outside of the assessed peak hour periods. Bus stops within the vicinity of the RDC are provided on;

- Woodstock Ave – near Kellogg Rd;
- Glendenning Rd – near Woodstock Ave; and
- Glendenning Rd – near Power St.

Route 756G runs between Mt Druitt and the Glendenning industrial area approximately 4 times a day (each way), with most services operating prior to 7am.

Route 757 operates between Rooty Hill Rd North and Mt Druitt, but only utilises Woodstock Ave and Glendenning Rd on five of its services throughout the day. All other services on this route skip this area and act as an 'express' between origin and destination.

Current pavement condition along Woodstock Ave, Kellogg Rd and Glendenning Rd is of an acceptable standard, with no obvious pot-holes or cracking. Kerbing is located on all sections of these roads within the vicinity of the site.

Continued maintenance of these roads is a Council responsibility, as they are not under RTA control.

8.2 Post-Development Conditions

The proposed RDC is not scheduled to become operational until 2008, after the opening of the Westlink M7.

This proposed development will involve the construction of a rail siding area, from which construction materials will be delivered to the site. Concrete distribution will be via concrete agitators out of Kellogg St. Under normal operating conditions aggregates will be distributed from the site to the Sydney market via heavy vehicles.

8.2.1 Expected Traffic Generation

This development will generate traffic due to the employee movements and the distribution of aggregates and concrete from the site. All heavy vehicle access to the facility will be via Kellogg Road.

The four most predominant vehicle movements at the site will be:

- Employee's cars;
- Laboratory and other deliveries (light vehicles);
- Concrete delivery trucks (agitators); and
- Trucks distributing aggregate to other Readymix sites (heavy vehicles).

The 'worst case' scenario was assessed for all intersections. This assumed that the *maximum* peak hour vehicle output under maximum operating conditions was used.

The AM peak was deemed the most critical as RTA counts in the area suggested this period was the most severe, and the RDC is expected to create more vehicular activity during this period than the afternoon peak. The expected maximum vehicle trip generation to be produced in the critical AM Peak Hour by the facility is outlined in Table 8.1:

Table 8.1 Traffic Generation at the site (AM Peak hour) – maximum output

	Type of Vehicle	No. of vehicles entering site in AM Peak hour	No of vehicles exiting site in AM Peak hour
Staff (into Humes carpark)	Car	**55** (all via Kellogg Rd)	**0**
Aggregate distribution	Heavy vehicle	**80**	**80**
Concrete deliveries	Agitator	**28**	**28**
Special product deliveries	Heavy vehicle	**2**	**2**
General deliveries	Car / Van	**10**	**10**

The critical extra traffic volumes will be those associated with the heavy vehicles used for aggregate distribution, as they exhibit much slower acceleration and deceleration characteristics than cars and their movements will correspond with the AM traffic peak in the area.

All aggregate distribution trucks will utilise the M7 on route to other Readymix sites around Sydney.

This will be done either via the Woodstock Ave interchange for southbound trucks, or via Glendenning Rd and the Power St interchange for distributions to the north. Readymix based heavy vehicles will not utilise Power Street west of the M7, only the stretch from the motorway to the Glendenning Road roundabout.

It should be noted that RDC staff shifts will be staggered, with the first of the day shift employees arriving at 5.00am. The majority of the employees (mainly concrete agitators drivers and the laboratory staff) will be on-site prior to 7.00am, therefore outside of the defined 'peak hour' for the surrou nding network. *As such, these movements were not included in the AM peak analysis*.

However, some RDC staff are expected to arrive in this peak period (and park either in the Humes carpark or the main site carpark, via Kellogg Rd)

8.2.2 Intersection Performance

The RDC will increase traffic circulating around the area, but analysis shows that the nearby intersections are expected to operate satisfactorily when the development becomes operational, however some upgrades may be required.

Intersection of Woodstock Ave / Kellogg Rd

The Kellogg Rd / Woodstock Ave intersection is the critical junction in terms of traffic impact associated with the proposed development.

