APPENDIX

O

Traffic and Transport Impact Assessment

Aston Resources

Maules Creek Coal Project

Traffic and transport impact assessment

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Aston Resources

Maules Creek Coal Project

Traffic and transport impact assessment

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This report has been prepared for Aston Resources in accordance with the terms and conditions of appointment for Maules Creek Coal Project dated 17 May 2010. Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

CONTENTS

1 Introduction

The Maules Creek Coal Project (the Project) is located in the Gunnedah Basin approximately 20km north-east of Boggabri, New South Wales. The Project Boundary includes mining tenements Coal Lease (CL) 375 and Authorisation (A) 346 as shown in Figure 1-1.

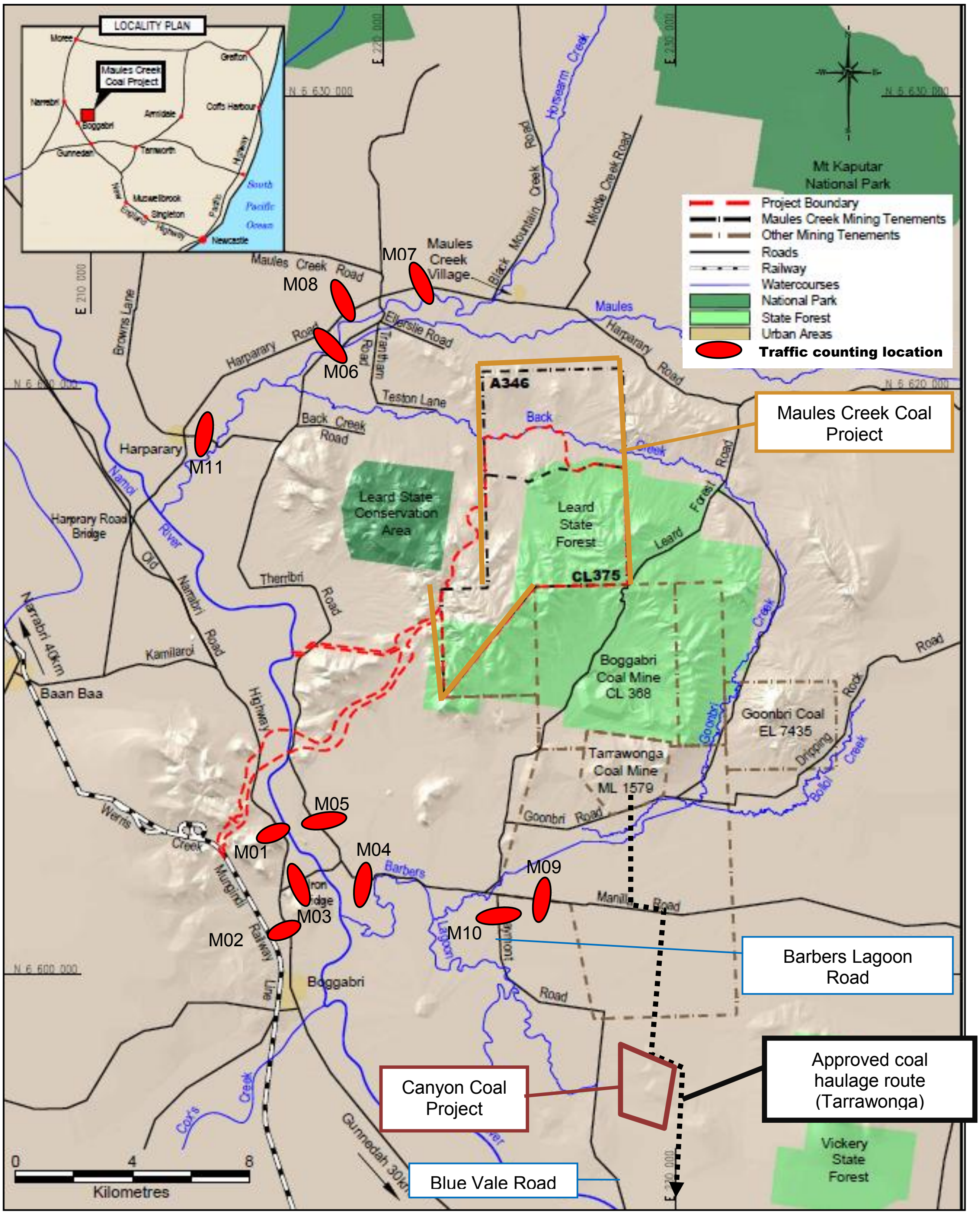


Figure 1-1 Locality map. Source: Hansen Bailey (2010a).

Hyder Consulting (Hyder) was commissioned by Hansen Bailey on behalf of Aston Resources Limited (Aston Resources) to undertake a *traffic and transport impact assessment* for the Maules Creek Coal Project (the Project). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support an application for a contemporary Project Approval under Part 3A of the Environmental Planning and Assessment

Act 1979 (EP&A Act) to facilitate the development of a 21 year open cut coal mining operation and associated infrastructure.

Specifically, the Project will consist of:

- The construction and operation of an open cut mining operation extracting up to 13 million tonnes per annum (Mtpa) Run of Mine (ROM) coal to the Templemore Seam;
- Open cut mining fleet including excavator / shovels and fleet of haul trucks, dozers, graders and water carts utilising up to 470 permanent employees;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput capacity of 13 Mtpa ROM coal;
- The construction and operation of Tailings Drying Area;
- The construction and operation of a rail spur, rail loop, associated load out facility and connection to the Werris Creek to Mungindi Railway Line;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of water management infrastructure including a water pipeline, pumping station and associated infrastructure for access to water from the Namoi River;
- The installation of supporting power and communications infrastructure; and
- The construction and operation of explosive magazine and explosive storage areas.

The scope of this traffic and transport impact assessment addresses the requirements as specified within the Director-General's Environmental Assessment Requirements (EARs) dated 2 November 2010. This was described as a transport assessment including the items in Table 1-1:

Table 1-2 Description of study scope items stated in the EARs.

No.	Scope item	Approach and methodology
1	Accurate predictions of the road and rail traffic of the project.	The (road) traffic volumes generated by the Project were determined by first principles by considering the number of staff reporting to the site during the construction and operational periods and a conservatively assumed vehicle occupancy. The number of heavy vehicles generated during the construction period was determined from the construction program supplied by Aston. These are described in Section 3 of the report. Rail traffic volumes were determined by considering the expected ROM quantities, assumed train lengths and wagon loading capacities. This has been described in Section 6 of this report.
2	A detailed assessment of the potential impacts of this traffic on the capacity, efficiency, and safety of the road and rail networks.	The potential impacts on key intersections was assessed by SIDRA modelling as described in Section 4. A midblock capacity analysis for Blue Vale Road was also undertaken and has been detailed in Section 4.2. A road safety impact assessment was also undertaken for all roads that are proposed to be used as part of the Project. The findings have been documented in Section 5. A commentary on the likely demand and safety impacts on

		the rail network has been provided in Section 6.
3	A detailed assessment of the potential impacts on the road/rail crossings at Gunnedah, Breeza and Curlewis.	The potential impact on railway level crossings was modelled in SIDRA as well as a manual method from first principles. This has been described in Section 6.1.1 A road safety impact assessment was undertaken for the railway level crossings and the findings have been documented in Section 6.1.2.

Further the scope was outlined in the Preliminary Environmental Assessment (PEA) report (Hansen Bailey, 2010) and is detailed in Table 1-2. This table also provides more detail on the approach and methodology used to address each scope item. The scope items do not necessarily reflect the sequential order that the tasks were completed or reported in.

Table 1-2 Description of study scope items stated in the PEA.

No.	Scope item	Approach and methodology
1	Review of traffic impact assessments and other available reports for the surrounding area.	Section 8 provides a full list of documents referenced as part of the background research for this study. In particular, Hyder referenced the following: ▪ ARTC documents regarding existing capacity and forecast demands on the rail network between Narrabri and the Port of Newcastle. ▪ Environmental assessment and related traffic impact assessment reports for the Tarrawonga Coal Mine, and Boggabri Coal Mine. Details of the traffic and transport implications reported in these documents have been included in various sections of this report where relevant.
2	Assessment of the likely impacts during the construction and operational phases of the mine, as well as the cumulative impacts due to future changes in the region.	The construction program prepared for the Project was used to determine the likely traffic generation implications during the construction phase. The forecast coal production volumes were used to determine the likely rail traffic generation implications. The background research described in item 1 above identified future traffic and transport generation implications of neighbouring mine projects. This was accounted for in this study to ensure a cumulative impact assessment was effectively carried out. These have been discussed in Sections 3 and 4.
3	Assessment of the increase in demand for rail movements due to increased coal production in the area.	A commentary has been provided in Section 6 on the existing rail network capacity, forecast demands and network deficiencies.
4	Identification of impacts of the project relating to works on the public road network.	Section 4 summarises the results of the traffic modelling used to assess the impacts at key intersections in the surrounding road network. The impact of increased rail movements at railway level crossings is described in Section 6.1.1
5	Quantification of predicted	Traffic surveys conducted in September 2010 were used to

	increases in traffic during the construction and operational phases (considering potential future traffic flows).	establish the baseline (existing) traffic conditions. The response to scope item 2 broadly describes the methodology used to forecast the traffic volumes generated by the construction and operational phases of the mine. The review of other literature described in scope item 1 was used to identify other traffic generation implications due to surrounding developments.
6	Identification of any mitigation measures necessary	Mitigation measures were developed, where necessary, to address impacts as described in Section 4, 5 and 6. These are summarised in Section 7.

2 Existing conditions

2.1 Road network conditions

A map of the surrounding road network is provided in Figure 1-1.

2.1.1 Kamilaroi Highway

The Kamilaroi Highway (MR72) is an undivided rural main road to the west of the Project Boundary. It provides an important regional link between Quirindi and Willow Tree in the south, and Walgett in the north-west quadrant of NSW. In the vicinity of the Project Boundary, the Kamilaroi Highway passes through Gunnedah and Boggabri townships before continuing north-west toward Narrabri. It intersects with other main roads such as the New England Highway near Willow Tree, the Oxley Highway at Gunnedah, and the Newell Highway at Narrabri. In 2002, the section of the Kamilaroi Highway to the south of Manilla Road carried approximately 2,200 vehicles/day (RTA, 2004). Heavy vehicles make up approximately 17% of all traffic using this section of the highway.

The Kamilaroi Highway is mostly a two-lane, two-way sealed road in the vicinity of the Project Boundary (see Figure 2-1) with short sections providing additional lanes for deceleration and storage of turning vehicles and acceleration for high-speed merges. The route generally provides sealed shoulders which are delineated by edge lines. The speed limit is generally 100km/h with the exception of towns where lower speed limits are used, such as the 50km/h general speed limit applied to the whole of the Boggabri township.

Figure 2-1 Kamilaroi Highway, looking northbound (the Manilla Road intersection is on the other side of the hill on the right-hand side of the photo).

The Kamilaroi Highway contains reasonable horizontal and vertical geometry mostly due to the flat surrounding terrain, which results in parts of the road being subjected to flooding. However, as a main road, the flood mitigation measures are generally better than other roads in the area with formalised culverts to minimise overland flow paths across the roadway.

The Kamilaroi Highway is an approved B-double route between Gunnedah and Narrabri. Throughout this area, the route runs parallel to and to the east of the Werris Creek-Mungindi Railway line. A school bus route exists on this road with associated advisory signs as well as *pedestrian ahead* warning signs in approach to bus stops.

During the construction period of the Project, heavy vehicles would use the Kamilaroi Highway to access Blue Vale Road from the south. They would then proceed northward along Blue Vale Road, Braymont Road, Barbers Lagoon Road, and Manilla Road towards the Project Boundary. Once on Manilla Road, the generated traffic would initially use Leard Forest Road and either East Link Road or Northern Ring Road to access the Project Boundary until such time as the Mine Access Road from Therribri Road is completed. Once completed and opened to traffic, Mine Access Road would be the ultimate means of accessing the Project Boundary.

2.1.2 Manilla Road

Manilla Road is an east-west rural undivided two-way road to the south of the Project Boundary project site. It provides access between the Kamilaroi Highway and Therribri Road, Leard Forest Road and Braymont Road. The road generally provides a two-lane, two-way configuration with a 6m sealed width and unsealed shoulders between the Kamilaroi Highway and Braymont Road (Figure 2-2). To the east of Braymont Road, Manilla Road is unsealed.

Figure 2-2 Manilla Road, looking eastbound at horizontal curve (Leard State Forest in background).

Most of Manilla Road is subjected to flooding with flood mitigation mainly provided by overland flow paths (causeways). This has resulted in some pavement damage such as the causeway associated with Bollol Creek between the Leard Forest Road and Braymont Road intersections (Figure 2-3).

Figure 2-3 Causeways on Manilla Road located (a) east of Iron Bridge (left) and (b) Bollol Creek, between Braymont Road and Leard Forest Road (right)

The posted speed limit for most of the Manilla Road route is 80km/h, although it also contains a number of horizontal curves with some having advisory speed limits of 55km/h. The Iron Bridge located approximately 1.5km east of the Kamilaroi Highway is signposted as a 10km/h zone to reduce safety risks for road users. This is a narrow structure with a trafficable width of 5m. As such, overtaking and passing are prohibited and drivers are required to give way to opposing vehicles traversing or entering the bridge (see Figure 2-4). A load limit of 42.5 tonnes applies to the bridge.

A seven-day midblock tube survey conducted in September 2010 indicated that the annual average daily traffic (AADT) volume on Manilla Road is between 350-400 vehicles/day between the Kamilaroi Highway and Barbers Lagoon Road. To the east of Barbers Lagoon Road, the AADT reduces to approximately 140 vehicles/day. Heavy vehicles make up approximately 10% of all traffic on this road. The route operates as a school bus route with associated advisory signs as well as *pedestrian ahead* warning signs in approach to bus stops.

Manilla Road would be a key access route during the construction and operation of the mine. During construction, heavy vehicles would use the Blue Vale Road-Braymont Road-Barbers Lagoon Road route to access Manilla Road from the south. During construction and operation, light vehicles would use Manilla Road to access Leard Forest Road (in the initial construction period) and then Therribri Road once the Mine Access Road has been completed.

Figure 2-4 Manilla Road - Iron Bridge

2.1.3 Therribri Road

Therribri Road is a rural undivided two-lane, two-way road linking Harparary Road in the north to Manilla Road in the south. It lies to the west of the Project Boundary and to the east of the Namoi River. For most of its length, it is an unsealed road with short sealed sections on the approaches to the Boggabri Coal Mine (private) haul road and on the approaches to the Manilla Road intersection.

Midblock surveys conducted in September 2010 indicated that the AADT on Therribri Road is approximately 70 vehicles/day immediately north of Manilla Road (6% heavy vehicles) and 40 vehicles/day immediately south of Harparary Road (14% heavy vehicles).

The road surface for the unsealed sections are reasonably well compacted although water ponding at the road side and across causeways could potentially provide poorer surface conditions (Figure 2-5).

To the south of Harparary Road, Therribri Road intersects Maules Creek as a causeway. The flood depth markers and embankment heights (Figure 2-6) indicate that the causeway may become significantly inundated and render the crossing untrafficable by most vehicles. In this event, traffic would need to Harparary Road-Old Narrabri Road-Kamilaroi Highway-Manilla Road as a detour.

The land either side of Therribri Road largely consists of agricultural cropping and grazing land that is prone to flooding. A number of cattle grids placed across the road imposes both a width constraint as well as a potential source of vehicle axle damage.

The Therribri Road/ Boggabri Coal Mine (private) haul road intersection is a cross intersection with the haul road as the eastern and western major road approaches. Therribri Road forms the northern and southern minor road approaches, which are controlled by *stop* signs (Figure 2-7). Vehicle-actuated boom gates are also used on the haul road approaches to restrict unauthorised entry.

Figure 2-5 Water ponding at the road side due to a road side embankment.

Figure 2-6 Therribri Road causeway at Maules Creek.

Figure 2-7 Therribri Road looking south towards intersection with Boggabri Coal haulage road.

The southern portion of Therribri Road would be used as the longer term access route to the Project. The Mine Access Road would provide a link from the western side of the Project Boundary to Therribri Road. The Therribri Road/ Mine Access Road is likely to intersect near the existing Boggabri Coal haulage road (Figure 2-7).

2.1.4 Leard Forest Road

Leard Forest Road is a rural undivided two-lane, two-way road passing to the east of the Project Boundary. At present, it provides a link from Manilla Road in the south, through the Leard State Forest to Harparary Road to the north of the Project Boundary. Boggabri Coal's recent Application for Project Approval proposes that this road be closed to enable the progression of mining operations. This is scheduled to occur after the construction phase of the Maules Creek Coal Project.

Between Manilla Road and the southern boundary of Leard State Forest, the road is mostly formalised as a 6m wide sealed road with unsealed shoulders (see Figure 2-8). North of the Boggabri Coal haulage road, the road is unsealed with a crown and natural road side channels provided for drainage. The road surface is largely comprised of loose material with poor skid resistance (See Figure 2-9).

Figure 2-8 Leard Forest Road, sealed section between Manilla Road and Leard State Forest.

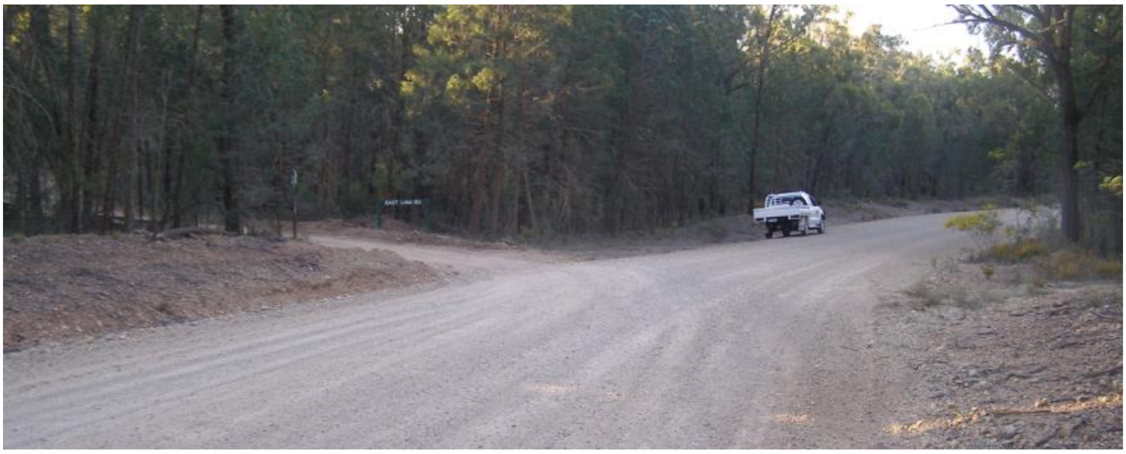


Figure 2-9 Leard Forest Road at East Link Road, the existing access to the Maules Creek Coal Project.

The intersection with the Boggabri Coal (private) haul road is *stop* sign controlled with the haul road approaches having priority over the Leard Forest Road approaches. Vehicle actuated boom gates have been provided to inhibit public access into the haul road.

Leard Forest Road operates as a school bus route with associated advisory signs as well as *pedestrian ahead* warning signs in approach to bus stops.

Leard Forest Road will be used for access to the Project Boundary during the early stages of construction and operation. Construction equipment and employees would access the site via East Link Road which meets Leard Forest Road to the north of the Boggabri Coal haul road. Once the Mine Access Road has been constructed, vehicular access to the Project Boundary would be via Therribri Road and the Mine Access Road.

2.1.5 East Link Road

East Link Road is an existing access road from Leard Forest Road to the Maules Creek mining authorities. It is currently a single lane track despite providing for two-way travel. The road is characterised by steep and undulating, curvilinear alignment with dense vegetation on both sides of the road (see Figure 2-10). The geometric conditions and width are major constraints to travel speed and as such a 30km/h speed limit has been put in place.

Figure 2-10 Typical conditions along East Link Road.

From Leard Forest Road, the route ascends towards the west along a ridge line. It passes a trig station access road and then descends towards the construction site.

As stated above, East Link Road would only be used for interim access to the Project Boundary until Mine Access Road has been constructed from Therribri Road. Northern Ring Road, to the north of East Link Road, is also proposed as a temporary means of access during the initial period of the construction program.

2.1.6 Harparary Road

Harparary Road is situated to the north and west of the Project Boundary. It is a two-lane, two-way, mostly unsealed rural road that provides a link between Leard Forest Road and the Kamilaroi Highway.

The September 2010 midblock surveys conducted as part of this study indicated that the AADT on Harparary Road is approximately 90 vehicles/day to the east of Maules Creek Road (10% heavy vehicles) and 40 vehicles/day to the west of Therribri Road (14% heavy vehicles).

As shown in Figure 2-11, there are signs in place prohibiting the use of Harparary Road by B doubles (articulated trucks up to 26m in length which consist of two trailers). The Project does not propose to use Harparary Road during both the construction and operational phases.

Figure 2-11 Harparary Road, looking west from Therribri Road.

2.1.7 Blue Vale Road-Braymont Road-Barbers Lagoon Road

The Blue Vale Road-Braymont Road-Barbers Lagoon Road route is an alternative route to the Kamilaroi Highway, between the Project Boundary and Gunnedah. This route commences at its northern end at the T intersection of Manilla Road and Barbers Lagoon Road. Barbers Lagoon Road is predominantly a north-south road and is mostly unsealed except for the short length in approach to Manilla Road. A portion of this route is also known as Johnston Road.

The September 2010 midblock surveys undertaken as part of this study indicated that the AADT on Barbers Lagoon Road is 46 vehicles/day immediately south of Manilla Road. Heavy vehicles make up approximately 14% of this traffic.

Braymont Road is an east-west road between the township of Boggabri and Blue Vale Road and is also unsealed. Blue Vale Road is the southern-most portion of the route and meets the Kamilaroi Highway at a T intersection (including a left-turn slip-lane) approximately 5.5km north of Gunnedah.

The Blue Vale Road-Braymont Road-Barbers Lagoon Road route is the nominated heavy vehicle route to and from the Project Boundary. This is due to load and width constraints across the Iron Bridge on Manilla Road, as well as the deep causeway/creek crossing at the northern end of Therribri Road. All roads along this route are two-lane, two-way roads. The southern portion of this route is also part of Tarrawonga Coal Mine’s nominated heavy vehicle access route. Coal haulage trucks from this mine use a private haul road to access Blue Vale Road via the southern arm of Hoads Lane. They then proceed to the Whitehaven CHPP on the southern side of the Kamilaroi Highway, near Gunnedah.

2.1.8 Browns Lane

Browns Lane is a local road which provides a link between Narrabri-Maules Road (near Tarriaro) and Therribri Road to the north-west of the Project Boundary. It is an unsealed road which mostly provides access to a number of rural properties. It crosses Maules Creek to the east of its intersection with Harparary Road.

In November 2010, a midblock traffic survey was carried out on the section of Browns Lane to the south of Harparary Road. During the seven-day period surveyed, an average of 44 vehicles/day used this section of Browns Lane. Heavy vehicles made up 25% of this traffic.

2.2 Key intersections

2.2.1 Kamilaroi Highway/ Manilla Road intersection

This is a T intersection with the Kamilaroi Highway as the northern and southern main road approaches, and Manilla Road (also known as Rangari Road) as the eastern and terminating approach (see Figure 2-12). The Manilla Road approach is *give way* controlled although no give way sign was present at the time of inspection.

Figure 2-12 The Kamilaroi Highway/ Manilla Road intersection (looking south).

The Kamilaroi Highway is on a relatively level grade in this area and has a posted speed limit of 100km/h. The Manilla Road approach is signposted as an 80km/h zone.

The intersection configuration provided is a channelised right turn (CHR) facility with a 50m right-turn bay and a 110m left-turn bay into Manilla Road. It should be noted that the RTA's Road Design Guide Section 4 (RTA, 1999) stipulates a minimum distance of 110m to decelerate a vehicle from 100km/h to rest using a maximum design deceleration rate of 3.5m/s/s.

A 100m long acceleration lane has been provided for the left-turn from Manilla Road to the Kamilaroi Highway. The Manilla Road approach is a two-lane, two-way road with a splayed approach to provide sufficient space for the swept paths of turning vehicles. The entering sight distance from the Manilla Road approach towards oncoming traffic from the north and south was observed to be acceptable.

Large box culverts are provided on the eastern side of the intersection and provide for passage of water under the Manilla Road approach as well as the northern approach of the Kamilaroi Highway. Although this appears to provide sufficient flood mitigation, it would have potential crash risks and would constrain any potential widening of the Manilla Road approach (if required).

2.2.2 Manilla Road/ Therribri Road intersection

This is a T intersection with Therribri Road as the northern main road approach, and Manilla Road South as the southern main road approach. Manilla Road West is the western and terminating approach. The intersection is *give way* controlled as indicated by the signage shown in Figure 2-13.

Figure 2-13 Manilla Road West looking towards Therribri Road (left) and Manilla Road South (right).

The intersection configuration is a basic right (BAR) and basic left (BAL) turn facility with no turning, deceleration or acceleration lanes provided. All approaches generally provide a 6m sealed width and unsealed shoulders.

The entering sight distances from the Manilla Road West approach towards oncoming traffic from either direction on the through approaches is generally acceptable.

2.2.3 Manilla Road/ Leard Forest Road intersection

This is a T intersection with Manilla Road as the eastern and western major road approaches, and Leard Forest Road as the northern and terminating approach. The intersection is *give way* controlled (see Figure 2-14) as indicated by the signage observed on site.

Figure 2-14 Manilla Road looking east towards Leard Forest Road (left).

The intersection configuration is a basic right and left turn facility (BAR/ BAL) with no turning, deceleration or acceleration lanes provided. All approaches generally provide a 6m sealed width and unsealed shoulders.

The entering sight distances from the Leard Forest Road approach towards oncoming traffic from either direction are generally acceptable.

2.2.4 Leard Forest Road/ East Link Road intersection

This is a T intersection with East Link Road as the western and terminating approach. All road approaches are unsealed. As described in Section 2.1.5, East Link Road is generally a single lane track despite allowing two way movements.

2.2.5 Manilla Road/ Barbers Lagoon Road intersection

This is a T intersection with Manilla Road as the eastern and western major road approaches, and Barbers Lagoon Road as the southern and terminating approach. The intersection is *give way* controlled (see Figure 2-15).

Figure 2-15 Barbers Lagoon Road looking north towards Manilla Road.

The intersection configuration is a basic right and left turn facility (BAR/ BAL) with no turning, deceleration or acceleration lanes provided. All approaches generally provide a 6m sealed width and unsealed shoulders.

The entering sight distances from the Barbers Lagoon Road approach towards oncoming traffic from either direction on Manilla Road are generally acceptable.

2.3 Existing traffic conditions

2.3.1 RTA traffic surveys

The RTA maintains a number of traffic counting stations on roads surrounding the study area. These are detailed as follows:

- Station 92.294 located on Kamilaroi Highway to the north Emerald Hill Road (between Gunnedah and Boggabri) which had survey results for 1984, 1995, 1998 and 2004.
- Station 99.368 located on Manilla Road located on the Tamworth/ Gunnedah LGA boundary which had survey results for 1980, 1984, 1988, 1995, 1998, 2001 and 2004.

The traffic volume data collected at each of these sites is in AADT volumes expressed in vehicles/day and account for the combined total traffic volume in both directions.

The traffic survey results have been presented in Figure 2-16 and 2-17 along with approximate linear trend lines. The survey results and projected increases for Station 92.294 correlate well with the traffic survey for M02 as described in Section 2.3.2 and Appendix A.

