Austen Quarry
Stage 2 Extension Project
via Hartley, NSW
Road Transport Assessment

transportation planning, design and delivery

13S9027000 17/09/14

GTAconsultants

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Stage 2 Extension Project, via Hartley, NSW

Road Transport Assessment

Issue: D 17/09/14

Client: Hy-Tec Industries Pty Ltd
Reference: 13S9027000
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	7/02/14	Final	Kelly Yoon	Penny Dalton	Ken Hollyoak	Ken Hollyoak
B	26/05/14	Final	Kelly Yoon	Penny Dalton	Ken Hollyoak	Ken Hollyoak
C	30/05/14	Final	Kelly Yoon	Penny Dalton	Ken Hollyoak	Ken Hollyoak
D	17/09/14	Final	Kelly Yoon	Penny Dalton	Ken Hollyoak	

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1. Introduction

1.1 Scope of Assessment

This report has been prepared on behalf of Hy-Tec Industries Pty Ltd (Hy-Tec) to present the findings of an assessment of a proposed extension to the existing extraction area and overburden emplacement at the Austen Quarry (the Proposal). The Austen Quarry is located 3.5 kilometres (km) south-southwest of Hartley village and 10 km south of Lithgow; approximately 100km west of Sydney (see **Figure 2.1**). The Austen Quarry is accessed via the Quarry Access Road off Jenolan Caves Road.

This report focuses on the traffic engineering aspects of the Proposal and forms one of the supporting reports for the Environmental Impact Statement (EIS) for the Proposal. Matters relating to rail transport and consultation with roadside residents are not included in this report and are addressed separately in the EIS.

The Austen Quarry is Hy-Tec's hard rock quarry immediately west of the Blue Mountains, distributing rhyolite aggregates and road pavement products to both local area projects and regional destinations. It has been despatching products since 2005. The products produced at the Quarry are primarily used for concrete production, road works, asphalting, rail infrastructure and landscaping purposes and are despatched between 5:00am and 10:00pm Monday to Friday and 5.00am and 3.00pm Saturday, public holidays excluded.

Hy-Tec proposes to apply for a new development consent to extend the extraction area and overburden emplacement within the Quarry whilst maintaining the maximum annual product despatch rate of 1,100,000 tonnes per annum (tpa) from the Austen Quarry[1]. This report has been prepared to present the findings of a review of the existing and expected future road transport conditions throughout the proposed extended operational life of the Austen Quarry in order to identify the implications of the Proposal and any measures required to mitigate the Proposal's impacts on the road network.

The remainder of the report is set out as follows:

- Section 2 discusses the existing operations at the Austen Quarry, and the road transport aspects of the Proposal.
- Section 3 describes the existing road network, and presents a review of the existing performance of the road network with regard to Levels of Service on key roads, delays at intersections, and the safety history of the road network used by trucks travelling to and from the Austen Quarry.
- Section 4 describes the changes which are expected to occur to the road transport environment assuming the Quarry operates at its maximum permitted despatch rate until its current approval ceases, including growth in background traffic not associated with the Quarry, and changes to the road network.
- Section 5 assesses the traffic generation of the Proposal and the impacts of that traffic on the efficiency and safety of the road network.
- Section 6 addresses the recommended mitigation measures relevant to the Proposal.
- Section 7 presents a summary of the report and the conclusions of the assessment.

1.2 Coverage of Director-General's Requirements

Table 1.1 lists the issues raised in the Director-General's Requirements, together with reference to the sections of this report where each issue is addressed.

[1] The production rate of 1,100,000 tpa has been confirmed by Lithgow City Council in correspondence to the NSW Environment Protection Authority following an application by Hy-Tec to increase the activity limits on Environment Protection Licence 12323.

Table 1.1: Coverage of Traffic and Transport-Related Director-General's Requirements

Director-General's Requirements	Relevant Section(s)
The EIS must include: • accurate predictions of the road and rail traffic generated by the construction and operation of the development;	3.10 4.3 5.1
• an assessment of potential traffic impacts on the safety and efficiency of the road network; and	4.6 4.8 5.3 5.4
• a detailed description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail networks in the surrounding area over the life of the development.	6

Table 1.2 lists the issues raised in the correspondence from Roads and Maritime Services (RMS), Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS), Lithgow City Council (LCC) and Blue Mountains City Council (BMCC), together with reference to the sections of this report where each issue is addressed.