Almost all of the RDC traffic will utilise this intersection (even if heading east / west on Woodstock Ave)

The additional movements of heavy vehicles during the peak hour are expected to create delays for right turning vehicles into and out of Kellogg Rd under the current 'give way' control. The analysis of the right turn out of Kellogg Rd shows a delay of over two minutes at LoS' F'. The right turn into Kellogg Rd also suffers an increase in delay to 24 seconds.

Even though the 'overall' intersection performance of the existing intersection configuration is acceptable (LoS 'B'), the safety aspects of these manoeuvres are most important. Due to the performance characteristics of heavy vehicles (ie. slow acceleration and deceleration), the need for an intersection upgrade should be considered.

A two-lane roundabout option is recommended to be constructed prior to the RDC becoming operational, as it would provide additional amenity and safety for all vehicles at the intersection. It will be designed in accordance with relevant Council, RTA and Australian Standards.

The implementation of a two-lane roundabout at this intersection would dramatically improve the performance of the right turn out of Kellogg Rd, with a LoS of 'B' and an average delay of 18 seconds. The 'overall' intersection performance would also improve to LoS 'A'.

The proximity of the nearby Glendenning Rd / Woodstock Ave roundabout will need to be considered in the intersection design, to ensure both intersections are able to operate efficiently and safely.

Analysis of the intersection using aaSIDRA version 2 identified that queuing at the Woodstock Ave / Kellogg Rd intersection under roundabout control will not be excessive. For vehicles approaching the intersection from the Glendenning Rd roundabout the 95% back of queue length is expected to be 13 metres in the AM peak hour. This queuing is not enough to intrude on the nearby Glendenning Rd intersection, therefore resulting in the two intersections functioning separately.

The recommended roundabout configuration will not interfere with the M7 interchanges, approximately 215m to the west.

<u>Intersection of Woodstock Ave / Glendenning Rd</u>

At the Woodstock Ave / Glendenning Rd intersection the only movements that are expected to be altered in the AM peak hour due to the new development are: those approaching from the west (through and left) and traffic turning out of Glendenning (right and left). All other movements are expected to remain unchanged from the existing conditions. The 'overall' intersection performance is predicted to operate at LoS 'A' during the AM peak hour with no major delays to any of the movements.

<u>Intersection of Power St / Glendenning Rd</u>

This intersection, under its existing configuration, is expected to operate at an overall Level of Service 'B' for the future AM peak, with or without the development of the RDC, with spare traffic carrying capacity.

Under normal future background growth conditions (ie. without the RDC) the most significant movement is expected to be the left turn from Glendenning north into Power St, which is predicted to experience an average delay of 25 seconds and a LoS 'B'. The 95% back of queue length for this movement will be just under 100m long.

With the development of the RDC this manoeuvre will experience in increase in queue to 137m with a LoS 'C'. The right turning movement from this approach is also expected to operate at LoS 'C', compared to the LoS 'B' predicted for general future background traffic only. All other movements at the intersection are only impacted marginally by the RDC related traffic. It should be noted that this intersection will provide direct access to the M7 interchange on Power St (upon its commission) and is expected to experience an increase in general traffic movements, even without the development of the RDC.

Even though the forecast RDC-related traffic will impose some additional delays and queuing to vehicles approaching the intersection from the north, the 'overall' performance analysis (LoS 'B') suggests spare capacity is available even after the development of the RDC. It should be noted that the RDC is predicted to only contribute approximately 5% (132 out of 2483 – as shown in Figures 8 and 9) of the total turning movements at the intersection during the AM peak hour.

All other movements at the intersection of Power St and Glendenning Rd are predicted to operate at LoS 'B' or better during the future AM peak hour.

This intersection will experience more obvious increases in heavy vehicle traffic outside of the peak periods under the proposed RDC's 24hr operational schedule. However, the industrial nature of the area and the capacity and configuration of Glendenning Rd, Power St and their junction will certainly allow for such an increase.

