## FR/SER

# Fraser Earthmoving Construction Pty Ltd 

## Part 1

## Road Transport Assessment

for the

# Howlong Sand and Gravel 

 Expansion ProjectState Significant Development 17_8804

Prepared by<br>The Transport Planning Partnership

March 2020


# Howlong Sand and Gravel Quarry 

Road Transport Assessment

Prepared for:

R.W. Corkery \& Co Pty Limited

2 March 2020
The Transport Planning Partnership

# Howlong Sand and Gravel Quarry 

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## References

Austroads (2017a), Guide to Traffic Management Part 3 Traffic Studies and Analysis.

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Transport for NSW Centre for Road Safety (2019), viewed on 16 October 2019, https://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html? tablga=4

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## 1 Introduction

This report has been prepared on behalf of R.W. Corkery \& Co Pty Ltd (RWC) to present the findings of an assessment of the road transport implications of an expansion of the existing quarry operations at the Howlong Quarry (the Quarry) located at 4343 Riverina Highway, Howlong, New South Wales (NSW).

The Quarry has been operating for more than 60 years in this location to supply local construction clients. It currently extracts, processes and transports sand and gravel material at a rate of 30,000 tonnes per annum (†pa). Approval is being sought to continue and expand the Quarry's operations, with an increased annual extraction and processing rate of up to 300,000 tpa in order to supply increasing demand for construction materials in Albury and beyond (the Project).

This report has been prepared as part of an SSD Application (SSD 17_8804) and has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the Project, issued on 7 November 2017. Table 1.1 lists the SEARs and the corresponding sections of the report where these are addressed.

Table 1.1: SEARs and Relevant Report Sections

| Traffic and Transport | Addressed in Section |
| :--- | :---: |
| - Accurate predictions of the road traffic generated by the construction and |  |
| operation of the development, including a description of the types of vehicles |  |
| likely to be used for transportation of quarry products |  |$\quad 4.1$

The relevant general requirements of the SEARs have also been considered in preparation of this assessment, noting that these require that the Environmental Impact Assessment (EIS) for the Project include:

- an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice;
- a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of:
- whether these measures are consistent with industry best practice and represent the full range of reasonable and feasible mitigation measures that could be implemented;

O the likely effectiveness of these measures; and
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- whether contingency measures would be necessary to manage any residual risks; and
- a description of the measures that would be implemented to monitor and report on the environmental performance of the development.

Regard has also been given to the Roads and Maritime Services (RMS) input to the SEARs, which indicates that RMS is:
interested in the characteristics of the traffic generated by the development and the impact of the development on the safety and efficiency of the road network... The TIA is to address the potential impacts on the road network, particularly intersections, associated with the development during the lifetime of the project and outline mitigation measures such as intersection upgrades, to be implemented to maintain the standard and safety of the road network and the procedures to monitor and ensure compliance. Consideration of the cumulative impacts of the potential traffic generation when added to existing traffic volumes upon the surrounding road network shall be undertaken. For this development a transport management plan, including a driver code of conduct, may also be appropriate to outline measures to manage traffic related issues related to the haulage of material from the site.

The remainder of this report is set out as follows:

- Section 2 describes the site location, and existing and proposed operations of the Quarry and the Project;
- Section 3 describes the existing road transport environment, including the existing condition of the road network, a review of the road crash history, the operating conditions at key midblock and intersection locations with potential changes to the road transport environment over a ten-year horizon;
- Section 4 assesses the traffic anticipated to be generated by the Project, and its impacts on the road transport environment. Appropriate measures to address the Projectgenerated changes to the road transport environment are identified;
- Section 5 present the conclusions of the study.


## 2 The Quarry and the Project

### 2.1 Site Location

The Quarry is located at 4343 Riverina Highway, Howlong, NSW, approximately 25 kilometres (km) west of Albury and 2.4 km east of the urban edge of Howlong township. Vehicular access to the site is provided off Riverina Highway on the northern frontage, with the Murray River bounding the south of the site.

The Quarry's location in the region is shown in Figure 2.1, and its extents are shown in Figure 2.2.

Figure 2.1: Regional Location


Figure 2.2: Howlong Quarry Site Extents


### 2.2 Existing Quarry Operations

The Quarry has been in operation for over 60 years, and is permitted to extract up to 30,000 TPA of sand and gravel. All vehicular access is via the Quarry Access Road to Riverina Highway, and due to heavy vehicle restrictions on the portion of Riverina Highway between Spitters Creek and Albury, east of the Quarry, all Quarry-generated haulage trucks travel on Riverina Highway to and from the west only. All Quarry-generated haulage trucks with an origin or destination to the east travel via Sturt Street south of Riverina Highway then River Road and roads on the southern side of the Murray River in Victoria to access Albury and its surrounds.

### 2.3 Project Description

The Project seeks approval to continue and expand quarry operations at the Quarry in order to supply increasing demand for construction materials in Albury and beyond. Sand and gravel material would continue to be extracted, processed on site and transported to supply local construction clients.

The proposed expansion of the Quarry includes:

- an increase in the annual extraction, processing and transport rate from 30,000 tpa to a maximum of 300,000 tpa of sand and gravel
- operation of the Quarry for up to 30 years;
- employment of eight to ten personnel;
- construction of associated site infrastructure and amenities;
- transportation of material off-site via public roads; and
- progressively rehabilitating the site.

Sand and gravel would be despatched between 7.00 am and 10 pm on weekdays, and between 7.00 am and midday on Saturdays. Saturday haulage would occur only occasionally, and no haulage would occur on Sundays. Some trucks may arrive prior to the despatch hours, i.e. from 6.30 am , consistent with existing practice at the Quarry.

Transport would be limited to a maximum of 40 laden loads per day, and are expected to occur over 46 operating weeks per year. Transport operations would be contracted, or trucks and drivers would be supplied by clients.

### 2.4 Project Access and Haulage Routes

The Project will deliver excavated material to several destinations in the region, with the significant majority of material being delivered to Albury, and lesser amounts to Corowa, and some to regional areas such as Benalla and Wangaratta.

Transportation routes and vehicle access for the operation would not be changed with the Project. Vehicular access would continue to be provided via the existing access to and from Riverina Highway. Due to heavy vehicle restrictions on the portion of Riverina Highway in the Albury City local government area (LGA), east of Splitters Creek, all Project-generated haulage trucks would continue to travel on Riverina Highway to and from the west only. All Project-generated haulage trucks with an origin or destination to the east would continue to travel via Howlong, using Sturt Street south of Riverina Highway then River Road and roads on the southern side of the Murray River in Victoria.

## 3 Existing Road Transport Environment

### 3.1 Road Network

The road network serving the Quarry is presented in Figure 3.3 and described below.
The Quarry Access Road is a private access road which provides all vehicular access for the Quarry. The Quarry Access Road extends southwards from Riverina Highway approximately 1.8 km east of Kywong-Howlong Road. The private access road is an unsealed two-way, twolane road with the exception of the single lane bridge which spans Black Swan Anabranch to access the Quarry disturbance site. It has a signposted speed limit of 40 kilometres per hour ( $\mathrm{km} / \mathrm{h}$ ) for approximately 1.3 km from its intersection with Riverina Highway, reducing to $15 \mathrm{~km} / \mathrm{h}$ in proximity to the landowner's residence, and then to $5 \mathrm{~km} / \mathrm{h}$ on the single lane bridge. South of the bridge, the posted speed limit is $10 \mathrm{~km} / \mathrm{h}$.

The Quarry Access Road is generally some 12 m wide. The typical cross-section is shown in Figure 3.1, and the bridge crossing of the Black Swan Anabranch is shown in Figure 3.2.

Figure 3.1: Site Access off Riverina Highway (looking south)


Figure 3.2: Quarry Disturbance Access across Black Swan Anabranch (looking north)


Riverina Highway (B58) is a State declared road which provides connectivity to Deniliquin to the west via Berrigan and Albury to the east. Riverina Highway is generally aligned in an eastwest direction and provides the only vehicular access to the Quarry via the Quarry Access Road. Within the vicinity of the Quarry, Riverina Highway has one travel lane in each direction with sealed shoulders. The posted speed limit is $100 \mathrm{~km} / \mathrm{h}$. In the town of Howlong, Riverina Highway is also known as Hawkins Street (east-west) and Sturt Street (north-south) and has a posted speed limit of $50 \mathrm{~km} / \mathrm{h}$. A $40 \mathrm{~km} / \mathrm{h}$ school zone speed limit applies on Hawkins Street past Howlong Public School. East of the intersection with Sturt Street, 45-degree angled kerb side parking is available on either side of Riverina Highway (Hawkins Street).

At the intersection of Hawkins Street and Sturt Street, Riverina Highway turns through 90degrees, continuing northwards before continuing approximately westwards. Outside of the township of Howlong, the speed limit on Riverina Highway is $100 \mathrm{~km} / \mathrm{h}$. Approximately 5 km north of Corowa, the Riverina Highway diverts north towards Berrigan.

Sturt Street is a north-south aligned road connecting Riverina Highway in the north and River Road to the south, which extends across the Black Swan Anabranch and Murray River, crossing the border into Victoria. Sturt Street provides one traffic lane in each direction with sealed shoulders. It should also be noted that north of the intersection between Riverina Highway and Sturt Street the north leg continues as Riverina Highway.

Figure 3.3: Road Network


Source: National Heavy Vehicle Regulator (NHVR) Route Planner

### 3.2 Intersections

The intersection of Riverina Highway and Sturt Street (Figure 3.4) is a four-way intersection, with Riverina Highway as both the eastern (Hawkins Street, give way) and northern (Sturt Street, priority) approaches. Sight distances on approaches to the intersection are considered satisfactory for the approach speed of vehicles, noting the speed limit is $50 \mathrm{~km} / \mathrm{h}$.

The configuration of the intersection of Riverina Highway and Sturt Street is shown in Figure 3.4 .

Figure 3.4: Riverina Highway and Sturt Street Intersection


The intersection formed between the Quarry Access Road and Riverina Highway (Figure 3.5) is a basic rural four way intersection, with no auxiliary turn lanes. There is no localised widening of the sealed surface of Riverina Highway at the intersection, with the Quarry Access Road being unsealed from the edge line of Riverina Highway. The northern approach to the intersection provides access to a rural landholding located opposite the site. Sight distances on approaches to and from the site access are considered satisfactory for the approach speed of vehicles.

Figure 3.5: Riverina Highway and Quarry Access Road Intersection


### 3.3 Heavy Vehicle Routes

As noted (Section 2.4), the Project will deliver excavated material to several destinations in the region, with the significant majority of material being delivered to Albury, and lesser amounts to Corowa, and some to regional areas such as Benalla and Wangaratta. The approved heavy vehicle routes in NSW are shown in Figure 3.6 while Figure 3.7 illustrates the approved heavy vehicle routes in Victoria.

Riverina Highway, Sturt Street and River Road are approved routes for General Mass Limit (GML) 25 m B-double vehicles. Within the Albury City LGA, east of Splitters Creek, B-double access is not approved, as seen in Figure 3.6.

Figure 3.6: NSW Approved Heavy Vehicle Routes


Source: National Heavy Vehicle Regulator (NHVR) Route Planner

Figure 3.7: Victoria Approved Heavy Vehicle Routes


### 3.4 Traffic Volumes

### 3.4.1 Historic Traffic Volumes

RMS collects and publishes traffic volume data at selected locations on its roads. Available data on roads in the vicinity of the Quarry site were reviewed and collated, noting that only limited data is available in this region. The closest RMS count stations are located on River Road (Station ID: 95467) approximately 5 km west of the Quarry, Riverina Highway (Station ID: 95045) approximately 7 km west and Riverina Highway (Station ID: 95042) approximately 16.5 km east of the Quarry.