Table 1.2: Coverage of Traffic and Transport-Related Agency Requirements

Organisation	Issues Raised by Agency	Relevant Section(s)
RMS (15/08/13)	Consider the potential impacts to the safety and efficiency of the classified road network.	5.3 5.4 5.5 5.8
	The EIS should include a Traffic Impact Assessment (TIA) that takes into account the key issues relevant to the scale of this proposal as set out in Table 2.1 of the Roads and Traffic Authority "Guide to Traffic Generating Developments" as well as information relating to:	Table 1.3
	the impact of the proposed development on the surrounding road network;	5
	the number and type of vehicles required to service the quarry;	2.2 3.10 4.3 5.1
	details of existing and proposed access conditions;	3.1.1 3.1.2
	intersection sight distances	3.1.1 3.1.2
	impact on Transport (i.e. School Bus Routes);	5.6
	road traffic noise and dust generation;	Elsewhere in EIS
	considerations for mining & extractive industries under Clause 16(1) of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007.	Elsewhere in EIS
	The TIA should consider the AUSTROADS "Checklist for Traffic Impact Assessments" that is Appendix A of the Guide to Traffic Management Part 12: Traffic Impacts of Development 2009 (provided with the agency submission to the DGRs).	Table 1.4
DTIRIS (19/08/13)	Document route(s) used to transport quarry products to market.	2.2 5.1
Lithgow City Council (03/09/13)	Consider the need for upgrades to the Glenroy Bridge based on the total number of trucks expected to use the bridge each day.	5.3
BMCC (29/08/13)	Consider the risks associated with heavy truck transport of materials as they cross the Blue Mountains.	5.7
	Consider rail transport as an alternative transportation method of materials.	Elsewhere in EIS

As referenced above, **Table 1.3** sets out the key issues set out in the RMS's "Guide to Traffic Generating Development" and **Table 1.4** sets out the Austroads technical checklist. Both tables include reference to the sections of this report where each issue is addressed, noting that because the Proposal refers to continued operation of an existing functioning facility, many of the design-based aspects of these checklists are not relevant in this instance. Furthermore, as no changes are proposed to on-site / off-site parking or pedestrian routes/public transport routes, references to these in the table have been annotated as 'no change'.

Table 1.3: RTA Guide to Traffic Generating Developments Standard Key Issues for Impact Studies

Procedures & Key Parameters	Relevant Section(s)
Brief description of the development	1.1
Application and study process	1.1
Introduction	
Background	1.1
Scope of report	1.1
The key issues and objectives of a traffic impact study	1.1
General Data Collection / Existing Conditions	
Description of the Site and Proposed Activity	2.2, 2.3
Site location	2.1
Current land use characteristics (zoning) of the proposed site and land use in the vicinity	3.1
Site access	3.1.1
The Existing Traffic Conditions	3.1
Road hierarchy; including the identification of the classified road network (major and minor roads) which may be affected by the development proposal	3.1
Inventory of road widths, road conditions, traffic management and parking control	3.1
Current and proposed road works, traffic management works and bikeways	3.1.3
Traffic Flows	
Selection of key streets - possibly divided into the major and the minor road network; selection of key assessment periods, chosen to cover the times at which the development would be expected to have its major impacts	3
AADT on key streets	3.6
Daily traffic flow hourly distribution, particularly in or near residential areas	3.11
Estimate of the speed of traffic on the road to which vehicular access is proposed	3.1.2
Current traffic generation of site	3.10
Daily and peak period heavy vehicle flows and percentages	3.6, 3.8
The adaptation of appropriate computer models or techniques for assessing levels of traffic congestion and queuing conditions	3.14
Traffic Safety	
Accident history of road network in the area	3.12
Parking Supply and Demand	
On-street parking provision	2.2
Off-street parking provision	2.2
Current parking demand, including utilisation by time of day and turnover rates	2.2
Short term pick up and set down areas	N/A
Modal Split	2.2
Public Transport	
Rail station locations	N/A
Bus routes and bus stop locations; Pedestrian access to bus stops; Constraints and conflicts	3.3
Rail and bus service frequencies, ideally separated into Monday to Friday, Saturday and Sunday, for both peak and off-peak times	3.3
Commuter parking provision	N/A
Pedestrian Network	
Identify major pedestrian routes	3.2
Pedestrian flows and potential conflicts with vehicles, particularly where such conflicts cause capacity constraint on either vehicular or pedestrian movement	3.2