M7 interchange at Woodstock Ave

Based on RTA modelled M7 volumes, the motorway off-ramp at Woodstock Ave is expected to experience an overall increase of 3% to the total movements at the intersection during the AM peak hour. The on-ramp will experience a 7% increase.

Both of these ramp intersections will be signalised and co-ordinated.

All movements to which the RDC contributes additional traffic are actually quite low volume turning movements. None of the high volume turns are impacted, as seen in Figure 11.

A preliminary investigation of the interchange performance was conducted; identifying only minor RDC related impacts on the Woodstock Ave interchange, namely:

- An increase in queue length for left turners from Woodstock Ave onto the on-ramp of 8m (20m with RDC and 12m without the development);
- An increase in queue length for right turners out of the off-ramp of 16m (52m with RDC and 36m without the development);

This interchange will be able to accommodate the comparatively small volumes of RDC traffic easily, without altering the 'overall' performance of the interchange (LoS and average delay).

M7 interchange at Power St

Based on RTA modelled M7 volumes, the motorway on-ramp at Power St is expected to experience an overall increase of 3% to the total movements at the intersection during the AM peak hour. The off-ramp will experience a 9% increase.

Both of these ramp intersections will be signalised and co-ordinated, with lanes and signal timings able to accommodate large volumes of traffic.

A preliminary investigation of the interchange performance was conducted; identifying only minor RDC related impacts on the Power St interchange, namely:

- An increase in queue length for right turners from Power St onto the on-ramp of 19m (22m with RDC and 3m without the development);
- An increase in queue length for left turners out of the off-ramp of 15m (37m with RDC and 22m without the development);

This interchange will be able to accommodate the comparatively small volumes of RDC traffic easily, without significantly deteriorating the 'overall' performance of the interchange.

8.2.3 Accident potential

The additional traffic generated by the proposed Regional Distribution Centre will increase the traffic volumes in the area. However, it is not expected to have any substantial impact on accidents along Woodstock Ave or the intersections of Woodstock Ave / Kellogg Rd or Woodstock Ave / Glendenning Rd due to the proposed improvements to the surrounding road network.

These improvements aim to enhance vehicle priority at intersections and promote a reduced speed environment. These accident opportunities should be reduced as a result of:

- the signalised M7 interchanges on both Woodstock Ave and Power St; and
- the recommended 2-lane roundabout at the intersection of Kellogg Rd and Woodstock Ave;

8.2.4 General Comments

North Parade realignment

As part of the proposed overall RDC project the existing North Parade will be realigned to accommodate the rail siding on the southern boundary of the site. As this is not a highly trafficked area the impact of the realignment will be minimal. It should at the very least be re-constructed to the same standard as the current road to maintain access to the Council Depot.

Linemarking and signage

It is recommended that clear and concise linemarking and signage be implemented within the site boundary to identify specific traffic routes (heavy and light). The proposed 'truck only' areas in which only heavy vehicles are allowed to circulate in a one-way system should be linemarked and signed accordingly.

Linemarking is currently non-existent along Kellogg Rd. It is recommended that centreline road markings be implemented to identify trafficable lanes, particularly due to the current and expected heavy vehicle volumes on this road. Formal kerbside parking 'lanes' should also be constructed to identify the possible presence of parked vehicles along Kellogg Rd. These should be made wide enough to accommodate truck parking (as currently occurs) and will provide the secondary benefit of a perceived narrowing of the road.

On-site truck parking areas will be provided for RDC heavy vehicles. The site is designed to run on an automated basis and not all trucks will be required to use the incoming weighbridge, as such minimising queuing in the 3 lanes provided and prevent queuing back onto Kellogg Rd.

Power Street as a B-Double route

It should be noted that Power Street is not currently a defined B-Double route. This status should be upgraded to allow for heavy vehicle movements, particularly considering the industrial nature of the area and its future interchange with the M7.