Data have not been collected at station 95467 and 95042 since 2011 while data has not been collected since 2010 at station 95045. Notwithstanding the available Annual Average Daily Traffic (AADT) data are presented in Table 3.1.
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Table 3.1: RMS Historic Traffic Volume Data

| Station ID | Data Period | Average Vehicles per Day |  |
| :--- | :---: | :---: | :---: |
|  |  | All Days | Weekday |
| Riverina Highway (95045) | 5 June 2010-22 June 2010 | 1,626 | 1,675 |
| Riverina Highway (95042) | 1 January 2011-29 May 2011 | 2,352 | 2,509 |
| River Road (95467) | 1 January 2011-4 December 2011 | 1,631 | 1,730 |

Reference: RMS

Surveys of traffic on Riverina Highway east of the Quarry Access Road were undertaken during March 2018 (Colston Budd Rogers \& Kafes, 2019). The summary results of the traffic surveys are presented in Table 3.2.

Table 3.2: Traffic Volumes on Riverina Highway March 2018

|  | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Daily <br> (vehicles per day) | 2,936 | 2,978 | 3,232 | 3,146 | 3,315 | 2,757 | 2,044 |
| AM Peak Hour <br> (vehicles per hour) | 256 | 240 | 316 | 232 | 254 | 199 | 152 |
| PM Peak Hour <br> (vehicles per hour) | 255 | 239 | 285 | 284 | 325 | 246 | 186 |

Source: Table 3.8 Colston Budd Rogers \& Kafes, 2019

The 2018 surveys demonstrate that traffic conditions on Riverina Highway are distinctly different on weekdays compared with weekend days. On weekdays, Riverina Highway carried an average of approximately 3,120 vehicles per day east of the Quarry Access Road.

### 3.4.2 Project Traffic Surveys

To quantify current traffic conditions on the roads serving the subject site as a baseline against which future conditions can be assessed, a program of traffic surveys was commissioned by TTPP. Automatic tube count surveys were completed over seven days between Monday 23 September 2019 and Monday 30 September 2019 on:

- Quarry Access Road;
- Riverina Highway, to the west of Quarry Access Road; and
- Sturt Street, south of the Riverina Highway intersection.

The tube count surveys collected vehicle volume, classification and speed data at hourly intervals over the seven-day survey period. The results of the surveys are presented in Appendix A.

### 3.4.3 Surveyed Traffic Volumes

The surveys collected details of the day-to-day variation in traffic and the composition of the traffic based on standard vehicle classifications. Light vehicles include motorcycles, cars,
vans, four-wheel drives (4WDs), and utilities (including those towing a trailer or caravan). Heavy vehicles include single unit trucks and buses and articulated vehicles such as semitrailers, rigid trucks with trailers, B-doubles and road trains.

Table 3.3 presents a summary of the daily traffic volumes at the surveyed locations, being the total number of vehicles passing the surveyed location in both directions of each 24-hour period.

Table 3.3: Surveyed Daily Traffic Volumes 2019 (vehicles per day)

|  | Quarry Access Road <br> south of Riverina Highway |  | Riverina Highway <br> west of Quarry Access Road |  | Sturt Street <br> south of Riverina Highway |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Light | Heavy | Light | Heavy | Light | Heavy |
|  | 35 | 11 | 2,597 | 301 | 1,507 | 488 |
| Tuesday | - A | - A | 2,731 | 358 | 1,662 | 416 |
| Wednesday | 44 | 8 | 2,787 | 364 | 1,703 | 498 |
| Thursday | 35 | 8 | 2,835 | 334 | 1,652 | 439 |
| Friday | 17 | 8 | 3,178 | 299 | 1,879 | 344 |
| Saturday | 3 | 3 | 1,926 | 159 | 1,575 | 228 |
| Sunday | 4 | 0 | 1,915 | 156 | 1,506 | 211 |

The results in Table 3.3 demonstrate that traffic conditions are notably different between weekdays and weekend days. As weekdays are the busier days, this assessment will consider the average weekday conditions rather than average daily conditions.

Over the surveyed week, Riverina Highway west of the Quarry Access Road carried an average of 3,157 vehicles per weekday, of which 332 vehicles ( 10.5 per cent) were heavy vehicles. Sturt Street south of Riverina Highway carried an average of 2,118 vehicles per weekday, of which 437 ( 20.6 per cent) were heavy vehicles. The Quarry Access Road carried an average of 42 vehicles per weekday, of which, nine ( 21 per cent) were heavy vehicles.

Table 3.4 presents a summary of the surveyed peak hourly traffic volumes at the surveyed locations over the average weekday, being the highest number of vehicles passing the surveyed location in both directions during any one hour before or after midday.
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Table 3.4: Surveyed Daily Traffic Volumes 2019 (vehicles per hour)

|  | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Hour | Light | Heavy | Hour Start | Light | Heavy |
| Quarry Access Road <br> south of Riverina Highway | 6am-7am | 3 | 2 | $1 \mathrm{pm}-2 \mathrm{pm}$ | 3 | 1 |
| Riverina Highway <br> west of Quarry Access Road | $8 \mathrm{~mm}-9 \mathrm{am}$ | 238 | 26 | $4 \mathrm{pm}-5 \mathrm{pm}$ | 261 | 28 |
| Sturt Street <br> south of Riverina Highway | $10 \mathrm{am}-11 \mathrm{am}$ | 112 | 30 | $5 \mathrm{pm}-6 \mathrm{pm}$ | 161 | 29 |

The results in Table 3.4 demonstrate that on weekdays, the highest traffic volumes do not coincide on the three surveyed roads. The overall busiest hours on Riverina Highway and Sturt Street occurred during the evening peak hour, while average weekday peak hour volumes on the Quarry Access Road were very low.

### 3.5 Road Safety History

Road crash information was obtained from the Centre for Road Safety (NSW) and Crash Statistics Vic Roads (VIC) across a five-year period between 2014 and 2018 for those roads in proximity to the Quarry and identified as Project heavy vehicle routes. The data include crashes which conform to the national guidelines for reporting and classifying road vehicle crashes based on the following criteria:

- The crash was reported to the police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving vehicle.
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Key findings of the review of the crash history on those routes which may be used by Project heavy vehicles are summarised below. As indicated in Section 3.3, the Quarry would deliver excavated material to several destinations across New South Wales and Victoria. As such, Figure 3.8 indicates the sections of the routes that haulage vehicles are likely to take depending on their destination. It should also be noted that all haulage vehicles would use Riverina Highway (Hawkins Street) between Howlong and the Quarry as highlighted in blue (see Figure 3.8 overleaf).

Figure 3.8: Crash Routes Investigated 2014 to 2018


Basemap: Google Maps Australia

## Riverina Highway, between East of Quarry Access Road and Howlong

A total of ten crashes were recorded on this 4.5 km route over the five year period investigated. No crashes occurred at or near the intersection of Riverina Highway and the Quarry Access Road. The location of these ten crashes (bold circle) are shown in Figure 3.9.

- Two crashes involved light vehicles rearing left off the carriageway into an object (Locations 4 and 6), and both occurred in the dark.
- Two crashes involved light vehicle or motorcycle striking an animal (Locations 1 and 10), and both occurred in the dark.
- Three crashes involved rear end crashes between vehicles travelling in the same direction (Locations 2, 3 and 5), all of which occurred within the township of Howlong. One of these crashes (location 3) involved a heavy truck and a car.
- One crash occurred while a vehicle was leaving parking (Location 7), within the Howlong township.
- One crash occurred at the intersection of Hawkins Street and Sturt Street between vehicles travelling in adjacent directions (Location 8). The crash involved a light vehicle and a heavy truck and occurred in daylight.
- One crash involved a light truck striking a pedestrian walking in the same direction (Location 9), and occurred in daylight.

Figure 3.9: Crashes on Riverina Highway, between East of Quarry and Howlong


Source: Transport for NSW Centre for Road Safety (2019)

## Riverina Highway, between Sturt Street Howlong and Corowa

A total of six crashes were recorded on this 20.6 km route over the five year period investigated. The locations of these crashes (bold circle) are shown in Figure 3.10.

- Four crashes involved light vehicles leaving the carriageway (Locations 11 to 14). One of these occurred at dusk, two occurred in the dark and one occurred in daylight.
- One crash involved a driver losing control of their vehicle, which remained on the carriageway (Location 15), which occurred at dusk.
- Crash location 16 involved a vehicle striking an animal in the dark.

Figure 3.10: Crashes on Riverina Highway, between Sturt Street and Corowa


Source: Transport for NSW Centre for Road Safety Crash Map

## Chiltern-Howlong Road (C381)

As noted previously, haulage vehicles wishing to travel to destinations east or south must turn left at the intersection of Riverina Highway-Sturt Street crossing the border into Victoria and continue southbound along Chiltern-Howlong Road. As such, crash data for a five-year period between 2014-2018 was obtained from Crash Statistics Vic Roads for this 7.7 km long route. The crash locations along Chiltern-Howlong Road are shown in Figure 3.11.

- Two crashes occurred along Chiltern-Howlong Road.
- One crash occurred at the intersection of Gooramadda Road and Chiltern-Howlong Road.
- One crash occurred at the intersection of Chiltern-Howlong Road and Barnawartha Road.
- One crash occurred at the intersection of Chiltern-Howlong Road and Murray Valley Highway.

Figure 3.11: Chiltern-Howlong Road C381, Victoria


Source: Crash Statistics VIC Roads

## Crash History Summary

The review of the crash history of the above road sections in the vicinity of the project does not highlight any location with a particularly poor crash history which may suggest an inherent issue with one or more aspects of that location. The intersection of Riverina Highway and the Quarry Access Road has experienced no recorded crashes over the five year period investigated.

### 3.6 School Buses

As noted (Section 3.1), a $40 \mathrm{~km} / \mathrm{h}$ school speed zone applies along Riverina Highway (Hawkins Street) adjacent to the Howlong Public School, located within the Howlong township on the northern side of Hawkins Street (Riverina Highway). Howlong Preschool is located opposite Howlong Public School on the southern side of Hawkins Street. The school facilities are serviced by bus stops on both the northern and southern sides of Hawkins Street, as shown in Figure 3.12.

The private bus service Route No. 915 operates at these stops, with three services per day Monday to Friday, and no services on weekends. The bus stop on the south side of Hawkins Street services bus route no. 1 provided by Public Transport Victoria (PTV), which operates one morning and one afternoon bus service.

Bus route no. 915 and bus route no. 1 both provide connectivity to Albury to Corowa via Howlong.

Figure 3.12: Bus Stops on Riverina Highway


### 3.7 Background Traffic Growth

Changes to existing traffic conditions can be expected to occur which are not directly attributable to any specific development. For the purpose of this assessment, an average growth rate of 1.0 per cent per annum has been assumed to occur on Riverina Highway and Sturt Street in the future, increasing the background peak hourly and daily traffic volumes over time.

A future horizon assuming ten years of growth on Riverina Highway and Sturt Street has been adopted, and the resulting traffic volumes are summarised in Table 3.5. Traffic volumes on Riverina Highway east of the Quarry Access Road have been estimated from the survey results, assuming that heavy vehicles on the Quarry Access Road all approach and depart to/from the west, and light vehicles approach and depart to/from both the east and west.