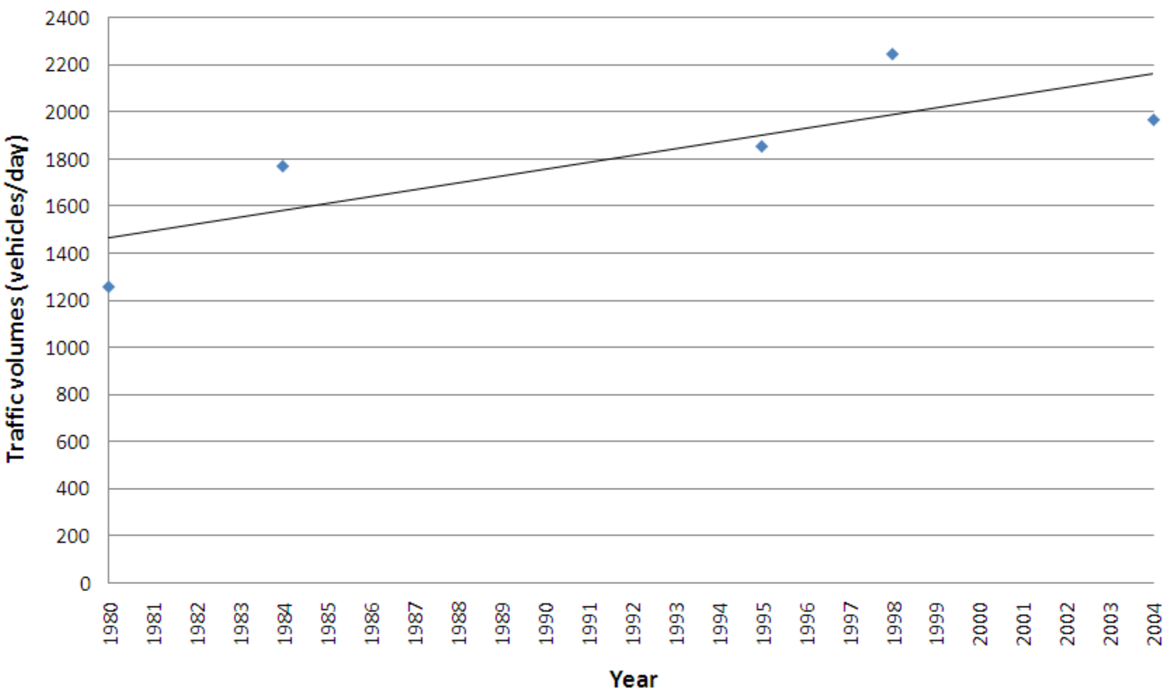


Figure 2-16 **RTA traffic volume counts (and approximate trend line) at station 92.294 – Kamilaroi Highway.**

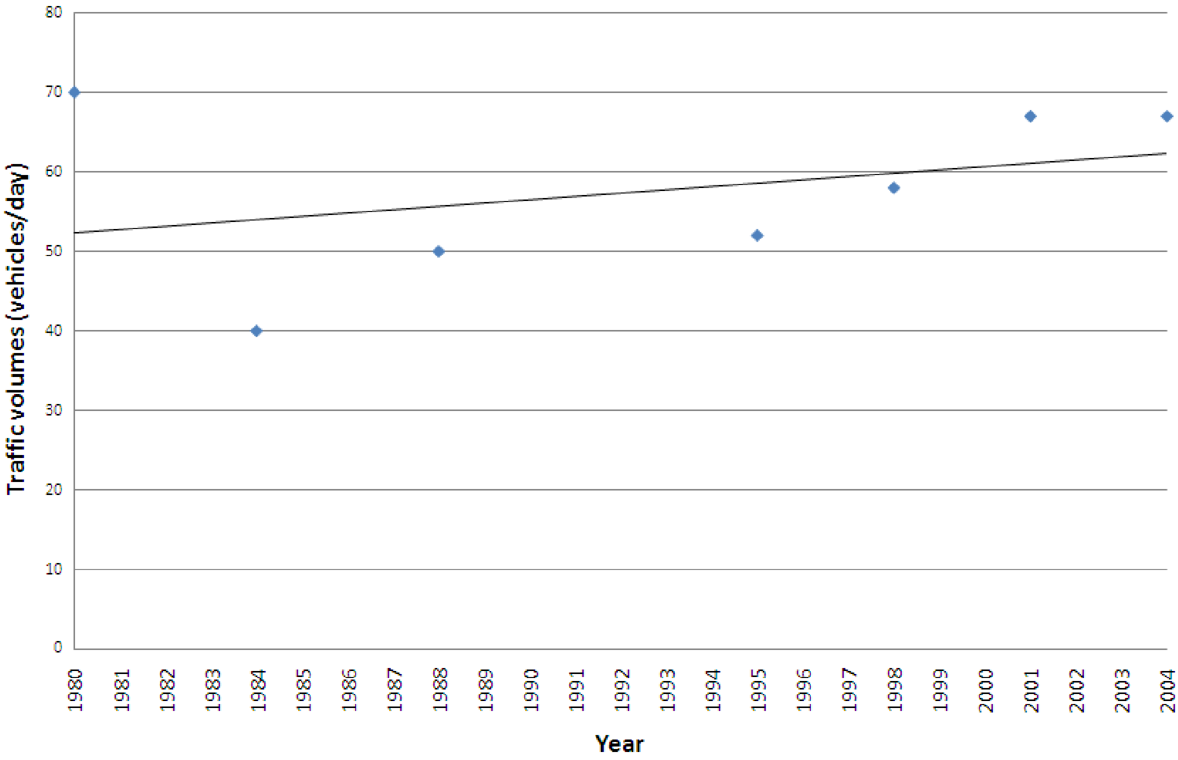


Figure 2-17 **RTA traffic volume counts (and approximate trend line) at station 92.368 – Manilla Road.**

The trend line in Figure 2-16 indicates that the traffic volumes on the Kamilaroi Highway have grown at an average rate of 2.1% per annum over the 24 years between 1980 and 2004. Figure 2-17 indicates that the traffic volumes on Manilla Road have grown at an average rate of 0.8% per annum over the same period. As such, this traffic and transport impact assessment has assumed a 2.1% per annum growth rate for traffic on the Kamilaroi Highway, and a 0.8% per annum growth rate for Manilla Road, Therribri Road, Harparary Road and Barbers Lagoon Road. This growth rate will be used to forecast increases in background traffic on these roads for future case scenarios.

2.3.2 2010 traffic survey results

As part of this Project, Hansen Bailey commissioned 24-hour, seven day continuous midblock traffic surveys between 4-10 September 2010. The surveys were carried out at the following locations:

- M01 – Kamilaroi Highway, north of Manilla Road.
- M02 – Kamilaroi Highway, south of Manilla Road.
- M03 – Manilla Road, east of Kamilaroi Highway.
- M04 – Manilla Road, east of Therribri Road.
- M05 – Therribri Road, north of Manilla Road.
- M06 – Therribri Road, south of Harparary Road.
- M07 – Harparary Road, east of Maules Creek Road.
- M08 - Harparary Road, West of Therribri Road.
- M09 – Manilla Road, east of Barbers Lagoon Road.
- M10 – Barbers Lagoon Road, south of Manilla Road.
- M11 – Browns Lane, south of Harparary Road.

These survey locations are shown in Figure 1-1.

The average hourly traffic volumes for the weekdays for each midblock survey location have been provided in Appendix A. This includes the total number of vehicles per direction for each hour of the day, as well as a breakdown by light and heavy vehicles.

2.4 Existing rail network and operational conditions

Product coal from the Project will be transported by rail via the Werris Creek-Mungindi Railway line which is part of the Hunter Valley coal corridor. This line extends in a south-east direction meeting the Muswellbrook-Ulan Railway line at Muswellbrook. South of this junction, the rail corridor continues south-westward to the Port of Newcastle via Singleton, Branxton and Maitland. The rail network is shown in Figures 2-18 and 2-19.

ARTC (2009) provides a broad snapshot of the existing conditions on the Hunter Valley rail corridor. Key points have been summarised below.

Rail network and fleet conditions

- The Hunter Valley coal network consists of a dedicated double track line between the Port of Newcastle and Maitland; a shared double track line from Maitland to Muswellbrook; and a shared single track with passing loops from that point north and west.
- Many of the passing loops on the single track section have insufficient lengths (see Figure 2-19).
- The section of the network immediately surrounding the Maules Creek Coal Project (ie. from the Dartbrook Junction to the Gunnedah basin) is currently limited to a maximum

axle load of 25 tonnes (100 tonne wagons). The network south of Dartbrook has a maximum axle load limit of 30 tonnes (120 tonne wagons).

- The fleet which currently services the network consists of (i) 17 trains of 91 x 120 tonne wagons, (ii) four trains of 74 x 120 tonne wagons, (iii) three trains of 72 x 100 tonne wagons, and (iv) five trains of 42 x 100 tonne wagons.

Operational conditions

- Trains with 120 tonne wagons are restricted to 60km/h when loaded and 80km/h when empty. Trains with 100 tonne wagons are restricted to 80km/h when loaded and empty.
- At present the theoretical export coal capacity of the Hunter Valley rail network is approximately 189 Mtpa. However, the practical delivery capacity is approximately 95Mtpa as this accounts for maintenance downtime, surge volume and system reliability.
- Modelling/ simulation work on existing network performance indicates that trains from the Gunnedah basin experience approximately 34 minutes delay per every 100km travelled. By comparison, the modelling indicates that trains on the Muswellbrook to Ulan Railway line experience approximately nine minutes delay per every 100km.
- Currently, there are six trains per direction per day between Narrabri and Gunnedah. This includes coal, other freight and passenger trains. This increases to seven between Gunnedah and Werris Creek, nine between Werris Creek and Scone, and 12 between Scone and Newcastle.
- The Liverpool Ranges at Ardglen present a significant constraint to coal train operations. The steep grades require loaded trains to be “banked” when ascending the grade. This involves the use of additional locomotives. The coupling and re-coupling of wagons, and the return paths of the banker locomotive are all factors affecting the capacity of this section.
- Other steep grades exist on the southern portion of the network and include the Allandale Bank (near Greta), the Minimbah Bank and the Numbah Bank (north of Singleton).
- Key junctions in the network include the Dartbrook junction (junction of the Muswellbrook to Ulan and Gunnedah basin line) and the Maitland junction (junction of the passenger line to Brisbane). Key junctions with coal loading loops include those at Whittingham (Mt. Thorley and Bulga), Newdell (Ravensworth, Newdell and Liddell) and Drayton (Drayton and Mt. Arthur). These junctions generate train conflicts which then have an impact on the capacity and operational performance of the rail line.

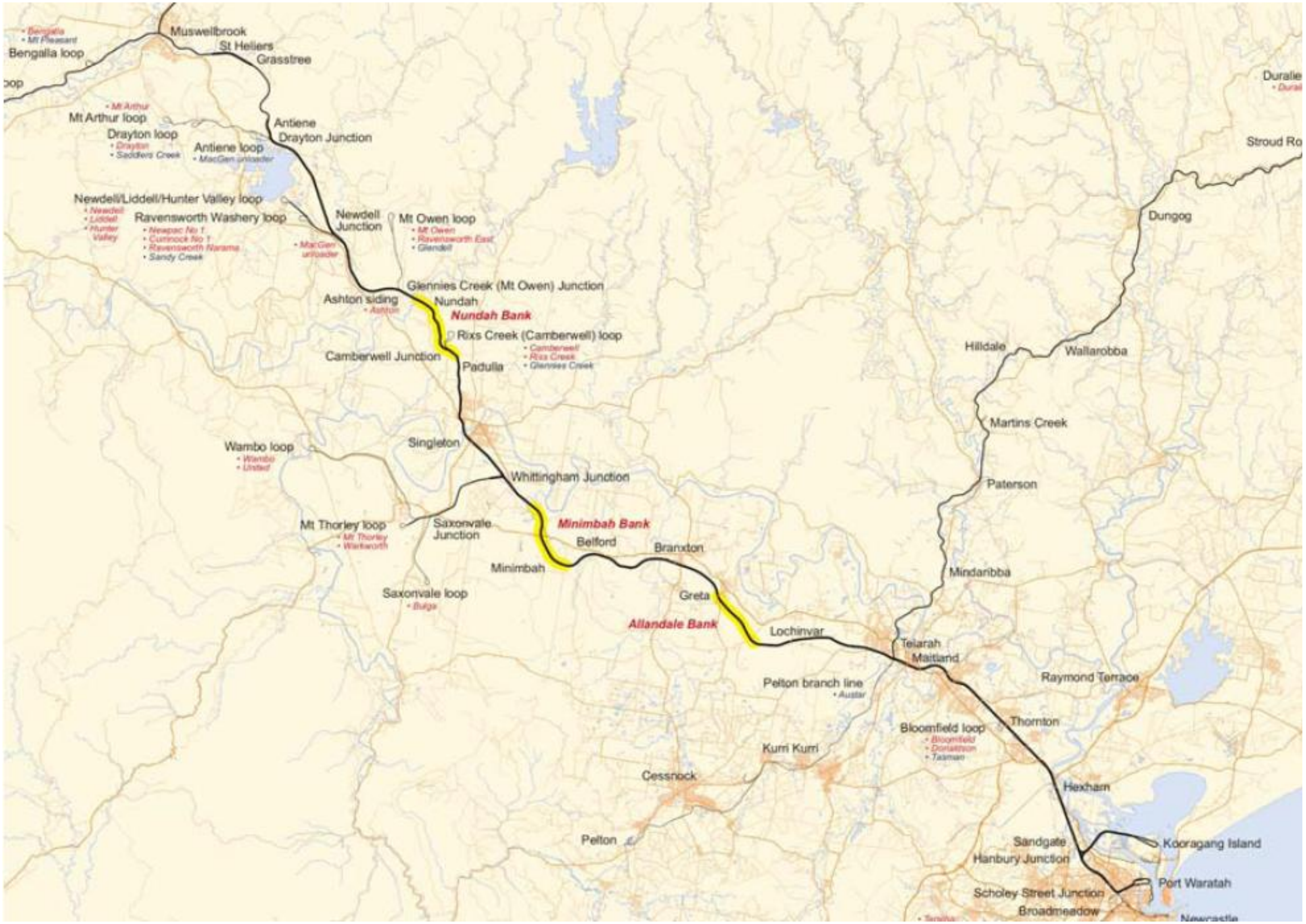


Figure 2-18 Hunter Valley coal rail network – southern portion from Muswellbrook (Dartbrook) to Newcastle (Source: ARTC, 2009).

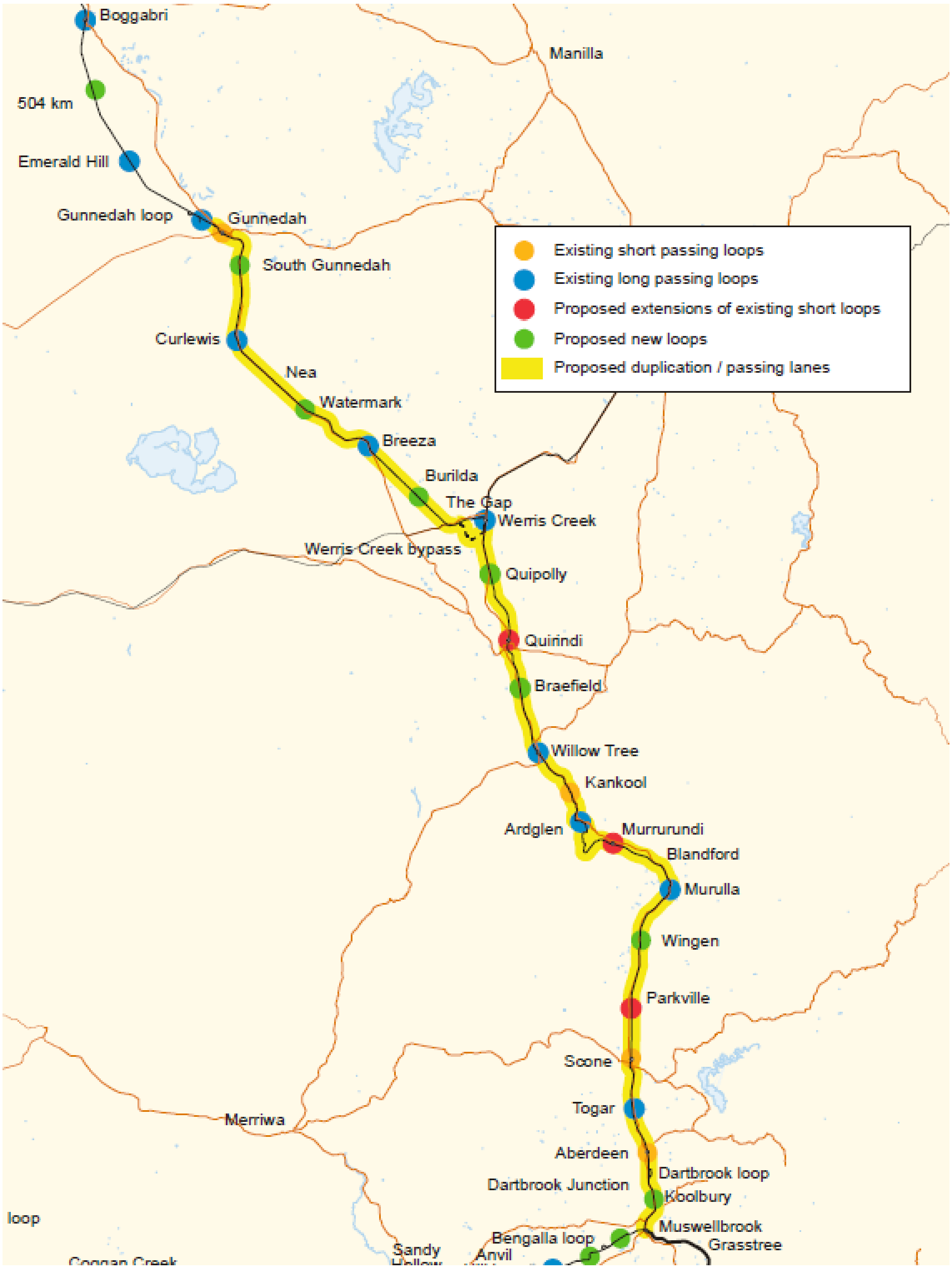


Figure 2-19 Hunter Valley coal rail network – northern portion from Narrabri to Muswellbrook (Dartbrook) (Source: ARTC, 2009).

3 Traffic and transport generation implications of the project

3.1 Potentially significant traffic and transport impacts

The construction phase of the Project will result in traffic generation associated with the delivery of construction equipment and materials to and from the site. There will also be traffic generated by the movement of construction workers to and from the site at the start and end of work shifts. Table 3-1 summarises the sources of traffic and whether each source is likely to be significant enough to warrant further detailed assessment. It also details the locations along the transport network that would need to be examined to assess potential impacts of the Project.

The operational phase of the Project will result in generation of road traffic associated with employees attending the site each day, as well as transport for delivery of consumables. All coal would be transported by rail and hence there would be no road traffic generated by coal transportation (on public roads). Table 4-2 summarises the sources of traffic and transport whether each source is likely to be significant enough to warrant further detailed assessment.

Table 4-1 Summary of traffic generation and likely significance of impact – construction phase.

Traffic source	Significance of impact	Locations that require assessment

Construction workers moving to and from site at start and end of shifts.	▪ A chartered bus service will be provided which will pick up workers from Boggabri.
	▪ At the peak construction period, up to 340 employees would be required to attend the site.
	▪ It has been assumed that 90% of employees would be transported by bus, and 10% by private vehicle.
	▪ This equates to 15 one-way bus trips based on 20 persons per bus, and 34 one-way car trips based on occupancy of 1 person/car.
	▪ All vehicle inbound movements would be between 6:00-7:00am based on a construction start time of 7:00am.
	▪ All outbound movements would be between 6:00-7:00pm based on a daily end of shift time of 6:00pm.
	▪ All inbound bus movements would be followed by a return movement in the following hour.
	▪ The traffic movements generated by inbound and outbound movements are not significant in isolation. However, the cumulative impact accounting for traffic generated by other neighbouring mines would need to be assessed.
		▪ The pick up point for the bus commuters will be located in Boggabri and all shuttle buses would access the Project Boundary via the Kamilaroi Highway, Manilla Road, Leard Forest Road and East Link Road during the initial period, and Therribri Road and Mine Access Road once Mine Access Road has been constructed.
		▪ An assumed 10% of construction employees would travel by private vehicle. Of these, 90% would access the Project Boundary via Manilla Road West (60% from Boggabri and the south, and 30% from Narrabri and the north). The remaining 10% would access the site via Barbers Lagoon Road.
		▪ Based on the above, the following intersections were assessed as part of this study:
		  ▪ Kamilaroi Highway/ Manilla Road
		  ▪ Manilla Road/ Barbers Lagoon Road
		  ▪ Manilla Road/ Therribri Road
		  ▪ Therribri Road/ Mine Access Road.
		▪ In the initial construction period, before Mine Access Road is constructed from Therribri Road, access to the Project Boundary would be via Leard Forest Road and East Link Road. However, the majority of construction related traffic (including traffic during the peak construction period) will access the site after Mine Access Road is opened to traffic.

Heavy vehicle traffic generated by construction activity	▪ The construction program indicates that weeks 5-10 of the construction program (see Appendix B) would be the peak period with regard to construction related traffic. ▪ Up to 230 one-way truck movements would be generated per week, which is an average of 33 one-way truck movements per day. The assessment has conservatively assumed a maximum of 10 one-way truck movements per hour. These would also generate a return movement presumably in the same hour.	▪ The designated heavy vehicle route is via Therribri Road, Manilla Road, Barbers Lagoon Road, Braymont Road and Blue Vale Road (with the southern portion following the approved coal haul route from Tarrawonga Coal Mine as shown in Figure 1-1). ▪ As such, the following intersections were assessed as part of this study: ▪ Manilla Road/ Barbers Lagoon Road

	▪ The heavy vehicle traffic generated by the peak construction period is significant and should be assessed in more detail.	▪ Manilla Road/ Therribri Road ▪ Therribri Road/ Mine Access Road ▪ In addition, a midblock capacity assessment was undertaken for the southern section of Blue Vale Road near Kamilaroi Highway.

Table 4-2 **Summary of traffic/transport generation and likely significance of impact – operational phase.**

Traffic/ transport source	**Significance of impact**	**Locations that require assessment**

Mine workers moving to and from site at start and end of shifts.	▪ A chartered bus service will be provided which will pick up workers from Boggabri.
	▪ Up to 470 persons would be permanently employed by the mine with an assumed maximum day shift work force of 140 workers, and an assumed maximum night shift workforce of 110 workers.
	▪ It has been assumed that 90% of employees would be transported by bus, and 10% by private vehicle.
	▪ This would equate to seven one-way bus trips based on 20 persons per bus, and 14 one-way car trips based on occupancy of 1 person/car, for the day shift.
	▪ It has been assumed that there would be two 12 hour shifts per weekday, with all inbound movements to be generated in the hour immediately prior to the shift start time, and all outbound movements to be generated in the hourly immediately following the end of shift.
	▪ All inbound bus movements would be followed by a return movement in the following hour. However, in this case, there are no empty trips due to the “start of shift” workers being transported inbound followed by the “end of shift” workers being transported outbound.
	▪ The traffic movements generated by inbound and outbound movements are not significant in isolation. However, the cumulative impact accounting for traffic generated by other neighbouring mines would need to be assessed.
		▪ All shuttle buses would access the Project Boundary via the Kamilaroi Highway, Manilla Road, Therribri Road, and Mine Access Road.
		▪ An assumed 10% of construction employees would travel by private vehicle. Of these, 90% would access the Project Boundary via Manilla Road West (60% from Boggabri and the south, and 30% from Narrabri and the north). The remaining 10% would access the site via Barbers Lagoon Road.
		▪ Based on the above, the following intersections were assessed as part of this study:
		  ▪ Kamilaroi Highway/ Manilla Road
		  ▪ Manilla Road/ Barbers Lagoon Road
		  ▪ Manilla Road/ Therribri Road
		  ▪ Therribri Road/ Mine Access Road.

Rail transportation of coal product	▪ 225Mt of product coal would be transported by rail using the Werris Creek - Mungindi Railway line over a 21 year mine life (Hansen Bailey, 2010b). ▪ The forecast maximum production rate would be 13Mtpa ROM (10.8Mtpa product) and is expected to be achieved in 2020 (Hansen Bailey, 2010b).	▪ Section 6 describes the likely impacts to the rail line between Narrabri and Newcastle based on the increased number of train movements for coal transportation. ▪ An assessment was also conducted for the impact of increased train movements across the three railway level crossings at Boggabri, Gunnedah and Curlewis.

3.2 Traffic generation during the construction phase

3.2.1 Traffic generated by construction personnel

The following assumptions have been made with respects to the construction program:

- Construction hours would be between 7:00am and 6:00pm, seven days a week.
- Workers would be transported by bus to and from the site from Boggabri. This study has assumed that 90% of workers would be transported by bus with an average bus occupancy of 20 persons/bus.
- There would be 340 workers required during the peak construction period of the Project.
- Of the 10% of workers that would travel to work by private transport, 90% would travel via Manilla Road West (with a further breakdown of 60% from Boggabri and the south, and 30% from Narrabri and the north). The remaining 10% would travel via Barbers Lagoon Road.

These assumptions are based on information provided by Aston, as well as information from background documents.

3.2.2 Heavy vehicle construction traffic

The indicative construction schedule for the Project is presented in Appendix B. This shows the scheduled timing of each construction item as well as the number of one-way heavy vehicle movements (number of *visits*) generated by the activity. It is important to note that each *visit* would generate two *trips/ movements* – an inbound movement and an outbound movement.

As shown in Appendix B, a peak of 230 one-way truck movements per week (average of 33 one-way truck movements per day) are forecast during the peak construction period (as shown in weeks 5-10 of the indicative construction program). For simplicity, this peak period has been referred to as “week 10” of the construction program for the remainder of this report.

Appendix A also describes the traffic distribution adopted for the modelled scenarios. This includes distribution by origin and destination as well as the distribution by time of day. This study has assumed that the 33 one-way truck movements (per day) would not be evenly distributed throughout the 12-hour work period. Rather, it has been assumed that a maximum of 10 one-way truck movements would be generated in the highest volume hour (ie. a vehicle dispatched every six minutes).

3.3 Operational phase traffic generation

There are anticipated to be approximately 470 full time workers engaged during periods of peak production. This includes contractors, maintenance activities, deliveries, coal processing, coal transport and mining operations. The mining operations will take place 24 hours a day, seven days a week. A maximum daytime and night time workforce of 140 persons and 110 persons respectively, have been adopted for the traffic assessment.

As stated in Section 1, a peak production rate of 13Mtpa ROM is likely to be achieved in 2020. All coal product would be transported by rail via the proposed rail loop which would link in with the Werris Creek-Mungindi railway line. Further description on potential impacts to the rail network are described in Section 6.

3.4 Traffic generation from neighbouring mine projects

There are several neighbouring coal mines which would be operational at the same time as the Maules Creek Coal Project. Those that are most likely to contribute to cumulative traffic generation in the future (that is, additional traffic generation above the current traffic volumes) are Boggabri Coal Mine and Tarrawonga Coal Mine.

3.4.1 Boggabri Coal Mine

Boggabri Coal Mine is located immediately south of the Project Boundary and is accessible via Leard Forest Road (see Figure 1-1).

In 2009, Idemitsu Australia Resources (IAR) submitted an Application for a Project Approval to enable the continuation of mining at the Boggabri Coal Mine for a further 21 year period. The maximum ROM production rate under this Application would be 7Mtpa (compared with the existing rate of 1.5Mtpa) and is anticipated to be achieved by 2017. Under these maximum production conditions, there would be an additional 353 workers (Parsons Brinckerhoff, 2010a). The mining operations at Boggabri Coal Mine would also be 24 hours a day, seven days a week. The change in shift would be 7:00am and 7:00pm.

In this study, it has been assumed that the increase in workforce at Boggabri Coal Mine would be at a linear rate. This equates to an increase of approximately 20 workers per year between 2010 and 2017. The traffic models associated with this study have assumed that all new employees would travel to and from the site by private vehicles and that they would be distributed by trip origin as such:

- 50% would head to Boggabri Coal Mine via Manilla Road West.
- 30% would head to Boggabri Coal Mine via Maules Creek Road and Harparary Road.
- 20% would head to Boggabri Coal Mine via Barbers Lagoon Road.

This study has assumed an average vehicle occupancy of 1 person per vehicle.

Other key traffic implications of the Boggabri Coal Mine are as follows:

- A section of Leard Forest Road would be closed off to through traffic due to the increased footprint of the mine. However, this road currently carries a very low volume of traffic. Furthermore, most of this traffic is related to the Boggabri Coal Mine and the Project and does not constitute through traffic.
- Increases in coal production will continue to be hauled by truck via the existing private haul road, towards the Boggabri coal loading terminal on the Werris Creek-Mungindi Railway line. This road includes grade separated crossings of the Namoi River and Kamilaroi Highway. A rail loop is proposed to be constructed in the future and will meet with the rail spur from Maules Creek. These will both have minimal impact on the public road network and hence have not been accounted for in this study.
- The construction activities associated with the Boggabri Coal Mine is likely to be spread over a considerable period. As such, it is not expected that this would have significant additional traffic generation implications.

3.4.2 Tarrawonga Coal Mine

Tarrawonga Coal Mine is located to the south of Boggabri Coal Mine and is accessible from Goonbri Road to the east of Leard Forest Road (see Figure 1-1).

In 2010, Tarrawonga Coal Pty Ltd applied for a Modification to DA-88-4-20058. Resource Strategies (2010) reported that this application was to seek approval for extraction of an additional 4Mt of coal. The additional yield would not result in an increase to the existing production (and haulage) rate of 2Mtpa. It can therefore be assumed, from a traffic generation perspective, that the September 2010 traffic surveys adequately account for the traffic generation implications of continued mining at Tarrawonga Coal Mine.

The extracted coal was assessed as being transported by truck from the mine site via an approved haulage route including a dedicated haulage road from Tarrawonga Coal Mine to Blue Vale Road (which crosses Manilla Road). Trucks would continue southbound on Blue Vale Road to the Whitehaven CHPP located on the western side of the Kamilaroi Highway, north of Gunnedah. The coal is then crushed, washed and then transported by rail to the Port of Newcastle.

Resource Strategies (2010) also describes a future proposal to develop a domestic coal hub at the Canyon Coal Mine on the western side of Blue Vale Road. Up to 0.45Mtpa of ROM coal from Tarrawonga Coal Mine would be transported to this site, and then later transported to ultimate receivers to the south. As this portion of coal is already included in the existing haul quantities, there would be negligible change to the heavy vehicle volumes generated on the northern and southern portions of the Blue Vale Road. The number of vehicle-kilometres of generated trips would be the same. The only difference would be that the trips would be split by the intermediate receiver (Canyon Coal).

The Modification does not propose any changes to the haulage rate or to the haulage hours which are currently approved as 7:00am to 10:00pm Monday to Friday, and 7:00am to 6:00pm on Saturday. The Modification also does not propose any changes to the workforce and as such it can be assumed that the existing surveys adequately account for journey to work trip generation.

In these respects, Tarrawonga Coal Mine is not likely to have any additional traffic generation implications from this proposed Modification. The September 2010 traffic surveys would have sufficiently captured the future traffic generation implications from this mine.

3.5 Traffic distribution

As stated in Section 2.3.2, midblock surveys were carried out in September 2010 at 11 locations across the surrounding road network. These provided 24-hour, seven day a week traffic volumes for light and heavy vehicles with a breakdown by hour of day and direction of travel. Appendix A contains a summary of the surveyed traffic volumes. The average weekday volumes have been used as these were generally higher than weekend volumes.

The breakdown of midblock traffic volumes by turning direction at the key intersections was approximated by considering local attractors and generators of traffic, and from observations of traffic movements during the site inspection. All assumptions have been documented in the notes on each sheet in Appendix A. Furthermore, where appropriate, downstream traffic surveys were used to validate the distribution of approaching traffic to each of the turning movements. Details have also been provided in Appendix A.