Monitoring

It is recommended that monitoring of road capacity and accidents statistics be undertaken to ensure that the extra traffic generated by the development does not unexpectedly affect the surrounding road network in an adverse manner.

irwinconsult

READYMIX

Proposed Readymix Regional Distribution Centre – Construction Traffic Impact Study

Final Report – 23rd June 2005

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CONTENTS

1. INTRODUCTION

The proposed construction of the Regional Distribution Centre (RDC), including earthworks will occur over a 2-year period. During this period access will be required to the site for both light and heavy vehicles.

This study aims to assess the routes and impacts of this construction related traffic and recommend, where necessary, any required ameliorative works. The report should be read in conjunction with the overall Traffic Impact Study for the RDC, '*Proposed Readymix Regional Distribution Centre at Rooty Hill – Traffic Impact Study*'.

The initial period of construction (the first 6 months) will involve the completion of the internal bridge over Angus Creek. In order for materials to be delivered to this site, heavy vehicular access will be required through parts of the Nurragingy Reserve via North Parade and Knox Rd. The performance of this intersection is outlined later in the document.

During this period, in the event that Eastern Creek is subjected to flooding and the initial construction access through the reserve is cut, an alternate route may be sought onto North Parade.

Upon completion of the Angus Creek road bridge all construction traffic will enter via Kellogg Rd and use the bridge to access the southern portion of the site, therefore eliminating the need to enter via Knox Rd.

The existing Woodstock Ave / Kellogg Rd give-way intersection will perform as the 'main' entry/exit point for heavy vehicles access to the site throughout the entire construction stage of development. This intersections existing and construction stage performance is also detailed later in the document.

2. EXPECTED CONSTRUCTION TRAFFIC ROUTES AND VOLUMES

2.1 Construction traffic volumes

The AM peak hour will be the most critical for construction related traffic at the Regional Distribution Centre, as most building materials will be brought on site in the morning period. As defined in the overall Traffic Impact Study, the AM peak hour for the surrounding road network occurs between 7.30 and 8.30am.

Construction staff over the course of the project is expected to peak at approximately 150 people for any one day. However, these people are expected to arrive on site prior to heavy vehicle deliveries (and therefore the AM peak), and as such these light vehicle traffic movements are not assessed in this analysis. Even so, the configuration of both intersections and the results from the traffic surveys undertaken suggests that these staff vehicle movements can be easily accommodated prior to the AM peak hour.

In order to assess a 'worst case' scenario for both the intersections, the maximum expected peak hour traffic generation during the construction period was used. Table 2.1 defines the expected average daily and maximum AM peak hour heavy vehicle traffic movement into and out of the site.

Table 2.1 Expected construction traffic generation for the site

	No. of vehicles entering the site		**No. of vehicles exiting the site**	
	Average Daily	**Maximum AM Peak Hour**	**Average Daily**	**Maximum AM Peak Hour**
Via the Knox Rd / Reserve access point intersection	20	10	20	10
Via the Woodstock Ave / Kellogg Rd intersection	150	50	150	50
TOTAL	**170**	**60**	**170**	**60**

Source: Readymix

2.2 Proposed routes to and from the site

The majority of the heavy vehicles visiting the site during the construction period are to come from / head towards the south, utilising the Phillip Parkway corridor until the M7 comes operational.

The construction truck routes will include either the Phillip Parkway or the M7, Woodstock Ave, Glendenning Rd, Power St and Knox Rd.

The anticipated directional breakdown of these AM peak construction vehicle movements are listed below:

Intersection of Knox Rd / Nurragingy Reserve access (0 – 6 months)

- Estimated maximum of 10 heavy vehicles entering North Parade via Knox Rd in the AM Peak
  - ♣ 10 turning right from Knox Rd (coming from the north)

- Estimated maximum of 10 heavy vehicles exiting North Parade onto Knox Rd in the AM Peak
  - ♣ 10 turning left onto Knox Rd (heading north)

No construction related traffic will travel along Knox Rd, south of the Nurragingy Reserve access road.