Table 3.5: Surveyed and Baseline Future Traffic Volumes

|  | AM Peak (vehicles per hour) |  | PM Peak (vehicles per hour) |  | Daily (vehicles per day) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Light | Heavy | Light | Heavy | Light | Heavy |
| Surveyed 2019 |  |  |  |  |  |  |
| Quarry Access Road | 3 | 2 | 3 | 1 | 32 | 10 |
| Riverina Highway east of Quarry Access Road ${ }^{\text {A }}$ | 238 | 26 | 261 | 28 | 2,825 | 321 |
| Riverina Highway west of Quarry Access Road | 238 | 26 | 261 | 28 | 2,825 | 332 |
| Sturt Street south of Riverina Highway | 112 | 30 | 161 | 29 | 1,676 | 437 |
| Baseline 2029 ${ }^{\text {B }}$ |  |  |  |  |  |  |
| Quarry Access Road | 3 | 2 | 3 | 1 | 32 | 10 |
| Riverina Highway east of Quarry Access Road ${ }^{\text {A }}$ | 263 | 29 | 289 | 30 | 3,120 | 355 |
| Riverina Highway west of Quarry Access Road | 263 | 29 | 289 | 30 | 3,120 | 366 |
| Sturt Street south of Riverina Highway | 124 | 33 | 178 | 32 | 1,851 | 483 |

A estimated from survey results and likely Quarry traffic distribution
B with Quarry operating at 2019 surveyed level of activity

Table 3.5 indicates that with ten years of background growth on the public roads, and the Quarry operating at the same level as surveyed in 2019, Riverina Highway can be expected to carry up to 319 vehicles per hour and 3,486 vehicles per day. Sturt Street south of Riverina Highway can be expected to carry 2,334 vehicles per day.

### 3.8 Road Network Efficiency

### 3.8.1 Midblock Level of Service

The capacity of a road is defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing roadway, traffic and control conditions. The capacity of a single traffic lane will be affected by factors such as the pavement width and restricted lateral clearances, the presence of heavy vehicles and grades.

Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers. A LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describes progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired
speeds or to manoeuvre in the traffic stream. The service flow rate for LOS E is taken as the capacity of a lane or roadway. In rural situations, LOS C is generally considered to be acceptable. At LOS C, most vehicles are travelling in platoons, and travel speeds are curtailed. At LOS D, platooning increases significantly, and the demand for passing is high, but the capacity to do so is low. The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road.

The Austroads (2017a) Guide to Traffic Management Part 3: Traffic Studies and Analysis provides guidelines for the capacity and performance of two lane, two-way rural roads, which in turn, refers to the Highway Capacity Manual (HCM) (Transportation Research Board, 2016).

The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road, and three classes of road are defined in the HCM. Class I roads are those on which motorists expect to travel at relatively high speeds. They most often serve long-distance trips or provide connecting links between facilities that serve long-distance trips. Class II roads are those on which motorists do not necessarily expect to travel at high speeds, and may function as access routes to Class I facilities, serve as scenic or recreational routes or pass through rugged terrain. Class III roads serve moderately developed areas, and may be portions of a Class I or Class II highway that pass through small towns or developed recreational areas, where local traffic mixes with through traffic, and the density of unsignalised roadside access points increases.

On Class I roads, LOS is defined in terms of Percent Time Spent Following (PTSF) and Average Travel Speed (ATS), with the worst of these criteria being adopted as the LOS. On Class II roads, LOS is defined only in terms of PTSF. The PTSF is a measure of the level of opportunities to overtake, and is estimated from the demand traffic volumes, the directional distribution of that traffic, and the percentage of no-passing zones. On Class III roads, LOS is defined in terms of Percent of Free-Flow Speed (PFFS), which is the ratio of ATS to the free-flow speed, representing the ability of vehicles to travel at or near the posted speed limit. The LOS criteria for two lane roads are as shown in Table 3.6.

Table 3.6: LOS Criteria for Two Lane Two Way Roads

| Level of Service | Class I |  | Class II | Class III |
| :---: | :---: | :---: | :---: | :---: |
|  | Average Travel <br> Speed (km/h) | PTSF <br> (percent) | PTSF <br> (percent) | PFFS <br> (percent) |
| A | $>90$ | $\leq 35$ | $\leq 40$ | $>91.7$ |
| B | $>80-90$ | $>35-50$ | $>40-55$ | $>83.3-91.7$ |
| C | $>70-80$ | $>50-65$ | $>55-70$ | $>75.0-83.3$ |
| D | $>60-70$ | $>65-80$ | $>70-85$ | $>66.7-75.0$ |
| E | $\leq 60$ | $\geq 80$ | $\leq 85$ | $\leq 66.7$ |

Source: Austroads (2017a)

Riverina Highway and Sturt Street may be considered as either a Class I or Class II route, and for the purpose of this review, the more stringent criteria for Class I roads have been adopted.

The PTSF resulted in the lower LOS compared to ATS. Table 3.7 summarises the results of the assessment of midblock LOS on Riverina Highway in the vicinity of the Quarry Access Road and Sturt Street south of Howlong (taken to be in the $100 \mathrm{~km} / \mathrm{h}$ speed limit zone). It should be noted that this calculation method does not apply to the Quarry Access Road as its posted speed limit of $20 \mathrm{~km} / \mathrm{h}$ is below the lower speed limit threshold of approximately $70 \mathrm{~km} / \mathrm{h}$ used in the HCM method.

Table 3.7: Average Weekday Midblock Level of Service

|  | Peak Hour | Outbound from Quarry Access Road |  | Inbound to Quarry Access Road |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | PTSF | LOS | PTSF | LOS |
| Riverina Highway west of Quarry Access Road |  |  |  |  |  |
| Surveyed 2019 | AM Peak | 24.0 | A | 40.9 | B |
|  | PM Peak | 41.0 | B | 29.6 | A |
| Baseline 2029 | AM Peak | 25.7 | A | 43.3 | B |
|  | PM Peak | 43.7 | B | 31.9 | A |
| Sturt Street south of Howlong |  |  |  |  |  |
| Surveyed 2019 | AM Peak | 23.6 | A | 25.0 | A |
|  | PM Peak | 31.4 | A | 24.7 | A |
| Baseline 2029 | AM Peak | 24.4 | A | 26.1 | A |
|  | PM Peak | 33.1 | A | 26.2 | A |

The results indicate that midblock levels of service on Riverina Highway are currently good during the surveyed morning and evening peak hours. With background growth in traffic demands which are unrelated to the Project, levels of service would remain at their current levels, with drivers experiencing only minor delays as a result of other traffic.

### 3.8.2 Operation of Intersections

At unsignalised intersections with minor roads, where there are relatively low volumes of through and turning vehicles, capacity considerations are usually not significant, and detailed analysis of capacity is not warranted. As a guide, at volumes below the following combinations of maximum hourly volumes at a cross intersection with a two lane two-way road, capacity analysis is not warranted:

- major road 400 vehicles per hour, minor road 250 vehicles per hour;
- major road 500 vehicles per hour, minor road 200 vehicles per hour; and
- major road 650 vehicles per hour, minor road 100 vehicles per hour.

Comparing the surveyed and baseline traffic volumes with the threshold volumes above, it is evident that the peak hourly volumes are well below the threshold volumes for analysis, and as such, there is no capacity concerns regarding the operation of the intersections of Riverina Highway with the Quarry Access Road and with Sturt Street.

Nevertheless, the operating characteristics of the intersection of Riverina Highway and the Quarry Access Road have been assessed using SIDRA INTERSECTION 8, an analysis program which determines characteristics of intersection operating conditions including the degree of saturation, average delays, and levels of service. The degree of saturation, or $x$-value, is the ratio of the arrival rate of vehicles to the capacity. The average delay, expressed in seconds per vehicle, is measured over all movements at signalised intersections, and over the movement with the highest average delay at roundabout and priority intersections. Average vehicle delay is the commonly used measure of intersection performance defined by RMS (RTA, 2002). Table 3.8 shows the criteria adopted by RMS for assessing the level of service.

Table 3.8: Intersection Level of Service Criteria

| Level of Service <br> (LoS) | Average Delay per <br> vehicle (secs/veh) | Traffic Signals, Roundabout | Give Way \& Stop Sign |
| :---: | :---: | :---: | :---: |
| A | Less than 14 | Good operation | Good operation |
| B | 15 to 28 | Good with acceptable delays and <br> spare capacity | Acceptable delays and spare <br> capacity |
| C | 29 to 42 | Satisfactory | Satisfactory, but accident study <br> required |
| D | 43 to 56 | Near capacity | Near capacity, accident study <br> required |
| E to 70 | At capacity, at signals incidents will <br> cause excessive delays | At capacity, requires other control <br> mode |  |
| F | Greater than 70 | Extra capacity required | Extreme delay, major treatment |
| required |  |  |  |

Table 3.9 presents a summary of the existing and forecast baseline peak hour operating characteristics of the intersection, which is under priority control, thus the reported average delay is for the movement with the highest average delay per vehicle. As a robust assessment, the analysis assumes the morning and evening peak hourly traffic on the Quarry Access Road coincides with the morning and evening peak hourly traffic on Riverina Highway. A small allowance has been made for vehicles entering and exiting the property access opposite the Quarry Access Road during the peak hours. The analysis assumes all heavy vehicle traffic on the Quarry Access Road are large trucks ( 25 m length) which travel to and from the west, and light vehicles traffic travels to and from both the east and west. Detailed results, including vehicle queues are presented in Appendix B.

Table 3.9: Peak Hour Operating Conditions Riverina Highway and Quarry Access Road

| Intersection | AM Peak |  |  | PM Peak |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X-Value | Average <br> Delay | LoS | X-Value | Average <br> Delay | LoS |
| Surveyed 2019 | 0.10 | 9.9 | A | 0.10 | 9.3 | A |
| Baseline 2029 | 0.11 | 10.0 | $A$ | 0.11 | 9.6 | A |

A seconds per vehicle for movement with highest average delay per vehicle.
On the basis of the above assessment results, it is evident that the intersection currently operates at a satisfactory level of service during peak periods, with spare capacity and
transport planning
acceptable delays. With the forecast changes to traffic conditions expected without the Project in 2029, the operation of the intersection would continue to be satisfactory.
transport planning

## 4 Impacts of the Project

### 4.1 Traffic Generation

The Project proposes an annual production rate of up to 300,000 tpa of sand and gravel. Based on the Project operating hours (Section 2.3), haulage would take place up to 15 hours per weekday and 5 hours on occasional Saturdays over an expected 46 weeks per year.

A mix of vehicle types would be used for product haulage, including truck and trailer combinations and B-doubles. The payload capacity of these vehicles varies, with an average capacity of $45 \dagger$ per truck assumed for this assessment. Haulage of 300,000 tonnes of material per year would therefore require 6,667 laden truck loads per year. Assuming continuous operation throughout the 46 operating weeks per year, and excluding Saturday haulage, this would be equivalent to an average of 29 laden truck loads per operating weekday.

Product despatch would be limited to a maximum of 40 laden truck loads per day, which would generate an average of four laden truck departures per hour over the 15 -hour haulage period on a weekday, however the Quarry operations tend to be busier during the morning, slowing during the afternoon and evening. Product despatch would be limited to a maximum of six laden trucks in any one hour. The laden truck departures would be matched by an equivalent number of empty truck arrivals.