Other key notes and assumptions relevant to traffic distribution are listed below:

- The heavy vehicle access route for the Project would be via Therribri Road, Manilla Road, Barbers Lagoon Road and Blue Vale Road to access the Kamilaroi Highway north of Gunnedah.
- All return truck trips for deliveries would be in the same hour.
- 90% of all construction and operational workers for the Project would be transported to the site by a shuttle bus from Boggabri.
- The shuttle bus would access the site via Kamilaroi Highway, Manilla Road, Therribri Road and the Mine Access Road.
- The shuttle bus has an assumed occupancy of 20 persons per vehicle.
- The remaining 10% of construction and operational workers would be transported to the site by private vehicle. These would be broken up as follows: (i) 90% from Manilla Road West with a further breakdown of 60% from Boggabri and the south, and 30% from Narrabri and the north, (ii) the remaining 10% would access the site via Barbers Lagoon Road.
- An assumed workforce of 340 persons was assumed for the peak construction period of the Maules Creek Coal Project.
- The maximum operational workforce of 470 persons would result in an assumed maximum of 140 persons per day shift and 110 persons per night shift.
- Boggabri Coal Mine is expected to have an increase of 353 full time equivalent positions by 2017. The maximum increase in day shift workers was assumed to be 40% of this. The maximum increase in night shift was assumed to be 20%.
- The additional staff employed by Boggabri Coal Mine were assumed to be distributed as such: (i) 20% from the south via Barbers Lagoon Road, (ii) 30% from the north via Maules Creek Road, (iii) 50% from the west/Boggabri via Manilla Road.
- Annual growth rates in the background traffic were approximated using the trends described in 2.3.1.

4 Assessment of road traffic impacts

This section presents the results of the traffic impact modelling undertaken for the Project.

4.1 Model results

As described in Section 3, three assessment scenarios were tested for the three study intersections using SIDRA 4.0. These scenarios are:

- **Assessment 1: 2010 base case:** This is based on the surveyed traffic volumes which also account for the existing traffic volumes generated by neighbouring mining projects at their current levels of activity.
- **Assessment 2: 2012 peak construction period:** This corresponds to week 10 of the construction program which is forecast to generate the highest number of vehicle movements.
- **Assessment 3: 2020 peak operational case:** This is when the mine is expected to be at peak production with an annual output of 13Mtpa serviced by 470 full time equivalent workers.

The following intersections were assessed to provide an indication of network-wide traffic impacts that are likely to occur due to the Project.

- Kamilaroi Highway/ Manilla Road
- Manilla Road/ Barbers Lagoon Road
- Manilla Road/ Therribri Road
- Therribri Road/ Mine Access Road.

The tables in Appendix A show the breakdown of forecast traffic volumes generated by the Project as well as the other neighbouring mine projects. From this, it was possible to determine the likely peak traffic period for each of the key intersections. It should be noted that whilst the Kamilaroi Highway exhibits distinct AM and PM peak periods, the local road network (ie. Manilla Road, Therribri Road, Barbers Lagoon Road) are governed by the specific traffic generation patterns associated with the major land uses. Significant sources of traffic include staff journeys to and from work, and heavy vehicles generated for construction and coal haulage (in the case of Tarrawonga Coal Mine). Whilst staff movements are typically generated before and after the work shift, the heavy vehicle movements may be less predictable throughout the day. This study has therefore adopted the likely peak traffic conditions associated with each intersection based on the highest likely volume period of the day. This period is not necessarily the same hour of day for each intersection, nor for each scenario assessed.

The forecast traffic volumes for each of the scenarios (assessments 1, 2 and 3) and for each of the four key intersections was modelled using SIDRA, an intersection performance/ simulation software. This package simulates the likely performance of each intersection based on the traffic volumes for each turning movement, the approach speed limits, geometric properties of the intersection, and gap acceptance requirements for any minor road movements. The performance of the intersection is summarised by four performance indicators: (i) level of service (LOS), (ii) degree of saturation (DOS), (iii) maximum queue length in metres and (iv) average delay per vehicle. These performance indicators are further described in Appendix C.

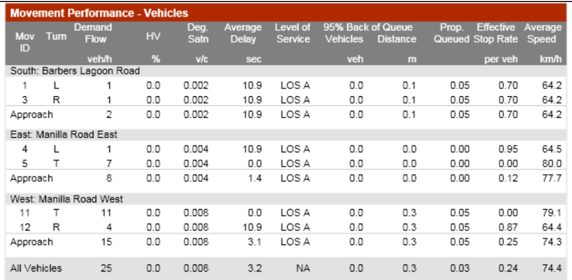
The SIDRA results for all scenarios are presented in Table 4-1.

Table 4-1 Comparison in modelled performance from the three scenarios: (i) existing 2010 base case, (ii) 2012 "week 10" peak construction case, and (iii) 2020 peak mining period.

Intersection	(i) 2010 base case.	(ii) Week 10 of construction program (2012).	(iii) 2020 Peak mining period.

I-01 – Manilla Road / Barbers Lagoon Road.

(i) 2010 base case.

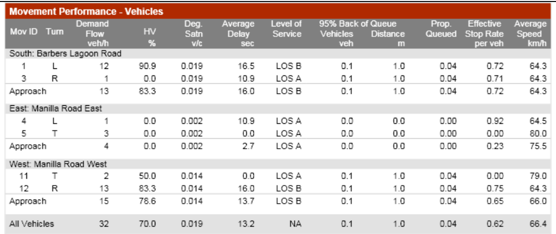


Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barbers Lagoon Road											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.1	0.05	0.70	64.2
3	R	1	0.0	0.002	10.9	LOS A	0.0	0.1	0.05	0.70	64.2
Approach		2	0.0	0.002	10.9	LOS A	0.0	0.1	0.05	0.70	64.2
East: Manilla Road East											
4	L	1	0.0	0.004	10.9	LOS A	0.0	0.0	0.00	0.95	64.5
5	T	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		8	0.0	0.004	1.4	LOS A	0.0	0.0	0.00	0.12	77.7
West: Manilla Road West											
11	T	11	0.0	0.008	0.0	LOS A	0.0	0.3	0.05	0.00	79.1
12	R	4	0.0	0.008	10.9	LOS A	0.0	0.3	0.05	0.87	64.4
Approach		15	0.0	0.008	3.1	LOS A	0.0	0.3	0.05	0.25	74.3
All Vehicles		25	0.0	0.008	3.2	NA	0.0	0.3	0.03	0.24	74.4

5:00-6:00pm

(ii) Week 10 of construction program (2012).

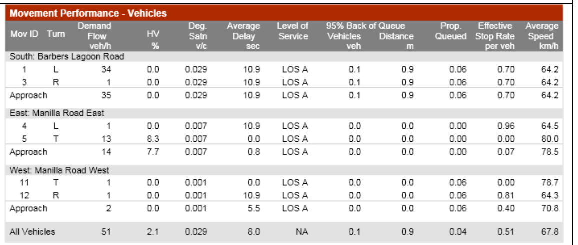


Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barbers Lagoon Road											
1	L	12	90.9	0.019	16.5	LOS B	0.1	1.0	0.04	0.72	64.3
3	R	1	0.0	0.019	10.9	LOS A	0.1	1.0	0.04	0.71	64.3
Approach		13	83.3	0.019	16.0	LOS B	0.1	1.0	0.04	0.72	64.3
East: Manilla Road East											
4	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.00	0.92	64.5
5	T	3	0.0	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		4	0.0	0.002	2.7	LOS A	0.0	0.0	0.00	0.23	75.5
West: Manilla Road West											
11	T	2	50.0	0.014	0.0	LOS A	0.1	1.0	0.04	0.00	79.0
12	R	13	83.3	0.014	16.0	LOS B	0.1	1.0	0.04	0.75	64.3
Approach		15	78.6	0.014	13.7	LOS B	0.1	1.0	0.04	0.65	66.0
All Vehicles		32	70.0	0.019	13.2	NA	0.1	1.0	0.04	0.62	66.4

10:00-11:00am

(iii) 2020 Peak mining period.



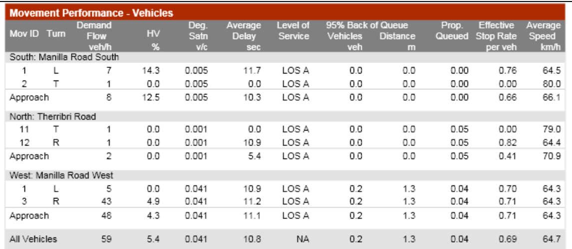
Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barbers Lagoon Road											
1	L	34	0.0	0.029	10.9	LOS A	0.1	0.9	0.06	0.70	64.2
3	R	1	0.0	0.029	10.9	LOS A	0.1	0.9	0.06	0.70	64.2
Approach		35	0.0	0.029	10.9	LOS A	0.1	0.9	0.06	0.70	64.2
East: Manilla Road East											
4	L	1	0.0	0.007	10.9	LOS A	0.0	0.0	0.00	0.96	64.5
5	T	13	8.3	0.007	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		14	7.7	0.007	0.8	LOS A	0.0	0.0	0.00	0.07	78.5
West: Manilla Road West											
11	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.06	0.00	78.7
12	R	1	0.0	0.001	10.9	LOS A	0.0	0.0	0.06	0.81	64.3
Approach		2	0.0	0.001	5.5	LOS A	0.0	0.0	0.06	0.40	70.8
All Vehicles		51	2.1	0.029	8.0	NA	0.1	0.9	0.04	0.51	67.8

6:00-7:00am

I-02 – Manilla Road / Therribri Road.

(i) 2010 base case.

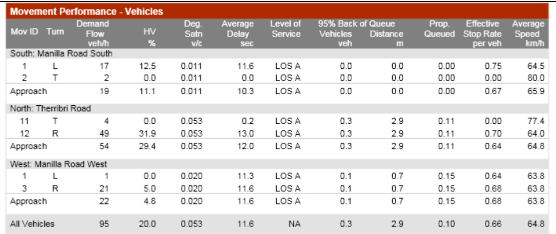


Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Manilla Road South											
1	L	7	14.3	0.005	11.7	LOS A	0.0	0.0	0.00	0.76	64.5
2	T	1	0.0	0.005	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		8	12.5	0.005	10.3	LOS A	0.0	0.0	0.00	0.66	66.1
North: Therribri Road											
11	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.05	0.00	79.0
12	R	1	0.0	0.001	10.9	LOS A	0.0	0.0	0.05	0.82	64.4
Approach		2	0.0	0.001	5.4	LOS A	0.0	0.0	0.05	0.41	70.9
West: Manilla Road West											
1	L	5	0.0	0.041	10.9	LOS A	0.2	1.3	0.04	0.70	64.3
3	R	43	4.9	0.041	11.2	LOS A	0.2	1.3	0.04	0.71	64.3
Approach		48	4.3	0.041	11.1	LOS A	0.2	1.3	0.04	0.71	64.3
All Vehicles		59	5.4	0.041	10.8	NA	0.2	1.3	0.04	0.69	64.7

6:00-7:00am

(ii) Week 10 of construction program (2012).

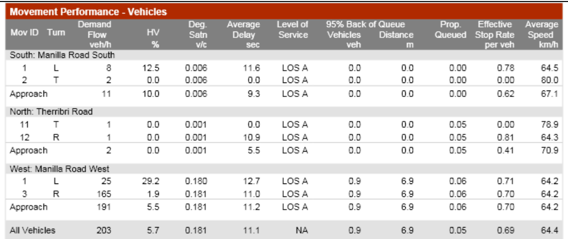


Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Manilla Road South											
1	L	17	12.5	0.011	11.6	LOS A	0.0	0.0	0.00	0.75	64.5
2	T	2	0.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		19	11.1	0.011	10.3	LOS A	0.0	0.0	0.00	0.67	65.9
North: Therribri Road											
11	T	4	0.0	0.053	0.2	LOS A	0.3	2.9	0.11	0.00	77.4
12	R	49	31.9	0.053	13.0	LOS A	0.3	2.9	0.11	0.70	64.0
Approach		54	29.4	0.053	12.0	LOS A	0.3	2.9	0.11	0.64	64.8
West: Manilla Road West											
1	L	1	0.0	0.020	11.3	LOS A	0.1	0.7	0.15	0.64	63.8
3	R	21	5.0	0.020	11.6	LOS A	0.1	0.7	0.15	0.68	63.8
Approach		22	4.8	0.020	11.6	LOS A	0.1	0.7	0.15	0.68	63.8
All Vehicles		95	20.0	0.053	11.6	NA	0.3	2.9	0.10	0.66	64.8

6:00-7:00pm

(iii) 2020 Peak mining period.



Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Manilla Road South											
1	L	8	12.5	0.006	11.6	LOS A	0.0	0.0	0.00	0.78	64.5
2	T	2	0.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		11	10.0	0.006	9.3	LOS A	0.0	0.0	0.00	0.62	67.1
North: Therribri Road											
11	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.05	0.00	78.9
12	R	1	0.0	0.001	10.9	LOS A	0.0	0.0	0.05	0.81	64.3
Approach		2	0.0	0.001	5.5	LOS A	0.0	0.0	0.05	0.41	70.9
West: Manilla Road West											
1	L	25	29.2	0.180	12.7	LOS A	0.9	6.9	0.06	0.71	64.2
3	R	165	1.9	0.181	11.0	LOS A	0.9	6.9	0.06	0.70	64.2
Approach		191	5.5	0.181	11.2	LOS A	0.9	6.9	0.06	0.70	64.2
All Vehicles		203	5.7	0.181	11.1	NA	0.9	6.9	0.05	0.69	64.4

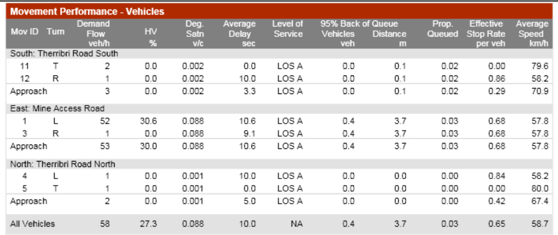
6:00-7:00am

I-03 – Therribri Road / Mine Access Road.

(i) 2010 base case.

Intersection does not exist.

(ii) Week 10 of construction program (2012).

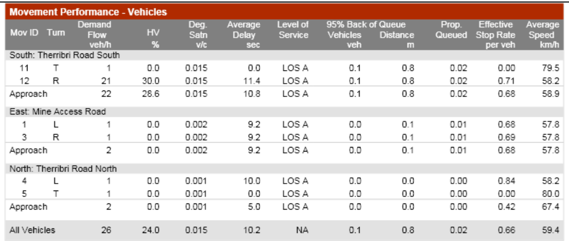


Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Therribri Road South											
11	T	2	0.0	0.002	0.0	LOS A	0.0	0.1	0.02	0.00	79.6
12	R	1	0.0	0.002	10.0	LOS A	0.0	0.1	0.02	0.86	58.2
Approach		3	0.0	0.002	3.3	LOS A	0.0	0.1	0.02	0.29	70.9
East: Mine Access Road											
1	L	52	30.6	0.088	10.6	LOS A	0.4	3.7	0.03	0.68	57.8
3	R	1	0.0	0.088	9.1	LOS A	0.4	3.7	0.03	0.68	57.8
Approach		53	30.0	0.088	10.6	LOS A	0.4	3.7	0.03	0.68	57.8
North: Therribri Road North											
4	L	1	0.0	0.001	10.0	LOS A	0.0	0.0	0.00	0.84	58.2
5	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	0.0	0.001	5.0	LOS A	0.0	0.0	0.00	0.42	67.4
All Vehicles		58	27.3	0.088	10.0	NA	0.4	3.7	0.03	0.65	58.7

6:00-7:00pm

(iii) 2020 Peak mining period.



Movement Performance - Vehicles

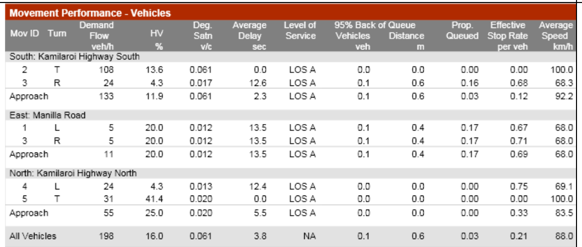
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Therribri Road South											
11	T	1	0.0	0.015	0.0	LOS A	0.1	0.8	0.02	0.00	79.5
12	R	21	30.0	0.015	11.4	LOS A	0.1	0.8	0.02	0.71	58.2
Approach		22	28.6	0.015	10.8	LOS A	0.1	0.8	0.02	0.68	58.9
East: Mine Access Road											
1	L	1	0.0	0.002	9.2	LOS A	0.0	0.1	0.01	0.68	57.8
3	R	1	0.0	0.002	9.2	LOS A	0.0	0.1	0.01	0.69	57.8
Approach		2	0.0	0.002	9.2	LOS A	0.0	0.1	0.01	0.68	57.8
North: Therribri Road North											
4	L	1	0.0	0.001	10.0	LOS A	0.0	0.0	0.00	0.84	58.2
5	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	0.0	0.001	5.0	LOS A	0.0	0.0	0.00	0.42	67.4
All Vehicles		26	24.0	0.015	10.2	NA	0.1	0.8	0.02	0.66	59.4

6:00-7:00am

I-04 – Kamilaroi Highway / Manilla Road.

AM peak

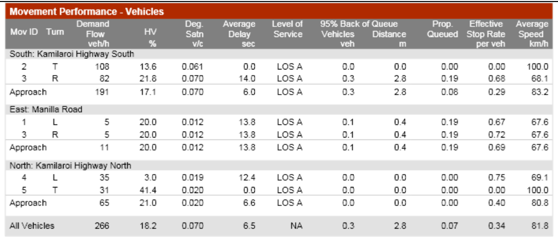
(i) 2010 base case.



Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kamilaroi Highway South											
2	T	108	13.6	0.061	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	24	4.3	0.017	12.6	LOS A	0.1	0.6	0.16	0.68	68.3
Approach		133	11.9	0.061	2.3	LOS A	0.1	0.6	0.03	0.12	92.2
East: Manilla Road											
1	L	5	20.0	0.012	13.5	LOS A	0.1	0.4	0.17	0.67	68.0
3	R	5	20.0	0.012	13.5	LOS A	0.1	0.4	0.17	0.71	68.0
Approach		11	20.0	0.012	13.5	LOS A	0.1	0.4	0.17	0.69	68.0
North: Kamilaroi Highway North											
4	L	24	4.3	0.013	12.4	LOS A	0.0	0.0	0.00	0.75	69.1
5	T	31	41.4	0.020	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		55	25.0	0.020	5.5	LOS A	0.0	0.0	0.00	0.33	83.5
All Vehicles		198	16.0	0.061	3.8	NA	0.1	0.6	0.03	0.21	88.0

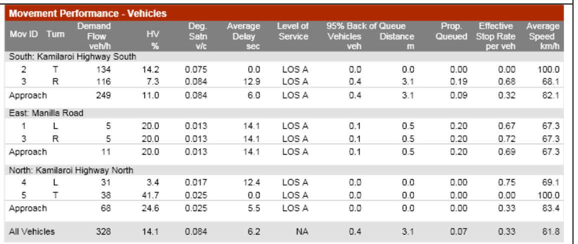
(ii) Week 10 of construction program (2012).



Movement Performance - Vehicles

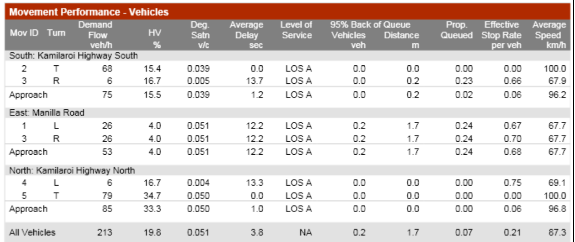
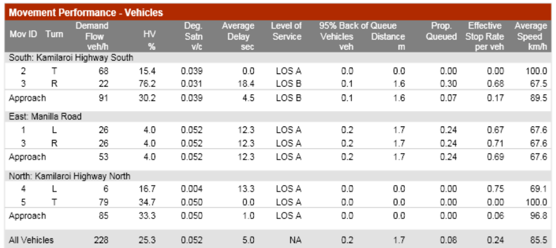
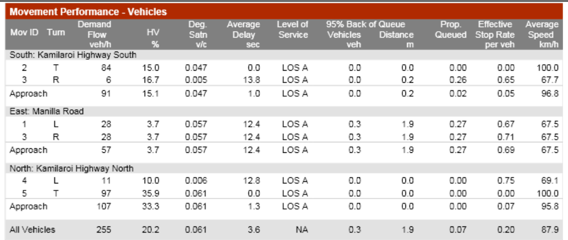
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kamilaroi Highway South											
2	T	108	13.6	0.061	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	82	21.8	0.070	14.0	LOS A	0.3	2.8	0.19	0.68	68.1
Approach		191	17.1	0.070	6.0	LOS A	0.3	2.8	0.08	0.29	83.2
East: Manilla Road											
1	L	5	20.0	0.012	13.8	LOS A	0.1	0.4	0.19	0.67	67.6
3	R	5	20.0	0.012	13.8	LOS A	0.1	0.4	0.19	0.72	67.6
Approach		11	20.0	0.012	13.8	LOS A	0.1	0.4	0.19	0.69	67.6
North: Kamilaroi Highway North											
4	L	35	3.0	0.019	12.4	LOS A	0.0	0.0	0.00	0.75	69.1
5	T	31	41.4	0.020	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		65	21.0	0.020	6.6	LOS A	0.0	0.0	0.00	0.40	80.8
All Vehicles		266	18.2	0.070	6.5	NA	0.3	2.8	0.07	0.34	81.8

(iii) 2020 Peak mining period.



Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kamilaroi Highway South											
2	T	134	14.2	0.075	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	116	7.3	0.084	12.9	LOS A	0.4	3.1	0.19	0.68	68.1
Approach		249	11.0	0.084	6.0	LOS A	0.4	3.1	0.09	0.32	82.1
East: Manilla Road											
1	L	5	20.0	0.013	14.1	LOS A	0.1	0.5	0.20	0.67	67.3
3	R	5	20.0	0.013	14.1	LOS A	0.1	0.5	0.20	0.72	67.3
Approach		11	20.0	0.013	14.1	LOS A	0.1	0.5	0.20	0.69	67.3
North: Kamilaroi Highway North											
4	L	31	3.4	0.017	12.4	LOS A	0.0	0.0	0.00	0.75	69.1
5	T	38	41.7	0.025	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		68	24.6	0.025	5.5	LOS A	0.0	0.0	0.00	0.33	83.4
All Vehicles		328	14.1	0.084	6.2	NA	0.4	3.1	0.07	0.33	81.8

Intersection	**(i) 2010 base case.**	**(ii) Week 10 of construction program (2012).**	**(iii) 2020 Peak mining period.**
	6:00-7:00am	6:00-7:00am	6:00-7:00am
I-04 – Kamilaroi Highway / Manilla Road. **PM peak**	 5:00-6:00pm	 5:00-6:00pm	 5:00-6:00pm

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
South: Kamilaroi Highway South											
2	T	68	15.4	0.039	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	6	16.7	0.005	13.7	LOS A	0.0	0.2	0.23	0.66	67.9
Approach		75	15.5	0.039	1.2	LOS A	0.0	0.2	0.02	0.06	96.2
East: Manilla Road											
1	L	26	4.0	0.051	12.2	LOS A	0.2	1.7	0.24	0.67	67.7
3	R	26	4.0	0.051	12.2	LOS A	0.2	1.7	0.24	0.70	67.7
Approach		53	4.0	0.051	12.2	LOS A	0.2	1.7	0.24	0.68	67.7
North: Kamilaroi Highway North											
4	L	6	16.7	0.004	13.3	LOS A	0.0	0.0	0.00	0.75	69.1
5	T	79	34.7	0.050	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		85	33.3	0.050	1.0	LOS A	0.0	0.0	0.00	0.06	96.8
All Vehicles		213	19.8	0.051	3.8	NA	0.2	1.7	0.07	0.21	87.3

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
South: Kamilaroi Highway South											
2	T	68	15.4	0.039	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	22	76.2	0.031	18.4	LOS B	0.1	1.6	0.30	0.68	67.5
Approach		91	30.2	0.039	4.5	LOS B	0.1	1.6	0.07	0.17	89.5
East: Manilla Road											
1	L	26	4.0	0.052	12.3	LOS A	0.2	1.7	0.24	0.67	67.6
3	R	26	4.0	0.052	12.3	LOS A	0.2	1.7	0.24	0.71	67.6
Approach		53	4.0	0.052	12.3	LOS A	0.2	1.7	0.24	0.69	67.6
North: Kamilaroi Highway North											
4	L	6	16.7	0.004	13.3	LOS A	0.0	0.0	0.00	0.75	69.1
5	T	79	34.7	0.050	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		85	33.3	0.050	1.0	LOS A	0.0	0.0	0.00	0.06	96.8
All Vehicles		228	25.3	0.052	5.0	NA	0.2	1.7	0.08	0.24	85.5

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
South: Kamilaroi Highway South											
2	T	84	15.0	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	6	16.7	0.005	13.8	LOS A	0.0	0.2	0.26	0.65	67.7
Approach		91	15.1	0.047	1.0	LOS A	0.0	0.2	0.02	0.05	96.8
East: Manilla Road											
1	L	28	3.7	0.057	12.4	LOS A	0.3	1.9	0.27	0.67	67.5
3	R	28	3.7	0.057	12.4	LOS A	0.3	1.9	0.27	0.71	67.5
Approach		57	3.7	0.057	12.4	LOS A	0.3	1.9	0.27	0.69	67.5
North: Kamilaroi Highway North											
4	L	11	10.0	0.006	12.8	LOS A	0.0	0.0	0.00	0.75	69.1
5	T	97	35.9	0.061	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		107	33.3	0.061	1.3	LOS A	0.0	0.0	0.00	0.07	95.8
All Vehicles		255	20.2	0.061	3.6	NA	0.3	1.9	0.07	0.20	87.9

In general, the SIDRA results shown in Figure 4-1 indicate that there is currently (2010 base case conditions) very little traffic demand at the four study intersections. All turning movements were modelled to have good levels of service (LOS A), negligible queue lengths and degrees of saturation (DOS) of 0.06 (6%) or less. This means that the current traffic volumes are only using 6% of the capacity available to their respective movements.

Another general finding was that the 2020 peak mining period was modelled to have similar performance as the 2010 base case. This was somewhat expected as the majority of the Project-related transport generation (ie. product coal transportation) would be by rail, with workers' journeys to and from work being the only road traffic generated by the Project. As such, the lack of any foreseeable impact would not warrant any mitigation measures in addition to the road improvements that have already been programmed (ie. construction of Mine Access Road and intersection, Therribri Road upgrade).

Week 10 of the construction period was generally the worse likely case with respect to road traffic impact. However, the overall impacts are still not likely to be significant with DOS on individual movements of 0.09 or less. That is, the forecast traffic volumes would only use up as much as 9% of the available capacity available for the respective movements. It is also important to note that the construction traffic impacts would be experienced over a short period, for example, the peak construction period from a traffic generation perspective, would be a six-week peak period within the overall 64 week construction program (see Appendix B).

For the Manilla Road/ Barbers Lagoon Road intersection, the SIDRA modelling showed that the peak construction period would result in an increase in average delay from three seconds to 13.2 seconds per vehicle during the highest volume periods on weekdays. Although the average delay per vehicle is higher for the "week 10" model compared with the 2010 base case, this is largely *dynamic* delay rather than *static/queuing* delay. That is, the delay is due to the additional time required by vehicles to slow down and then speed up as they negotiate a turning movement. The vehicles affected by the delay increase would only be in conflict with a very small volume of traffic on the other approaches of the intersection.

The Manilla Road/ Therribri Road intersection would have a marginal increase in average delay in the "week 10" scenario. This is due to the additional generated traffic being largely comprised of through movements on the major road approaches, which have less delay potential compared with the minor road approach.

The Therribri Road/ Mine Access Road intersection does not exist at present. As such there is no 2010 base case model for this intersection. The "week 10" model showed that there could potentially be maximum queue lengths of 11m in the Mine Access Road approach due to the high volume of construction-related trucks that would be turning left onto Therribri Road. However, these vehicles would be entering the southbound through traffic movement of Therribri Road which would be a low volume traffic stream (ie. one vehicle per hour). As such, this is not regarded as a major risk and as such there are no mitigation measures proposed.

The Kamilaroi Highway/ Manilla Road intersection is not expected to experience significant traffic impact as a result of the Project. This is largely due to the deliberate assignment of construction-related heavy vehicles to the Barbers Lagoon Road-Braymont Road-Blue Vale Road route. As such, the "week 10" model is similar to the 2010 base case model. The 2020 peak mining period model showed minor increases in traffic demand at this intersection. However, this was largely a result of the growth in background traffic. Similar to the peak construction case, there would be little project-related traffic that would use this intersection.

4.2 Midblock capacity assessment – Blue Vale Road

As previously stated, the nominated heavy vehicle access route during the construction period of the Project is via Blue Vale Road, Braymont Road and Barbers Lagoon Road. This route provides a connection between Manilla Road to the east of Leard Forest Road, and the Kamilaroi Highway to the north of Gunnedah.

The southern portion of the route between Vickery Mine and the Kamilaroi Highway also forms part of the nominated heavy vehicle haulage route between Tarrawonga Coal Mine and the Whitehaven CHPP. The CHPP is located on the southern side of the Kamilaroi Highway near its intersection with Blue Vale Road.

The distribution of the Project's heavy vehicle traffic to this route would consume more of the spare capacity available. As such, a midblock capacity analysis was undertaken to quantify the likely impacts. A summary of the assessment is described in Table 4-2.

Table 4-2 Summary of midblock assessment for Blue Vale Road.

Approximated current traffic volume on Blue Vale Road	600 vehicles/day[1].
Approximated highest hourly volume per direction on Blue Vale Road	30 vehicles/hour
Nominal one-lane midblock capacity[2]	1200 vehicles/hour
Volume to capacity (V/C) ratio under highest hour conditions	0.03
Approximate practical absorption capacity[3]	1000 vehicles/hour.
Additional traffic generated in peak construction of the Project (one direction)	30 vehicles/ hour.
Proportion of absorption capacity used by additional traffic	3% (very good)
Residual capacity[4] following absorption of Project related traffic:	970 vehicles/hour (good)
V/C ratio including Project-related traffic	0.05 (good)

This assessment indicates that there is sufficient spare capacity in Blue Vale Road to absorb the additional traffic generated by the Project highest traffic volume case conditions (ie. week 10 of the construction program). Furthermore, this also indicates that with the additional Project-related traffic there would be substantial residual capacity (ie. an absorption capacity of 970 vehicles/hour) in Blue Vale Road.