The Woodstock Ave / Kellogg Rd intersection will be assessed under two scenarios, the first is that the M7 is not yet open during the RDC construction and all trucks travel via Phillip Parkway; and the second assumes the M7 has become operational with a directional split of 40% to/from the north and 60% to/from the south. These 'splits' are estimates only and may change during certain periods of construction.

Intersection of Woodstock Ave / Kellogg Rd (0 – 24 months) – utilising Phillip Parkway

- Estimated maximum of 50 heavy vehicles entering the site via Kellogg Rd in the AM Peak
  - ♣ 50 turning right into Kellogg Rd from Woodstock Ave (coming from the Phillip Parkway)

- Estimated maximum of 50 heavy vehicles exiting the site via Kellogg Rd in the AM Peak.
  - ♣ 50 turning left onto Woodstock Ave from Kellogg Rd (heading towards Phillip Parkway)

Intersection of Woodstock Ave / Kellogg Rd (0 – 24 months) – utilising M7

- Estimated maximum of 50 heavy vehicles entering the site via Kellogg Rd in the AM Peak
  - ♣ 30 turning right into Kellogg Rd from Woodstock Ave (coming from M7 northbound lanes)
  - ♣ 20 turning left into Kellogg Rd from Woodstock Ave (coming from Glendenning Rd and M7 southbound lanes)

- Estimated maximum of 50 heavy vehicles exiting the site via Kellogg Rd in the AM Peak.
  - ♣ 30 turning left onto Woodstock Ave from Kellogg Rd (heading towards M7 southbound lanes)
  - ♣ 20 turning right onto Woodstock Ave from Kellogg Rd (heading towards Glendenning Rd and M7 northbound lanes)

All construction related traffic is expected to utilise the Phillip Parkway (or the M7 upon its completion) to gain access to either the Knox Rd (first 6 months only) or Kellogg Rd access points.

2.3 Road network description

2.3.1 Knox Rd and the intersection with the Nurragingy Reserve access point

Knox Rd performs the role of a collector road within Doonside / Rooty Hill, linking Eastern Rd and Richmond Rd. In the vicinity of the Nurragingy Reserve access intersection Knox Rd consists of one lane in each direction with a posted speed limit of 60km/hr.

The intersection with the Nurragingy Reserve, which is to be used by RDC related heavy vehicle traffic only for the first 6 months of the construction period, is a 'T' type intersection under give-way control. Both of the Knox Rd approaches have designated turning lanes (left for northbound and right for southbound), as can be seen in Figure 1.

The Nurragingy Reserve access approach has a median of varying width near the intersection with room at the 'hold line' to accommodate both a left and right turning vehicle. Right turning vehicles are provided with a refuge (small acceleration lane) in the median of Knox Rd, therefore allowing the manoeuvre to be undertaken in two parts; firstly from the Reserve to the median, then merging from the median with the southbound vehicles on Knox Rd. This acceleration lane can be seen in Figure 2.

An on-street bicycle lane is provided on the northbound kerb of Knox Rd.

Figure 1 Knox Rd / Nurragingy Reserve access intersection – looking south

Figure 2 **Knox Rd / Nurragingy Reserve access intersection – looking south from Reserve access approach**

2.3.2 Woodstock Ave, Kellogg Rd and their intersection

The role and configuration of Woodstock Ave, Kellogg Rd and their intersection are defined in the overall Traffic Impact Study, and are therefore not defined in this document.

2.3.3 North Parade

North Parade services the Council works depot and the Nurragingy Reserve, with access onto Knox Rd. It is a sealed road that is not highly trafficked by either light or heavy vehicles.

North Parade is proposed to be used as an access point to the site during the construction of the bridge over Angus Creek (the first 6 months of the construction period). Upon completion of this bridge, this route will no longer be used by construction traffic and all access to the southern part of the site (including the rail siding construction works) will be from Kellogg Rd and through the Readymix site.