The Project workforce would travel to and from the site each day by private vehicle. Without allowing for any car sharing, up to 10 workers would attend the Project each day, generating up to 20 light vehicle trips per day, being 10 arrivals in the morning and 10 departures in the evening. The workforce would tend to arrive prior to the start of haulage and leave following completion of haulage, and so would not travel at the same time as the haulage trucks are operating, nor would they travel at the same time as the background peak hours on Riverina Highway and Sturt Street (Section 3.4.3).

Up to three non-employee visitors may be expected to attend the Project on any one day, generating six light vehicle trips per day. These trips may occur at any time during the Project operating hours, however would typically occur during the daytime and it is expected that not more than four visitor trips would occur in any one hour.

Occasional maintenance or delivery heavy vehicles would attend the Project, however would typically be managed to avoid coinciding with the peak haulage days, so are not considered further in this assessment. The traffic generation of the Project assumed for the purpose of this assessment is therefore:

- 26 light vehicle trips per day; and
- 80 heavy vehicle trips per day.

The peak hours for product haulage and visitor traffic may coincide and may occur at any time throughout the operating hours, thus this assessment considers the scenario in which these Project-generated trips coincide with the peak hour of background traffic, regardless of when that peak occurs. The arrival and departure of employees would not coincide with peak haulage or visitor trips and so is not included in the assessment of peak hour conditions.

- 4 light vehicle trips per hour; and
- 12 heavy vehicle trips per hour.


### 4.2 Traffic Distribution

The distribution of Project-generated traffic would remain the same as the current distribution, with all heavy vehicles approaching and departing to and from the west due to the heavy vehicle restriction to the east on Riverina Highway. All haulage trucks would therefore use Riverina Highway between the Quarry Access Road and Howlong.

The applicant has estimated that at Howlong, approximately 95 per cent of laden trucks would furn left from Hawkins Street to Sturt Street (south) and then continue across the Murray River via River Road, and 5 per cent would turn right and continue along Riverina Highway to Corowa. Due to the campaign nature of quarry operations however, on any one day, the distribution of trucks may vary significantly, such that all trucks may follow a particular route.

For the purpose of this assessment, it is assumed that visitor traffic would be sourced from either the east or west.

Table 4.1 summarises the resulting Project-generated trips on the surrounding road network, which assumes the destination of all quarry products is south or east of the Project.

Table 4.1: Project Peak Vehicle Trips on the Road Network

| Road and Location | Peak Hour <br> (vehicles per hour) |  |  | Daily <br> (vehicles per day) |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Light | Heavy | Total | Light | Heavy | Total |
| Quarry Access Road | 4 | 12 | 16 | 26 | 80 | 106 |
| Riverina Highway <br> East of Quarry Access Road | 2 | 0 | 2 | 13 | 0 | 13 |
| Riverina Highway <br> West of Quarry Access Road | 2 | 12 | 14 | 13 | 80 | 93 |
| Sturt Street <br> South of Riverina Highway | 2 | 12 | 14 | 13 | 80 | 93 |

### 4.3 Future Traffic Volumes

Table 4.2 presents the baseline and resulting future peak hour traffic volumes on the surveyed roads on a busy day with regard to Project traffic generation at the maximum production rate of 300,000 tpa.

Table 4.2: Project Impact on Daily Traffic

| Location | Light Vehicles per Day | Heavy Vehicles per Day |
| :--- | :---: | :---: |
| Baseline with 10 Years' Growth - No Project ${ }^{\text {A }}$ |  |  |
| Quarry Access Road | 32 | 10 |
| Riverina Highway East of Quarry Access Road ${ }^{\text {B }}$ | 3,120 | 355 |
| Riverina Highway West of Quarry Access Road | 3,120 | 366 |
| Sturt Street South of Riverina Highway | 1,851 | 483 |

Project Busy Day Traffic

| Quarry Access Road | 26 | 80 |
| :--- | :---: | :---: |
| Riverina Highway East of Quarry Access Road | 13 | 0 |
| Riverina Highway West of Quarry Access Road | 13 | 80 |
| Sturt Street South of Riverina Highwayc | 13 | 80 |

Future With 10 years' Background Growth and Project Traffic

| Quarry Access Road | 26 | 80 |
| :--- | :---: | :---: |
| Riverina Highway East of Quarry Access Road | 3,117 | 355 |
| Riverina Highway West of Quarry Access Road | 3,117 | 436 |
| Sturt Street South of Riverina Highwayc | 1,848 | 553 |

A with Quarry operating at 2019 surveyed level of activity
${ }^{\text {B }}$ estimated
c assumes all haulage vehicles travel to/from south or east

Table 4.3 presents the existing and resulting future peak hour traffic volumes on the surveyed roads on a busy day with regard to Project traffic generation at the maximum production rate of 300,000 tpa.
transport planning
Table 4.3: Project Impact on Peak Hourly Traffic (vehicles per hour)

| Location | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Light | Heavy | Total | Light | Heavy | Total |

Baseline with 10 Years' Growth - No Project ${ }^{\wedge}$

| Quarry Access Road | 3 | 2 | 3 | 1 | 31 | 10 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Riverina Highway <br> East of Quarry Access RoadB | 263 | 29 | 292 | 289 | 30 | 319 |
| Riverina Highway <br> West of Quarry Access Road | 263 | 29 | 292 | 289 | 30 | 319 |
| Sturt Street <br> South of Riverina Highway | 124 | 33 | 157 | 178 | 32 | 210 |

Project Busy Day Traffic

| Quarry Access Road | 4 | 12 | 16 | 4 | 12 | 16 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Riverina Highway <br> East of Quarry Access Road | 2 | 0 | 0 | 2 | 0 | 0 |
| Riverina Highway <br> West of Quarry Access Road | 2 | 12 | 16 | 2 | 12 | 16 |
| Sturt Street <br> South of Riverina Highwayc | 2 | 12 | 16 | 2 | 12 | 16 |

Future With 10 years' Background Growth and Project Traffic

| Quarry Access Road | 4 | 12 | 16 | 4 | 12 | 16 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Riverina Highway <br> East of Quarry Access Road | 265 | 29 | 294 | 291 | 30 | 321 |
| Riverina Highway <br> West of Quarry Access Road | 265 | 41 | 306 | 291 | 42 | 333 |
| Sturt Street <br> South of Riverina Highwayc | 126 | 45 | 171 | 180 | 44 | 224 |

A with Quarry operating at 2019 surveyed level of activity
${ }^{\text {B }}$ estimated
c assumes all haulage vehicles travel to/from south or east

The results in Table 4.3 indicate that with the cumulative impacts of the Project operating at its maximum capacity, together with background growth, Riverina Highway can be expected to carry up to 333 vehicles per hour during the peak hour near the Quarry Access Road and Sturt Street can be expected to carry up to 224 vehicles per hour during the peak hours south of Riverina Highway.

### 4.4 Future Road Network Efficiency

### 4.4.1 Future Midblock Level of Service

The impact of the Project-generated traffic on the efficiency of the road network has been quantified by considering the future midblock LOS on Riverina Highway in the vicinity of the Quarry Access Road and on Sturt Street south of Howlong with background traffic growth and the Project operating at its capacity. Applying the HCM method (Section 3.8.1), the
results of the assessment are summarised in Table 3.6, again adopting the more stringent criteria for Class I roads, and the lower LOS results based on PTSF rather than ATS.

Table 4.4: Impact of the Project on Average Weekday Midblock Level of Service

|  | Peak Hour | Outbound from Quarry Access Road |  | Inbound to Quarry Access Road |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | PTSF | LOS | PTSF | LOS |
| Riverina Highway west of Quarry Access Road |  |  |  |  |  |
| Baseline 2029 | AM Peak | 25.5 | A | 43.2 | B |
|  | PM Peak | 43.6 | B | 31.8 | A |
| Project 2029 | AM Peak | 27.1 | A | 43.7 | B |
|  | PM Peak | 44.3 | B | 33.0 | A |
| Sturt Street south of Howlong |  |  |  |  |  |
| Baseline 2029 | AM Peak | 24.4 | A | 26.1 | A |
|  | PM Peak | 33.1 | A | 26.2 | A |
| Project 2029 | AM Peak | 25.4 | A | 26.7 | A |
|  | PM Peak | 34.1 | A | 27.7 | A |

The results indicate that the Project traffic would have only minor impacts on the PTSF experienced by drivers on Riverina Highway and Sturt Street, and would have no impact on the midblock levels of service.

### 4.4.2 Future Operation of Intersections

The impact of the Project-generated traffic on the operation of the intersection of Riverina Highway with the Quarry Access Road has been assessed by analysing the forecast peak hourly traffic volumes using SIDRA INTERSECTION. Similar to Section 3.8.2, as a robust assessment, the analysis assumes the morning and evening peak hourly traffic on the Quarry Access Road coincides with the morning and evening peak hourly traffic on Riverina Highway, noting that Project-generated traffic is likely to be somewhat lower later in the day compared with the morning. A small allowance has been made for vehicles entering and exiting the property access opposite the Quarry Access Road during the peak hours. Detailed results, including vehicle queves are presented in Appendix B.

Table 4.5: Future Peak Hour Operating Conditions Riverina Highway and Quarry Access Road

| Intersection | AM Peak |  |  | PM Peak |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X-Value | Average Delay ${ }^{A}$ | LoS | X-Value | Average Delay ${ }^{\text {A }}$ | LoS |
| No Project |  |  |  |  |  |  |
| Surveyed 2019 | 0.10 | 9.9 | A | 0.10 | 9.3 | A |
| Baseline 2029 | 0.11 | 10.0 | A | 0.11 | 9.6 | A |
| With Project |  |  |  |  |  |  |
| With Project 2019 | 0.11 | 11.7 | A | 0.10 | 13.4 | A |
| With Project 2029 | 0.12 | 12.0 | A | 0.11 | 13.9 | A |

A seconds per vehicle for movement with highest average delay per vehicle.
The SIDRA results demonstrate that the intersection of the Quarry Access Road with Riverina Highway can be expected to operate at a good level of service should the peak product haulage coincide with the peak hourly traffic on Riverina Highway. The movement with the highest average delay in future would be the right turn in to the Quarry Access Road, and through movements on Riverina Highway would experience negligible delays. No upgrade of the intersection would be required to provide any additional capacity.

### 4.5 Intersection Treatment

The minimum layout for a rural road access should be designed for the largest vehicles likely to use the access. Austroads (2017b) presents rural access layouts suitable for use by articulated vehicles, and notes that a road intersection layout should be adopted where there is a high demand for articulated vehicles. The number of articulated vehicle trips forecast to use the Quarry Access Road with the Project operating at capacity would be limited to a maximum of 40 inbound and 40 outbound movements per day, or up to six inbound and six outbound movements in any one hour. This level of activity is considered to warrant a road intersection layout, and the Austroads (2019) warrants for the treatment of rural road intersections have therefore been considered.

Austroads (2019) sets out warrants for rural intersection treatments on the major road, which are based on the number of turning and through vehicle movements at the intersection. On the basis of the warrant on roads with an operating speed of $100 \mathrm{~km} / \mathrm{h}$ or more, the forecast peak hourly volumes at the intersection would warrant the minimum preferred treatment. The general minimum preferred treatment at rural road intersections are Basic Auxiliary Left (BAL) and Basic Auxiliary Right (BAR) treatments.

The rural BAL treatment on the major road has a widened shoulder, which assists vehicles turning left into the minor road to move further off the through carriageway, making it easier for through vehicles to pass a vehicle turning left into the minor road. It is noted that there is expected to be no demand for heavy vehicles to turn left from Riverina Highway to the Quarry Access Road, however it remains appropriate to provide a BAL treatment suitable for light vehicles.