Procedures & Key Parameters	Relevant Section(s)
Pedestrian infrastructure	3.2
Proposed developments in the vicinity	3.10
Proposed Development	
The Development	2.3
Plan reference, if plans not contained in study report	
Nature of development	Section 2
Gross floor areas of each component of development	N/A
Projected number of employees/users/residents	2.3
Hours and days of operations	Section 2
Staging and timing of development	2.3
Selection of appropriate design vehicles for determining access and circulation requirements	Section 2
Access	
Driveway location, including review of alternative locations	5, 6
Sight distance of driveways and comparisons with stopping and desirable minimum sight distances	3.1.1, 3.1.2
Service vehicle access	N/A
Analysis of projected queuing at entrances	Table 3.1.5
Current access to site and comparison with proposed access	N/A
Provision for access to, and by, public transport	N/A
Circulation	
Proposed pattern of circulation	N/A
Internal road widths	N/A
Provision for bus movements	N/A
Service area layout	Section 6
Parking	
Proposed supply	N/A
Parking provision recommended by State Government policy	N/A
Council code and local parking policies and plans	N/A
Parking layout	N/A
Projected peak demand, based where appropriate on similar research reports and on surveys of similar developments	N/A
Parking for Service / courier vehicles and bicycles	N/A
Impact of Proposed Development	
Traffic generation during design periods	
Daily and seasonal factors	4.3, 5.1
Pedestrian generation and movements	N/A
Traffic Distribution and Assignments	
Hourly distribution of trips	4.3
Assignments of these trips to the road system based where possible on development feasibility studies or on origin/ destination surveys undertaken at similar developments in the areas	5.1
Impact on Traffic Safety	
Assessment of Road Safety Impact	5.7
Impact of Generated Traffic	
Daily traffic flows and composition on key streets and their expected effect on the environment particularly in residential areas	4.6, 4.7, 5.3

Procedures & Key Parameters	Relevant Section(s)
Peak period volumes at key intersections and effect of generated traffic on congestion levels	4.8, 4.9, 5.4, 5.5
Impact of construction traffic during construction stages	2.3
Other proposed developments in the vicinity their timing and likely impact, if known	N/A
Assessment of traffic noise	Elsewhere in EIS
Public Transport	
Options for extensions and changes to bus routes and bus stops following discussions with the STA and or private bus operators	No Change
Provision for pedestrian access to bus stops	No Change
Recommended Works	
Improvements to site access and circulation	Section 6
Improvements to roads, signals, roundabouts and other traffic management measures	Section 6
Improvements to pedestrian facilities	Section 6
Effect of recommended works on the operation of adjacent developments	N/A
Effect of recommended works on public transport services including access to bus routes and bus stops	N/A
Provision of LATM measures	N/A
Funding of proposed improvement projects	N/A
Noise attenuation measures	N/A

Table 1.4: Austroads Guide to Traffic Management Technical Completeness Checklist