3. INTERSECTION PERFORMANCE

As part of the construction traffic analysis Irwinconsult conducted a traffic survey at the intersection of Knox Rd / Nurrangingy Reserve access point on the 21st February 2005. This survey was conducted between 7.00 and 9.00am, with the peak hour found to be between 7.30 and 8.30am.

Total two-way traffic volumes observed along Knox Rd were similar to the published RTA permanent station counts (station 70.154) from 2002. Heavy vehicle volumes made up 11% and 7% respectively for the northbound and southbound traffic on Knox Rd in the AM peak period.

The Woodstock Ave / Kellogg Rd intersection was not surveyed again, as this was undertaken on the 1st December 2004 as part of the overall Traffic Impact Study for the Regional Distribution Centre. However, this was assessed under two scenarios; the first utilising the Phillip Parkway (with the M7 not open) and the second when the M7 is operational with a direction split of 40% to/from the north and 60% to/from the south.

Performance analysis was undertaken for the two key intersections with the inclusion of the construction traffic for the Regional Distribution Centre using aaSIDRA version 2.

Intersection performance is ranked as a Level of Service as follows:

LoS	Description
A or B	Very Good
C	Good
D	Acceptable
E or F	Bad

An assumed 2.5% per annum traffic growth factor was applied to the surveyed movements at each intersection (base case), so as to simulate estimated conditions during the future construction period.

3.1 Intersection of Knox Rd with Nurrangingy Reserve access point

The existing performance of the Knox Rd / Nurragingy Reserve access intersection is detailed in Table 3.1.

Table 3.1 Existing performance of the Knox Rd / Nurragingy Reserve access point intersection – AM Peak hour

Movement	Degree of Saturation	Average Delay (sec)	95% back of queue length (m)	Level of Service
Knox Rd south (northbound)				
Left	0.001	9.0	0 (0 cars)	A
Through	0.425	0.0	0 (0 cars)	A
Knox Rd north (southbound)				
Through	0.585	0.0	0 (0 cars)	A
Right	0.001	12.2	0 (0 cars)	A
Nurragingy Reserve access point (eastbound)				
Left	0.008	22.5	0 (0 cars)	B
Right	0.008	54.0*	0 (0 cars)	D

Note: * is a combination of both movements - the first movement into the median refuge (22 sec) and the second waiting to enter the southbound lanes of Knox Rd (32 sec).

This intersection is currently operating overall at a very good Level of Service 'A', with an average delay to all vehicles of 1 second. This is due to the high volumes of traffic utilising Knox Rd unimpeded and the very low existing turning movements at the intersection (almost non-existent).

The analysis suggests this intersection has enough spare capacity to accommodate additional traffic.

With the inclusion of the construction related heavy vehicle traffic at this intersection the performance of the junction alters, as can be seen in Table 3.2.

Table 3.2 Forecast performance of the Knox Rd / Nurragingy Reserve access point intersection during the construction stages - AM Peak hour

Movement	Degree of Saturation	Average Delay (sec)	95% back of queue length (m)	Level of Service
Knox Rd south (northbound)				
Left	0.001	9.0	0 (0 cars)	A
Through	0.445	0.0	0 (0 cars)	A
Knox Rd north (southbound)				
Through	0.614	0.0	0 (0 cars)	A
Right	0.026	17.1	1 (1 car)	B
Nurragingy Reserve access point (eastbound)				
Left	0.078	27.0	1 (1 car)	B
Right	0.008	54.0*	0 (0 cars)	D

Note: * is a combination of both movements - the first movement into the median refuge (22 sec) and the second waiting to enter the southbound lanes of Knox Rd (32 sec).

The analysis shows that the Knox Rd / Nurragingy Reserve access intersection will operate overall at a Level of Service 'A', with an average delay to all vehicles of approximately 1 second during the construction period for the Regional Distribution Centre (first 6 months only). The impact of the RDC construction traffic is minimal at this intersection.