The rural BAR treatment features a widened shoulder on the major road that allows through vehicles, having slowed, to pass to the left of vehicles turning right into the minor road. The BAL treatment on the minor road allows turning movements to occur from a single lane, with a shoulder that is too narrow to be used by left-turning vehicles, so as to prevent vehicles from standing two abreast at the holding line.

These design features are preferred to safely manage the movement of vehicles in the high speed rural environment, and it is therefore recommended that BAL and BAR treatments be provided at the intersection of the Quarry Access Road with Riverina Highway, and that the design of those treatments be consistent with Austroads requirements, taking into account the characteristics of the largest vehicle expected to use the Quarry Access Road, and incorporating the property access on the northern side of Riverina Highway opposite the Quarry Access Road.

Safe Intersection Sight Distance (SISD) is the minimum sight distance which should be provided on the major road at any intersection, and is measured from a driver's eye height (car 1.1 m , truck 2.4 m ) to an object height of 1.25 m at the potential conflict point and assumes the driver on a minor road is situated 7.0 m (minimum 5.0 m ) from the potential conflict point on the major road. SISD allows for approaching drivers to see an articulated vehicle which has properly commenced a manoeuvre from a leg without priority, but its length creates an obstruction. Austroads (2017c) indicates that the desirable minimum SISD is 248 m for the general minimum driver reaction time of 2.0 s and assuming a level road surface. Observations on site suggest that the available sight distance for both eastbound and westbound drivers on Riverina Highway exceeds 248 m , which is satisfactory.

### 4.6 Road Safety Implications

The review of the road crash history of the road network serving the Project (Section 3.5) did not identify any causation factors associated with the existing road network that may be exacerbated by increased traffic demands.

### 4.7 Mitigation Measures

The assessment results above demonstrate that no measures would be required to provide additional capacity to accommodate the Project traffic. Existing approved heavy vehicles routes are of an adequate standard to accommodate the Project heavy vehicles, noting that the Project proposes use of existing approved heavy vehicle routes, and so would not introduce heavy vehicles to any roads not currently used by heavy vehicles.

As described in Section 4.5, and consistent with Austroads (2017b) where there is a high demand for articulated vehicles, it is recommended that the existing intersection of the Quarry Access Road with Riverina Highway be upgraded to meet basic rural road intersection standard. Such treatment should include a BAR treatment suitable for Projectgenerated trucks turning right into the Quarry Access Road, and a BAL treatment for light
vehicles turning left into the Quarry Access Road. A BAL treatment should also be provided on the Quarry Access Road suitable for the Project-generated trucks to exit the Quarry Access Road without crossing the centreline of Riverina Highway. A conceptual layout fot the intersection is presented in Appendix C. These treatments would enhance safety for the turning vehicles and minimise interference to through traffic, and would be designed and constructed in consultation with RMS.

The increase in truck trips generated by the Project would increase the likelihood of haulage trucks needing to pass each other at or near the intersection of the Quarry Access Road and Riverina Highway or on the single lane bridge over the Black Swan Anabranch. It is recommended that operational protocols be implemented to require truck drivers to maintain communication with each other, to minimise the potential for conflicts between vehicles travelling in opposing directions, and to clarify priority at those locations. A suitable space should be provided on each side of the Black Swan Anabranch bridge, in which a truck can wait clear of the swept path of a truck travelling in the opposing direction. Similarly, a suitable space should be designated within the Quarry site for an outbound truck on the Quarry Access Road to wait clear of the swept path of an inbound truck, which should be given priority.

It is recommended that drivers of Project trucks be subject to operational protocols relating to driver behaviour and interaction with other roads users, which would be included in a Project Traffic Management Plan (TMP). The TMP would form part of the employee contract or transport contractual arrangements and would address such matters as:

- compliance with access routes;
- road rules, laws and regulations, including the use of mobile phones;
- respecting the rights of other road users and displaying courtesy to other motorists;
- maintaining the required minimum headway between departures of laden trucks;
- maintaining safe following distances between vehicles, and increasing separation in poor weather;
- vehicle condition and maintenance;
- medical fitness of the driver;
- covering of loads;
- reporting of any unsafe driving practices or incidents;
- maintaining communication with other drivers to minimise the potential for delays to traffic on the public road near the site access; and
- driver behaviour expectations at any specific locations or situations on the public road network including near schools.
transport planning


## 5 Conclusions

This study has found that the Project would be accommodated on the surrounding road network with acceptable impacts on the capacity, efficiency and safety of the road network. It is recommended that:

- The intersection of the Quarry Access Road with Riverina Highway be upgraded to basic rural road intersection standard, consistent with Austroads requirements; and that
- a Project TMP be developed and implemented including operational protocols relating to driver behaviour and interaction with other haulage trucks, school buses and other roads users.


## Appendix A

Traffic Surveys

## austraffic

| Road | Quarry Access Road |  | 19 |
| :--- | :--- | :--- | ---: |
| Location | At 4343 Riverina Hwy | Average Weekday | 14 |
| Suburb | Howlong | All Day Average $18.2 \%$ <br> Site No. 1 <br> Weekday Heavy's $18.5 \%$ <br> Start Date Wednesday 25/09/2019 <br> Direction Northbound |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 30-Sep |  | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 5 |  | 7 | 5 | 2 | 1 | 0 |  |  |
| PM Peak | 4 |  | 4 | 3 | 2 | 1 | 1 |  |  |
| 0:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7:00 | 3 |  | 7 | 5 | 0 | 0 | 0 | 4 | 3 |
| 8:00 | 1 |  | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 9:00 | 5 |  | 0 | 1 | 0 | 0 | 0 | 2 | 1 |
| 10:00 | 1 |  | 0 | 0 | 2 | 0 | 0 | 1 | 1 |
| 11:00 | 1 |  | 1 | 4 | 2 | 1 | 0 | 2 | 2 |
| 12:00 | 0 |  | 4 | 1 | 0 | 0 | 1 | 1 | 1 |
| 13:00 | 4 |  | 2 | 0 | 2 | 0 | 0 | 2 | 1 |
| 14:00 | 1 |  | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 15:00 | 0 |  | 2 | 1 | 1 | 0 | 0 | 1 | 1 |
| 16:00 | 2 |  | 1 | 2 | 2 | 0 | 0 | 2 | 1 |
| 17:00 | 2 |  | 3 | 2 | 1 | 0 | 0 | 2 | 1 |
| 18:00 | 0 |  | 2 | 3 | 0 | 0 | 1 | 1 | 1 |
| 19:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 20 |  | 24 | 21 | 12 | 2 | 2 | 19 | 14 |
| \% Heavies | 25.0\% |  | 12.5\% | 14.3\% | 25.0\% | 50.0\% | 0.0\% | 18.2\% | 18.5\% |



## austraffic

| Road | Quarry Access Road |  |  |
| :---: | :---: | :---: | :---: |
| Location | At 4343 Riverina Hwy | Average Weekday | 22 |
| Suburb | Howlong | All Day Average | 16 |
| Site No. | 1 | Weekday Heavy's | 23.6\% |
| Start Date | Wednesday 25/09/2019 | All Day Heavy's | 24.2\% |
| Direction | Southbound |  |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 30-Sep |  | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 6 |  | 11 | 3 | 4 | 2 | 0 |  |  |
| PM Peak | 4 |  | 3 | 2 | 2 | 0 | 1 |  |  |
| 0:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5:00 | 0 |  | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 6:00 | 6 |  | 11 | 3 | 2 | 1 | 0 | 6 | 4 |
| 7:00 | 0 |  | 2 | 2 | 0 | 0 | 0 | 1 | 1 |
| 8:00 | 3 |  | 0 | 3 | 0 | 0 | 0 | 2 | 1 |
| 9:00 | 4 |  | 0 | 3 | 3 | 0 | 0 | 3 | 2 |
| 10:00 | 1 |  | 3 | 2 | 1 | 2 | 0 | 2 | 2 |
| 11:00 | 3 |  | 3 | 1 | 4 | 1 | 0 | 3 | 2 |
| 12:00 | 0 |  | 1 | 2 | 1 | 0 | 1 | 1 | 1 |
| 13:00 | 4 |  | 1 | 1 | 0 | 0 | 0 | 2 | 1 |
| 14:00 | 1 |  | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 15:00 | 4 |  | 3 | 0 | 2 | 0 | 0 | 2 | 2 |
| 16:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17:00 | 0 |  | 2 | 1 | 0 | 0 | 1 | 1 | 1 |
| 18:00 | 0 |  | 1 | 2 | 0 | 0 | 0 | 1 | 1 |
| 19:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 26 |  | 28 | 22 | 13 | 4 | 2 | 22 | 16 |
| \% Heavies | 23.1\% |  | 17.9\% | 22.7\% | 38.5\% | 50.0\% | 0.0\% | 23.6\% | 24.2\% |



## austraffic

| Road | Quarry Access Road |  |  |
| :--- | :--- | :--- | ---: |
| Location | At 4343 Riverina Hwy |  |  |
| Suburb | Howlong | Average Weekday | 29 |
| Site No. | 1 | All Day Average | $21.1 \%$ |
| Start Date | Wednesday 25/09/2019 | Weekday Heavy's | $21.6 \%$ |
| All Day Heavy's |  |  |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 30-Sep |  | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 9 |  | 11 | 7 | 6 | 2 | 0 |  |  |
| PM Peak | 8 |  | 5 | 5 | 3 | 1 | 2 |  |  |
| 0:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5:00 | 0 |  | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 6:00 | 6 |  | 11 | 3 | 2 | 1 | 0 | 6 | 4 |
| 7:00 | 3 |  | 9 | 7 | 0 | 0 | 0 | 5 | 3 |
| 8:00 | 4 |  | 1 | 4 | 1 | 0 | 0 | 3 | 2 |
| 9:00 | 9 |  | 0 | 4 | 3 | 0 | 0 | 4 | 3 |
| 10:00 | 2 |  | 3 | 2 | 3 | 2 | 0 | 3 | 2 |
| 11:00 | 4 |  | 4 | 5 | 6 | 2 | 0 | 5 | 4 |
| 12:00 | 0 |  | 5 | 3 | 1 | 0 | 2 | 2 | 2 |
| 13:00 | 8 |  | 3 | 1 | 2 | 0 | 0 | 4 | 2 |
| 14:00 | 2 |  | 2 | 2 | 1 | 1 | 0 | 2 | 1 |
| 15:00 | 4 |  | 5 | 1 | 3 | 0 | 0 | 3 | 2 |
| 16:00 | 2 |  | 1 | 2 | 2 | 0 | 0 | 2 | 1 |
| 17:00 | 2 |  | 5 | 3 | 1 | 0 | 1 | 3 | 2 |
| 18:00 | 0 |  | 3 | 5 | 0 | 0 | 1 | 2 | 2 |
| 19:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23:00 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 46 |  | 52 | 43 | 25 | 6 | 4 | 42 | 29 |
| \% Heavies | 23.9\% |  | 15.4\% | 18.6\% | 32.0\% | 50.0\% | 0.0\% | 21.1\% | 21.6\% |