4.3 Construction works on public roads

4.3.1 Kamilaroi Highway

The proposed rail spur will extend from the mine infrastructure area to the Werris Creek-Mungindi Railway line to the south of the Project Boundary near the existing Boggabri coal loading terminal. This rail spur will pass above the Kamilaroi Highway as an overbridge and may

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[1] This is based on the 2Mtpa of coal hauled by Tarrawonga, an assumed 300 haul days per year, 10 haul hours per day and an average truck payload of 30t. This also includes background traffic volumes on Barber Lagoon Road. Volumes were rounded up to the nearest 100 as a conservative measure.

[2] Based on a three second headway.

[3] Based on an assumed gap acceptance of five seconds, and an assumed follow up headway of three seconds.

[4] Based on absorption capacity of Blue Vale Road when it is carrying the additional traffic generated by the Project.

require lane/ road occupancy during the placement or installation of the bridge deck and supports.

The proposed bridge structure may require Aston to enter into a Works Authorisation Deed with the RTA, seeing that it will cross over the Kamilaroi Highway, an RTA road asset. The agreement with the RTA will also need to cover the basic design criteria such as minimum vertical clearance, design life and load capacity.

The traffic implications for the Kamilaroi Highway have not been discussed in this report as these were previously assessed as part of Boggabri Coal Mine’s Project Approval and would be similar to this project.

4.3.2 Therribri Road

For improved access to the Project, Aston is proposing to upgrade a 3km section of Therribri Road in consultation with Narrabri Shire Council. This will be between its intersections with Manilla Road and the Mine Access Road. The upgrade will involve sealing the road which will improve its drainage and strength. This upgrade work will take place in year 1 of the construction program.

The 40-80 vehicles per day (highest hourly volume of less than 10 vehicles/hour) which currently use Therribri Road will be affected by the roadworks. As this is a low volume of traffic, there are a range of acceptable measures that can be adopted for managing traffic through or around the road works. These broadly include (but are not limited to):

- Sealing the road in increments (eg. 500m at a time), confining traffic to a one-lane portion of roadway and bi-directional traffic control with stop/go flagmen or portable traffic signals.
- Complete closure of the affected section of Therribri Road with signposted detours via Harparary Road.

There are also several variations to these options. As such, the overall number of options available means any traffic impacts as a result of the works would be easily managed/ addressed. The ultimate management of potential impacts will be developed in consultation with the potentially affected landowners and to the satisfaction of Narrabri Shire Council. Traffic management plans will be completed, where necessary, to demonstrate that traffic access and thoroughfare requirements can be maintained during the works period.

5 Road safety impact assessment

5.1 General road safety findings

The following roads will be used by traffic generated by the Project and as such, were reviewed for potential road safety impacts.

- Manilla Road, between and including the intersections with Kamilaroi Highway and Barbers Lagoon Road;
- Therribri Road, between the intersections with Manilla Road and the future Mine Access Road;
- Leard Forest Road between and including the intersections with Manilla Road and East Link Road;
- East Link Road between Leard Forest Road and the Project Boundary; and
- The Barbers Lagoon Road- Braymont Road-Johnston Road-Blue Vale Road route from Manilla Road to the Kamilaroi Highway.

Potential road safety impacts and recommended management/mitigation measures have been documented in Tables 5-1 to 5-5.

Table 5-1 Manilla Road, Kamilaroi Highway to Therribri Road - potential road safety impacts and recommended measures.

Chainage (km from Kamilaroi Highway)	Road safety issue	Recommended management/mitigation measure
0.0	Large cell box culverts are placed under the Manilla Road and Kamilaroi Highway (northern) approach. These are potential clear zone crash hazards. 	**Short term** ▪ Provide *reduce speed* signs in approach to intersection with Kamilaroi Highway. ▪ Provide advanced warning sign to culvert on Manilla Road to the east of the culvert. ▪ Monitor for effectiveness. **Long term** ▪ Provide safety barrier or modify culvert to a more traversable type if further measures still required.
1.5	Iron Bridge contains substandard bridge parapets and approach safety barriers. 	**Short term** ▪ Conduct regular audits of compliance with 40km/h speed limit, 42.5t load limit, and give way requirements. **Long term** ▪ Modify approach safety barriers if further measures still required. It is noted that the RTA is proposing a new bridge.

3.4-3.5 1.0-1.1 from Therribri Road)	The flood waters have deposited a substantial amount of sediment and debris on the road which will affect pavement skid resistance. 	**Short term** If the sediment does not wash out with the next rain, this should be manually removed by sweeping and/or water blasting. **Long term** The drainage of the road and roadside environment would need to be reviewed to identify long term drainage needs. This would need to consider the local hydrology and any modification to the landscape either side of the road.
Various	Generally, there are many informal floodways that have not been signposted. Examples noted at chainages 1.9 (Figure 2-3a) and 2.1.	Provide additional *floodway* or *causeway* warning signs if warranted following hydrological assessment.

Table 5-2 Therribri Road, between Manilla Road and future Mine Access Road - potential road safety impacts and recommended measures

Chainage (km from Manilla Road)	Road safety issue	Recommended management/mitigation measure
2.9	A culvert crossing has no run-off-road crash protection. 	**Short term** ▪ Provide advanced warning sign to culvert. ▪ Monitor for effectiveness. **Long term** ▪ Provide safety barrier or extend/modify culvert to a more crashworthy structure as part of the Therribri Road improvements.
Various	There were several locations where large trees are immediately adjacent to the roadway and pose a significant crash and sight distance hazard. Examples were noted at chainages 0.3, 0.8 (see photo below), 1.4, 1.6, 3.0, and 4.5. 	**Short term** ▪ Provide retro-reflective taping or guideposts to augment the presence of these trees. **Long term** ▪ Consider clearing the trees as part of the Therribri Road upgrade.
Various	**Dips and floodways** The road contained a number of depressions where water ponding still remained from the recent rains. These may affect skid resistance and increase aquaplaning potential.	These should be formalised as lined/waterproof structures along as part of the Therribri Road upgrade works.

Table 5-3 Leard Forest Road, between Manilla Road and East Link Road - potential road safety impacts and recommended measures

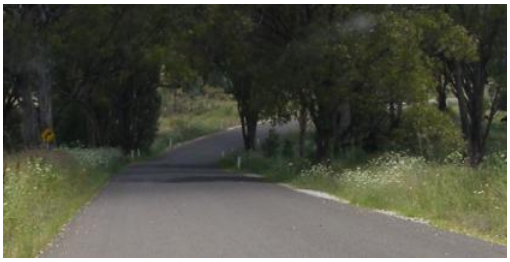
Chainage (km from Manilla Road)	Road safety issue	Recommended management/ mitigation measure
1.4	Leard Forest Road curves to the west. A side road extends in a straight alignment off Leard Forest Road and may be misinterpreted by drivers as the main alignment of Leard Forest Road. 	Provide give way linemarking across the interface between the side road and Leard Forest Road as well as double barrier (BB) lines on the Leard Forest Road approaches.
5.8-6.3	There is restricted sight distance around the horizontal curve on Leard Forest Road which restricts the overtaking sight distance available at this location. 	Double barrier centrelines should be provided at this location to prohibit overtaking.
12.6	There is poor visibility to the intersection with East Link Road and the safe intersection sight distance sightlines are obscured by roadside vegetation.  	Advanced warning signs such as those in Appendix D should be provided.

Table 5-4 **East Link Road, between Leard Forest Road and Project Boundary - potential road safety impacts and recommended measures (similar safety issues exist should also be addressed, where appropriate, for Northern Ring Road)**

Chainage (km from Leard Forest Road)	Road safety issue	Recommended management/ mitigation measure
Various	In general, the road width is insufficient for safe passage of heavy vehicles accessing the site. 	Clearing should be carried out to provide sufficient tracking width for vehicles entering and egressing from the site.
Various	The road surface is generally uneven and contains corrugations and localised depressions. 	The road would need to be profiled (ie. with a grader) regularly to maintain a safe surface for construction vehicles entering and egressing from the site.

Table 5-5 **Barbers Lagoon Road-Braymont Road-Johnston Road-Blue Vale Road, between Manilla Road and Kamilaroi Highway - potential road safety impacts and recommended measures**

Chainage (km from Manilla Road)	Road safety issue	Recommended management/ mitigation measure
2.8	The culvert at this location has an approximate 1.0-1.5m drop off with no safety barrier protection. 	**Short term** ▪ Provide advanced warning sign to culvert. ▪ Monitor for effectiveness. **Long term** ▪ Consider providing safety barriers or extending/modifying the culvert.
10.9	The formation of the road suddenly becomes narrower.	A *W4-3 road narrows* sign should be provided at this location.

		
17.3	There is poor guidance and delineation around this horizontal curve in approach to the intersection with Vickery Mine Access Road. There is also a poor interface between the unpaved and paved sections of the road at this location. 	Appropriate signage including (i) curve advanced warning signs, (ii) curve alignment markers (CAMs) around the outside of the curve and (iii) T intersection ahead warning signs should be provided.
Various	The road surface is generally uneven and contains corrugations and localised depressions.	The road should be profiled (ie. with a grader) regularly to maintain a safe trafficable surface.
Various	There were several locations where large trees are immediately adjacent to the roadway and pose a significant crash and sight distance hazard. Examples noted at chainages 1.1 (below), 2.8, and 14.0 	**Short term** ▪ Provide retro-reflective taping or guideposts to augment the presence of these trees. **Long term** ▪ Consider clearing the trees.
Various	There were several locations where water ponding remained after the recent rain and increases aquaplaning crash risk. Examples are at chainages 1.1, 2.6, 3.7, 9.5 (below), 14.5, and 15.7. 	If water accumulation is due to a regular floodway, these should be signposted. Otherwise, water ponding risks can be managed by regularly profiling the road as part of ongoing maintenance.

5.2 Adherance to nominated access routes

The following routes would be available for access to the Project Boundary:

- **Truck route:** The nominated truck route would be Mine Access Road, Therribri Road South, Manilla Road, Barbers Lagoon Road, Braymont Road, and Blue Vale Road to access the Kamilaroi Highway to the north of Gunnedah. No trucks would be permitted on the section of Manilla Road between the Kamilaroi Highway and Therribri Road, which contains the load limited and narrow Iron Bridge.
- **Light vehicle route:** Light vehicles would be permitted to access the site from the south, ie. via Mine Access Road, Therribri Road, Manilla Road, and then either Manilla Road West to the Kamilaroi Highway, or alternatively, Manilla Road East towards Braymont.

The following routes/ roads would be prohibited for use by mine-related vehicles (both construction and operational) unless they are to a specific destination along that route (ie. as a place of residence or for a field survey):

- Harparary Road between Leard Forest Road and the Kamilaroi Highway.
- Leard Forest Road, between Northern Ring Road and Harparary Road.
- Therribri Road, between the Mine Access Road and Harparary Road.
- Browns Lane, entire length.

Appropriate wayfinding signs would be required for the nominated route, as well as signs prohibiting access to the sections of Harparary Road, Leard Forest Road North, Therribri Road North and Browns Lane as described above. These would need to be installed at appropriate locations across the network as well as documented in a traffic management plan. The traffic management plan would need to specify the nominated access routes and describe the prohibited routes.

6 Rail network impacts

Table 6-1 outlines assumptions have been used to determine the number of train movements likely to be generated by the Project.

Table 6-1 Assumptions used in the assessment of rail network impacts

Allowable gross mass per wagon (based on 25 tonne axle limit)	100 tonnes
Tare weight of each wagon	21 tonnes
Maximum allowable payload per wagon	79 tonnes
Average number of wagons per train[5]	72 wagons
Total payload per train[6]	5415 tonnes
Project coal production	
Maximum product coal production	10.8 Mtpa
Number of trains per year (one-way).	1995 trains
Number of trains per haul day[7] (one-way).	7 trains
Number of trains per hour (one-way).	0.29 trains/hour
Boggabri Coal Mine production	
Additional coal production (above existing rate)	5.5Mtpa
Number of additional trains per year (one-way)	1020 trains
Number of additional trains per haul day[7] (one way).	3.4 trains
Number of additional trains per hour (one way).	0.14 trains/hour
Total number of trains generated by both mine projects (one way).	0.43 trains/hour.

From this assessment, it is estimated that an additional 11 trains per day would be generated by both the peak production period of the Project as well as the additional coal production from Boggabri Coal Mine. If averaged out over 24 hours of a day, this equates to 0.43 trains/hour (or one train every two hours for each direction). These figures will be used to assess the likely impacts on the railway level crossings at Boggabri, Gunnedah and Curlewis.

6.1 Impact assessment on railway level crossings

Railway level crossings relevant to the Project exist at the following locations

- Currabubula Road, Breeza;

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[5] ARTC's strategy (ARTC, 2009) had assumed that the 100 tonne wagons used north of Dartbrook would consist of 72 wagons.

[6] ARTC (2009) assumed that wagons would be loaded to 95% of their capacity.

[7] Assumed 300 haul days per year with 24 haul hours per day.

- Hogarth Street, Breeza;
- Kamilaroi Highway, Curlewis;
- Carroll Street, Gunnedah;
- Marquis Street, Gunnedah;
- New Street, Gunnedah and
- Boston Street, Boggabri.

The potential impacts of increased rail traffic generated by the Project as well as other surrounding mine projects were assessed via the following:

- Main road traffic impacts (Section 6.1.1).
- Local road traffic impacts (Section 6.1.2).

6.1.1 Road safety and queuing risks at main road railway level crossing

Road safety issues

The Kamilaroi Highway is the only main road site, of all the railway level crossing sites listed in Section 6.1. This railway level crossing contains the following traffic control devices for each of the road approaches:

- *Railway crossing ahead* (W7-7) advanced warning sign;
- *Railway crossing flashing signals ahead* (W7-4) advanced warning sign;
- Active advanced warning assembly in accordance with section 2.3.7 of Australian Standards (AS) 1742.7. This includes:
  - *Railway crossing flashing signals ahead* sign (W7-4);
  - *Prepare to stop* base panel;
  - Actuated flashing lights which are linked to the railway level crossing signals;
  - *Rail X* pavement marking;
  - Railway crossing sign combination (G9-32 and G9-33 signs);
  - Active control including signals and boom gates.

The extent and type of traffic control are appropriate for this site. To address the issue of high speeds for approaching road traffic, adequate warning signs have been provided well in advance of the level crossing. Furthermore, the actuated flashing light warning assembly provides real-time advice on the signal phasing and the need to slow down and stop. The approach horizontal curves also complement the facility by providing some speed attenuation for approaching drivers.

The boom gates and the active advanced warning assembly are relatively new enhancements that were added to this site. As an at-grade road/railway crossing, there is very little that can be done to further improve the traffic control at this location without full-scale grade-separation.

As such, there are no mitigation measures proposed for this site with respect to road user safety.

Queuing and delay risks

RTA (2004) indicated that there were approximately 2,100 vehicles/day using the Kamilaroi Highway at the Curlewis railway level crossing in 2004.

The likely performance of the Curlewis railway level crossing was simulated using SIDRA. The input parameters used for the existing base case and the future peak mining period case are detailed in Table 6-2.

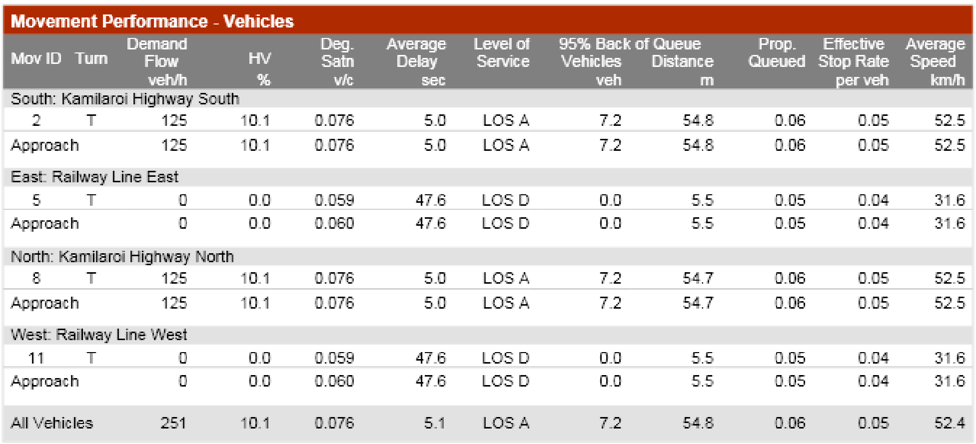
Table 6-2 Input parameters for SIDRA assessment – Curlewis railway level crossing

2010 existing base case	**2020 peak production case**[8]
7 trains per day per direction[9] 1 train every 3 hours (one way).	19 trains per day per direction. 3 trains every 3 hours (one way).
Train length: 1200m	Train length: 1200m
Kamilaroi Highway traffic volume (two-way): 2380 vehicles/day 238 vehicles/hour[10]	Kamilaroi Highway traffic volume (two-way): 2930 vehicles/day 293 vehicles/hour[10]
Traffic signal controlled	Traffic signal controlled

The SIDRA results for the simulation of the Curlewis railway level crossing are presented in Table 6-3. It is important to note that the SIDRA models provide a good indication of the performance of the railway level crossing from a road vehicle perspective. However, the modelled delays of 47-49 seconds for approaching trains are not necessarily a realistic outcome. For actuated signalised intersections (intersections whose signals are altered when approaching vehicles are detected), SIDRA assumes that the detection method for the approaching train is similar to that of a road vehicle. That is, it assumes that the train will only be detected when in the immediate vicinity of the crossing. In reality, approaching trains could be detected well in advanced of the crossing, so that by the time they arrive at the signals, the signals would have turned green in their favour. In these respects, the modelled delays and queue lengths of the two train approaches should be treated with scrutiny and as such the focus should be on the modelled delays to the road traffic only.

Table 6-3 SIDRA outputs for the Kamilaroi Highway railway level crossing (Curlewis) - base and peak production scenarios.

2010 existing base case



Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kamilaroi Highway South											
2	T	125	10.1	0.076	5.0	LOS A	7.2	54.8	0.06	0.05	52.5
Approach		125	10.1	0.076	5.0	LOS A	7.2	54.8	0.06	0.05	52.5
East: Railway Line East											
5	T	0	0.0	0.059	47.6	LOS D	0.0	5.5	0.05	0.04	31.6
Approach		0	0.0	0.060	47.6	LOS D	0.0	5.5	0.05	0.04	31.6
North: Kamilaroi Highway North											
8	T	125	10.1	0.076	5.0	LOS A	7.2	54.7	0.06	0.05	52.5
Approach		125	10.1	0.076	5.0	LOS A	7.2	54.7	0.06	0.05	52.5
West: Railway Line West											
11	T	0	0.0	0.059	47.6	LOS D	0.0	5.5	0.05	0.04	31.6
Approach		0	0.0	0.060	47.6	LOS D	0.0	5.5	0.05	0.04	31.6
All Vehicles		251	10.1	0.076	5.1	LOS A	7.2	54.8	0.06	0.05	52.4

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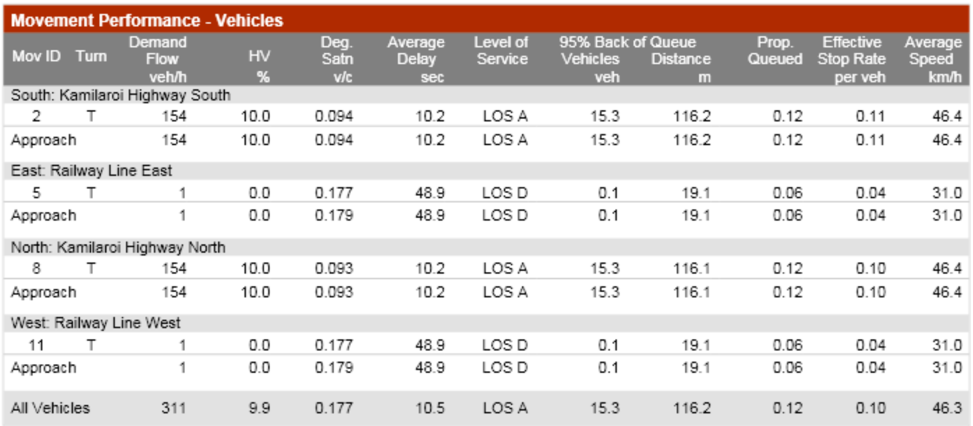
[8] Includes the additional trains generated by Boggabri Coal Mine's forecast increase coal production.

[9] Sourced from ARTC (2009)

[10] A 2.1%pa growth rate was adopted to account for annual increases in traffic volumes. This was used to approximate volumes for the 2010 existing base case and the 2020 peak production case. The highest volume hour of the day is assumed to carry 10% of the daily traffic volume.

2020 peak production case	

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kamilaroi Highway South											
2	T	154	10.0	0.094	10.2	LOS A	15.3	116.2	0.12	0.11	46.4
Approach		154	10.0	0.094	10.2	LOS A	15.3	116.2	0.12	0.11	46.4
East: Railway Line East											
5	T	1	0.0	0.177	48.9	LOS D	0.1	19.1	0.06	0.04	31.0
Approach		1	0.0	0.179	48.9	LOS D	0.1	19.1	0.06	0.04	31.0
North: Kamilaroi Highway North											
8	T	154	10.0	0.093	10.2	LOS A	15.3	116.1	0.12	0.10	46.4
Approach		154	10.0	0.093	10.2	LOS A	15.3	116.1	0.12	0.10	46.4
West: Railway Line West											
11	T	1	0.0	0.177	48.9	LOS D	0.1	19.1	0.06	0.04	31.0
Approach		1	0.0	0.179	48.9	LOS D	0.1	19.1	0.06	0.04	31.0
All Vehicles		311	9.9	0.177	10.5	LOS A	15.3	116.2	0.12	0.10	46.3

The results in Table 6-3 indicate that there is not likely to be any major additional impact to road traffic delay as a result of the forecast increase in rail movements associated with the Project. The maximum queue lengths could increase from 7.2 vehicles to 15.3 vehicles.

This is better understood by considering the performance of the railway level crossing in terms of arrival and queue dissipation rates of the Kamilaroi Highway traffic each time a train passes through the intersection. A 1200m train is estimated to require road traffic to be held for a three minute period. This accounts for the passing/clearance time as well as a safety margin before the train reaches the conflict zone. Within this three minute period, a total of eight vehicles would arrive at the hold line (based on the modelled arrival rate of 154 vehicles/hour and assuming the arrival rate is uniform). Following the passing of the train, these eight vehicles would require 16 seconds to clear the intersection. In that time, less than one vehicle would have arrived at the intersection. The average delay for the affected vehicles would be 90 seconds. However, it should also be acknowledged that only 10% of all road vehicles using the crossing would be required to stop for the passing of a train.

This analysis indicates that the additional train movements generated by the Maules Creek Coal Project (also accounting for the cumulative impact due to the Boggabri Coal Mine project) are not likely to result in significant *additional* impact to the Kamilaroi Highway railway level crossing at Curlewis.

This is also put into perspective by considering how much additional train traffic could be generated *before* the delay to road vehicles becomes unacceptable. Generally in traffic engineering design, once the level of service (LOS) reaches D (see Appendix C), the delays to vehicles becomes unacceptable. An LOS of D corresponds to an average delay of 43-56 seconds per vehicle. However, appreciating that these level crossings are all in rural areas, the drivers would have a much lower tolerance to traffic delay compared with those in urban areas. As such, for this study, a maximum acceptable delay of 20 seconds per vehicle has been conservatively adopted.

Further modelling work indicates that an additional three train paths could be generated per hour before the average delay per vehicle exceeds the adopted threshold of 20 seconds. The total of five train paths per hour would have a total red signal time (for road traffic) of 15 minutes in the hour and up to 40 vehicles per hour could be affected. This analysis suggests that there is spare capacity in the rail network with respects to maintaining reasonable operation of the railway level crossings. Future growth beyond this (ie. where the additional train paths required exceeds four per hour) would require improvements to be made.

6.1.2 Road safety and queuing risks at local road railway level crossings

Road safety risks were identified through a site inspection carried out in December 2010. Queuing risks were determined by using a similar philosophy as that presented in Section 6.1.1 for the Kamilaroi Highway railway level crossing.

Currabubula Road railway level crossing, Breeza

Currabubula Road is a local road which is the southern access road to the village of Breeza. It crosses the Werris Creek-Mungindi Railway Line as a railway level crossing to the east of the Kamilaroi Highway.

This railway level crossing is passively controlled with a *stop* sign which is an appropriate measure for the expected function of this road. Furthermore, there is good visibility and sight distance from the hold line of the road approaches to oncoming trains from either direction.

There is substantial storage length on both sides of the railway level crossing and as such there is very little short stacking risk. In these respects, there are no mitigation measures recommended for this site.

Hogarth Street railway level crossing, Breeza

Hogarth Street is a local road and the northern access road to the village of Breeza. It crosses the Werris Creek-Mungindi Railway Line as a railway level crossing approximately 50m to the east of the Kamilaroi Highway.

This railway level crossing is actively controlled with traffic signals and boom gates which are all appropriate measures for the expected function of Hogarth Street. Furthermore, there is good visibility and sight distance from road traffic at the hold line to oncoming trains.

The 50m storage length between the Kamilaroi Highway and the railway line could present short stacking related crash risks. A queue from a red signal activated by a passing train could spill back into the control area of the Kamilaroi Highway/ Hogarth Street intersection thereby increasing crash potential with the traffic on Kamilaroi Highway. Furthermore, the steep grade of Hogarth Street in approach to its intersection with the Kamilaroi Highway may restrict visibility and inhibit drivers from assessing the extent of queuing in Hogarth Street (see Figure 6-3). As Hogarth Street was not observed to carry a large volume of traffic, this safety risk could be appropriately mitigated by installing signs on both approaches of the Kamilaroi Highway to warn drivers of the presence of the railway level crossing in the side road.

Figure 6-3 The short storage length and short-stacking risk at the Hogarth Street railway level crossing (photo is facing west).

The potential queue spill back from the Kamilaroi Highway intersection across the railway lines is also a risk, although a less probable one. This is due to the low traffic volumes on Hogarth Road and the high frequency gaps in the Kamilaroi Highway traffic. Furthermore, there are wide traversable verges either side of Hogarth Street which could be used as an escape route in the event of short-stacking risk in this regard.

Carroll Street railway level crossing, Gunnedah

Carroll Street is a local road which intersects with the Oxley Highway at Gunnedah. The Werris Creek - Mungindi railway line passes through Gunnedah in an approximate east-west direction and lies to the south of the Oxley Highway. It crosses Carroll Street as a railway level crossing.

The Carroll Street railway level crossing is signal-controlled with no boom gates. Two traffic lanes are provided with one lane for each direction of traffic. Appropriate regulatory signs are in place to advise motorists of the traffic control requirements at this site. These include a *stop on red signal* sign to accompany the traffic signals.

On the northern side of the railway line, approximately 135m of storage length is available on Carroll Street between the railway level crossing and the Oxley Highway. This equates to approximately 22 passenger vehicles or 10 rigid trucks. A maximum arrival rate of 145 vehicles per hour (both directions) has been estimated based on observations on site[11]. This equates to an arrival rate of 1.2 vehicles per direction per minute. Assuming a total red signal display of three minutes as described in Section 6.1.1, a total of four vehicles could arrive at the hold line during the red display. Furthermore, this queue would take eight seconds to dissipate once the train has cleared the crossing. Based on this assessment, it is unlikely that the Carroll Street traffic will queue back to the Oxley Highway. As such, there is little short stacking risk associated with this crossing.

In addition to the signalised control of traffic at this crossing, there is sufficient gap acceptance sight distance for road traffic. The roadways either side of the crossing are wide and offer a good escape route to avoid queue spillback over the railway line.

A fenced pedestrian crossing is also provided. Although it contains a rough surface, there is not expected to be a high volume of pedestrian traffic at this site. Generally, the facilities were regarded as appropriate for the function and likely pedestrian volumes.

Marquis Street railway level crossing, Gunnedah

Marquis Street is a local road connecting Oxley Highway and the Gunnedah town centre. The Werris Creek - Mungindi Railway Line crosses Marquis Street immediately north of its intersection with Oxley Highway. The railway level crossing is signal controlled with no boom gates. Appropriate regulatory signs are provided and advise motorists of the traffic control requirements at this site.

Marquis Street carries a substantial volume of traffic due to the major traffic generators and attractors including the Gunnedah town centre. It is also one of the few railway crossings linking the precincts to the north and south of the railway line. A maximum arrival rate of 570 vehicles per hour (both directions) has been estimated based on observations on site[12]. This equates to

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[11] The site inspection was carried out between 1030-1100h on a weekday. The arrival rate during this period was 95 vehicles/hour (both directions). A maximum hourly arrival rate of 135 vehicles/hour was adopted based on a multiplier of 1.5.

[12] The site inspection was carried out between 1100-1130h on a weekday. The arrival rate during this period was 380 vehicles/hour (both directions). A maximum hourly arrival rate of 570 vehicles/hour was adopted based on a multiplier of 1.5.

an arrival rate of five vehicles per direction per minute. Assuming a total red signal display of three minutes as described in Section 6.1.1, a total of 15 vehicles could arrive at the hold line during the red display. On the southern side of the railway line, approximate 25m of storage space is provided between the railway level crossing and the Oxley Highway/ Marquis Street roundabout. This equates to approximately four passenger vehicles or two rigid trucks. As such, there is a short stacking risk (see Figure 6-1) as the estimated 15 vehicle queue would spillback into the control area of the roundabout.