GTM section	Steps in traffic impact assessment	Relevant Section(s)
4.4.1 Document proposed development		
	Obtained plans showing layout of all traffic and pedestrian areas on site, locations of vehicle and pedestrian accesses, position and layout of nearby driveways and intersections.	No change
	Each type of internal access (cars, pedestrians, trucks, etc.) is direct, connected, continuous and makes sense.	No change
	Approach roads and paths are clearly understood and practical.	No change
	The correct design vehicle and checking vehicle have been used in various sections of the development.	No change
	Basic design requirements have been applied.	No change
	Land use planning zonings in the vicinity are documented.	No change
	Traffic-related features of the development have been summarised.	3.1, 3.10, 3.11
	Timing and staged phasing (if any) has been described, including any connections with external timings.	4.3, 5.1
4.4.2 Resolve any initial problems with designers		
	Any initial problems or issues needing resolution by designers have been identified.	N/A
	Designers notified.	N/A
	Issues have been checked and reworked by designers.	N/A
	Amended proposal has been re-documented.	N/A
4.4.3 Identify area and stakeholders affected		
	Agreed functional road hierarchy in area has been documented.	3.1
	Relevant or affected non-car transport networks or services have been documented.	3.3
	Initial assessment of area affected by changed traffic conditions has been made.	Section 5
	Sites potentially impacted have been listed.	Section 5
	All affected stakeholders have been identified and a note made about when each needs to be consulted.	Elsewhere in EIS
4.4.4 Describe existing and design year conditions		
	Existing on-site conditions, including traffic and parking, have been documented.	Section 3
	Existing traffic conditions for external sites, road lengths and/or areas identified as potentially impacted have been documented for critical periods.	Section 3
	Design year has been selected, and traffic conditions, excluding traffic generated by the development, have been documented. Volumes shown on plan.	4, 5
	Parking conditions, as relevant, have been described.	2.2
	Traffic crashes at potentially impacted locations have been documented.	3.12
	Other known traffic safety or operational problems, and any proposals to address them, have been documented.	4.2
	Any traffic, transport or parking policies which affect the proposed development have been documented.	N/A

GTM section	Steps in traffic impact assessment	Relevant Section(s)
4.4.5 Determine generated traffic and modal split		
	Number of trips which will be generated by the development (daily, peak period, etc.) has been determined for the design year or years.	4.3, 5.1
	The split of general traffic, commercial vehicles, public transport vehicles (including taxis), bicycles, pedestrians, etc. has been determined.	3.7
4.4.6 Determine approach and departure directions		
	Approach and departure directions for the traffic have been determined.	3.6
	Nature of attracted traffic (same origin and return destination, linked trips, etc.) has been considered and described.	3.11
4.4.7 Assign traffic to roads		
	Traffic generated by the development has been assigned to the road network in the potentially affected area for the design year or years,	4.3, 5.1
	Development-generated traffic has been shown on plans.	Table 3.9
	Background traffic (existing volumes factored to the design year) and development-generated traffic have been added together.	4.4, 4.5, 5.2
	Total traffic has been shown on plans for critical times of day or week, etc.	Table 3.9
4.4.8 Determine where non-car traffic will go		
	Paths, lanes, etc. required for pedestrians, cyclists, buses, delivery vehicles, etc. have been determined.	No change
4.4.9 Review limits of area affected		
	Limits of area impacted by the development have been checked, and necessary alterations noted.	Section 5
	If assessment over a greater area is needed, further analysis has been done.	N/A
4.4.10 Assess traffic operation on roads		
	Traffic operations (traffic volumes, capacity, level of service, delays) for access points, in Id-blocks and intersections have been assessed; consequences rioted.	4.8, 4.9, 5.4, 5.5
	Circulation of traffic near the site has been considered.	N/A
	Need for on-street parking, and potential impact on arterial roads I traffic routes, has been determined.	N/A
	Impact on public transport services, from development generated use and from increased traffic on public transport routes (buses and trains) has been assessed.	5.6
4.4.11 Assess traffic operation on-site		
	Traffic operation of roads, aisles, access ways on-site, including traffic circulation within the site, has been analysed.	N/A
	Expected traffic volumes and vehicle types can be safely and efficiently accommodated within the traffic and parking areas on-site.	5.3
	On-site parking provision is adequate and is suitably located.	2.2
4.4.12 Determine required impact-mitigating treatments		
	Required changes, improvements, upgrades and/or modifications to roads, intersections, traffic lanes, controls, access driveways, have been determined.	Section 6
	Required changes on-site and on nearby roads/streets to manage parking have been determined.	N/A
	Required works and traffic management to accommodate pedestrians, cyclists, public transport, delivery vehicles, on-site and in the nearby area, have been determined.	No Change
	Required treatments relating to pavements, safety and environmental issues have been determined.	N/A
	Coordination of all required treatments has been considered.	N/A