## austraffic

| Road | Riverina Hwy |  |  |
| :---: | :---: | :---: | :---: |
| Location | West Of Quarry Access Rd | Average Weekday | 1601 |
| Suburb | Howlong | All Day Average | 1448 |
| Site No. | 2 | Weekday Heavy's | 7.8\% |
| Start Date | Monday 23/09/2019 | All Day Heavy's | 7.2\% |
| Direction | Eastbound |  |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 23-Sep | 24-Sep | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 149 | 168 | 164 | 176 | 189 | 127 | 123 |  |  |
| PM Peak | 138 | 158 | 167 | 144 | 154 | 95 | 118 |  |  |
| 0:00 | 1 | 2 | 3 | 6 | 5 | 11 | 7 | 3 | 5 |
| 1:00 | 2 | 4 | 4 | 4 | 1 | 6 | 6 | 3 | 4 |
| 2:00 | 0 | 6 | 2 | 4 | 2 | 3 | 4 | 3 | 3 |
| 3:00 | 1 | 2 | 2 | 0 | 2 | 3 | 2 | 1 | 2 |
| 4:00 | 12 | 9 | 8 | 8 | 11 | 7 | 3 | 10 | 8 |
| 5:00 | 20 | 31 | 28 | 31 | 27 | 7 | 8 | 27 | 22 |
| 6:00 | 69 | 69 | 74 | 65 | 65 | 14 | 16 | 68 | 53 |
| 7:00 | 110 | 118 | 132 | 121 | 103 | 41 | 25 | 117 | 93 |
| 8:00 | 149 | 168 | 164 | 176 | 189 | 93 | 53 | 169 | 142 |
| 9:00 | 117 | 136 | 143 | 133 | 169 | 115 | 123 | 140 | 134 |
| 10:00 | 132 | 131 | 128 | 120 | 151 | 116 | 93 | 132 | 124 |
| 11:00 | 107 | 113 | 99 | 120 | 148 | 127 | 93 | 117 | 115 |
| 12:00 | 89 | 101 | 86 | 85 | 140 | 95 | 95 | 100 | 99 |
| 13:00 | 89 | 87 | 111 | 107 | 107 | 87 | 100 | 100 | 98 |
| 14:00 | 104 | 91 | 103 | 119 | 141 | 52 | 79 | 112 | 98 |
| 15:00 | 138 | 158 | 167 | 144 | 154 | 50 | 118 | 152 | 133 |
| 16:00 | 120 | 125 | 121 | 133 | 103 | 63 | 83 | 120 | 107 |
| 17:00 | 75 | 95 | 108 | 109 | 99 | 40 | 76 | 97 | 86 |
| 18:00 | 46 | 51 | 57 | 70 | 51 | 41 | 29 | 55 | 49 |
| 19:00 | 28 | 13 | 25 | 24 | 30 | 25 | 19 | 24 | 23 |
| 20:00 | 10 | 15 | 16 | 17 | 12 | 22 | 16 | 14 | 15 |
| 21:00 | 14 | 9 | 11 | 14 | 16 | 22 | 9 | 13 | 14 |
| 22:00 | 11 | 7 | 9 | 7 | 8 | 13 | 6 | 8 | 9 |
| 23:00 | 11 | 12 | 13 | 14 | 17 | 12 | 1 | 13 | 11 |
| Total | 1455 | 1553 | 1614 | 1631 | 1751 | 1065 | 1064 | 1601 | 1448 |
| \% Heavies | 7.4\% | 8.6\% | 9.2\% | 8.0\% | 6.2\% | 4.5\% | 4.6\% | 7.8\% | 7.2\% |



## austraffic

| Road | Riverina Hwy |  | 1556 |
| :--- | :--- | :--- | ---: |
| Location | West Of Quarry Access Rd | Average Weekday | 1401 |
| Suburb | Howlong | All Day Average $13.2 \%$ <br> Site No. 2 | Weekday Heavy's |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 23-Sep | 24-Sep | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 92 | 107 | 104 | 96 | 134 | 96 | 101 |  |  |
| PM Peak | 157 | 174 | 176 | 165 | 174 | 123 | 126 |  |  |
| 0:00 | 2 | 0 | 0 | 5 | 1 | 2 | 5 | 2 | 2 |
| 1:00 | 0 | 1 | 0 | 2 | 2 | 5 | 8 | 1 | 3 |
| 2:00 | 2 | 2 | 1 | 0 | 1 | 2 | 6 | 1 | 2 |
| 3:00 | 2 | 0 | 1 | 2 | 0 | 2 | 4 | 1 | 2 |
| 4:00 | 9 | 2 | 3 | 8 | 2 | 1 | 3 | 5 | 4 |
| 5:00 | 17 | 23 | 25 | 29 | 19 | 8 | 3 | 23 | 18 |
| 6:00 | 76 | 90 | 84 | 84 | 72 | 33 | 15 | 81 | 65 |
| 7:00 | 82 | 84 | 89 | 81 | 82 | 32 | 23 | 84 | 68 |
| 8:00 | 81 | 101 | 104 | 92 | 96 | 50 | 30 | 95 | 79 |
| 9:00 | 67 | 69 | 89 | 92 | 92 | 62 | 64 | 82 | 76 |
| 10:00 | 92 | 65 | 82 | 72 | 114 | 92 | 73 | 85 | 84 |
| 11:00 | 86 | 107 | 80 | 96 | 134 | 96 | 101 | 101 | 100 |
| 12:00 | 101 | 88 | 96 | 93 | 110 | 115 | 126 | 98 | 104 |
| 13:00 | 89 | 103 | 102 | 98 | 124 | 123 | 111 | 103 | 107 |
| 14:00 | 115 | 128 | 133 | 127 | 154 | 92 | 96 | 131 | 121 |
| 15:00 | 109 | 138 | 127 | 127 | 163 | 54 | 78 | 133 | 114 |
| 16:00 | 156 | 174 | 176 | 165 | 174 | 69 | 82 | 169 | 142 |
| 17:00 | 157 | 164 | 140 | 137 | 161 | 51 | 55 | 152 | 124 |
| 18:00 | 93 | 88 | 70 | 78 | 74 | 49 | 46 | 81 | 71 |
| 19:00 | 34 | 34 | 52 | 38 | 51 | 14 | 24 | 42 | 35 |
| 20:00 | 34 | 30 | 27 | 43 | 38 | 19 | 17 | 34 | 30 |
| 21:00 | 20 | 24 | 23 | 34 | 25 | 14 | 19 | 25 | 23 |
| 22:00 | 16 | 16 | 22 | 25 | 27 | 18 | 13 | 21 | 20 |
| 23:00 | 3 | 5 | 11 | 10 | 10 | 17 | 5 | 8 | 9 |
| Total | 1443 | 1536 | 1537 | 1538 | 1726 | 1020 | 1007 | 1556 | 1401 |
| \% Heavies | 13.4\% | 14.6\% | 14.1\% | 13.2\% | 11.0\% | 10.9\% | 10.6\% | 13.2\% | 12.7\% |



## austraffic

| Road | Riverina Hwy |  |  |
| :--- | :--- | :--- | ---: |
| Location | West Of Quarry Access Rd | Average Weekday | 2849 |
| Suburb | Howlong |   <br> Site No. 2 | All Day Average |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 23-Sep | 24-Sep | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 230 | 269 | 268 | 268 | 285 | 223 | 194 |  |  |
| PM Peak | 276 | 299 | 297 | 298 | 317 | 210 | 221 |  |  |
| 0:00 | 3 | 2 | 3 | 11 | 6 | 13 | 12 | 5 | 7 |
| 1:00 | 2 | 5 | 4 | 6 | 3 | 11 | 14 | 4 | 6 |
| 2:00 | 2 | 8 | 3 | 4 | 3 | 5 | 10 | 4 | 5 |
| 3:00 | 3 | 2 | 3 | 2 | 2 | 5 | 6 | 2 | 3 |
| 4:00 | 21 | 11 | 11 | 16 | 13 | 8 | 6 | 14 | 12 |
| 5:00 | 37 | 54 | 53 | 60 | 46 | 15 | 11 | 50 | 39 |
| 6:00 | 145 | 159 | 158 | 149 | 137 | 47 | 31 | 150 | 118 |
| 7:00 | 192 | 202 | 221 | 202 | 185 | 73 | 48 | 200 | 160 |
| 8:00 | 230 | 269 | 268 | 268 | 285 | 143 | 83 | 264 | 221 |
| 9:00 | 184 | 205 | 232 | 225 | 261 | 177 | 187 | 221 | 210 |
| 10:00 | 224 | 196 | 210 | 192 | 265 | 208 | 166 | 217 | 209 |
| 11:00 | 193 | 220 | 179 | 216 | 282 | 223 | 194 | 218 | 215 |
| 12:00 | 190 | 189 | 182 | 178 | 250 | 210 | 221 | 198 | 203 |
| 13:00 | 178 | 190 | 213 | 205 | 231 | 210 | 211 | 203 | 205 |
| 14:00 | 219 | 219 | 236 | 246 | 295 | 144 | 175 | 243 | 219 |
| 15:00 | 247 | 296 | 294 | 271 | 317 | 104 | 196 | 285 | 246 |
| 16:00 | 276 | 299 | 297 | 298 | 277 | 132 | 165 | 289 | 249 |
| 17:00 | 232 | 259 | 248 | 246 | 260 | 91 | 131 | 249 | 210 |
| 18:00 | 139 | 139 | 127 | 148 | 125 | 90 | 75 | 136 | 120 |
| 19:00 | 62 | 47 | 77 | 62 | 81 | 39 | 43 | 66 | 59 |
| 20:00 | 44 | 45 | 43 | 60 | 50 | 41 | 33 | 48 | 45 |
| 21:00 | 34 | 33 | 34 | 48 | 41 | 36 | 28 | 38 | 36 |
| 22:00 | 27 | 23 | 31 | 32 | 35 | 31 | 19 | 30 | 28 |
| 23:00 | 14 | 17 | 24 | 24 | 27 | 29 | 6 | 21 | 20 |
| Total | 2898 | 3089 | 3151 | 3169 | 3477 | 2085 | 2071 | 3157 | 2849 |
| \% Heavies | 10.4\% | 11.6\% | 11.6\% | 10.5\% | 8.6\% | 7.6\% | 7.5\% | 10.5\% | 9.9\% |