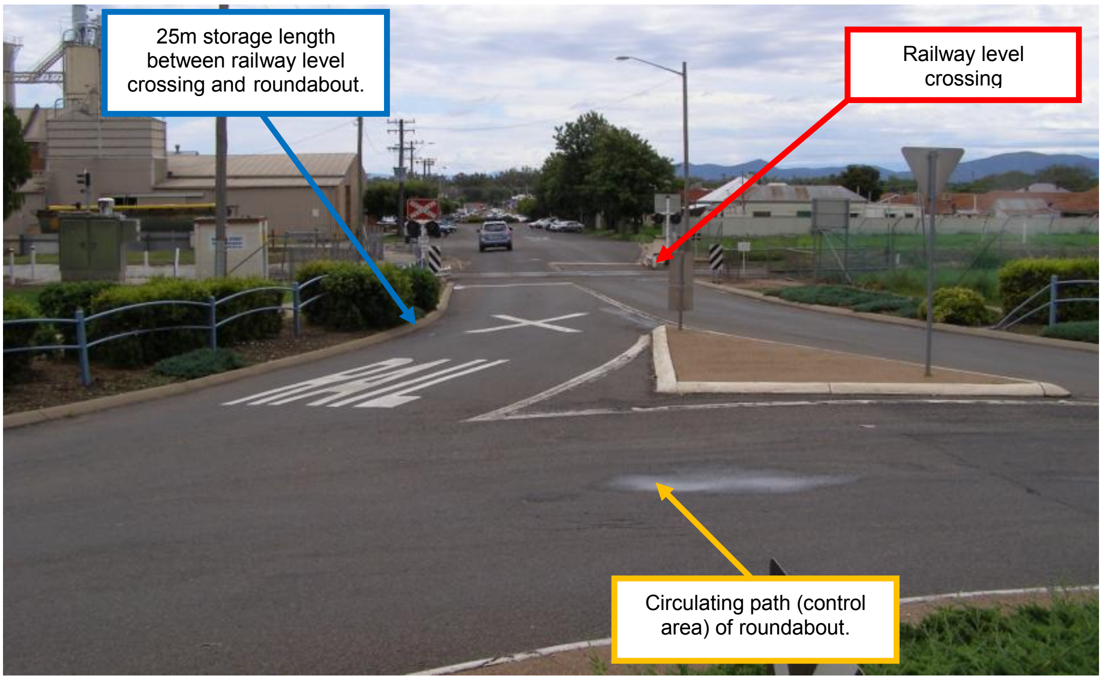

Figure 6-1 **The short storage length and short-stacking risk at the Marquis Street railway level crossing (photo is facing north).**

The short stacking risk is twofold. That is, a queue in the northbound direction of Marquis Street would spillback into the roundabout and risk clogging the circulating path of the roundabout. Approaching drivers may not be able to see the queue build up nor judge the amount of storage space available in Marquis Street. Secondly, any queue that develops in the southbound lane of Marquis Street due to the roundabout may result in vehicles queuing over the railway line and putting them at risk of impact by a passing train. However, site observations indicate that the roundabout operates efficiently with little queue generation. As such, the southbound queue potential would not be as critical as the northbound direction.

The short stacking risk described above will require some form of mitigation to minimise the safety and operational risks associated with the railway level crossing and roundabout intersection. The following measures could be considered:

- **Actuated movement restrictions at the roundabout:** This would involved the use of actuated *no entry* signs to prohibit road vehicles entering Marquis Street and the railway level crossing during red signal displays activated by a passing train. For example, *no right turn – when signals flashing* and *no left turn – when signals flashing* signs could be provided for the eastern and western approaches to the Oxley Highway/ Marquis Street roundabout respectively. A *no entry sign – when signals flashing* could be placed at the interface between Marquis Street and the roundabout intersection. All signs could be accompanied by flashing lights which would be linked to and activated by a red signal display at the railway level crossing. This would minimise risk of the roundabout clogging up by prohibiting vehicles to enter Marquis Street and thereby adding to its queue.

- **Box pavement markings and *keep tracks clear* signage:** Box pavement markings could be provided across the road approaches of the railway level crossing in accordance with section 3.6 of Australian Standards (AS) 1742.7. Furthermore, a *G9-67-2 – keep tracks clear* sign could be installed at the railway level crossing for the southbound direction on Marquis Street. These regulatory devices would advise approaching motorists to be wary of any queue development from the Oxley Highway/ Marquis Street roundabout and not to proceed through the railway level crossing if there is a risk that the queue will extend over the control area (conflict zone) of the crossing.

New Street railway level crossing, Gunnedah

New Street is the western-most railway level crossing in Gunnedah and like Marquis Street it is a critical route providing a link between the precincts to the north and south of the railway line. This may also be an attractive route for drivers heading from Oxley Highway South (ie. Coonabarabran) to Kamilaroi Highway (ie. Narrabri) as it allows them to bypass the more congested streets in the Gunnedah town centre.

The railway level crossing is signal controlled with no boom gates. Appropriate regulatory signs are in place to advise motorists of the traffic control requirements at this site.

New Street has similar issues as Marquis Street in that its railway level crossing is to the north of the Oxley Highway and provides a short storage (stacking) length of 85m which equates to 14 passenger vehicles or six rigid trucks (see Figure 6-2). A maximum arrival rate of 850 vehicles per hour (both directions) has been estimated based on observations on site[13]. This equates to an arrival rate of seven vehicles per direction per minute. Assuming a total red signal display of three minutes as described in Section 6.1.1, a total of 21 vehicles could arrive at the hold line during the red display. As such, it is likely that a red signal display at the railway level crossing could result in vehicles queuing back into the Oxley Highway/ New Street roundabout.

To address the short stacking risks described above, it is recommended that consideration be given to the two strategies described for the Marquis Street railway level crossing. That is,

- Actuated movement restrictions at the roundabout
- Box pavement markings and keep tracks clear signage

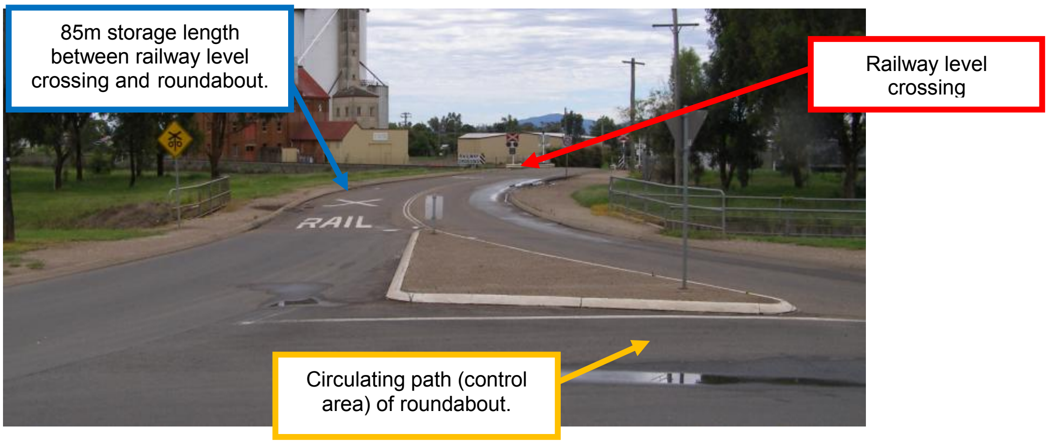

Figure 6-2 The short storage length and short-stacking risk at the New Street railway level crossing (photo is facing north).

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[13] The site inspection was carried out between 1120-1140h on a weekday. The arrival rate during this period was 570 vehicles/hour (both directions). A maximum hourly arrival rate of 850 vehicles/hour was adopted based on a multiplier of 1.5.

Boston Street railway level crossing, Boggabri

Boston Street is a local road and the northern-most street in the Boggabri residential street grid. A railway level crossing is located on Boston Street between Watson Street and Oakham Street which is to the west of the Kamilaroi Highway. The level crossing is controlled by signals which include a pair of boom gates. These are both relatively new improvements as the crossing was previously controlled by stop signs for the road approaches.

Boston Street carries very little traffic. Furthermore, there are no short-stacking risks as per the Marquis Street and New Street (Gunnedah) sites. The traffic control and warning devices provided on site are all appropriate for the expected function and usage of Boston Street. As such, there are no mitigation measures proposed for this site.

6.2 Greater rail network deficiencies

The *2009-2018 Hunter Valley Corridor Capacity Strategy Consultation Document* (ARTC, 2009) provides a detailed review of the existing deficiencies on the Hunter Valley coal corridor which includes the rail network up to Narrabri and Ulan. This document covers a wide range of deficiencies in the coal supply chain from individual mines to the port. Although the movement of coal from the Project would be affected by deficiencies at any point in this supply chain, those to the south of Muswellbrook are a more "global" problem which affect a much wider range of customers including mines along the Ulan rail line as well as the mines to the south of Muswellbrook. By contrast, the forecast train movements generated by the Project would be directly affected by the section of the network between Narrabri and Muswellbrook.

ARTC (2009) describes a number of deficiencies as well as proposed network upgrades. It is important to note that the network upgrades proposed in the ARTC document are not formal recommendations for mitigation measures for this study. Rather, they are described in this report to highlight the need for ongoing liaison between Aston Resources and ARTC regarding the scheduled roll out of rail network infrastructure improvement. This is essential to enable continual refinement to the coal production forecasts. A number of neighbouring coal mine projects will also need to be involved in the consultative process. These may include Narrabri, Watermark, Tarrawonga Coal Mine, Goonbri Coal Project and Boggabri Coal Mine.

The single biggest constraint to the movement of coal is the Liverpool Ranges at Ardglen which was briefly described in Section 2.4. The steep grades at this location require loaded trains (on the northern bank) to be supported by banker locomotives. This is a major impediment since the return of the banker locomotive to the base of the grade adds a northbound path which would otherwise be negated if the train did not require banker support.

ARTC has developed and established a short list of two options for a new route across the Liverpool Ranges. This includes both surface and tunnel options. The existing track would be retained for northbound (unloaded) train movements as well as lighter trains that do not require banker locomotives. A reduced grade also reduces the power requirements for the uphill climb and would enable longer train units (with higher payloads) to be used. In summary, the Liverpool Ranges should increase the coal movement capacity by:

1. Reducing/eliminating train paths associated with the return of banker locomotives (non-productive movements), hence providing more paths for "productive" movements;
2. Providing some level of passing opportunity through track duplication. This could increase the number of paths, as opposing train movements are not required to share a common single track; and
3. Allowing longer train units to be used and thereby increasing the coal payload per train. Currently, train lengths are limited at 1300m.

Subsequent analyses have indicated that the capacity increase that would result from the Liverpool Ranges realignment would oversupply capacity by as much as 140Mtpa. That is the maximum demand forecasts for coal transportation by rail over the next 10-15 years is 60Mtpa and the Liverpool Ranges realignment options would increase the capacity to 90-200Mtpa. As such, the ARTC has committed to further studies which will focus on duplication of the existing alignment in stages over the Liverpool Ranges to generate capacity of 60Mtpa (30 trains each way each day).

Apart from the above initiatives, the total coal payload per train could also be increased by:

- Increasing the axle load limit to 30 tonnes (ie. gross wagon load of 120 tonnes): The rail network north of Dartbrook is currently rated to 25 tonne axle load limit. The ARTC (2009) reports that the exact scope to allow for the increase in load limit is unresolved. However, several sections have been upgraded with concrete sleepers and have thereby increased load strength in those locations.
- Increasing power by adding more locomotives. By adding an additional locomotive, ARTC has concluded that trains with 110-120 wagons could be used. This equates to approximately 51% more payload per train. However, increased train lengths would also require other infrastructure improvements including re-design of loading/ unloading terminals as well as the lengths of passing loops.

In conclusion, it is recommended that Aston Resources continues to liaise with ARTC regarding the scheduled timing of the rail network upgrades. ARTC would be interested in the production forecasts for this and other mine projects. Also, Aston would need to continue working with Boggabri Coal Mine regarding the timing of the rail spur from the Werris Creek to Mungindi Railway line to the Project Boundary.

7 Conclusions

This traffic and transport impact assessment has demonstrated that there are not likely to be any major traffic capacity impacts as a result of the Project. The traffic generation, distribution and modelling work indicate that the most significant road traffic impact would be experienced during the peak construction period, due to the heavier reliance on trucks. However, despite this, the modelled impact on the four study intersections as well as the midblock capacity assessment of Blue Vale Road all indicate that the resulting impacts would not be major.

During the operational phase, there would not be major impacts to road traffic as most transport requirements from the coal mine would be met by rail movements. As such, the road traffic impacts during the operational phase would be confined to a smaller volume of vehicular movements associated with mine staff moving to and from the site.

The road safety impact assessment identified a number of potential risks that would need to be addressed by management/ mitigation measures. These are risks to railway level crossings as well as the road routes which would be used by traffic generated by the mine. A summary of mitigation measures is provided in Table 7-1.

A traffic management plan would need to be prepared to specify the nominated access routes for light and heavy vehicles. This would include the nominated truck access route via Manilla Road, Barbers Lagoon Road, Braymont Road and Blue Vale Road. The traffic management plan would also include appropriate wayfinding signage for truck operators on this route. It would also include signs prohibiting mine-related traffic from using the following roads:

- Harparary Road between Leard Forest Road and the Kamilaroi Highway.
- Leard Forest Road, between East Link Road and Harparary Road.
- Therribri Road, between the Mine Access Road and Harparary Road.
- Browns Lane.

The impact of train movements generated by the operational phase of the mine was assessed by considering the number of trains likely to be generated by the peak mine production period. This assessment showed that up to 11 additional trains would be generated per day (including the additional haulage requirements from Boggabri Coal Mine). The 24-hour window available for rail haul movements would allow this to be well distributed throughout the day with approximately one train movement generated every two hours. The potential impact of these additional movements on the railway level crossings in Boggabri, Gunnedah and Curlewis were also assessed. Recommended management/ mitigation measures have been summarised in Table 7-1.

The biggest transport-related risk associated with the proposed coal production schedule is the capacity of the rail network to handle the additional train movements. This has been recognised by the ARTC as a more “global” problem as a result of increased train movement demands from Hunter Valley, Western Coalfields and Gunnedah basin coal mines. The Gunnedah basin mines will be particularly affected by the timing of the Liverpool Ranges realignment which is the single biggest impediment to rail movements between this region and the coast. In this regard, it is recommended that Aston Resources continue to liaise with the ARTC and neighbouring mines (eg. Boggabri Coal Mine) regarding the scheduling of network-wide improvements as well as the scheduled timing of the railway spur accessing the project site. Any delay in network-wide improvements (including any capacity constraints at the Port of Newcastle coal terminal) may affect the coal production schedule proposed by Aston Resources.

Table 7-1 Summary of recommended management/ mitigation measures

Location/ impact description	Management/ mitigation measure
Kamilaroi Highway rail bridge construction	▪ Work with RTA to enter Works Authorisation Deed for asset ownership and responsibility for ongoing maintenance. ▪ Apply for lane/ road occupancy during bridge construction as required.
Therribri Road upgrade	Prepare a traffic management plan for the management of general and construction related traffic using the affected section of Therribri Road.
Road safety impacts to Manilla Road, Therribri Road, Leard Forest Road, East Link Road and the nominated heavy vehicle route of Barbers Lagoon Road-Braymont Road-Johnston Road-Blue Vale Road.	Implement line marking, safety barrier, vegetation removal, drainage and road profiling improvements as described in Tables 5-1 to 5-5 as part of the ongoing management and maintenance of these routes.
Access restrictions	▪ Install appropriate wayfinding signs for the nominated light and heavy vehicle routes. ▪ Install signs to prohibit use of Browns Lane, Harparary Road, Leard Forest Road (north of East Link Road), and Therribri Road (north of the Mine Access Road) by mine-related traffic (unless there is a specified purpose/destination along those routes). ▪ Conduct necessary induction and training to advise Project-related traffic of these access restrictions.
Hogarth Street railway level crossing, Breeza.	Provide warning signs on Kamilaroi Highway regarding presence of railway level crossing in the side road (Hogarth Street).
Marquis Street railway level crossing, Gunnedah.	Provide: ▪ Actuated movement restriction signs at the Oxley Highway/ Marquis Street roundabout. ▪ Provide box pavement markings and keep tracks clear signage across the railway line.
New Street railway level crossing, Gunnedah	Provide: ▪ Actuated movement restriction signs at the Oxley Highway/ New Street roundabout. ▪ Provide box pavement markings and keep tracks clear signage across the railway line.
Greater rail network deficiencies	▪ Liaise with ARTC regarding the scheduled timing of rail network upgrades. ▪ Continue to work with Boggabri Coal regarding the timing of the rail spur from the Project Boundary to the Werris Creek-Mungindi Railway Line.

8 References

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RTA (2010) *Traffic control at work sites manual*.

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RTA (2002) *Traffic volume data for Western Region 2002*.

RTA (1999) *Road Design Guide – Section 4: Intersections at Grade*.

RTA (1998) *Road Design Guide – Section 2: Road Geometry*.

Appendix A: Surveyed traffic volumes and derived traffic generation/ distribution figures.

I-01: Manilla Road and Barbers Lagoon Road. Existing base case.

Midblock tube survey results - average weekday.

M04 - Manilla Rd, Boggabri. (East of Therribri Rd)

EB

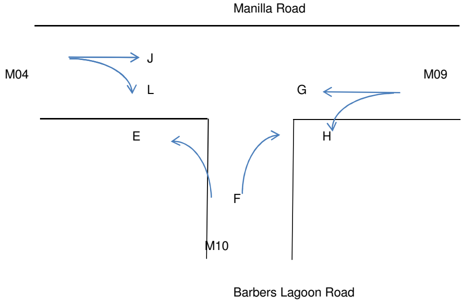
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	26	25	0
6:00	45	44	1
7:00	18	16	1
8:00	11	8	2
9:00	8	6	2
10:00	8	7	1
11:00	10	7	3
12:00	10	9	1
13:00	7	6	1
14:00	8	7	1
15:00	12	10	2
16:00	21	21	0
17:00	9	8	1
18:00	4	4	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	203	184	18

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	6	5	0
3:00	8	7	0
4:00	1	1	0
5:00	2	1	0
6:00	8	7	1
7:00	6	4	2
8:00	11	10	1
9:00	10	8	2
10:00	10	9	1
11:00	6	5	1
12:00	6	5	1
13:00	9	7	1
14:00	9	6	2
15:00	12	10	2
16:00	22	21	1
17:00	46	43	3
18:00	18	16	2
19:00	3	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	198	174	23



M09

Manilla Rd, Boggabri. (East of Braymont Rd)

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	1	0	0
2:00	1	1	0
3:00	3	3	0
4:00	1	1	0
5:00	4	4	0
6:00	11	10	0
7:00	4	3	1
8:00	4	3	1
9:00	4	2	1
10:00	3	2	1
11:00	4	3	1
12:00	4	3	1
13:00	4	3	1
14:00	5	3	1
15:00	7	5	2
16:00	7	7	0
17:00	11	10	0
18:00	4	4	0
19:00	2	2	0
20:00	1	0	1
21:00	0	0	0
22:00	0	0	1
23:00	0	0	0
Total	85	71	14

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	2	2	0
3:00	0	0	0
4:00	1	1	0
5:00	5	4	1
6:00	12	11	1
7:00	4	3	1
8:00	4	4	1
9:00	3	3	0
10:00	4	3	0
11:00	3	2	0
12:00	3	2	1
13:00	4	3	0
14:00	6	4	2
15:00	5	4	0
16:00	12	11	0
17:00	8	8	0
18:00	4	3	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	80	69	10

M10

Braymont Rd, Boggabri. (South of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	2	2	0
6:00	2	2	0
7:00	2	2	0
8:00	2	2	0
9:00	2	2	0
10:00	1	1	0
11:00	1	1	0
12:00	1	1	0
13:00	2	1	0
14:00	1	1	0
15:00	3	2	0
16:00	1	1	0
17:00	1	1	0
18:00	0	0	0
19:00	1	1	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	25	22	3

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	1	1	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	0	0	0
8:00	2	1	1
9:00	1	1	0
10:00	3	3	0
11:00	2	2	0
12:00	2	1	1
13:00	2	2	0
14:00	3	3	0
15:00	2	1	1
16:00	2	2	0
17:00	5	4	0
18:00	2	2	0
19:00	1	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	29	25	4

Notes:
(1) Although M04 is located on Manilla Road to the east of Therribri, a substantial volume of this traffic would turn off at Leard Forest Road.
(2) Assumed that 0.8 x M10N = movement E
(3) Assumed that 0.2 x M10N = movement F
(4) Assumewd that 0.8 x M10S = movement L
(5) Assumed that 0.2 x M10S = movement H
(6) Therefore M09W - H = movement G
(7) Therefore M09E - F = movement J
(8) Assumed that future base case during week 39 to 43 is same as existing survey case

Derivation of turning movement volumes

Movement E

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	2	2	0
7:00	2	1	0
8:00	2	1	0
9:00	1	1	0
10:00	1	1	0
11:00	1	1	0
12:00	1	1	0
13:00	1	1	0
14:00	1	1	0
15:00	2	2	0
16:00	1	1	0
17:00	1	1	0
18:00	0	0	0
19:00	1	1	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement F

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	0	0	0
8:00	0	0	0
9:00	0	0	0
10:00	0	0	0
11:00	0	0	0
12:00	0	0	0
13:00	0	0	0
14:00	0	0	0
15:00	1	0	0
16:00	0	0	0
17:00	0	0	0
18:00	0	0	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement G

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	1	1	0
3:00	0	0	0
4:00	1	1	0
5:00	5	4	1
6:00	12	11	1
7:00	4	3	1
8:00	4	3	0
9:00	3	2	0
10:00	3	3	0
11:00	2	2	0
12:00	2	2	1
13:00	3	3	0
14:00	5	3	2
15:00	4	4	0
16:00	11	11	0
17:00	7	7	0
18:00	3	3	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement H

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	0	0	0
8:00	0	0	0
9:00	0	0	0
10:00	1	1	0
11:00	0	0	0
12:00	0	0	0
13:00	0	0	0
14:00	1	1	0
15:00	0	0	0
16:00	0	0	0
17:00	1	1	0
18:00	0	0	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement J

Time	Total	LV	HV
0:00	0	0	0
1:00	1	0	0
2:00	1	1	0
3:00	3	3	0
4:00	1	1	0
5:00	4	3	0
6:00	11	10	0
7:00	4	3	1
8:00	4	3	1
9:00	4	2	1
10:00	3	2	1
11:00	4	3	1
12:00	4	3	1
13:00	4	3	1
14:00	4	3	1
15:00	7	5	2
16:00	7	7	0
17:00	10	10	0
18:00	4	4	0
19:00	2	2	0
20:00	1	0	1
21:00	0	0	0
22:00	0	0	1
23:00	0	0	0

Movement L

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	0	0	0
8:00	2	1	1
9:00	1	1	0
10:00	2	2	0
11:00	2	1	0
12:00	2	1	1
13:00	1	1	0
14:00	3	2	0
15:00	1	1	0
16:00	2	2	0
17:00	4	4	0
18:00	2	2	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

I-01: Manilla Road and Barbers Lagoon Road. Week 10 of construction program

Midblock tube survey results - average weekday.

M04 - Manilla Rd, Boggabri. (East of Therribri Rd)

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	26	25	0
6:00	45	44	1
7:00	18	16	1
8:00	11	8	2
9:00	8	6	2
10:00	8	7	1
11:00	10	7	3
12:00	10	9	1
13:00	7	6	1
14:00	8	7	1
15:00	12	10	2
16:00	21	21	0
17:00	9	8	1
18:00	4	4	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	203	184	18

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	6	5	0
3:00	8	7	0
4:00	1	1	0
5:00	2	1	0
6:00	8	7	1
7:00	6	4	2
8:00	11	10	1
9:00	10	8	2
10:00	10	9	1
11:00	6	5	1
12:00	6	5	1
13:00	9	7	1
14:00	9	6	2
15:00	12	10	2
16:00	22	21	1
17:00	46	43	3
18:00	18	16	2
19:00	3	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	198	174	23

M09 Manilla Rd, Boggabri. (East of Braymont Rd)

EB

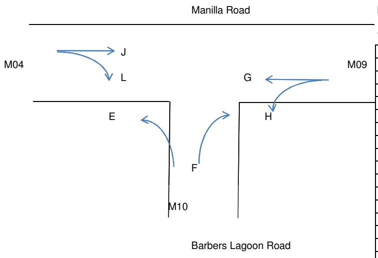
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	1	0	0
2:00	1	1	0
3:00	3	3	0
4:00	1	1	0
5:00	4	4	0
6:00	11	10	0
7:00	4	3	1
8:00	4	3	1
9:00	4	2	1
10:00	3	2	1
11:00	4	3	1
12:00	4	3	1
13:00	4	3	1
14:00	5	3	1
15:00	7	5	2
16:00	7	7	0
17:00	11	10	0
18:00	4	4	0
19:00	2	2	0
20:00	1	0	1
21:00	0	0	0
22:00	0	0	1
23:00	0	0	0
Total	85	71	14

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	2	2	0
3:00	0	0	0
4:00	1	1	0
5:00	5	4	1
6:00	12	11	1
7:00	4	3	1
8:00	4	4	1
9:00	3	3	0
10:00	4	3	0
11:00	3	2	0
12:00	3	2	1
13:00	4	3	0
14:00	6	4	2
15:00	5	4	0
16:00	12	11	0
17:00	8	8	0
18:00	4	3	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	80	69	10



M10 Braymont Rd, Boggabri. (South of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	2	2	0
6:00	2	2	0
7:00	2	2	0
8:00	2	2	0
9:00	2	2	0
10:00	1	1	0
11:00	1	1	0
12:00	1	1	0
13:00	2	1	0
14:00	1	1	0
15:00	3	2	0
16:00	1	1	0
17:00	1	1	0
18:00	0	0	0
19:00	1	1	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	25	22	3

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	1	1	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	0	0	0
8:00	2	1	1
9:00	1	1	0
10:00	3	3	0
11:00	2	2	0
12:00	2	1	1
13:00	2	2	0
14:00	3	3	0
15:00	2	1	1
16:00	2	2	0
17:00	5	4	0
18:00	2	2	0
19:00	1	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	29	25	4

Derivation of turning movement volumes

Movement E

			exist	Maule	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	1	0	1	0	0	0	0	0	0	0
6:00	13	0	2	3	8	0	0	0	0	0
7:00	3	1	1	0	0	0	0	1	0	0
8:00	2	1	1	0	0	0	0	1	0	0
9:00	2	1	1	0	0	0	0	1	0	0
10:00	11	10	1	0	0	0	0	10	0	0
11:00	7	6	1	0	0	0	0	6	0	0
12:00	5	4	1	0	0	0	0	4	0	0
13:00	3	2	1	0	0	0	0	2	0	0
14:00	3	2	1	0	0	0	0	2	0	0
15:00	4	2	2	0	0	0	0	2	0	0
16:00	3	2	1	0	0	0	0	2	0	0
17:00	3	2	1	0	0	0	0	2	0	0
18:00	4	0	0	0	4	0	0	0	0	0
19:00	1	0	1	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement F

			exist	Maules	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	1	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement G

			exist	Maule	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	1	0	1	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	5	1	4	0	0	0	1	0	0	0
6:00	12	1	11	0	0	0	1	0	0	0
7:00	4	1	3	0	0	0	1	0	0	0
8:00	4	0	3	0	0	0	0	0	0	0
9:00	3	0	2	0	0	0	0	0	0	0
10:00	3	0	3	0	0	0	0	0	0	0
11:00	2	0	2	0	0	0	0	0	0	0
12:00	2	1	2	0	0	0	1	0	0	0
13:00	3	0	3	0	0	0	0	0	0	0
14:00	5	2	3	0	0	0	2	0	0	0
15:00	4	0	4	0	0	0	0	0	0	0
16:00	11	0	11	0	0	0	0	0	0	0
17:00	7	0	7	0	0	0	0	0	0	0
18:00	3	0	3	0	0	0	0	0	0	0
19:00	1	0	0	0	0	0	0	0	0	0
20:00	1	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement H

			exist	Maule	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	1	0	1	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	1	0	1	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	1	0	1	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement J

			exist	Maules	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	1	0	0	0	0	0	0	0	0	0
2:00	1	0	1	0	0	0	0	0	0	0
3:00	3	0	3	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	3	0	3	0	0	0	0	0	0	0
6:00	10	0	10	0	0	0	0	0	0	0
7:00	4	1	3	0	0	0	1	0	0	0
8:00	3	1	3	0	0	0	1	0	0	0
9:00	3	1	2	0	0	0	1	0	0	0
10:00	2	1	2	0	0	0	1	0	0	0
11:00	4	1	3	0	0	0	1	0	0	0
12:00	4	1	3	0	0	0	1	0	0	0
13:00	4	1	3	0	0	0	1	0	0	0
14:00	4	1	3	0	0	0	1	0	0	0
15:00	6	2	5	0	0	0	2	0	0	0
16:00	7	0	7	0	0	0	0	0	0	0
17:00	10	0	10	0	0	0	0	0	0	0
18:00	4	0	4	0	0	0	0	0	0	0
19:00	2	0	2	0	0	0	0	0	0	0
20:00	1	1	0	0	0	0	1	0	0	0
21:00	1	0	0	0	0	0	0	0	0	0
22:00	1	1	0	0	0	0	1	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement L

			exist	Maule	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	5	1	0	0	4	0	0	1	0	0
8:00	3	2	1	0	0	0	1	1	0	0
9:00	2	1	1	0	0	0	0	1	0	0
10:00	12	10	2	0	0	0	0	10	0	0
11:00	7	6	1	0	0	0	0	6	0	0
12:00	6	5	1	0	0	0	1	4	0	0
13:00	3	2	1	0	0	0	0	2	0	0
14:00	5	2	2	0	0	0	0	2	0	0
15:00	3	2	1	0	0	0	0	2	0	0
16:00	4	2	2	0	0	0	0	2	0	0
17:00	6	2	4	0	0	0	0	2	0	0
18:00	5	0	2	3	0	0	0	0	0	0
19:00	8	0	0	0	8	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Notes:

(1) Although M04 is located on Manilla Road to the east of Therribri, a substantial volume of this traffic would turn off at Leard Forest Road.
(2) Assumed that 0.8 x M10N = movement E
(3) Assumed that 0.2 x M10N = movement F
(4) Assumewd that 0.8 x M10S = movement L
(5) Assumed that 0.2 x M10S = movement H
(6) Therefore M09W - H = movement G
(7) Therefore M09E - F = movement J
(8) no percentage increased in background traffic applied as it has been less than one year since being surveyed.
(9) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.
(10) construction hours 0700-1800.
(11) 230 one-way truck movements per week in weeks 6 to 10. This equates to an average of 33 one-way truck movements per day, and 4 one-way truck movements per hour However, a skewed distribution was assumed.
(12) Truck route is Barbers Lagoon Road to Manilla Road to Therribri Road.
(13) Assumed that return truck trips are within the same hour.
(14) 340 employees at peak construction period.
(15) Assumed that 10% employees arrive by private vehicle.
(16) Assumed that bus capacity of 20 passengers.
(17) all bussed workers come from Boggabri
(18) private vehicle workers - 10% come from Braymont. 90% from Manilla Road (Iron Bridge).
(19) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
linear increase in additional staff between 2010 and 2017. Therefore 100 additional employees in 2012 (week 10).
Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.
40% of all employees to work day shift.
20% of all employees to work night shifts.