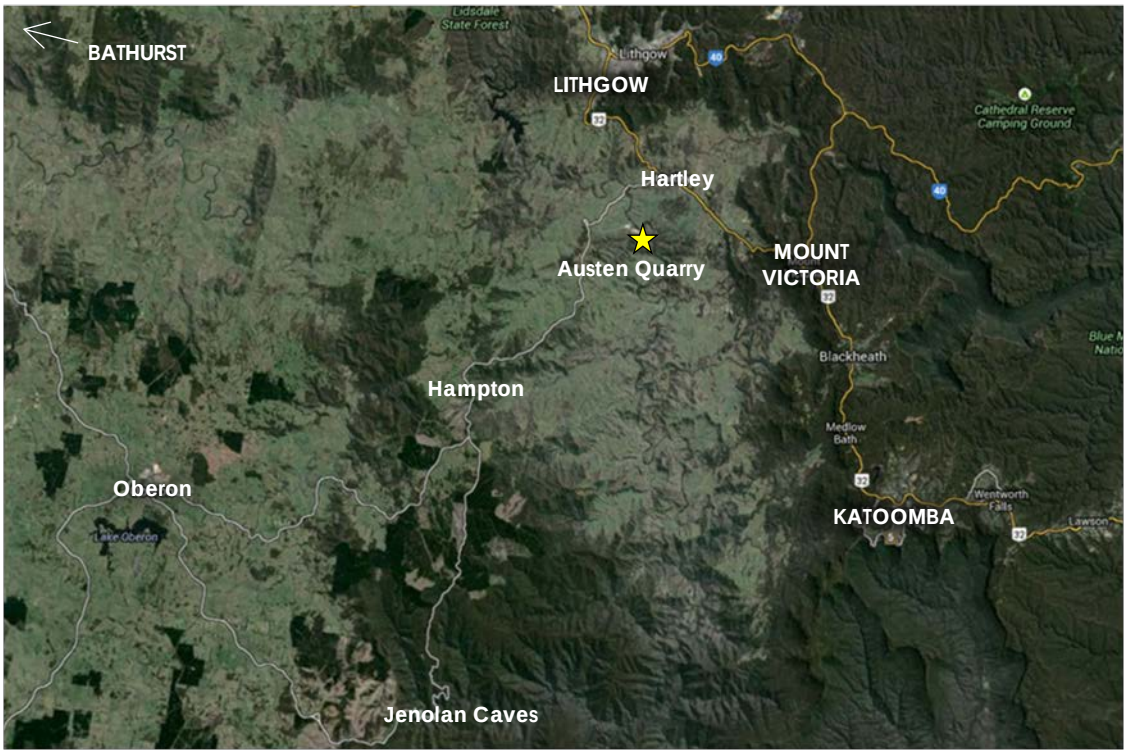
GTM section	Steps in traffic impact assessment	Relevant Section(s)
4.4.13 Obtain road safety engineering assessment		
	Need for an independent assessment of the road safety aspects of the development has been considered.	N/A
	If necessary, independent road safety engineering assessment has been arranged.	N/A
4.4.14 Document findings and recommendations		
	The above steps and their outcomes have been documented in a suitable report.	Section 7

2. Austen Quarry Operations

2.1 Site Location

The Austen Quarry is accessed from a sealed access road ("Quarry Access Road") which intersects with Jenolan Caves Road 4.2km south of the intersection of Jenolan Caves Road with the Great Western Highway. The Quarry Access Road extends southwards and then eastwards from Jenolan Caves Road, crossing Yorkeys Creek (an ephemeral tributary of Coxs River) at an elevated culvert crossing, before entering the secondary processing area of the Quarry via the incoming weighbridge.

Figure 2.1: Site Location



Source: Google Maps 2013

2.2 Existing Austen Quarry Operations

The Austen Quarry is a hard rock quarry which has approval to despatch up to 1.1 million tonnes per annum (Mtpa) of products until March 2020. It is currently operating below its approved maximum limit, despatching approximately 750,000 tonnes per annum (tpa). Products are despatched between 5.00am and 10.00pm Monday to Friday, and between 5.00am and 3.00pm on Saturdays, public holidays excluded.

Product transportation is largely influenced by customer requirements and so varies from day to day, using a variety of truck configurations, depending on the customer and the destinations of the product. Generally, products destined for the Sydney metropolitan area are despatched with truck and dog combinations, or 19m long B-Doubles. Deliveries to local road works projects tend to be done using smaller volume rigid trucks, with a capacity of less than 15 tonnes (t). All trucks travelling to and from the Quarry use Jenolan Caves Road to reach the Great Western Highway.