## austraffic

| Road | Stuart St |  | 1053 |
| :--- | :--- | :--- | ---: |
| Location | South Of Riverina Hwy | Average Weekday | 1000 |
| Suburb | Howlong | $23.3 \%$ |  |
| Site No. | 3 | All Day Average | Weekday Heavy's |
| Start Date | Monday 23/09/2019 | All Day Heavy's |  |
| Direction | Northbound |  |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 23-Sep | 24-Sep | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 78 | 74 | 73 | 78 | 96 | 102 | 88 |  |  |
| PM Peak | 90 | 102 | 101 | 97 | 101 | 88 | 93 |  |  |
| 0:00 | 2 | 1 | 4 | 5 | 7 | 4 | 3 | 4 | 4 |
| 1:00 | 3 | 2 | 4 | 0 | 2 | 1 | 1 | 2 | 2 |
| 2:00 | 3 | 5 | 1 | 5 | 3 | 2 | 0 | 3 | 3 |
| 3:00 | 2 | 1 | 5 | 6 | 3 | 2 | 3 | 3 | 3 |
| 4:00 | 5 | 9 | 4 | 10 | 10 | 3 | 4 | 8 | 6 |
| 5:00 | 19 | 17 | 26 | 17 | 23 | 10 | 4 | 20 | 17 |
| 6:00 | 54 | 72 | 70 | 60 | 40 | 20 | 15 | 59 | 47 |
| 7:00 | 66 | 65 | 70 | 68 | 49 | 29 | 19 | 64 | 52 |
| 8:00 | 64 | 74 | 69 | 78 | 81 | 49 | 47 | 73 | 66 |
| 9:00 | 55 | 68 | 67 | 52 | 69 | 82 | 65 | 62 | 65 |
| 10:00 | 78 | 64 | 73 | 50 | 81 | 102 | 57 | 69 | 72 |
| 11:00 | 71 | 73 | 62 | 65 | 96 | 100 | 88 | 73 | 79 |
| 12:00 | 74 | 61 | 62 | 60 | 91 | 88 | 93 | 70 | 76 |
| 13:00 | 63 | 67 | 71 | 78 | 101 | 87 | 82 | 76 | 78 |
| 14:00 | 74 | 74 | 79 | 94 | 75 | 51 | 87 | 79 | 76 |
| 15:00 | 83 | 70 | 96 | 97 | 99 | 40 | 71 | 89 | 79 |
| 16:00 | 90 | 102 | 88 | 94 | 80 | 44 | 74 | 91 | 82 |
| 17:00 | 77 | 87 | 101 | 85 | 67 | 41 | 64 | 83 | 75 |
| 18:00 | 52 | 45 | 52 | 63 | 52 | 39 | 35 | 53 | 48 |
| 19:00 | 28 | 23 | 20 | 23 | 29 | 24 | 26 | 25 | 25 |
| 20:00 | 17 | 17 | 18 | 16 | 8 | 26 | 9 | 15 | 16 |
| 21:00 | 13 | 12 | 13 | 10 | 15 | 10 | 5 | 13 | 11 |
| 22:00 | 11 | 7 | 12 | 10 | 10 | 13 | 6 | 10 | 10 |
| 23:00 | 5 | 7 | 10 | 10 | 9 | 5 | 3 | 8 | 7 |
| Total | 1009 | 1023 | 1077 | 1056 | 1100 | 872 | 861 | 1053 | 1000 |
| \% Heavies | 27.8\% | 22.4\% | 25.9\% | 23.3\% | 17.5\% | 14.8\% | 14.2\% | 23.3\% | 21.1\% |



## austraffic

| Road | Stuart St |  | 1065 |
| :--- | :--- | :--- | ---: |
| Location | South Of Riverina Hwy | Average Weekday | 1016 |
| Suburb | Howlong | All Day Average | $18.0 \%$ |
| Site No. | 3 | Weekday Heavy's | $16.1 \%$ |
| Start Date | Monday 23/09/2019 | All Day Heavy's |  |
| Direction | Southbound |  |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 23-Sep | 24-Sep | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 72 | 81 | 79 | 78 | 84 | 94 | 95 |  |  |
| PM Peak | 101 | 115 | 117 | 102 | 114 | 106 | 85 |  |  |
| 0:00 | 2 | 1 | 2 | 3 | 1 | 3 | 3 | 2 | 2 |
| 1:00 | 0 | 1 | 2 | 1 | 4 | 1 | 2 | 2 | 2 |
| 2:00 | 3 | 2 | 3 | 4 | 3 | 0 | 4 | 3 | 3 |
| 3:00 | 4 | 7 | 3 | 6 | 6 | 3 | 2 | 5 | 4 |
| 4:00 | 4 | 9 | 4 | 4 | 3 | 2 | 3 | 5 | 4 |
| 5:00 | 28 | 22 | 22 | 23 | 11 | 14 | 4 | 21 | 18 |
| 6:00 | 41 | 44 | 49 | 39 | 20 | 13 | 8 | 39 | 31 |
| 7:00 | 72 | 81 | 79 | 78 | 43 | 38 | 22 | 71 | 59 |
| 8:00 | 46 | 61 | 58 | 46 | 56 | 62 | 49 | 53 | 54 |
| 9:00 | 62 | 78 | 65 | 62 | 77 | 93 | 63 | 69 | 71 |
| 10:00 | 72 | 48 | 65 | 56 | 71 | 94 | 95 | 62 | 72 |
| 11:00 | 62 | 68 | 66 | 63 | 84 | 90 | 94 | 69 | 75 |
| 12:00 | 70 | 79 | 75 | 76 | 88 | 106 | 85 | 78 | 83 |
| 13:00 | 68 | 59 | 88 | 72 | 92 | 83 | 85 | 76 | 78 |
| 14:00 | 62 | 75 | 89 | 80 | 94 | 62 | 65 | 80 | 75 |
| 15:00 | 92 | 99 | 93 | 94 | 114 | 55 | 71 | 98 | 88 |
| 16:00 | 80 | 90 | 117 | 95 | 98 | 39 | 53 | 96 | 82 |
| 17:00 | 101 | 115 | 102 | 102 | 114 | 58 | 60 | 107 | 93 |
| 18:00 | 65 | 68 | 65 | 58 | 70 | 37 | 43 | 65 | 58 |
| 19:00 | 23 | 14 | 22 | 26 | 16 | 28 | 21 | 20 | 21 |
| 20:00 | 12 | 13 | 21 | 9 | 14 | 15 | 8 | 14 | 13 |
| 21:00 | 9 | 10 | 13 | 14 | 21 | 13 | 7 | 13 | 12 |
| 22:00 | 5 | 3 | 7 | 8 | 9 | 11 | 4 | 6 | 7 |
| 23:00 | 3 | 8 | 14 | 16 | 14 | 11 | 5 | 11 | 10 |
| Total | 986 | 1055 | 1124 | 1035 | 1123 | 931 | 856 | 1065 | 1016 |
| \% Heavies | 21.1\% | 17.7\% | 19.5\% | 18.6\% | 13.5\% | 10.6\% | 10.4\% | 18.0\% | 16.1\% |



## austraffic

| Road | Stuart St |  |  |
| :--- | :--- | :--- | ---: |
| Location | South Of Riverina Hwy | 2118 |  |
| Suburb | Howlong | Average Weekday | 2015 |
| Site No. | 3 | All Day Average $20.6 \%$ <br> Start Date Monday 23/09/2019 | Weekday Heavy's |
| All Day Heavy's | $18.6 \%$ |  |  |


| Starting Time | Day of Week |  |  |  |  |  |  | Ave W'day | All Days Ave |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mon | Tue | Wed | Thu | Fri | Sat | Sun |  |  |
|  | 23-Sep | 24-Sep | 25-Sep | 26-Sep | 27-Sep | 28-Sep | 29-Sep |  |  |
| AM Peak | 150 | 146 | 149 | 146 | 180 | 196 | 182 |  |  |
| PM Peak | 178 | 202 | 205 | 191 | 213 | 194 | 178 |  |  |
| 0:00 | 4 | 2 | 6 | 8 | 8 | 7 | 6 | 6 | 6 |
| 1:00 | 3 | 3 | 6 | 1 | 6 | 2 | 3 | 4 | 3 |
| 2:00 | 6 | 7 | 4 | 9 | 6 | 2 | 4 | 6 | 5 |
| 3:00 | 6 | 8 | 8 | 12 | 9 | 5 | 5 | 9 | 8 |
| 4:00 | 9 | 18 | 8 | 14 | 13 | 5 | 7 | 12 | 11 |
| 5:00 | 47 | 39 | 48 | 40 | 34 | 24 | 8 | 42 | 34 |
| 6:00 | 95 | 116 | 119 | 99 | 60 | 33 | 23 | 98 | 78 |
| 7:00 | 138 | 146 | 149 | 146 | 92 | 67 | 41 | 134 | 111 |
| 8:00 | 110 | 135 | 127 | 124 | 137 | 111 | 96 | 127 | 120 |
| 9:00 | 117 | 146 | 132 | 114 | 146 | 175 | 128 | 131 | 137 |
| 10:00 | 150 | 112 | 138 | 106 | 152 | 196 | 152 | 132 | 144 |
| 11:00 | 133 | 141 | 128 | 128 | 180 | 190 | 182 | 142 | 155 |
| 12:00 | 144 | 140 | 137 | 136 | 179 | 194 | 178 | 147 | 158 |
| 13:00 | 131 | 126 | 159 | 150 | 193 | 170 | 167 | 152 | 157 |
| 14:00 | 136 | 149 | 168 | 174 | 169 | 113 | 152 | 159 | 152 |
| 15:00 | 175 | 169 | 189 | 191 | 213 | 95 | 142 | 187 | 168 |
| 16:00 | 170 | 192 | 205 | 189 | 178 | 83 | 127 | 187 | 163 |
| 17:00 | 178 | 202 | 203 | 187 | 181 | 99 | 124 | 190 | 168 |
| 18:00 | 117 | 113 | 117 | 121 | 122 | 76 | 78 | 118 | 106 |
| 19:00 | 51 | 37 | 42 | 49 | 45 | 52 | 47 | 45 | 46 |
| 20:00 | 29 | 30 | 39 | 25 | 22 | 41 | 17 | 29 | 29 |
| 21:00 | 22 | 22 | 26 | 24 | 36 | 23 | 12 | 26 | 24 |
| 22:00 | 16 | 10 | 19 | 18 | 19 | 24 | 10 | 16 | 17 |
| 23:00 | 8 | 15 | 24 | 26 | 23 | 16 | 8 | 19 | 17 |
| Total | 1995 | 2078 | 2201 | 2091 | 2223 | 1803 | 1717 | 2118 | 2015 |
| \% Heavies | 24.5\% | 20.0\% | 22.6\% | 21.0\% | 15.5\% | 12.6\% | 12.3\% | 20.6\% | 18.6\% |



## Appendix B

Sidra Intersection Outputs

## MOVEMENT SUMMARY

## sTof Site: 101 [Existing 2019 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road
2019 Surveyed
AM Peak
Site Category: (None)
Stop (Two-Way)


Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

## stof Site: 101 [Existing 2019 PM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road
2019 Surveyed
PM Peak
Site Category: (None)
Stop (Two-Way)


Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

Site: 101 [Baseline 2029 AM Riverina Hwy and Quarry Access]
Riverina Highway and Quarry Access Road
2029 Baseline No Project
AM Peak
Site Category: (None)
Stop (Two-Way)

| Movement Performance - Vehicles |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Mov ID | Turn | Demand Total veh/h | Flows <br> HV <br> \% | Deg. Satn v/c | Average Delay sec | Level of Service | 95\% Back <br> Vehicles <br> veh | of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
| South: Quarry Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | L2 | 1 | 0.0 | 0.002 | 4.5 | LOS A | 0.0 | 0.1 | 0.26 | 0.85 | 0.26 | 40.4 |
| 3 | R2 | 1 | 0.0 | 0.002 | 9.4 | LOS A | 0.0 | 0.1 | 0.26 | 0.85 | 0.26 | 36.3 |
| Appr |  | 2 | 0.0 | 0.002 | 6.9 | LOS A | 0.0 | 0.1 | 0.26 | 0.85 | 0.26 | 38.2 |
| East: Riverina Hwy East |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | L2 | 1 | 0.0 | 0.063 | 7.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 88.3 |
| 5 | T1 | 111 | 16.2 | 0.063 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 99.4 |
| Approad | ch | 112 | 16.0 | 0.063 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 99.2 |
| North: Property Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | R2 | 1 | 0.0 | 0.002 | 6.0 | LOS A | 0.0 | 0.0 | 0.39 | 0.82 | 0.39 | 30.4 |
| Appr |  | 1 | 0.0 | 0.002 | 6.0 | LOS A | 0.0 | 0.0 | 0.39 | 0.82 | 0.39 | 30.4 |
| West: Riverina Hwy West |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | L2 | 1 | 0.0 | 0.111 | 9.0 | LOS A | 0.1 | 0.6 | 0.02 | 0.02 | 0.02 | 33.5 |
| 11 | T1 | 197 | 6.4 | 0.111 | 0.1 | LOS A | 0.1 | 0.6 | 0.02 | 0.02 | 0.02 | 99.3 |
| 12 | R2 | 4 | 50.0 | 0.111 | 10.0 | LOS A | 0.1 | 0.6 | 0.02 | 0.02 | 0.02 | 34.0 |
| Appr |  | 202 | 7.3 | 0.111 | 0.3 | NA | 0.1 | 0.6 | 0.02 | 0.02 | 0.02 | 94.6 |
| All Ve | icles | 317 | 10.3 | 0.111 | 0.3 | NA | 0.1 | 0.6 | 0.02 | 0.02 | 0.02 | 94.5 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