I-01: Manilla Road and Barbers Lagoon Road. Peak mining period (2020)

Midblock tube survey results - average weekday.

M04 - Manilla Rd, Boggabri. (East of Therribri Rd)

EB
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	26	25	0
6:00	45	44	1
7:00	18	16	1
8:00	11	8	2
9:00	8	6	2
10:00	8	7	1
11:00	10	7	3
12:00	10	9	1
13:00	7	6	1
14:00	8	7	1
15:00	12	10	2
16:00	21	21	0
17:00	9	8	1
18:00	4	4	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	203	184	18

WB
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	6	5	0
3:00	8	7	0
4:00	1	1	0
5:00	2	1	0
6:00	8	7	1
7:00	6	4	2
8:00	11	10	1
9:00	10	8	2
10:00	10	9	1
11:00	6	5	1
12:00	6	5	1
13:00	9	7	1
14:00	9	6	2
15:00	12	10	2
16:00	22	21	1
17:00	46	43	3
18:00	18	16	2
19:00	3	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	198	174	23

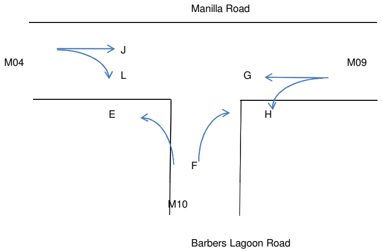
M09 Manilla Rd, Boggabri. (East of Braymont Rd)

EB
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	1	0	0
2:00	1	1	0
3:00	3	3	0
4:00	1	1	0
5:00	4	4	0
6:00	11	10	0
7:00	4	3	1
8:00	4	3	1
9:00	4	2	1
10:00	3	2	1
11:00	4	3	1
12:00	4	3	1
13:00	4	3	1
14:00	5	3	1
15:00	7	5	2
16:00	7	7	0
17:00	11	10	0
18:00	4	4	0
19:00	2	2	0
20:00	1	0	1
21:00	0	0	0
22:00	0	0	1
23:00	0	0	0
Total	85	71	14

WB
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	2	2	0
3:00	0	0	0
4:00	1	1	0
5:00	5	4	1
6:00	12	11	1
7:00	4	3	1
8:00	4	4	1
9:00	3	3	0
10:00	4	3	0
11:00	3	2	0
12:00	3	2	1
13:00	4	3	0
14:00	6	4	2
15:00	5	4	0
16:00	12	11	0
17:00	8	8	0
18:00	4	3	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	80	69	10



M10 Braymont Rd, Boggabri. (South of Manilla Rd)

NB
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	2	2	0
6:00	2	2	0
7:00	2	2	0
8:00	2	2	0
9:00	2	2	0
10:00	1	1	0
11:00	1	1	0
12:00	1	1	0
13:00	2	1	0
14:00	1	1	0
15:00	3	2	0
16:00	1	1	0
17:00	1	1	0
18:00	0	0	0
19:00	1	1	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	25	22	3

SB
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	1	1	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	0	0	0
8:00	2	1	1
9:00	1	1	0
10:00	3	3	0
11:00	2	2	0
12:00	2	1	1
13:00	2	2	0
14:00	3	3	0
15:00	2	1	1
16:00	2	2	0
17:00	5	4	0
18:00	2	2	0
19:00	1	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	29	25	4

Derivation of turning movement volumes

Movement E

			exist	Grow	Maule	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	1	0	1	1	0	0	0	0	0	0
6:00	32	0	2	2	1	28	0	0	0	0
7:00	2	0	1	2	0	0	0	0	0	0
8:00	2	0	1	1	0	0	0	0	0	0
9:00	1	0	1	1	0	0	0	0	0	0
10:00	1	0	1	1	0	0	0	0	0	0
11:00	1	0	1	1	0	0	0	0	0	0
12:00	1	0	1	1	0	0	0	0	0	0
13:00	2	0	1	1	0	0	0	0	0	0
14:00	1	0	1	1	0	0	0	0	0	0
15:00	2	0	2	2	0	0	0	0	0	0
16:00	1	0	1	1	0	0	0	0	0	0
17:00	1	0	1	1	0	0	0	0	0	0
18:00	15	0	0	0	1	14	0	0	0	0
19:00	1	0	1	1	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement F

			exist	Growth	Maules	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement G

			exist	Grow	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	2	0	1	2	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	5	1	4	5	0	0	1	1	0	0
6:00	12	1	11	12	0	0	1	1	0	0
7:00	4	1	3	3	0	0	1	1	0	0
8:00	4	0	3	4	0	0	0	0	0	0
9:00	3	0	2	3	0	0	0	0	0	0
10:00	4	0	3	3	0	0	0	0	0	0
11:00	2	0	2	2	0	0	0	0	0	0
12:00	3	1	2	2	0	0	1	1	0	0
13:00	4	0	3	3	0	0	0	0	0	0
14:00	6	2	3	4	0	0	2	2	0	0
15:00	4	0	4	4	0	0	0	0	0	0
16:00	12	0	11	11	0	0	0	0	0	0
17:00	8	0	7	7	0	0	0	0	0	0
18:00	3	0	3	3	0	0	0	0	0	0
19:00	1	0	0	0	0	0	0	0	0	0
20:00	1	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement H

			exist	Grow	Maule	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	1	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	1	0	1	1	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	1	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	1	0	1	1	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	1	0	0	0	0	0	0	0	0	0
17:00	1	0	1	1	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement J

			exist	Growth	Maules	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	1	1	0	0	0	0	1	1	0	0
8:00	1	1	0	0	0	0	1	1	0	0
9:00	2	2	0	0	0	0	1	2	0	0
10:00	1	1	0	0	0	0	1	1	0	0
11:00	1	1	0	0	0	0	1	1	0	0
12:00	1	1	0	0	0	0	1	1	0	0
13:00	1	1	0	0	0	0	1	1	0	0
14:00	1	1	0	0	0	0	1	1	0	0
15:00	2	2	0	0	0	0	2	2	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	1	1	0	0	0	0	1	1	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	1	0	0	0	0	1	1	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement L

			exist	Grow	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	1	0	0	1	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	16	0	0	0	1	14	0	0	0	0
8:00	2	1	1	1	0	0	1	1	0	0
9:00	1	0	1	1	0	0	0	0	0	0
10:00	2	0	2	2	0	0	0	0	0	0
11:00	2	0	1	1	0	0	0	0	0	0
12:00	2	1	1	1	0	0	1	1	0	0
13:00	2	0	1	1	0	0	0	0	0	0
14:00	3	0	2	2	0	0	0	0	0	0
15:00	2	1	1	1	0	0	0	1	0	0
16:00	2	0	2	2	0	0	0	0	0	0
17:00	4	0	4	4	0	0	0	0	0	0
18:00	2	0	2	2	0	0	0	0	0	0
19:00	30	0	0	0	1	28	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Notes:
(1) Although M04 is located on Manilla Road to the east of Therribri, a substantial volume of this traffic would turn off at Leard Forest Road.
(2) Assumed that 0.8 x M10N = movement E
(3) Assumed that 0.2 x M10N = movement F
(4) Assumewd that 0.8 x M10S = movement L
(5) Assumed that 0.2 x M10S = movement H
(6) Therefore M09W - H = movement G
(7) Therefore M09E - F = movement J
(8) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.
(9) Mining shifts 7am-7pm, 7pm-7am.
(10) maximum number of mine employees in 2020 is 470 with an assumed maximum day shift of 140 and an assumed maximum night shift of 110.
(11) Assume 90% employees transported by bus from Boggabri. Other 10% arrive by private car and are distributed Manilla Road East/ Barbers Lagoon Road as 90%/ 10%
(12) bus occupancy of 20 persons per bus.
(13) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.
40% of all employees to work day shift.
20% of all employees to work night shifts.
(14) background growth rate is 0.8% pa for local roads and 2.1% pa for the Kamilaroi Highway.
There are 10 years of growth.
(15) assumed car occupancy = 1 person per vehicle.

I-02: Manilla Road and Therribri Road. Existing base case

Midblock tube survey results - average weekday.

M03 Manilla Road, East of Kamilaroi Highway

EB

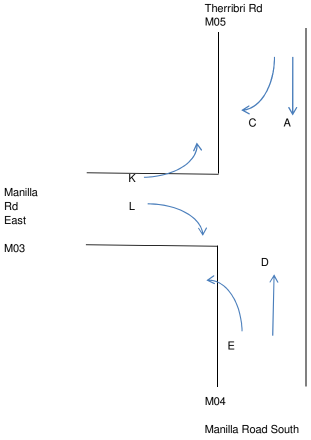
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	27	25	2
6:00	45	43	3
7:00	21	19	2
8:00	16	11	4
9:00	10	8	2
10:00	11	9	1
11:00	12	9	3
12:00	10	9	1
13:00	8	6	2
14:00	9	8	1
15:00	15	12	3
16:00	23	22	1
17:00	12	11	1
18:00	4	4	0
19:00	3	2	0
20:00	2	2	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0
Total	233	205	27

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	8	8	0
4:00	2	2	0
5:00	3	2	0
6:00	9	8	1
7:00	7	5	2
8:00	12	10	2
9:00	13	11	2
10:00	10	9	1
11:00	9	8	1
12:00	9	8	0
13:00	10	9	1
14:00	12	10	2
15:00	16	15	1
16:00	23	21	2
17:00	49	48	1
18:00	19	18	1
19:00	4	3	0
20:00	2	2	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	226	206	19



M05 - Therribri Rd, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	1	1	0
7:00	4	4	0
8:00	4	4	0
9:00	3	3	0
10:00	4	3	0
11:00	3	3	0
12:00	1	1	0
13:00	1	0	0
14:00	2	2	0
15:00	3	2	0
16:00	5	5	0
17:00	3	3	0
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	40	38	2

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	2	1	0
7:00	3	3	0
8:00	2	2	0
9:00	3	3	0
10:00	1	1	0
11:00	3	2	0
12:00	4	4	0
13:00	2	2	0
14:00	4	4	0
15:00	4	4	0
16:00	4	3	1
17:00	3	3	0
18:00	2	1	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	39	36	3

M04 - Manilla Rd, Boggabri. (East of Therribri Rd)

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	26	25	0
6:00	45	44	1
7:00	18	16	1
8:00	11	8	2
9:00	8	6	2
10:00	8	7	1
11:00	10	7	3
12:00	10	9	1
13:00	7	6	1
14:00	8	7	1
15:00	12	10	2
16:00	21	21	0
17:00	9	8	1
18:00	4	4	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	203	184	18

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	6	5	0
3:00	8	7	0
4:00	1	1	0
5:00	2	1	0
6:00	8	7	1
7:00	6	4	2
8:00	11	10	1
9:00	10	8	2
10:00	10	9	1
11:00	6	5	1
12:00	6	5	1
13:00	9	7	1
14:00	9	6	2
15:00	12	10	2
16:00	22	21	1
17:00	46	43	3
18:00	18	16	2
19:00	3	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	198	174	23

Notes:

(1) Assumed that 0.3 x M05S = movement A
(2) Assumed that 0.7 x M05S = movement C
(3) Assumed that 0.1 x M04W = movement D
(4) Assumed that 0.9 x M04W = movement E
(5) Assumed that 0.1 x M03E = movement K
(6) Assumed that 0.9 x M03E = movement L

(7) Check 1: Movement K + movement D = M05N

(8) Check 2: Movement L + movement A = M04E

(9) Check 3: Movement C + Movement E = M03W

(10) Assumed that future base case during week 39 to 43 is same as existing survey case

Derivation of turning movement volumes

Movement A

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	1	1	0
8:00	1	1	0
9:00	1	1	0
10:00	0	0	0
11:00	1	1	0
12:00	1	1	0
13:00	1	1	0
14:00	1	1	0
15:00	1	1	0
16:00	1	1	0
17:00	1	1	0
18:00	0	0	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement C

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	1	1	0
7:00	2	2	0
8:00	2	1	0
9:00	2	2	0
10:00	1	1	0
11:00	2	2	0
12:00	3	3	0
13:00	2	1	0
14:00	3	3	0
15:00	3	3	0
16:00	3	2	0
17:00	2	2	0
18:00	1	1	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement D

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	1	1	0
3:00	1	1	0
4:00	0	0	0
5:00	0	0	0
6:00	1	1	0
7:00	1	0	0
8:00	1	1	0
9:00	1	1	0
10:00	1	1	0
11:00	1	1	0
12:00	1	0	0
13:00	1	1	0
14:00	1	1	0
15:00	1	1	0
16:00	2	2	0
17:00	5	4	0
18:00	2	2	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement E

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	7	7	0
4:00	1	1	0
5:00	2	1	0
6:00	7	6	1
7:00	5	4	1
8:00	10	9	1
9:00	9	8	2
10:00	9	8	1
11:00	6	5	1
12:00	5	4	1
13:00	8	6	1
14:00	8	6	2
15:00	11	9	2
16:00	20	19	1
17:00	41	38	3
18:00	16	14	2
19:00	2	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0

Movement K

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	3	3	0
6:00	5	4	0
7:00	2	2	0
8:00	2	1	0
9:00	1	1	0
10:00	1	1	0
11:00	1	1	0
12:00	1	1	0
13:00	1	1	0
14:00	1	1	0
15:00	1	1	0
16:00	2	2	0
17:00	1	1	0
18:00	0	0	0
19:00	0	0	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0

Movement L

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	24	23	1
6:00	41	38	2
7:00	19	17	2
8:00	14	10	4
9:00	9	7	2
10:00	10	8	1
11:00	11	8	3
12:00	9	8	1
13:00	7	6	1
14:00	8	7	1
15:00	13	11	2
16:00	21	20	1
17:00	11	10	1
18:00	4	4	0
19:00	2	2	0
20:00	2	1	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0

Check 1: reasonable

0:00	0	0
1:00	0	0
2:00	1	0
3:00	1	0
4:00	0	0
5:00	3	1
6:00	5	1
7:00	3	4
8:00	3	4
9:00	2	3
10:00	2	4
11:00	2	3
12:00	2	1
13:00	2	1
14:00	2	2
15:00	3	3
16:00	5	5
17:00	6	3
18:00	2	2
19:00	1	1
20:00	0	1
21:00	0	0
22:00	0	1
23:00	0	0

Check 2: Good!

0:00	0	0
1:00	0	0
2:00	0	0
3:00	1	0
4:00	1	1
5:00	24	26
6:00	41	45
7:00	20	18
8:00	15	11
9:00	10	8
10:00	10	8
11:00	12	10
12:00	11	10
13:00	8	7
14:00	9	8
15:00	15	12
16:00	22	21
17:00	12	9
18:00	4	4
19:00	3	1
20:00	2	1
21:00	2	1
22:00	1	1
23:00	1	0

Check 3: good!

0:00	0	0
1:00	2	2
2:00	5	5
3:00	7	8
4:00	1	2
5:00	2	3
6:00	8	9
7:00	7	7
8:00	12	12
9:00	11	13
10:00	10	10
11:00	7	9
12:00	8	9
13:00	9	10
14:00	10	12
15:00	14	16
16:00	23	23
17:00	44	49
18:00	18	19
19:00	3	4
20:00	2	2
21:00	0	1
22:00	1	1
23:00	0	0

I-02: Manilla Road and Therribri Road. Week 10 of construction program

Midblock tube survey results - average weekday.

M03 Manilla Road, East of Kamilaroi Highway

EB

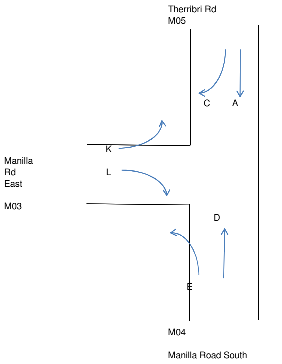
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	27	25	2
6:00	45	43	3
7:00	21	19	2
8:00	16	11	4
9:00	10	8	2
10:00	11	9	1
11:00	12	9	3
12:00	10	9	1
13:00	8	6	2
14:00	9	8	1
15:00	15	12	3
16:00	23	22	1
17:00	12	11	1
18:00	4	4	0
19:00	3	2	0
20:00	2	2	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0
Total	233	205	27

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	8	8	0
4:00	2	2	0
5:00	3	2	0
6:00	9	8	1
7:00	7	5	2
8:00	12	10	2
9:00	13	11	2
10:00	10	9	1
11:00	9	8	1
12:00	9	8	0
13:00	10	9	1
14:00	12	10	2
15:00	16	15	1
16:00	23	21	2
17:00	49	48	1
18:00	19	18	1
19:00	4	3	0
20:00	2	2	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	226	206	19



M05 - Therribri Rd, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	1	1	0
7:00	4	4	0
8:00	4	4	0
9:00	3	3	0
10:00	4	3	0
11:00	3	3	0
12:00	1	1	0
13:00	1	0	0
14:00	2	2	0
15:00	3	2	0
16:00	5	5	0
17:00	3	3	0
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	40	38	2

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	2	1	0
7:00	3	3	0
8:00	2	2	0
9:00	3	3	0
10:00	1	1	0
11:00	3	2	0
12:00	4	4	0
13:00	2	2	0
14:00	4	4	0
15:00	4	4	0
16:00	4	3	1
17:00	3	3	0
18:00	2	1	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	39	36	3

M04 - Manilla Rd, Boggabri. (East of Therribri R

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	26	25	0
6:00	45	44	1
7:00	18	16	1
8:00	11	8	2
9:00	8	6	2
10:00	8	7	1
11:00	10	7	3
12:00	10	9	1
13:00	7	6	1
14:00	8	7	1
15:00	12	10	2
16:00	21	21	0
17:00	9	8	1
18:00	4	4	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	203	184	18

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	6	5	0
3:00	8	7	0
4:00	1	1	0
5:00	2	1	0
6:00	8	7	1
7:00	6	4	2
8:00	11	10	1
9:00	10	8	2
10:00	10	9	1
11:00	6	5	1
12:00	6	5	1
13:00	9	7	1
14:00	9	6	2
15:00	12	10	2
16:00	22	21	1
17:00	46	43	3
18:00	18	16	2
19:00	3	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	198	174	23

Notes:
(1) Assumed that 0.3 x M05S = movement A
(2) Assumed that 0.7 x M05S = movement C
(3) Assumed that 0.1 x M04W = movement D
(4) Assumed that 0.9 x M04W = movement E
(5) Assumed that 0.1 x M03E = movement K
(6) Assumed that 0.9 x M03E = movement L
(7) Assumed that future base case during week 6-10 is same as existing survey case
(8) no percentage increased in background traffic applied as it has been less than one year since being surveyed.
(9) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.

(10) construction hours 0700-1800.
(11) 230 one-way truck movements per week in weeks 6-10. This equates to an average of 33 one-way truck movements per day, and
4 one-way truck movements per hour
However, a skewed distribution was assumed.

(12) Truck route is Barbers Lagoon Road to Manilla Road to Therribri Road.
(13) Assumed that return truck trips are within the same hour.

(14) Assumed 340 employees at peak construction period.
(15) Assumed that 10% employees arrive by private vehicle.
(16) Assumed that bus capacity of 20 passengers.
(17) all bussed workers come from Boggabri
(18) private vehicle workers - 10% come from Braymont. 90% from Manilla Road (via Iron Bridge)

(19) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
linear increase in additional staff between 2010 and 2017. Therefore 100 additional employees in 2012 (week 43).

Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.

40% of all employees to work day shift.
20% of all employees to work night shifts.

Note: Because Leard Forest Road would be closed, all Maules Creek Road traffic are likely to come via the Kamilaroi Highway and Manilla Road West.

Derivation of turning movement volumes

Movement A

			exist	Maule	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	2	1	1	0	0	0	0	1	0	0
8:00	2	1	1	0	0	0	0	1	0	0
9:00	2	1	1	0	0	0	0	1	0	0
10:00	10	10	0	0	0	0	0	10	0	0
11:00	7	6	1	0	0	0	0	6	0	0
12:00	5	4	1	0	0	0	0	4	0	0
13:00	3	2	1	0	0	0	0	2	0	0
14:00	3	2	1	0	0	0	0	2	0	0
15:00	3	2	1	0	0	0	0	2	0	0
16:00	3	2	1	0	0	0	0	2	0	0
17:00	3	2	1	0	0	0	0	2	0	0
18:00	4	0	0	3	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement C

			exist	Maule	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	1	0	1	0	0	0	0	0	0	0
6:00	1	0	1	0	0	0	0	0	0	0
7:00	17	15	2	0	0	0	0	15	0	0
8:00	2	0	1	0	0	0	0	0	0	0
9:00	2	0	2	0	0	0	0	0	0	0
10:00	1	0	1	0	0	0	0	0	0	0
11:00	2	0	2	0	0	0	0	0	0	0
12:00	3	0	3	0	0	0	0	0	0	0
13:00	2	0	1	0	0	0	0	0	0	0
14:00	3	0	3	0	0	0	0	0	0	0
15:00	3	0	3	0	0	0	0	0	0	0
16:00	3	0	2	0	0	0	0	0	0	0
17:00	2	0	2	0	0	0	0	0	0	0
18:00	47	15	1	31	0	0	0	15	0	0
19:00	1	0	1	0	0	0	0	0	0	0
20:00	1	0	1	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement D

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	1	0	1	0	0	0	0	0	0	0
3:00	1	0	1	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	4	0	1	3	0	0	0	0	0	0
7:00	2	1	0	0	0	0	0	1	0	0
8:00	2	1	1	0	0	0	0	1	0	0
9:00	2	1	1	0	0	0	0	1	0	0
10:00	11	10	1	0	0	0	0	10	0	0
11:00	7	6	1	0	0	0	0	6	0	0
12:00	5	4	0	0	0	0	0	4	0	0
13:00	3	2	1	0	0	0	0	2	0	0
14:00	3	2	1	0	0	0	0	2	0	0
15:00	3	2	1	0	0	0	0	2	0	0
16:00	4	2	2	0	0	0	0	2	0	0
17:00	7	2	4	0	0	0	0	2	0	0
18:00	2	0	2	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement E

			exist	Maule	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	2	0	2	0	0	0	0	0	0	0
2:00	5	0	5	0	0	0	0	0	0	0
3:00	7	0	7	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	2	0	1	0	0	0	0	0	0	0
6:00	7	1	6	0	0	0	1	0	0	0
7:00	21	1	4	0	16	0	1	0	0	0
8:00	10	1	9	0	0	0	1	0	0	0
9:00	9	2	8	0	0	0	2	0	0	0
10:00	9	1	8	0	0	0	1	0	0	0
11:00	6	1	5	0	0	0	1	0	0	0
12:00	5	1	4	0	0	0	1	0	0	0
13:00	8	1	6	0	0	0	1	0	0	0
14:00	8	2	6	0	0	0	2	0	0	0
15:00	11	2	9	0	0	0	2	0	0	0
16:00	20	1	19	0	0	0	1	0	0	0
17:00	41	3	38	0	0	0	3	0	0	0
18:00	16	2	14	0	0	0	2	0	0	0
19:00	34	1	2	0	32	0	1	0	0	0
20:00	2	0	2	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	0	1	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement K

			exist	Maule	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	3	0	3	0	0	0	0	0	0	0
6:00	50	16	4	31	0	0	0	15.3	0	0
7:00	2	0	2	0	0	0	0	0	0	0
8:00	2	0	1	0	0	0	0	0	0	0
9:00	1	0	1	0	0	0	0	0	0	0
10:00	1	0	1	0	0	0	0	0	0	0
11:00	1	0	1	0	0	0	0	0	0	0
12:00	1	0	1	0	0	0	0	0	0	0
13:00	1	0	1	0	0	0	0	0	0	0
14:00	1	0	1	0	0	0	0	0	0	0
15:00	1	0	1	0	0	0	0	0	0	0
16:00	2	0	2	0	0	0	0	0	0	0
17:00	16	15	1	0	0	0	0	15	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement L

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	1	0	1	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	24	1	23	0	0	0	1	0	0	0
6:00	73	2	38	0	32	0	2	0	0	0
7:00	19	2	17	0	0	0	2	0	0	0
8:00	14	4	10	0	0	0	4	0	0	0
9:00	9	2	7	0	0	0	2	0	0	0
10:00	10	1	8	0	0	0	1	0	0	0
11:00	11	3	8	0	0	0	3	0	0	0
12:00	9	1	8	0	0	0	1	0	0	0
13:00	7	1	6	0	0	0	1	0	0	0
14:00	8	1	7	0	0	0	1	0	0	0
15:00	13	2	11	0	0	0	2	0	0	0
16:00	21	1	20	0	0	0	1	0	0	0
17:00	11	1	10	0	0	0	1	0	0	0
18:00	20	0	4	0	16	0	0	0	0	0
19:00	2	0	2	0	0	0	0	0	0	0
20:00	2	0	1	0	0	0	0	0	0	0
21:00	2	0	1	0	0	0	0	0	0	0
22:00	1	0	1	0	0	0	0	0	0	0
23:00	1	0	1	0	0	0	0	0	0	0

I-02: Manilla Road and Therribri Road. Peak mining period (2020)

Midblock tube survey results - average weekday.

M03 Manilla Road, East of Kamilaroi Highway

EB

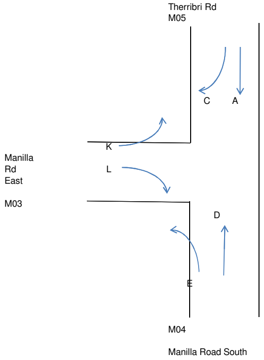
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	27	25	2
6:00	45	43	3
7:00	21	19	2
8:00	16	11	4
9:00	10	8	2
10:00	11	9	1
11:00	12	9	3
12:00	10	9	1
13:00	8	6	2
14:00	9	8	1
15:00	15	12	3
16:00	23	22	1
17:00	12	11	1
18:00	4	4	0
19:00	3	2	0
20:00	2	2	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0
Total	233	205	27

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	8	8	0
4:00	2	2	0
5:00	3	2	0
6:00	9	8	1
7:00	7	5	2
8:00	12	10	2
9:00	13	11	2
10:00	10	9	1
11:00	9	8	1
12:00	9	8	0
13:00	10	9	1
14:00	12	10	2
15:00	16	15	1
16:00	23	21	2
17:00	49	48	1
18:00	19	18	1
19:00	4	3	0
20:00	2	2	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	226	206	19



M05 - Therribri Rd, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	1	1	0
7:00	4	4	0
8:00	4	4	0
9:00	3	3	0
10:00	4	3	0
11:00	3	3	0
12:00	1	1	0
13:00	1	0	0
14:00	2	2	0
15:00	3	2	0
16:00	5	5	0
17:00	3	3	0
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	40	38	2

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	2	1	0
7:00	3	3	0
8:00	2	2	0
9:00	3	3	0
10:00	1	1	0
11:00	3	2	0
12:00	4	4	0
13:00	2	2	0
14:00	4	4	0
15:00	4	4	0
16:00	4	3	1
17:00	3	3	0
18:00	2	1	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	39	36	3

M04 - Manilla Rd, Boggabri. (East of Therribri R

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	26	25	0
6:00	45	44	1
7:00	18	16	1
8:00	11	8	2
9:00	8	6	2
10:00	8	7	1
11:00	10	7	3
12:00	10	9	1
13:00	7	6	1
14:00	8	7	1
15:00	12	10	2
16:00	21	21	0
17:00	9	8	1
18:00	4	4	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	203	184	18

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	6	5	0
3:00	8	7	0
4:00	1	1	0
5:00	2	1	0
6:00	8	7	1
7:00	6	4	2
8:00	11	10	1
9:00	10	8	2
10:00	10	9	1
11:00	6	5	1
12:00	6	5	1
13:00	9	7	1
14:00	9	6	2
15:00	12	10	2
16:00	22	21	1
17:00	46	43	3
18:00	18	16	2
19:00	3	2	1
20:00	2	2	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	198	174	23

Notes:

(1) Although M04 is located on Manilla Road to the east of Therribri, a substantial volume of this traffic would turn off at Leard Forest Road.
(2) Assumed that 0.8 x M10N = movement E
(3) Assumed that 0.2 x M10N = movement F
(4) Assumewd that 0.8 x M10S = movement L
(5) Assumed that 0.2 x M10S = movement H
(6) Therefore M09W - H = movement G
(7) Therefore M09E - F = movement J
(8) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.
(9) Mining shifts 7am-7pm, 7pm-7am.
(10) maximum number of mine employees in 2020 is 470 but would be 140 in day shift and 110 in night shift
(11) Assume 90% employees transported by bus from Boggabri. Other 10% arrive by private car and are distributed Manilla Road East/ Barbers Lagoon Road as 90%/10%

(12) bus occupancy of 20 persons per bus.
(13) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.
40% of all employees to work day shift.
20% of all employees to work night shifts.
(14) background growth rate is 0.8% pa for local roads and 2.1% pa for the Kamilaroi Highway.
There are 10 years of growth.
(15) assumed car occupancy = 1 person per vehicle.
(16) assume outbound buses are sufficient to transport end-of-shift workers.