The right turn into the Reserve is the only movement that will worsen from the existing conditions, with an anticipated performance of LoS 'B' and delay of 17 seconds (5 seconds worse than existing conditions).

All other movements are expected to perform at existing condition levels.

Once the Angus Creek road bridge is complete, construction traffic will not be required to enter from this intersection, utilising only the main entry/exit point on Kellogg Rd.

3.2 Intersection of Woodstock Ave with Kellogg Rd

This intersection will perform as the 'main' entry/exit point for construction related traffic throughout the whole construction period.

The performance of the intersection under existing conditions can be seen in Table 3.3.

Table 3.3 Existing performance of the Woodstock Ave / Kellogg Rd intersection – AM Peak hour

Movement	Degree of Saturation	Average Delay (sec)	95% back of queue length (m)	Level of Service
Kellogg Rd (northbound)				
Left	0.098	15.7	3 (1 car)	B
Right	0.095	32.5	2 (1 car)	C
Woodstock Ave east (westbound)				
Left	0.125	9.6	0 (0 cars)	A
Through	0.125	0.0	0 (0 cars)	A
Woodstock Ave west (eastbound)				
Through	0.143	0.0	0 (0 cars)	A
Right	0.271	14.6	6 (1 car)	B

Under existing conditions this intersection performs at an overall LoS of 'A' with an average delay to all vehicles of 3 seconds.

The worst performed movement is the right turn out of Kellogg Rd, which operates at a LoS 'C' an average delay of 33 seconds. This delay is primarily due to the high volumes of opposing traffic on Woodstock Ave and the need to give way to two directions of traffic (westbound and eastbound on Woodstock Ave). The existing right turn volumes out of Kellogg Rd during the AM peak are quite low.

The analysis suggests that the intersection, under its current configuration, has spare capacity and is capable of accommodating additional traffic.

The future construction phase performance of this intersection was conducted under two scenarios; the first utilising Phillip Parkway only (with the M7 still not open), and the second utilising the M7 with a direction split of 40% to/from the north and 60% to/from the south.

3.2.1 Utilising Phillip Parkway only

Table 3.4 details the performance of the intersection with the additional of the expected heavy vehicles from the construction stage of development. In this scenario the M7 is not operational and all trucks are utilising Phillip Parkway only.

Table 3.4 Forecast performance of the Woodstock Ave / Kellogg Rd intersection during the construction stages - AM Peak hour (Phillip Parkway ONLY)

Movement	Degree of Saturation	Average Delay (sec)	95% back of queue length (m)	Level of Service
Kellogg Rd (northbound)				
Left	0.298	18.6	12 (2 cars)	B
Right	0.133	40.6	3 (1 car)	C
Woodstock Ave east (westbound)				
Left	0.131	9.6	0 (0 cars)	A
Through	0.131	0.0	0 (0 cars)	A
Woodstock Ave west (eastbound)				
Through	0.150	0.0	0 (0 cars)	A
Right	0.492	18.0	15 (3 cars)	B

As can be seen in Table 3.4, the additional traffic expected to utilise this intersection in the construction period will slightly alter the performance. The overall LoS is predicted to still operate at LoS 'A' with an average delay to all vehicles of 4 seconds.

The right turn out of Kellogg Rd will still remain the worst performed movements (LoS 'C') with a delay of 41 seconds, primarily as a result of the expected increase in opposing volumes. All other movements are expected to operate at a level similar to the existing conditions.

3.2.2 Utilising the M7

Table 3.5 details the performance of the intersection with the additional of the expected heavy vehicles from the construction stage of development. In this scenario the M7 is operational and the directional split is 40% to/from the north and 60% to/from the south.