## stap Site: 101 [Baseline 2029 PM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road
2029 Baseline No Project
PM Peak
Site Category: (None)
Stop (Two-Way)

| Movement Performance - Vehicles |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Mov Turn ID | Demand <br> Total <br> veh/h | $\begin{gathered} \text { Flows } \\ \text { HV } \\ \% \end{gathered}$ | Deg. Satn v/c | Average Delay sec | Level of Service | 95\% Back Vehicles veh | of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
| South: Quarry Access Rd |  |  |  |  |  |  |  |  |  |  |  |
| 1 L2 | 2 | 50.0 | 0.005 | 7.8 | LOS A | 0.0 | 0.3 | 0.40 | 0.89 | 0.40 | 35.0 |
| 3 R2 | 1 | 0.0 | 0.005 | 9.6 | LOS A | 0.0 | 0.3 | 0.40 | 0.89 | 0.40 | 35.9 |
| Approach | 3 | 33.3 | 0.005 | 8.4 | LOS A | 0.0 | 0.3 | 0.40 | 0.89 | 0.40 | 35.3 |
| East: Riverina Hwy East |  |  |  |  |  |  |  |  |  |  |  |
| 4 L2 | 1 | 0.0 | 0.109 | 7.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 88.4 |
| $5 \quad$ T1 | 197 | 11.8 | 0.109 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 99.6 |
| Approach | 198 | 11.7 | 0.109 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 99.5 |
| North: Property Access Rd |  |  |  |  |  |  |  |  |  |  |  |
| 9 R2 | 1 | 0.0 | 0.002 | 6.2 | LOS A | 0.0 | 0.0 | 0.40 | 0.82 | 0.40 | 30.4 |
| Approach | 1 | 0.0 | 0.002 | 6.2 | LOS A | 0.0 | 0.0 | 0.40 | 0.82 | 0.40 | 30.4 |
| West: Riverina Hwy West |  |  |  |  |  |  |  |  |  |  |  |
| 10 L2 | 1 | 0.0 | 0.075 | 8.2 | LOS A | 0.0 | 0.1 | 0.01 | 0.01 | 0.01 | 33.5 |
| 11 T1 | 139 | 6.1 | 0.075 | 0.0 | LOS A | 0.0 | 0.1 | 0.01 | 0.01 | 0.01 | 99.6 |
| 12 R2 | 1 | 0.0 | 0.075 | 8.1 | LOS A | 0.0 | 0.1 | 0.01 | 0.01 | 0.01 | 34.1 |
| Approach | 141 | 6.0 | 0.075 | 0.1 | NA | 0.0 | 0.1 | 0.01 | 0.01 | 0.01 | 96.8 |
| All Vehicles | 343 | 9.5 | 0.109 | 0.2 | NA | 0.0 | 0.3 | 0.01 | 0.02 | 0.01 | 96.1 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

## sTaF Site: 101 [Project 2019 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road
2019 With Project
AM Peak
Site Category: (None)
Stop (Two-Way)

| Movement Performance - Vehicles |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Mov } \\ & \text { ID } \end{aligned}$ |  | Demand <br> Total veh/h | $\begin{array}{r} \text { Flows } \\ \text { HV } \\ \% \end{array}$ | Deg. Satn v/c | Average Delay sec | Level of Service | 95\% Back Vehicles veh | of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average <br> Speed km/h |
| South: Quarry Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | L2 | 7 | 85.7 | 0.016 | 8.3 | LOS A | 0.1 | 1.4 | 0.32 | 1.00 | 0.32 | 32.2 |
| 3 | R2 | 1 | 0.0 | 0.016 | 9.3 | LOS A | 0.1 | 1.4 | 0.32 | 1.00 | 0.32 | 36.0 |
| Appr |  | 8 | 75.0 | 0.016 | 8.4 | LOS A | 0.1 | 1.4 | 0.32 | 1.00 | 0.32 | 32.7 |
| East: Riverina Hwy East |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | L2 | 1 | 0.0 | 0.057 | 7.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 88.2 |
| 5 | T1 | 100 | 15.8 | 0.057 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 99.3 |
| Appr |  | 101 | 15.6 | 0.057 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 99.2 |
| North: Property Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | R2 | 1 | 0.0 | 0.001 | 6.0 | LOS A | 0.0 | 0.0 | 0.38 | 0.82 | 0.38 | 30.4 |
| Appr |  | 1 | 0.0 | 0.001 | 6.0 | LOS A | 0.0 | 0.0 | 0.38 | 0.82 | 0.38 | 30.4 |
| West: Riverina Hwy West |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | L2 | 1 | 0.0 | 0.110 | 9.7 | LOS A | 0.2 | 1.6 | 0.05 | 0.03 | 0.05 | 33.4 |
| 11 | T1 | 178 | 6.5 | 0.110 | 0.2 | LOS A | 0.2 | 1.6 | 0.05 | 0.03 | 0.05 | 99.0 |
| 12 | R2 | 7 | 85.7 | 0.110 | 11.7 | LOS A | 0.2 | 1.6 | 0.05 | 0.03 | 0.05 | 34.0 |
| Approach |  | 186 | 9.6 | 0.110 | 0.7 | NA | 0.2 | 1.6 | 0.05 | 0.03 | 0.05 | 91.1 |
| All Vehicles |  | 297 | 13.5 | 0.110 | 0.7 | NA | 0.2 | 1.6 | 0.04 | 0.05 | 0.04 | 88.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

ज्ञाणF Site: 101 [Project 2019 PM Riverina Hwy and Quarry Access]
Riverina Highway and Quarry Access Road
2019 With Project
PM Peak
Site Category: (None)
Stop (Two-Way)


Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

## siof Site: 101 [Project 2029 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road
2029 With Project
AM Peak
Site Category: (None)
Stop (Two-Way)

| Movement Performance - Vehicles |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Mov } \\ & \text { ID } \end{aligned}$ |  | Demand <br> Total veh/h | $\begin{array}{r} \text { Flows } \\ \text { HV } \\ \% \end{array}$ | Deg. Satn v/c | Average Delay sec | Level of Service | 95\% Back Vehicles veh | of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average <br> Speed km/h |
| South: Quarry Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | L2 | 7 | 85.7 | 0.017 | 8.5 | LOS A | 0.1 | 1.4 | 0.34 | 1.00 | 0.34 | 32.2 |
| 3 | R2 | 1 | 0.0 | 0.017 | 9.6 | LOS A | 0.1 | 1.4 | 0.34 | 1.00 | 0.34 | 35.9 |
| Appr |  | 8 | 75.0 | 0.017 | 8.7 | LOS A | 0.1 | 1.4 | 0.34 | 1.00 | 0.34 | 32.6 |
| East: Riverina Hwy East |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | L2 | 1 | 0.0 | 0.063 | 7.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 88.3 |
| 5 | T1 | 111 | 16.2 | 0.063 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 99.4 |
| Appr |  | 112 | 16.0 | 0.063 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.01 | 0.00 | 99.2 |
| North: Property Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | R2 | 1 | 0.0 | 0.002 | 6.2 | LOS A | 0.0 | 0.0 | 0.40 | 0.82 | 0.40 | 30.3 |
| Appr |  | 1 | 0.0 | 0.002 | 6.2 | LOS A | 0.0 | 0.0 | 0.40 | 0.82 | 0.40 | 30.3 |
| West: Riverina Hwy West |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | L2 | 1 | 0.0 | 0.121 | 10.0 | LOS A | 0.2 | 1.7 | 0.05 | 0.03 | 0.05 | 33.4 |
| 11 | T1 | 198 | 6.9 | 0.121 | 0.2 | LOS A | 0.2 | 1.7 | 0.05 | 0.03 | 0.05 | 99.0 |
| 12 | R2 | 7 | 85.7 | 0.121 | 12.0 | LOS A | 0.2 | 1.7 | 0.05 | 0.03 | 0.05 | 34.0 |
| Approach |  | 206 | 9.7 | 0.121 | 0.7 | NA | 0.2 | 1.7 | 0.05 | 0.03 | 0.05 | 91.8 |
| All Vehicles |  | 327 | 13.5 | 0.121 | 0.7 | NA | 0.2 | 1.7 | 0.04 | 0.05 | 0.04 | 89.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

strof Site: 101 [Project 2029 PM Riverina Hwy and Quarry Access]
Riverina Highway and Quarry Access Road
2029 With Project
PM Peak
Site Category: (None)
Stop (Two-Way)

| Movement Performance - Vehicles |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Mov } \\ & \text { ID } \end{aligned}$ |  | Demand <br> Total <br> veh/h | $\begin{gathered} \text { Flows } \\ \text { HV } \\ \% \end{gathered}$ | Deg. Satn v/c | Average Delay sec | Level of Service | 95\% Back Vehicles veh | of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average <br> Speed km/h |
| South: Quarry Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | L2 | 7 | 85.7 | 0.020 | 10.9 | LOS A | 0.1 | 1.7 | 0.46 | 0.97 | 0.46 | 31.6 |
| 3 | R2 | 1 | 0.0 | 0.020 | 9.8 | LOS A | 0.1 | 1.7 | 0.46 | 0.97 | 0.46 | 35.3 |
| Appr |  | 8 | 75.0 | 0.020 | 10.8 | LOS A | 0.1 | 1.7 | 0.46 | 0.97 | 0.46 | 32.1 |
| East: Riverina Hwy East |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | L2 | 1 | 0.0 | 0.109 | 7.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 88.4 |
| 5 | T1 | 197 | 11.8 | 0.109 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 99.6 |
| Appr |  | 198 | 11.7 | 0.109 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 99.5 |
| North: Property Access Rd |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | R2 | 1 | 0.0 | 0.002 | 6.5 | LOS A | 0.0 | 0.0 | 0.42 | 0.82 | 0.42 | 30.3 |
| Appr |  | 1 | 0.0 | 0.002 | 6.5 | LOS A | 0.0 | 0.0 | 0.42 | 0.82 | 0.42 | 30.3 |
| West: Riverina Hwy West |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | L2 | 1 | 0.0 | 0.092 | 11.9 | LOS A | 0.3 | 2.2 | 0.10 | 0.04 | 0.10 | 33.3 |
| 11 | T1 | 140 | 6.8 | 0.092 | 0.6 | LOS A | 0.3 | 2.2 | 0.10 | 0.04 | 0.10 | 97.5 |
| 12 | R2 | 7 | 85.7 | 0.092 | 13.9 | LOS A | 0.3 | 2.2 | 0.10 | 0.04 | 0.10 | 33.8 |
| Approach |  | 148 | 10.6 | 0.092 | 1.4 | NA | 0.3 | 2.2 | 0.10 | 0.04 | 0.10 | 88.0 |
| All Vehicles |  | 356 | 12.7 | 0.109 | 0.9 | NA | 0.3 | 2.2 | 0.05 | 0.04 | 0.05 | 89.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## Appendix C

Intersection Treatment Concept Plan



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