Derivation of turning movement volumes

Movement A

			exist	Grow	Maule	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	1	0	0	0	0	0	0	0	0	0
7:00	2	0	1	1	1	0	0	0	0	0
8:00	1	0	1	1	0	0	0	0	0	0
9:00	1	0	1	1	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	1	0	1	1	0	0	0	0	0	0
12:00	1	0	1	1	0	0	0	0	0	0
13:00	1	0	1	1	0	0	0	0	0	0
14:00	1	0	1	1	0	0	0	0	0	0
15:00	1	0	1	1	0	0	0	0	0	0
16:00	1	0	1	1	0	0	0	0	0	0
17:00	1	0	1	1	0	0	0	0	0	0
18:00	1	0	0	0	0	0	0	0	0	0
19:00	2	0	0	0	1	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement C

			exist	Grow	Maule	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	1	0	1	1	0	0	0	0	0	0
6:00	1	0	1	1	0	0	0	0	0	0
7:00	18	6	2	2	10	0	0	0	6	0
8:00	2	0	1	2	0	0	0	0	0	0
9:00	2	0	2	2	0	0	0	0	0	0
10:00	1	0	1	1	0	0	0	0	0	0
11:00	2	0	2	2	0	0	0	0	0	0
12:00	3	0	3	3	0	0	0	0	0	0
13:00	2	0	1	1	0	0	0	0	0	0
14:00	3	0	3	3	0	0	0	0	0	0
15:00	3	0	3	3	0	0	0	0	0	0
16:00	3	0	2	2	0	0	0	0	0	0
17:00	3	0	2	3	0	0	0	0	0	0
18:00	1	0	1	1	0	0	0	0	0	0
19:00	20	6	1	1	13	0	0	0	6	0
20:00	1	0	1	1	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement D

			exist	Growt	Maule	Bog	exist	Grow	Maules	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	1	0	1	1	0	0	0	0	0	0
3:00	1	0	1	1	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	2	0	1	1	1	0	0	0.1	0	0
7:00	1	0	0	0	0	0	0	0.2	0	0
8:00	1	0	1	1	0	0	0	0.2	0	0
9:00	1	0	1	1	0	0	0	0.2	0	0
10:00	1	0	1	1	0	0	0	0.1	0	0
11:00	1	0	1	1	0	0	0	0.1	0	0
12:00	1	0	0	1	0	0	0	0.1	0	0
13:00	1	0	1	1	0	0	0	0.2	0	0
14:00	1	0	1	1	0	0	0	0.2	0	0
15:00	1	0	1	1	0	0	0	0.2	0	0
16:00	2	0	2	2	0	0	0	0.1	0	0
17:00	5	0	4	5	0	0	0	0.4	0	0
18:00	3	0	2	2	1	0	0	0.2	0	0
19:00	0	0	0	0	0	0	0	0.1	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement E

			exist	Grow	Maule	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	2	0	2	2	0	0	0	0	0	0
2:00	5	0	5	5	0	0	0	0	0	0
3:00	8	0	7	7	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	2	0	1	1	0	0	0	0	0	0
6:00	8	1	6	7	0	0	1	1	0	0
7:00	62	2	4	4	0	56	1	2	0	0
8:00	11	1	9	10	0	0	1	1	0	0
9:00	10	2	8	8	0	0	2	2	0	0
10:00	9	1	8	9	0	0	1	1	0	0
11:00	6	1	5	5	0	0	1	1	0	0
12:00	5	1	4	5	0	0	1	1	0	0
13:00	8	1	6	7	0	0	1	1	0	0
14:00	8	2	6	6	0	0	2	2	0	0
15:00	12	2	9	10	0	0	2	2	0	0
16:00	22	1	19	20	0	0	1	1	0	0
17:00	45	3	38	42	0	0	3	3	0	0
18:00	18	2	14	16	0	0	2	2	0	0
19:00	115	1	2	2	0	113	1	1	0	0
20:00	2	0	2	2	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	0	1	1	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement K

			exist	Grow	Maule	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	3	0	3	3	0	0	0	0	0	0
6:00	24	7	4	5	13	0	0	0	6	0
7:00	2	0	2	2	0	0	0	0	0	0
8:00	2	0	1	1	0	0	0	0	0	0
9:00	1	0	1	1	0	0	0	0	0	0
10:00	1	0	1	1	0	0	0	0	0	0
11:00	1	0	1	1	0	0	0	0	0	0
12:00	1	0	1	1	0	0	0	0	0	0
13:00	1	0	1	1	0	0	0	0	0	0
14:00	1	0	1	1	0	0	0	0	0	0
15:00	2	0	1	1	0	0	0	0	0	0
16:00	3	0	2	2	0	0	0	0	0	0
17:00	1	0	1	1	0	0	0	0	0	0
18:00	17	6	0	0	10	0	0	0	6	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement L

			exist	Growt	Maule	Bog	exist	Grow	Maules	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0.2	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0.2	0	0
3:00	1	0	1	1	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	26	2	23	25	0	0	1	1.6	0	0
6:00	157	3	38	42	0	113	2	2.5	0	0
7:00	20	2	17	18	0	0	2	1.8	0	0
8:00	15	4	10	11	0	0	4	3.9	0	0
9:00	9	2	7	7	0	0	2	1.9	0	0
10:00	11	1	8	9	0	0	1	1.4	0	0
11:00	12	3	8	9	0	0	3	3.1	0	0
12:00	10	1	8	9	0	0	1	1.2	0	0
13:00	8	2	6	6	0	0	1	1.6	0	0
14:00	9	1	7	7	0	0	1	1.4	0	0
15:00	14	3	11	12	0	0	2	2.5	0	0
16:00	23	1	20	22	0	0	1	1.2	0	0
17:00	12	1	10	10	0	0	1	1.2	0	0
18:00	4	0	4	4	0	0	0	0.2	0	0
19:00	59	0	2	2	0	56.5	0	0.2	0	0
20:00	2	0	1	2	0	0	0	0.2	0	0
21:00	2	0	1	1	0	0	0	0.4	0	0
22:00	1	0	1	1	0	0	0	0.2	0	0
23:00	1	0	1	1	0	0	0	0	0	0

I-03: Therribri Road and future mine access road. Week 10 of construction program

Midblock tube survey results - average weekday.

M06 **M06**

Therribri Rd, Maules Creek. (South of Harparary Rd)

NB

Weekday Average

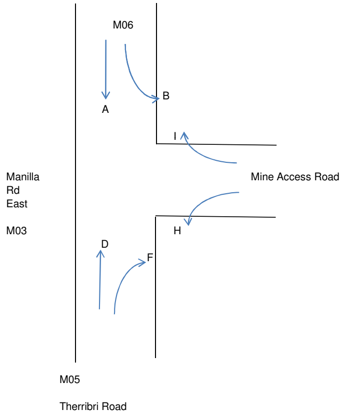
Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	4	3	1
8:00	2	1	1
9:00	1	1	0
10:00	2	1	1
11:00	1	1	0
12:00	1	1	1
13:00	2	1	1
14:00	2	1	0
15:00	1	1	0
16:00	2	2	0
17:00	1	1	0
18:00	0	0	0
19:00	1	1	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	20	15	4

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	3	1	0
8:00	2	1	0
9:00	1	1	0
10:00	2	1	0
11:00	1	1	0
12:00	1	0	1
13:00	1	1	0
14:00	2	1	0
15:00	1	0	0
16:00	3	2	0
17:00	2	1	0
18:00	1	1	0
19:00	0	0	0
20:00	1	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	22	13	3

Notes:
(1) Movement D = M05N
(2) Movement E = construction schedule generated traffic.
(3) Movement A - M06S
(4) Movement B - construction schedule generated traffic.
(5) Assumed that all construction traffic would arrive from the south.
(6) Mostemployees would be bussed in.
(7) Assumed that additional 10 staff generated private vehicles in peak hours.
(8) Movement H and I are construction traffic generated.
No traffic in existing base case as intersection does not exist.
(9) Assumed that future base case during week 6-10 is same as existing survey case



M05 **M05**

Therribri Rd, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	1	1	0
7:00	4	4	0
8:00	4	4	0
9:00	3	3	0
10:00	4	3	0
11:00	3	3	0
12:00	1	1	0
13:00	1	0	0
14:00	2	2	0
15:00	3	2	0
16:00	5	5	0
17:00	3	3	0
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	40	38	2

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	2	1	0
7:00	3	3	0
8:00	2	2	0
9:00	3	3	0
10:00	1	1	0
11:00	3	2	0
12:00	4	4	0
13:00	2	2	0
14:00	4	4	0
15:00	4	4	0
16:00	4	3	1
17:00	3	3	0
18:00	2	1	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	39	36	3

(10) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.
(11) construction hours 0700-1800.
(12) 33 one-way truck movements per day in weeks 6-10. This equates to an average of 4 one-way truck movements per hour.
However, a skewed distribution was assumed.
(13) Truck route is Barbers Lagoon Road to Manilla Road to Therribri Road.
(14) Assumed that return truck trips are within the same hour.
(15) Assumed 340 employees at peak construction period.
(16) Assumed that 10% employees arrive by private vehicle.
(17) Assumed that bus capacity of 20 passengers.
(18) all bussed workers come from Boggabri
(19) private vehicle workers - 10% come from Braymont. 90% come from Manilla Road

Derivation of turning movement volumes

Movement A

			exist	Maul	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	1	0	1	0	0	0	0	0	0	0
8:00	1	0	1	0	0	0	0	0	0	0
9:00	1	0	1	0	0	0	0	0	0	0
10:00	1	0	1	0	0	0	0	0	0	0
11:00	1	0	1	0	0	0	0	0	0	0
12:00	1	1	0	0	0	0	1	0	0	0
13:00	1	0	1	0	0	0	0	0	0	0
14:00	1	0	1	0	0	0	0	0	0	0
15:00	1	0	0	0	0	0	0	0	0	0
16:00	2	0	2	0	0	0	0	0	0	0
17:00	1	0	1	0	0	0	0	0	0	0
18:00	1	0	1	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement B

			exist	Maul	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement D

			exist	Maul	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	1	0	1	0	0	0	0	0	0	0
6:00	1	0	1	0	0	0	0	0	0	0
7:00	4	0	4	0	0	0	0	0	0	0
8:00	4	0	4	0	0	0	0	0	0	0
9:00	3	0	3	0	0	0	0	0	0	0
10:00	4	0	3	0	0	0	0	0	0	0
11:00	3	0	3	0	0	0	0	0	0	0
12:00	1	0	1	0	0	0	0	0	0	0
13:00	1	0	0	0	0	0	0	0	0	0
14:00	2	0	2	0	0	0	0	0	0	0
15:00	3	0	2	0	0	0	0	0	0	0
16:00	5	0	5	0	0	0	0	0	0	0
17:00	3	0	3	0	0	0	0	0	0	0
18:00	2	0	2	0	0	0	0	0	0	0
19:00	1	0	1	0	0	0	0	0	0	0
20:00	1	0	1	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	0	1	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement F

			exist	Maul	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	49	15	0	34	0	0	0	15	0	0
7:00	1	1	0	0	0	0	0	1	0	0
8:00	1	1	0	0	0	0	0	1	0	0
9:00	1	1	0	0	0	0	0	1	0	0
10:00	10	10	0	0	0	0	0	10	0	0
11:00	6	6	0	0	0	0	0	6	0	0
12:00	4	4	0	0	0	0	0	4	0	0
13:00	2	2	0	0	0	0	0	2	0	0
14:00	2	2	0	0	0	0	0	2	0	0
15:00	2	2	0	0	0	0	0	2	0	0
16:00	2	2	0	0	0	0	0	2	0	0
17:00	17	17	0	0	0	0	0	17	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement H

			exist	Maul	Bog	Tar	exist	Maule	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	16	16	0	0	0	0	0	16	0	0
8:00	1	1	0	0	0	0	0	1	0	0
9:00	1	1	0	0	0	0	0	1	0	0
10:00	10	10	0	0	0	0	0	10	0	0
11:00	6	6	0	0	0	0	0	6	0	0
12:00	4	4	0	0	0	0	0	4	0	0
13:00	2	2	0	0	0	0	0	2	0	0
14:00	2	2	0	0	0	0	0	2	0	0
15:00	2	2	0	0	0	0	0	2	0	0
16:00	2	2	0	0	0	0	0	2	0	0
17:00	2	2	0	0	0	0	0	2	0	0
18:00	49	15	0	34	0	0	0	15	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement I

			exist	Maul	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

(20) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
linear increase in additional staff between 2010 and 2017. Therefore 100 additional employees in 2012 (week 43).

Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.

40% of all employees to work day shift.
20% of all employees to work night shifts.

Note: Because Leard Forest Road would be closed, all Maules Creek Road traffic are likely to come via the Kamilaroi Highway and Manilla Road West.

I-03: Therribri Road and future mine access road. Peak mining period (2020)

Midblock tube survey results - average weekday.

M06 **M06**

Therribri Rd, Maules Creek. (South of Harparary Rd)

NB

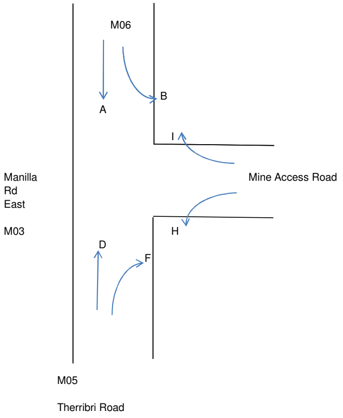
Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	4	3	1
8:00	2	1	1
9:00	1	1	0
10:00	2	1	1
11:00	1	1	0
12:00	1	1	1
13:00	2	1	1
14:00	2	1	0
15:00	1	1	0
16:00	2	2	0
17:00	1	1	0
18:00	0	0	0
19:00	1	1	0
20:00	0	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	20	15	4

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	0	0	0
6:00	0	0	0
7:00	3	1	0
8:00	2	1	0
9:00	1	1	0
10:00	2	1	0
11:00	1	1	0
12:00	1	0	1
13:00	1	1	0
14:00	2	1	0
15:00	1	0	0
16:00	3	2	0
17:00	2	1	0
18:00	1	1	0
19:00	0	0	0
20:00	1	0	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	22	13	3



Notes:

(1) Although M04 is located on Manilla Road to the east of Therribri, a substantial volume of this traffic would turn off at Leard Forest Road.
(2) Assumed that 0.8 x M10N = movement E
(3) Assumed that 0.2 x M10N = movement F
(4) Assumewd that 0.8 x M10S = movement L
(5) Assumed that 0.2 x M10S = movement H
(6) Therefore M09W - H = movement G
(7) Therefore M09E - F = movement J
(8) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.
(9) Mining shifts 7am-7pm, 7pm-7am.
(10) maximum number of mine employees in 2020 is 470 but would be 140 in day shift and 110 in night shift
(11) Assume 90% employees transported by bus from Boggabri. Other 10% arrive by private car and are distributed Manilla Road East Barbers Lagoon Road as 90%/ 10%.

(12) bus occupancy of 20 persons per bus.
(13) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.
40% of all employees to work day shift.
20% of all employees to work night shifts.

M05 **M05**

Therribri Rd, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	1	1	0
7:00	4	4	0
8:00	4	4	0
9:00	3	3	0
10:00	4	3	0
11:00	3	3	0
12:00	1	1	0
13:00	1	0	0
14:00	2	2	0
15:00	3	2	0
16:00	5	5	0
17:00	3	3	0
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	1	1	0
23:00	0	0	0
Total	40	38	2

SB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	0	0	0
5:00	1	1	0
6:00	2	1	0
7:00	3	3	0
8:00	2	2	0
9:00	3	3	0
10:00	1	1	0
11:00	3	2	0
12:00	4	4	0
13:00	2	2	0
14:00	4	4	0
15:00	4	4	0
16:00	4	3	1
17:00	3	3	0
18:00	2	1	0
19:00	1	1	0
20:00	1	1	0
21:00	0	0	0
22:00	0	0	0
23:00	0	0	0
Total	39	36	3

(14) background growth rate is 0.8% pa for local roads and 2.1% pa for the Kamilaroi Highway.
There are 10 years of growth.
(15) assumed car occupancy = 1 person per vehicle.
(16) assume outbound buses are sufficient to transport end-of-shift workers.

Derivation of turning movement volumes

Movement A			exist	Grow	Maul	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	2	0	1	2	0	0	0	0	0	0
8:00	1	0	1	1	0	0	0	0	0	0
9:00	1	0	1	1	0	0	0	0	0	0
10:00	2	0	1	1	0	0	0	0	0	0
11:00	1	0	1	1	0	0	0	0	0	0
12:00	1	1	0	0	0	0	1	1	0	0
13:00	1	0	1	1	0	0	0	0	0	0
14:00	2	0	1	1	0	0	0	0	0	0
15:00	1	0	0	0	0	0	0	0	0	0
16:00	2	0	2	2	0	0	0	0	0	0
17:00	2	0	1	1	0	0	0	0	0	0
18:00	1	0	1	1	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement B			exist	Grow	Maul	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement D			exist	Grow	Maul	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	1	0	1	1	0	0	0	0	0	0
6:00	1	0	1	1	0	0	0	0	0	0
7:00	4	0	4	4	0	0	0	0	0	0
8:00	4	0	4	4	0	0	0	0	0	0
9:00	4	0	3	3	0	0	0	0	0	0
10:00	4	0	3	3	0	0	0	0	0	0
11:00	3	0	3	3	0	0	0	0	0	0
12:00	1	0	1	1	0	0	0	0	0	0
13:00	1	0	0	0	0	0	0	0	0	0
14:00	2	0	2	2	0	0	0	0	0	0
15:00	3	0	2	3	0	0	0	0	0	0
16:00	5	0	5	5	0	0	0	0	0	0
17:00	3	0	3	3	0	0	0	0	0	0
18:00	2	0	2	2	0	0	0	0	0	0
19:00	2	0	1	2	0	0	0	0	0	0
20:00	1	0	1	1	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	1	0	1	1	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement F			exist	Grow	Maul	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	20	6	0	0	14	0	0	0	6	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	17	6	0	0	11	0	0	0	6	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement H			exist	Grow	Maul	Bog	exist	Growt	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	17	6	0	0	11	0	0	0	6	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	20	6	0	0	14	0	0	0	6	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement I			exist	Grow	Maul	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0
19:00	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

I-04: Kamilaroi Highway and Manilla Road. Existing base case

Midblock tube survey results - average weekday.

M01

Kamilaroi Hwy, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Hour commencing	Total vehicles	Light vehicles	Heavy vehicles
0:00	9	4	5
1:00	5	2	3
2:00	6	3	3
3:00	4	2	2
4:00	8	2	7
5:00	26	11	14
6:00	73	34	39
7:00	58	23	34
8:00	67	35	33
9:00	67	32	35
10:00	56	26	31
11:00	60	24	35
12:00	60	20	39
13:00	58	21	37
14:00	59	27	32
15:00	74	32	42
16:00	71	32	40
17:00	69	34	35
18:00	43	23	21
19:00	24	8	16
20:00	22	9	13
21:00	14	4	10
22:00	8	2	6
23:00	7	1	6
Total	948	411	537

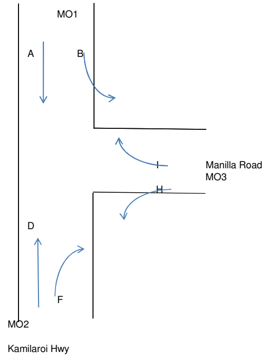
SB

Weekday Average

Time	Total vehicles	Light vehicles	Heavy vehicles
0:00	5	3	2
1:00	4	1	3
2:00	2	1	1
3:00	3	1	2
4:00	5	3	2
5:00	12	9	4
6:00	31	18	13
7:00	61	41	19
8:00	72	51	21
9:00	75	52	23
10:00	74	45	30
11:00	68	42	26
12:00	74	43	31
13:00	72	45	27
14:00	71	44	27
15:00	72	49	23
16:00	93	65	28
17:00	79	51	28
18:00	43	28	15
19:00	25	13	12
20:00	15	9	6
21:00	12	6	6
22:00	9	5	4
23:00	6	3	2
Total	984	628	356

Notes:
(1) Assumed that 0.5x MO3E = B = F
(2) Assumed that 0.5xMO3W = H = I

(3) Assumed that 0.95*MO1S = A
(4) Assumed that 0.95*MO2N = D
(5) Check 1: MO2N -F + I = MO1N
(6) Check 2: MO1S - B + H = MO2S
(7) Assumed that future base case during week 39 to 43 is same as existing survey case
(8) no percentage increased in background traffic applied as it has been less than one year since being surveyed.
(9) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.
(10) construction hours 0700-1800.
(11) Truck route is Barbers Lagoon Road to Manilla Road to Therribri Road. Therefore, no project-related trucks through this intersection.
(12) Assumed 340 employees at peak construction period.
(13) Assumed that 10% employees arrive by private vehicle.
(14) Assumed that bus capacity of 20 passengers.
(15) all bussed workers come from Boggabri
(16) private vehicle workers - 10% come from Braymont. Further 90% from Manilla Road (Iron Bridge).



M03

Manilla Road, East of Kamilaroi Highway

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	27	25	2
6:00	45	43	3
7:00	21	19	2
8:00	16	11	4
9:00	10	8	2
10:00	11	9	1
11:00	12	9	3
12:00	10	9	1
13:00	8	6	2
14:00	9	8	1
15:00	15	12	3
16:00	23	22	1
17:00	12	11	1
18:00	4	4	0
19:00	3	2	0
20:00	2	2	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0
Total	233	205	27

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	8	8	0
4:00	2	2	0
5:00	3	2	0
6:00	9	8	1
7:00	7	5	2
8:00	12	10	2
9:00	13	11	2
10:00	10	9	1
11:00	9	8	1
12:00	9	8	0
13:00	10	9	1
14:00	12	10	2
15:00	16	15	1
16:00	23	21	2
17:00	49	48	1
18:00	19	18	1
19:00	4	3	0
20:00	2	2	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	226	206	19

M02

Kamilaroi Hwy, Boggabri. (South of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	9	7	2
1:00	4	2	2
2:00	3	1	2
3:00	2	1	1
4:00	9	5	4
5:00	49	42	7
6:00	108	93	15
7:00	70	54	15
8:00	73	55	18
9:00	71	53	18
10:00	64	51	13
11:00	66	50	16
12:00	68	54	14
13:00	62	49	13
14:00	63	54	8
15:00	83	68	15
16:00	84	72	13
17:00	69	58	10
18:00	43	39	5
19:00	25	20	5
20:00	23	17	6
21:00	16	11	5
22:00	8	5	3
23:00	8	4	4
Total	1079	866	213

SB

Weekday Average

Time	Total	LV	HV
0:00	5	3	2
1:00	5	1	3
2:00	4	3	1
3:00	9	7	2
4:00	6	4	1
5:00	9	7	3
6:00	29	21	7
7:00	59	50	7
8:00	76	65	9
9:00	82	67	12
10:00	79	63	13
11:00	72	57	12
12:00	80	63	14
13:00	76	62	12
14:00	78	62	12
15:00	81	67	11
16:00	104	87	14
17:00	120	103	13
18:00	58	47	9
19:00	29	20	8
20:00	16	11	5
21:00	13	8	5
22:00	10	7	4
23:00	6	4	2
Total	1106	890	184

Notes (cont'd)

(17) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
linear increase in additional staff between 2010 and 2017. Therefore 100 additional employees in 2012 (week 43).

Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.

40% of all employees to work day shift.
20% of all employees to work night shifts.

Note: Because Leard Forest Road would be closed, all Maules Creek Road traffic are likely to come via the Kamilaroi Highway and Manilla Road West.

Derivation of turning movement volumes

Movement A

Time	Total	LV	HV
0:00	5	3	2
1:00	4	1	3
2:00	2	1	1
3:00	3	1	2
4:00	4	3	2
5:00	12	8	4
6:00	29	17	12
7:00	58	39	18
8:00	69	48	20
9:00	71	49	22
10:00	71	42	28
11:00	65	40	25
12:00	70	41	30
13:00	68	43	25
14:00	68	42	26
15:00	68	46	22
16:00	88	62	26
17:00	75	49	26
18:00	41	26	14
19:00	24	13	11
20:00	14	8	6
21:00	12	6	6
22:00	9	5	4
23:00	5	3	2

Movement B

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	13	13	1
6:00	23	21	1
7:00	10	9	1
8:00	8	6	2
9:00	5	4	1
10:00	5	5	1
11:00	6	5	2
12:00	5	5	1
13:00	4	3	1
14:00	5	4	1
15:00	7	6	1
16:00	12	11	1
17:00	6	5	1
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	0	0	0
23:00	0	0	0

Movement D

Time	Total	LV	HV
0:00	8	6	2
1:00	4	2	2
2:00	3	1	2
3:00	2	1	1
4:00	9	5	4
5:00	46	40	6
6:00	103	89	14
7:00	66	52	15
8:00	70	53	17
9:00	67	50	17
10:00	61	48	13
11:00	63	48	15
12:00	65	52	13
13:00	59	46	13
14:00	59	52	8
15:00	79	65	14
16:00	80	68	12
17:00	65	55	10
18:00	41	37	5
19:00	24	19	5
20:00	22	16	6
21:00	15	10	4
22:00	8	5	3
23:00	7	3	4

Movement F

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	0	0	0
4:00	1	1	0
5:00	13	13	1
6:00	23	21	1
7:00	10	9	1
8:00	8	6	2
9:00	5	4	1
10:00	5	5	1
11:00	6	5	2
12:00	5	5	1
13:00	4	3	1
14:00	5	4	1
15:00	7	6	1
16:00	12	11	1
17:00	6	5	1
18:00	2	2	0
19:00	1	1	0
20:00	1	1	0
21:00	1	1	0
22:00	0	0	0
23:00	0	0	0

Movement H

Time	Total	LV	HV
0:00	0	0	0
1:00	1	1	0
2:00	3	2	0
3:00	4	4	0
4:00	1	1	0
5:00	1	1	0
6:00	5	4	1
7:00	4	3	1
8:00	6	5	1
9:00	6	5	1
10:00	5	5	0
11:00	5	4	1
12:00	4	4	0
13:00	5	4	1
14:00	6	5	1
15:00	8	8	1
16:00	11	11	1
17:00	25	24	1
18:00	10	9	1
19:00	2	2	0
20:00	1	1	0
21:00	1	0	0
22:00	1	0	0
23:00	0	0	0

Movement I

Time	Total	LV	HV
0:00	0	0	0
1:00	1	1	0
2:00	3	2	0
3:00	4	4	0
4:00	1	1	0
5:00	1	1	0
6:00	5	4	1
7:00	4	3	1
8:00	6	5	1
9:00	6	5	1
10:00	5	5	0
11:00	5	4	1
12:00	4	4	0
13:00	5	4	1
14:00	6	5	1
15:00	8	8	1
16:00	11	11	1
17:00	25	24	1
18:00	10	9	1
19:00	2	2	0
20:00	1	1	0
21:00	1	0	0
22:00	1	0	0
23:00	0	0	0

Check 1 Reasonable

Time	MO2N - F +	MO1N	Ratio
0:00	9	9	1.0
1:00	5	5	1.0
2:00	5	6	1.0
3:00	6	4	1.6
4:00	9	8	1.1
5:00	37	26	1.4
6:00	90	73	1.2
7:00	63	58	1.1
8:00	72	67	1.1
9:00	72	67	1.1
10:00	63	56	1.1
11:00	65	60	1.1
12:00	67	60	1.1
13:00	63	58	1.1
14:00	64	59	1.1
15:00	84	74	1.1
16:00	84	71	1.2
17:00	87	69	1.3
18:00	51	43	1.2
19:00	26	24	1.1
20:00	23	22	1.0
21:00	15	14	1.1
22:00	8	8	1.1
23:00	8	7	1.1

Check 2 Reasonable

Time	01S - B +	MO2S	Ratio
0:00	5	5	1.0
1:00	5	5	1.0
2:00	5	4	1.0
3:00	7	9	1.3
4:00	5	6	1.2
5:00	0	9	30.7
6:00	13	29	2.3
7:00	54	59	1.1
8:00	71	76	1.1
9:00	77	82	1.1
10:00	74	79	1.1
11:00	67	72	1.1
12:00	73	80	1.1
13:00	73	76	1.0
14:00	73	78	1.1
15:00	73	81	1.1
16:00	92	104	1.1
17:00	98	120	1.2
18:00	50	58	1.1
19:00	26	29	1.1
20:00	15	16	1.0
21:00	12	13	1.1
22:00	10	10	1.0
23:00	6	6	1.1

I-04: Kamilaroi Highway and Manilla Road. Week 10 of construction program.

Midblock tube survey results - average weekday.

M01

Kamilaroi Hwy, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Hour commencing	Total vehicles	Light vehicles	Heavy vehicles
0:00	9	4	5
1:00	5	2	3
2:00	6	3	3
3:00	4	2	2
4:00	8	2	7
5:00	26	11	14
6:00	73	34	39
7:00	58	23	34
8:00	67	35	33
9:00	67	32	35
10:00	56	26	31
11:00	60	24	35
12:00	60	20	39
13:00	58	21	37
14:00	59	27	32
15:00	74	32	42
16:00	71	32	40
17:00	69	34	35
18:00	43	23	21
19:00	24	8	16
20:00	22	9	13
21:00	14	4	10
22:00	8	2	6
23:00	7	1	6
Total	948	411	537

SB

Weekday Average

Time	Total vehicles	Light vehicles	Heavy vehicles
0:00	5	3	2
1:00	4	1	3
2:00	2	1	1
3:00	3	1	2
4:00	5	3	2
5:00	12	9	4
6:00	31	18	13
7:00	61	41	19
8:00	72	51	21
9:00	75	52	23
10:00	74	45	30
11:00	68	42	26
12:00	74	43	31
13:00	72	45	27
14:00	71	44	27
15:00	72	49	23
16:00	93	65	28
17:00	79	51	28
18:00	43	28	15
19:00	25	13	12
20:00	15	9	6
21:00	12	6	6
22:00	9	5	4
23:00	6	3	2
Total	984	628	356

Notes:

(1) Assumed that 0.5x MO3E = B = F

(2) Assumed that 0.5xMO3W = H = I

(3) Assumed that 0.95*MO1S = A

(4) Assumed that 0.95*MO2N = D

(5) Check 1: MO2N -F + I = MO1N

(6) Check 2: MO1S - B + H = MO2S

(7) Assumed that future base case during week 6-10 is same as existing survey case

(8) no percentage increased in background traffic applied as it has been less than one year since being surveyed.

(9) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.

(10) construction hours 0700-1800.

(11) Truck route is Barbers Lagoon Road to Manilla Road to Therribri Road. Therefore, no project-related trucks through this intersection.

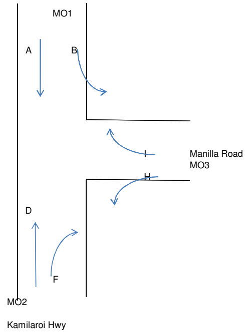
(12) Assumed 340 employees at peak construction period.