Table 3.5 Forecast performance of the Woodstock Ave / Kellogg Rd intersection during the construction stages - AM Peak hour (M7 operational)

Movement	Degree of Saturation	Average Delay (sec)	95% back of queue length (m)	Level of Service
Kellogg Rd (northbound)				
Left	0.232	17.9	8 (2 cars)	B
Right	0.479	55.7	14 (3 cars)	D
Woodstock Ave east (westbound)				
Left	0.142	10.9	0 (0 cars)	A
Through	0.142	0.0	0 (0 cars)	A
Woodstock Ave west (eastbound)				
Through	0.149	0.0	0 (0 cars)	A
Right	0.429	17.8	13 (2 cars)	B

As can be seen in Table 3.5, the use of the M7 during the construction period will slightly alter the performance. The overall LoS is predicted to still remain at LoS 'A' with an average delay to all vehicles of 5 seconds.

The right turn out of Kellogg Rd will worsen to LoS 'D' with a delay of 56 seconds, primarily as a result of the expected increase in opposing volumes. All other movements are expected to operate at a level similar to the existing conditions.

As identified in the overall traffic study '*Proposed Readymix Regional Distribution Centre – Traffic Impact Study*' this intersection would need to be upgraded to accommodate post development traffic movements.

The analysis of the construction period suggests that this intersection upgrade is not warranted at this stage of development and the existing configuration is capable of accommodating the expected construction-related traffic, whether the M7 is open at the time of construction or not. It is recommended however, that the upgrade be completed prior to the Regional Distribution Centre becoming operational.

4. RECOMMENDATIONS AND CONCLUSIONS

4.1 Intersection requirements

Woodstock Ave / Kellogg Rd intersection

Intersection analysis identifies that the existing configuration for the Woodstock Ave / Kellogg Rd intersection is capable of accommodating the additional heavy vehicle traffic during the construction stages (ie. 150 trucks entering and exiting the site per average construction day).

This is true for both scenarios assessed; where all traffic utilises Phillip Parkway (the M7 is not open), or the M7 is utilised with a directional split of 40% to/from the north and 60% to/from the south. Noting these 'splits' are estimates only and may change during certain periods of construction.

Knox Rd / Nurragingy Reserve access point intersection

The use of the Knox Rd / Nurragingy Reserve access point intersection during the initial stages of construction (first 6 months) will slightly decrease the overall performance of the intersection. However this impact will be minor as the RDC construction-related heavy vehicle traffic volumes will be very low during the AM peak hour. The major vehicle movements along Knox Rd (north and southbound) are not expected to be impeded greatly by the additional turning movements expected at this intersection.

The right turn into the Reserve is the only movement that will worsen as a result of the RDC construction traffic, with an anticipated performance of LoS 'B' and additional delay of 5 seconds (total 17 seconds).

All other movements are expected to perform at existing condition levels.

It is recommended that signage be installed on the Knox Rd approaches to the intersection warning motorists of the possibility of construction traffic entering the roadway (eg. 'Construction traffic ahead', or 'Construction trucks entering') .

4.2 North Parade

North Parade will only be utilised for the first 6 months of the construction stage, while the internal bridge over Angus Creek is completed. Once completed all construction traffic will use the Kellogg Rd entrance.

This road is currently lightly trafficked, providing access to the Nurragingy Reserve and Knox Rd for the Council Depot. The main users of the roadway are vehicles associated with Blacktown City Council, with some general public vehicles.

It is recommended that a condition survey of North Parade be undertaken prior to, and upon completion of, RDC construction works to ensure that it remains at the same level of amenity following its limited use for construction access. It is proposed that this will be undertaken in conjunction with Blacktown City Council officers.

Even though the volumes of traffic using this road are very low, to further improve safety within the reserve, signage should be installed along North Parade (including the entry points and any areas where pedestrians may gather), outlining the presence of heavy vehicles to other motorist and pedestrians. A construction traffic speed limit of approximately 25km/hr should be imposed within the Nurragingy Reserve, with all construction related drivers notified of the speed restriction.

4.3 General Recommendations

It is recommended that both key intersections be monitored to ensure that the construction-related traffic does not create any unexpected safety or efficiency problems in the surrounding road network.