(13) Assumed that 10% employees arrive by private vehicle.

(14) Assumed that bus capacity of 20 passengers.

(15) all bussed workers come from Boggabri

(16) private vehicle workers - 10% come from Braymont. Further 90% from Manilla Road (Iron Bridge) The 90% from Manilla Road (East) are further broken up as 60% from the south and 30% from the north.



M03

Manilla Road, East of Kamilaroi Highway

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	27	25	2
6:00	45	43	3
7:00	21	19	2
8:00	16	11	4
9:00	10	8	2
10:00	11	9	1
11:00	12	9	3
12:00	10	9	1
13:00	8	6	2
14:00	9	8	1
15:00	15	12	3
16:00	23	22	1
17:00	12	11	1
18:00	4	4	0
19:00	3	2	0
20:00	2	2	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0
Total	233	205	27

M03

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	8	8	0
4:00	2	2	0
5:00	3	2	0
6:00	9	8	1
7:00	7	5	2
8:00	12	10	2
9:00	13	11	2
10:00	10	9	1
11:00	9	8	1
12:00	9	8	0
13:00	10	9	1
14:00	12	10	2
15:00	16	15	1
16:00	23	21	2
17:00	49	48	1
18:00	19	18	1
19:00	4	3	0
20:00	2	2	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	226	206	19

M02

Kamilaroi Hwy, Boggabri. (South of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	9	7	2
1:00	4	2	2
2:00	3	1	2
3:00	2	1	1
4:00	9	5	4
5:00	49	42	7
6:00	108	93	15
7:00	70	54	15
8:00	73	55	18
9:00	71	53	18
10:00	64	51	13
11:00	66	50	16
12:00	68	54	14
13:00	62	49	13
14:00	63	54	8
15:00	83	68	15
16:00	84	72	13
17:00	69	58	10
18:00	43	39	5
19:00	25	20	5
20:00	23	17	6
21:00	16	11	5
22:00	8	5	3
23:00	8	4	4
Total	1079	866	213

M02

SB

Weekday Average

Time	Total	LV	HV
0:00	5	3	2
1:00	5	1	3
2:00	4	3	1
3:00	9	7	2
4:00	6	4	1
5:00	9	7	3
6:00	29	21	7
7:00	59	50	7
8:00	76	65	9
9:00	82	67	12
10:00	79	63	13
11:00	72	57	12
12:00	80	63	14
13:00	76	62	12
14:00	78	62	12
15:00	81	67	11
16:00	104	87	14
17:00	120	103	13
18:00	58	47	9
19:00	29	20	8
20:00	16	11	5
21:00	13	8	5
22:00	10	7	4
23:00	6	4	2
Total	1106	890	184

Notes (cont'd)

(17) Boggabri traffic generation
353 additional mining employees in year 5 (2017)
2 x 12h shifts per day
linear increase in additional staff between 2010 and 2017. Therefore 100 additional employees in 2012 (week 43).

Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.

40% of all employees to work day shift.
20% of all employees to work night shifts.

Note: Because Leard Forest Road would be closed, all Maules Creek Road traffic are likely to come via the Kamilaroi Highway and Manilla Road West.

Derivation of turning movement volumes

Movement A

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	5	2	3	0	0	0	2	0	0	0
1:00	4	3	1	0	0	0	3	0	0	0
2:00	2	1	1	0	0	0	1	0	0	0
3:00	3	2	1	0	0	0	2	0	0	0
4:00	4	2	3	0	0	0	2	0	0	0
5:00	12	4	8	0	0	0	4	0	0	0
6:00	29	12	17	0	0	0	12	0	0	0
7:00	58	18	39	0	0	0	18	0	0	0
8:00	69	20	48	0	0	0	20	0	0	0
9:00	71	22	49	0	0	0	22	0	0	0
10:00	71	28	42	0	0	0	28	0	0	0
11:00	65	25	40	0	0	0	25	0	0	0
12:00	70	30	41	0	0	0	30	0	0	0
13:00	68	25	43	0	0	0	25	0	0	0
14:00	68	26	42	0	0	0	26	0	0	0
15:00	68	22	46	0	0	0	22	0	0	0
16:00	88	26	62	0	0	0	26	0	0	0
17:00	75	26	49	0	0	0	26	0	0	0
18:00	41	14	26	0	0	0	14	0	0	0
19:00	24	11	13	0	0	0	11	0	0	0
20:00	14	6	8	0	0	0	6	0	0	0
21:00	12	6	6	0	0	0	6	0	0	0
22:00	9	4	5	0	0	0	4	0	0	0
23:00	5	2	3	0	0	0	2	0	0	0

Movement B

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	13	1	13	0	0	0	1	0	0	0
6:00	33	1	21	10	0	0	1	0	0	0
7:00	10	1	9	0	0	0	1	0	0	0
8:00	8	2	6	0	0	0	2	0	0	0
9:00	5	1	4	0	0	0	1	0	0	0
10:00	5	1	5	0	0	0	1	0	0	0
11:00	6	2	5	0	0	0	2	0	0	0
12:00	5	1	5	0	0	0	1	0	0	0
13:00	4	1	3	0	0	0	1	0	0	0
14:00	5	1	4	0	0	0	1	0	0	0
15:00	7	1	6	0	0	0	1	0	0	0
16:00	12	1	11	0	0	0	1	0	0	0
17:00	6	1	5	0	0	0	1	0	0	0
18:00	2	0	2	0	0	0	0	0	0	0
19:00	1	0	1	0	0	0	0	0	0	0
20:00	1	0	1	0	0	0	0	0	0	0
21:00	1	0	1	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement D

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	8	2	6	0	0	0	2	0	0	0
1:00	4	2	2	0	0	0	2	0	0	0
2:00	3	2	1	0	0	0	2	0	0	0
3:00	2	1	1	0	0	0	1	0	0	0
4:00	9	4	5	0	0	0	4	0	0	0
5:00	46	6	40	0	0	0	6	0	0	0
6:00	103	14	89	0	0	0	14	0	0	0
7:00	66	15	52	0	0	0	15	0	0	0
8:00	70	17	53	0	0	0	17	0	0	0
9:00	67	17	50	0	0	0	17	0	0	0
10:00	61	13	48	0	0	0	13	0	0	0
11:00	63	15	48	0	0	0	15	0	0	0
12:00	65	13	52	0	0	0	13	0	0	0
13:00	59	13	46	0	0	0	13	0	0	0
14:00	59	8	52	0	0	0	8	0	0	0
15:00	79	14	65	0	0	0	14	0	0	0
16:00	80	12	68	0	0	0	12	0	0	0
17:00	65	10	55	0	0	0	10	0	0	0
18:00	41	5	37	0	0	0	5	0	0	0
19:00	24	5	19	0	0	0	5	0	0	0
20:00	22	6	16	0	0	0	6	0	0	0
21:00	15	4	10	0	0	0	4	0	0	0
22:00	8	3	5	0	0	0	3	0	0	0
23:00	7	4	3	0	0	0	4	0	0	0

Movement F

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	13	1	13	0	0	0	1	0	0	0
6:00	78	17	21	20	20	0	1	15	0	0
7:00	10	1	9	0	0	0	1	0	0	0
8:00	8	2	6	0	0	0	2	0	0	0
9:00	5	1	4	0	0	0	1	0	0	0
10:00	5	1	5	0	0	0	1	0	0	0
11:00	6	2	5	0	0	0	2	0	0	0
12:00	5	1	5	0	0	0	1	0	0	0
13:00	4	1	3	0	0	0	1	0	0	0
14:00	5	1	4	0	0	0	1	0	0	0
15:00	7	1	6	0	0	0	1	0	0	0
16:00	12	1	11	0	0	0	1	0	0	0
17:00	21	16	5	0	0	0	1	15	0	0
18:00	12	0	2	0	10	0	0	0	0	0
19:00	1	0	1	0	0	0	0	0	0	0
20:00	1	0	1	0	0	0	0	0	0	0
21:00	1	0	1	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement H

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	1	0	1	0	0	0	0	0	0	0
2:00	3	0	2	0	0	0	0	0	0	0
3:00	4	0	4	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	1	0	1	0	0	0	0	0	0	0
6:00	5	1	4	0	0	0	1	0	0	0
7:00	38	25	3	0	10	0	1	15	9	0
8:00	6	1	5	0	0	0	1	0	0	0
9:00	6	1	5	0	0	0	1	0	0	0
10:00	5	0	5	0	0	0	0	0	0	0
11:00	5	1	4	0	0	0	1	0	0	0
12:00	4	0	4	0	0	0	0	0	0	0
13:00	5	1	4	0	0	0	1	0	0	0
14:00	6	1	5	0	0	0	1	0	0	0
15:00	8	1	8	0	0	0	1	0	0	0
16:00	11	1	11	0	0	0	1	0	0	0
17:00	25	1	24	0	0	0	1	0	0	0
18:00	25	16	9	0	0	0	1	15	0	0
19:00	51	9	2	20	20	0	0	0	9	0
20:00	1	0	1	0	0	0	0	0	0	0
21:00	1	0	0	0	0	0	0	0	0	0
22:00	1	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement I

			exist	Maules	Bog	Tar	exist	Maules	Bog	Tar
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	1	0	1	0	0	0	0	0	0	0
2:00	3	0	2	0	0	0	0	0	0	0
3:00	4	0	4	0	0	0	0	0	0	0
4:00	1	0	1	0	0	0	0	0	0	0
5:00	1	0	1	0	0	0	0	0	0	0
6:00	5	1	4	0	0	0	1	0	0	0
7:00	4	1	3	0	0	0	1	0	0	0
8:00	6	1	5	0	0	0	1	0	0	0
9:00	6	1	5	0	0	0	1	0	0	0
10:00	5	0	5	0	0	0	0	0	0	0
11:00	5	1	4	0	0	0	1	0	0	0
12:00	4	0	4	0	0	0	0	0	0	0
13:00	5	1	4	0	0	0	1	0	0	0
14:00	6	1	5	0	0	0	1	0	0	0
15:00	8	1	8	0	0	0	1	0	0	0
16:00	11	1	11	0	0	0	1	0	0	0
17:00	25	1	24	0	0	0	1	0	0	0
18:00	10	1	9	0	0	0	1	0	0	0
19:00	12	0	2	10	0	0	0	0	0	0
20:00	1	0	1	0	0	0	0	0	0	0
21:00	1	0	0	0	0	0	0	0	0	0
22:00	1	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

I-04: Kamilaroi Highway and Manilla Road. Peak mining period (2020)

Midblock tube survey results - average weekday.

M01

Kamilaroi Hwy, Boggabri. (North of Manilla Rd)

NB

Weekday Average

Hour commencing	Total vehicles	Light vehicles	Heavy vehicles
0:00	9	4	5
1:00	5	2	3
2:00	6	3	3
3:00	4	2	2
4:00	8	2	7
5:00	26	11	14
6:00	73	34	39
7:00	58	23	34
8:00	67	35	33
9:00	67	32	35
10:00	56	26	31
11:00	60	24	35
12:00	60	20	39
13:00	58	21	37
14:00	59	27	32
15:00	74	32	42
16:00	71	32	40
17:00	69	34	35
18:00	43	23	21
19:00	24	8	16
20:00	22	9	13
21:00	14	4	10
22:00	8	2	6
23:00	7	1	6
Total	948	411	537

SB

Weekday Average

Time	Total vehicles	Light vehicles	Heavy vehicles
0:00	5	3	2
1:00	4	1	3
2:00	2	1	1
3:00	3	1	2
4:00	5	3	2
5:00	12	9	4
6:00	31	18	13
7:00	61	41	19
8:00	72	51	21
9:00	75	52	23
10:00	74	45	30
11:00	68	42	26
12:00	74	43	31
13:00	72	45	27
14:00	71	44	27
15:00	72	49	23
16:00	93	65	28
17:00	79	51	28
18:00	43	28	15
19:00	25	13	12
20:00	15	9	6
21:00	12	6	6
22:00	9	5	4
23:00	6	3	2
Total	984	628	356

Notes:

(1) Although M04 is located on Manilla Road

to the east of Therribri, a substantial volume of

this traffic would turn off at Leard Forest Road.

(2) Assumed that 0.8 x M10N = movement E

(3) Assumed that 0.2 x M10N = movement F

(4) Assumewd that 0.8 x M10S = movement L

(5) Assumed that 0.2 x M10S = movement H

(6) Therefore M09W - H = movement G

(7) Therefore M09E - F = movement J

(8) Traffic generators include (i) Maules Creek (ii) Boggabri and (iii) Tarrawonga.

(9) Mining shifts 7am-7pm, 7pm-7am.

(10) maximum number of mine employees in 2020 is 470 but would be 140 in day shift and 110 in night shift

(11) Assume 90% employees transported by bus from Boggabri. Other 10% arrive by private car and are distributed Manilla Road East/ Barbers Lagoon Road as 90%/ 10%

The 90% from Manilla Road (East) are further broken up as 60% from the south and 30% from the north.

(12) bus occupancy of 20 persons per bus.

(13) Boggabri traffic generation

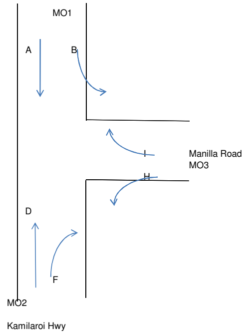
353 additional mining employees in year 5 (2017)

2 x 12h shifts per day

Distribution by Manilla East, Maules Creek Road and Barbers Lagoon Road is 50%/30%/20%.

40% of all employees to work day shift.

20% of all employees to work night shifts.



M03

Manilla Road, East of Kamilaroi Highway

EB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	0	0	0
2:00	0	0	0
3:00	1	1	0
4:00	1	1	0
5:00	27	25	2
6:00	45	43	3
7:00	21	19	2
8:00	16	11	4
9:00	10	8	2
10:00	11	9	1
11:00	12	9	3
12:00	10	9	1
13:00	8	6	2
14:00	9	8	1
15:00	15	12	3
16:00	23	22	1
17:00	12	11	1
18:00	4	4	0
19:00	3	2	0
20:00	2	2	0
21:00	2	1	0
22:00	1	1	0
23:00	1	1	0
Total	233	205	27

M03

WB

Weekday Average

Time	Total	LV	HV
0:00	0	0	0
1:00	2	2	0
2:00	5	5	0
3:00	8	8	0
4:00	2	2	0
5:00	3	2	0
6:00	9	8	1
7:00	7	5	2
8:00	12	10	2
9:00	13	11	2
10:00	10	9	1
11:00	9	8	1
12:00	9	8	0
13:00	10	9	1
14:00	12	10	2
15:00	16	15	1
16:00	23	21	2
17:00	49	48	1
18:00	19	18	1
19:00	4	3	0
20:00	2	2	0
21:00	1	1	0
22:00	1	1	0
23:00	0	0	0
Total	226	206	19

M02

Kamilaroi Hwy, Boggabri. (South of Manilla Rd)

NB

Weekday Average

Time	Total	LV	HV
0:00	9	7	2
1:00	4	2	2
2:00	3	1	2
3:00	2	1	1
4:00	9	5	4
5:00	49	42	7
6:00	108	93	15
7:00	70	54	15
8:00	73	55	18
9:00	71	53	18
10:00	64	51	13
11:00	66	50	16
12:00	68	54	14
13:00	62	49	13
14:00	63	54	8
15:00	83	68	15
16:00	84	72	13
17:00	69	58	10
18:00	43	39	5
19:00	25	20	5
20:00	23	17	6
21:00	16	11	5
22:00	8	5	3
23:00	8	4	4
Total	1079	866	213

M02

SB

Weekday Average

Time	Total	LV	HV
0:00	5	3	2
1:00	5	1	3
2:00	4	3	1
3:00	9	7	2
4:00	6	4	1
5:00	9	7	3
6:00	29	21	7
7:00	59	50	7
8:00	76	65	9
9:00	82	67	12
10:00	79	63	13
11:00	72	57	12
12:00	80	63	14
13:00	76	62	12
14:00	78	62	12
15:00	81	67	11
16:00	104	87	14
17:00	120	103	13
18:00	58	47	9
19:00	29	20	8
20:00	16	11	5
21:00	13	8	5
22:00	10	7	4
23:00	6	4	2
Total	1106	890	184

Notes (cont'd)

(14) background growth rate is 0.8% pa for local roads and 2.1% pa for the Kamilaroi Highway.

There are 10 years of growth.

(15) assumed car occupancy = 1 person per vehicle.

(16) assume outbound buses are sufficient to transport end-of-shift workers.

Derivation of turning movement volumes

Movement A

			exist	Growth	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	6	3	3	3	0	0	2	3	0	0
1:00	5	4	1	1	0	0	3	4	0	0
2:00	3	1	1	1	0	0	1	1	0	0
3:00	4	2	1	1	0	0	2	2	0	0
4:00	5	2	3	4	0	0	2	2	0	0
5:00	15	4	8	10	0	0	4	4	0	0
6:00	36	15	17	21	0	0	12	15	0	0
7:00	71	22	39	48	0	0	18	22	0	0
8:00	84	25	48	60	0	0	20	25	0	0
9:00	88	27	49	61	0	0	22	27	0	0
10:00	87	35	42	52	0	0	28	35	0	0
11:00	80	30	40	49	0	0	25	30	0	0
12:00	87	36	41	50	0	0	30	36	0	0
13:00	84	31	43	53	0	0	25	31	0	0
14:00	83	32	42	52	0	0	26	32	0	0
15:00	84	27	46	57	0	0	22	27	0	0
16:00	108	32	62	76	0	0	26	32	0	0
17:00	92	33	49	60	0	0	26	33	0	0
18:00	50	18	26	33	0	0	14	18	0	0
19:00	30	14	13	16	0	0	11	14	0	0
20:00	18	7	8	10	0	0	6	7	0	0
21:00	14	7	6	7	0	0	6	7	0	0
22:00	11	5	5	6	0	0	4	5	0	0
23:00	7	3	3	4	0	0	2	3	0	0

Movement B

			exist	Growth	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	15	1	13	14	0	0	1	1	0	0
6:00	29	1	21	23	4	0	1	1	0	0
7:00	11	1	9	10	0	0	1	1	0	0
8:00	8	2	6	6	0	0	2	2	0	0
9:00	5	1	4	4	0	0	1	1	0	0
10:00	6	1	5	5	0	0	1	1	0	0
11:00	7	2	5	5	0	0	2	2	0	0
12:00	6	1	5	5	0	0	1	1	0	0
13:00	4	1	3	3	0	0	1	1	0	0
14:00	5	1	4	4	0	0	1	1	0	0
15:00	8	1	6	7	0	0	1	1	0	0
16:00	13	1	11	12	0	0	1	1	0	0
17:00	10	1	5	6	3	0	1	1	0	0
18:00	2	0	2	2	0	0	0	0	0	0
19:00	1	0	1	1	0	0	0	0	0	0
20:00	1	0	1	1	0	0	0	0	0	0
21:00	1	0	1	1	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement D

			exist	Growth	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	10	3	6	8	0	0	2	3	0	0
1:00	4	2	2	2	0	0	2	2	0	0
2:00	4	2	1	2	0	0	2	2	0	0
3:00	3	1	1	2	0	0	1	1	0	0
4:00	11	5	5	6	0	0	4	5	0	0
5:00	57	8	40	49	0	0	6	8	0	0
6:00	127	18	89	109	0	0	14	18	0	0
7:00	82	18	52	64	0	0	15	18	0	0
8:00	86	21	53	65	0	0	17	21	0	0
9:00	83	21	50	62	0	0	17	21	0	0
10:00	75	15	48	59	0	0	13	15	0	0
11:00	77	19	48	59	0	0	15	19	0	0
12:00	80	16	52	64	0	0	13	16	0	0
13:00	72	15	46	57	0	0	13	15	0	0
14:00	73	10	52	64	0	0	8	10	0	0
15:00	97	17	65	80	0	0	14	17	0	0
16:00	99	15	68	84	0	0	12	15	0	0
17:00	80	12	55	68	0	0	10	12	0	0
18:00	51	6	37	45	0	0	5	6	0	0
19:00	30	6	19	23	0	0	5	6	0	0
20:00	27	7	16	20	0	0	6	7	0	0
21:00	18	5	10	13	0	0	4	5	0	0
22:00	10	4	5	6	0	0	3	4	0	0
23:00	9	5	3	4	0	0	4	5	0	0

Movement F

			exist	Growth	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	15	1	13	14	0	0	1	1	0	0
6:00	110	8	21	23	8	71	1	1	6	0
7:00	11	1	9	10	0	0	1	1	0	0
8:00	8	2	6	6	0	0	2	2	0	0
9:00	5	1	4	4	0	0	1	1	0	0
10:00	6	1	5	5	0	0	1	1	0	0
11:00	7	2	5	5	0	0	2	2	0	0
12:00	6	1	5	5	0	0	1	1	0	0
13:00	4	1	3	3	0	0	1	1	0	0
14:00	5	1	4	4	0	0	1	1	0	0
15:00	8	1	6	7	0	0	1	1	0	0
16:00	13	1	11	12	0	0	1	1	0	0
17:00	6	1	5	6	0	0	1	1	0	0
18:00	51	6	2	2	7	35	0	0	6	0
19:00	1	0	1	1	0	0	0	0	0	0
20:00	1	0	1	1	0	0	0	0	0	0
21:00	1	0	1	1	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement H

			exist	Growth	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	1	0	1	1	0	0	0	0	0	0
2:00	3	0	2	3	0	0	0	0	0	0
3:00	4	0	4	4	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	1	0	1	1	0	0	0	0	0	0
6:00	5	1	4	4	0	0	1	1	0	0
7:00	52	7	3	3	7	35	1	1	6	0
8:00	6	1	5	6	0	0	1	1	0	0
9:00	7	1	5	6	0	0	1	1	0	0
10:00	5	0	5	5	0	0	0	0	0	0
11:00	5	1	4	4	0	0	1	1	0	0
12:00	5	0	4	4	0	0	0	0	0	0
13:00	6	1	4	5	0	0	1	1	0	0
14:00	6	1	5	5	0	0	1	1	0	0
15:00	9	1	8	8	0	0	1	1	0	0
16:00	12	1	11	11	0	0	1	1	0	0
17:00	27	1	24	26	0	0	1	1	0	0
18:00	11	1	9	10	0	0	1	1	0	0
19:00	87	7	2	2	8	71	0	0	6	0
20:00	1	0	1	1	0	0	0	0	0	0
21:00	1	0	0	0	0	0	0	0	0	0
22:00	1	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Movement I

			exist	Growth	Maule	Bog	exist	Growth	Maule	Bog
Time	**Total**	**Tot HV**	**LV**	**LV**	**LV**	**LV**	**HV**	**HV**	**HV**	**HV**
0:00	0	0	0	0	0	0	0	0	0	0
1:00	1	0	1	1	0	0	0	0	0	0
2:00	3	0	2	3	0	0	0	0	0	0
3:00	4	0	4	4	0	0	0	0	0	0
4:00	1	0	1	1	0	0	0	0	0	0
5:00	1	0	1	1	0	0	0	0	0	0
6:00	5	1	4	4	0	0	1	1	0	0
7:00	7	1	3	3	3	0	1	1	0	0
8:00	6	1	5	6	0	0	1	1	0	0
9:00	7	1	5	6	0	0	1	1	0	0
10:00	5	0	5	5	0	0	0	0	0	0
11:00	5	1	4	4	0	0	1	1	0	0
12:00	5	0	4	4	0	0	0	0	0	0
13:00	6	1	4	5	0	0	1	1	0	0
14:00	6	1	5	5	0	0	1	1	0	0
15:00	9	1	8	8	0	0	1	1	0	0
16:00	12	1	11	11	0	0	1	1	0	0
17:00	27	1	24	26	0	0	1	1	0	0
18:00	11	1	9	10	0	0	1	1	0	0
19:00	6	0	2	2	4	0	0	0	0	0
20:00	1	0	1	1	0	0	0	0	0	0
21:00	1	0	0	0	0	0	0	0	0	0
22:00	1	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0

Appendix B: Indicative construction program and forecast heavy vehicle (one-way) movements

				Week																								
Sub-package	**Task**	**Duration (Wks)**	**Truck Movements**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Site Establishment	Construct temporary access road Construct pad for mining fleet assembly construct temporary MIA	10	2167	217	217	217	217	217	217	217	217	217	217															
Pump station & Pipeline	pump station construction	20	1479					74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	
	power to pump station																											
	construct pipeline	8	44																									5
Therribri Rd upgrade	Therribri Rd upgrade	16	292					18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18					
Earthworks	construct sed basins																											
	clear and grub																											
	strip topsoil																											
	Cut to fill earthworks (Moxy 40T, plus Mine Trucks)	38	21800											574	574	574	574	574	574	574	574	574	574	574	574	574	574	574
	retaining walls	28	90																	3	3	3	3	3	3	3	3	3
Drainage	Construct drainage	14	75					5	5	5	5	5	5	5														
Kamilaroi Highway Crossing	Construct bridge	15	42												3	3	3	3	3	3	3	3	3	3	3	3	3	3
Namoi River flood plain crossing	Construct Bridge	50	766					15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Haul road crossing	Construct bridge	8	42																									
Rail line construction	Construct track	26	2339																									
Road construction	road construction (Moxy 40T)	20	8763																									
Fencing and landscaping	Fencing and landscaping																											
dam construction	dam construction	35	105																					3	3	3	3	3
MIA Construction	bulk earthworks	20	3813																								191	191
	buildings	20	432																									
	services	20	15																									
			Totals	108	108	108	108	221	221	221	221	221	221	113	110	110	110	110	110	114	114	114	114	98	98	98	98	30

				Week																								
Sub-package	**Task**	**Duration (Wks)**	**Truck Movements**	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Site Establishment	Construct temporary access road Construct pad for mining fleet assembly construct temporary MIA	10	2167																									
Pump station & Pipeline	pump station construction	20	1479																									
	power to pump station																											
	construct pipeline	8	44	5	5	5	5	5	5	5																		
Therribri Rd upgrade	Therribri Rd upgrade	16	292																									
Road and rail upgrade.	construct sed basins																											
	clear and grub																											
	strip topsoil																											
	Road/rail construction: Cut to fill earthworks (Moxy 40T, plus Mine Trucks)	38	21800	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574	574		
	retaining walls	28	90	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3					
	Road drainage: Construct drainage	14	75																									
	Kamilaroi Hwy crossing: Construct bridge	15	42	3																								
	Namoi River crossing: Construct Bridge	50	766	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Haul road crossing: Construct bridge	8	42		5	5	5	5	5	5	5	5																
	Rail line: Construct track	26	2339														90	90	90	90	90	90	90	90	90	90	90	90
	road construction (Moxy 40T)	20	8763										438	438	438	438	438	438	438	438	438	438	438	438	438	438	438	438
	Fencing and landscaping																											
Dam construction	dam construction	35	105	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
MIA Construction	bulk earthworks	20	3813	191	191	191	191	191	191	191	191	191	191	191	191	191	191	191	191	191	191							
	buildings	20	432																			22	22	22	22	22	22	22
	services	20	15																									
			Totals	30	32	32	32	32	32	32	27	27	22	22	22	22	112	112	112	112	133	133	130	130	130	130	130	130

				Week																								
Sub-package	**Task**	**Duration (Wks)**	**Truck Movements**	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Site Establishment	Construct temporary access road Construct pad for mining fleet assembly construct temporary MIA	10	2167																									
Pump station & Pipeline	pump station construction	20	1479																									
	power to pump station																											
	construct pipeline	8	44																									
Therribri Rd upgrade	Therribri Rd upgrade	16	292																									
Road and rail upgrade.	construct sed basins																											
	clear and grub																											
	strip topsoil																											
	Road/rail construction: Cut to fill earthworks (Moxy 40T, plus Mine Trucks)	38	21800																									
	retaining walls	28	90																									
	Road drainage: Construct drainage	14	75				5	5	5	5	5	5	5															
	Kamilaroi Hwy crossing: Construct bridge	15	42																									
	Namoi River crossing: Construct Bridge	50	766	15	15	15	15																					
	Haul road crossing: Construct bridge	8	42																									
	Rail line: Construct track	26	2339	90	90	90	90	90	90	90	90	90	90	90	90	90	90											
	road construction (Moxy 40T)	20	8763	438	438	438	438																					
	Fencing and landscaping																											
Dam construction	dam construction	35	105	3	3	3	3	3																				
MIA Construction	bulk earthworks	20	3813																									
	buildings	20	432	22	22	22	22	22	22	22	22	22	22	22	22	22												
	services	20	15				1	1	1	1	1	1	1	1	1	1	1											
			Totals	130	130	130	136	121	118	118	118	118	118	112	112	112	91	0	0	0	0	0	0	0	0	0	0	0

Appendix C: SIDRA model performance indicators.

Level of service (LoS)

The SIDRA intersection simulation software is used to determine the likely traffic performance indicators including level of service (LoS), degree of saturation (DoS), average delay and maximum queue length (represented by 95th percentile queue length). At signalised and roundabout intersections, the LoS critera are related to average intersection delay (seconds per vehicle). At sign controlled intersections (give way and stop), the LoS is based on the average delay (seconds per vehicle) for the worst movement. The following table summarises the intersection LoS criteria.

Level of Service	Average Delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments, 2002.

Degree of saturation (DoS)

DoS is defined as the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For DoS greater than 1.0, a small increment in traffic volumes would result in an exponential increase in delays and queue length. For a satisfactory situation, the DoS should be less than the nominated practical degree of saturation, usually 0.90. The intersection DoS is based on the movement with the highest ratio.

Average delay

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from stop, as well as delays experienced by all vehicles negotiating the intersection. At signalised and roundabout intersections, the average intersection delay is usually reported and is taken as the weighted average delay by summing the product of the individual movement traffic volumes and their corresponding calculated delays and dividing these by the total number of vehicles entering the intersection. At sign controlled intersections, the average delay for the worst movement is usually reported.

Maximum queue length

Queue length is the number of vehicles waiting at the hold line and is usually quoted as the 95th percentile back of queue, which is the value below which 95 percent of all observed queue lengths fall. For signalised intersections, it is measured as the number of vehicles per traffic lane at the start of the green period, when the traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

Appendix D: TCP195 (RTA, 2010)