As there are fewer despatch hours on Saturdays, the number of truck trips generated tends to be higher on weekdays than on Saturdays.

At the rate of product despatch of 750,000 tpa, and taking into account the number of operational days in a typical year, the Austen Quarry generates an average of 83 loads or 166 trips per weekday, where a trip is a one way movement. A truck departing the Quarry loaded, and returning to the Quarry empty therefore generates two trips. It is estimated that the peak number of trips made on a weekday is approximately 300 truck trips per day on a peak day, i.e. 150 loads. On days when there are higher numbers of truck trips made, these trips include a number of smaller rigid vehicles with lower capacity rather than the larger articulated vehicles.

On the same basis as above, should production reach its approved maximum of 1.1 Mtpa, it is expected that the Austen Quarry would generate an average of approximately 250 truck trips per weekday, up to a maximum of 360 truck trips per weekday for the transportation of quarry products to the Sydney metropolitan area. The peak of 360 truck trips per weekday is expected to occur in the order of approximately five times per year.

On those days when local projects are supplied, i.e. between Lithgow and Mount Victoria, and smaller rigid trucks are used, the Quarry would generate an average of 300 truck trips per weekday and up to 500 truck trips per weekday. This peak of 500 truck trips per weekday is expected to occur on only one or two days per year.

The Austen Quarry's Road Truck Traffic Management Plan sets out requirements of all truck drivers approaching, leaving and being loaded at the Austen Quarry to provide safe standard procedures and guidelines. The plan aims to maximise the safety of road users both inside the Quarry and on public roads, ensure compliance with applicable legislation, standards, codes, licences and approvals, and to result in no significant traffic incidents or delays caused by quarry-related traffic movements. The Plan specifies the route to be used by trucks, i.e. Jenolan Caves Road and the Great Western Highway.

Hy-Tec operates a driver and vehicle check system at the Austen Quarry (and all of its operations), which has been recognised by Cement, Concrete and Aggregates Australia. Hy-Tec developed the standard, *Hy-Tec Chain of Responsibility – Driver/Vehicle Checks*, which applies to any person involved in consigning; packing; loading; driving; operating a business which controls the use of a commercial vehicle and receiving goods or freight. This standard addresses legal obligations relating to drivers, vehicles, roads and route selection and vehicle operations (e.g. fatigue management, vehicle mass and load compliance, load restraint, daily vehicle checks). A Driver Fatigue Manual has been produced and issued to all Hy-Tec drivers as well as everyone with links to the Chain of Responsibility. A systematic and documented approach has been developed to check compliance of all drivers, be they Hy-Tec drivers or contractors.

An adequate amount of informal on-site parking is provided on site to meet the demands of employees and visitors. Due to the Quarry's isolated location and the operating hours of the Quarry, all employees/visitors travel to and from the Quarry is by car.

2.3 The Proposal

Hy-Tec proposes to maintain the existing approved maximum level of quarry despatch activity of 1.1 Mtpa, with an extension to the life of the Quarry for 30 years from March 2020 to March 2050. No change is proposed to the hours during which quarry products are despatched, or to the type of trucks used or the route used by the trucks. The proposed average and maximum number of loads or trips would be the same as that outlined in Section 2.2.

It is noted the Austen Quarry has not yet operated at its maximum permitted despatch rate of 1.1 Mtpa, thus the road network has not accommodated the truck movements associated with the despatch of 1.1 Mtpa of quarry products in any year. This assessment assumes that should the Proposal not be approved, the rate of despatch of products from the Austen Quarry could still increase to the maximum permitted rate of 1.1 Mtpa until the end of its current approval period in March 2020. This assessment therefore

reviews the implications of production at the maximum approved rate of 1.1 Mtpa for a longer period, with the approval being sought for 30 years, i.e. to March 2050.

With the Proposal, as the despatch rate approaches the limit of 1.1 Mtpa, the workforce at the Austen Quarry would gradually increase from 16 to 20 employees. For the purpose of this assessment, it is also assumed that there would be an associated increase in the number of contractors and visitors as a result of the increased activity.

The Proposal would not require any additional construction works on site. There would be no changes to the vehicular access, parking or internal layout of the site. No change is proposed to the general size or type of vehicles used for transporting quarry products.

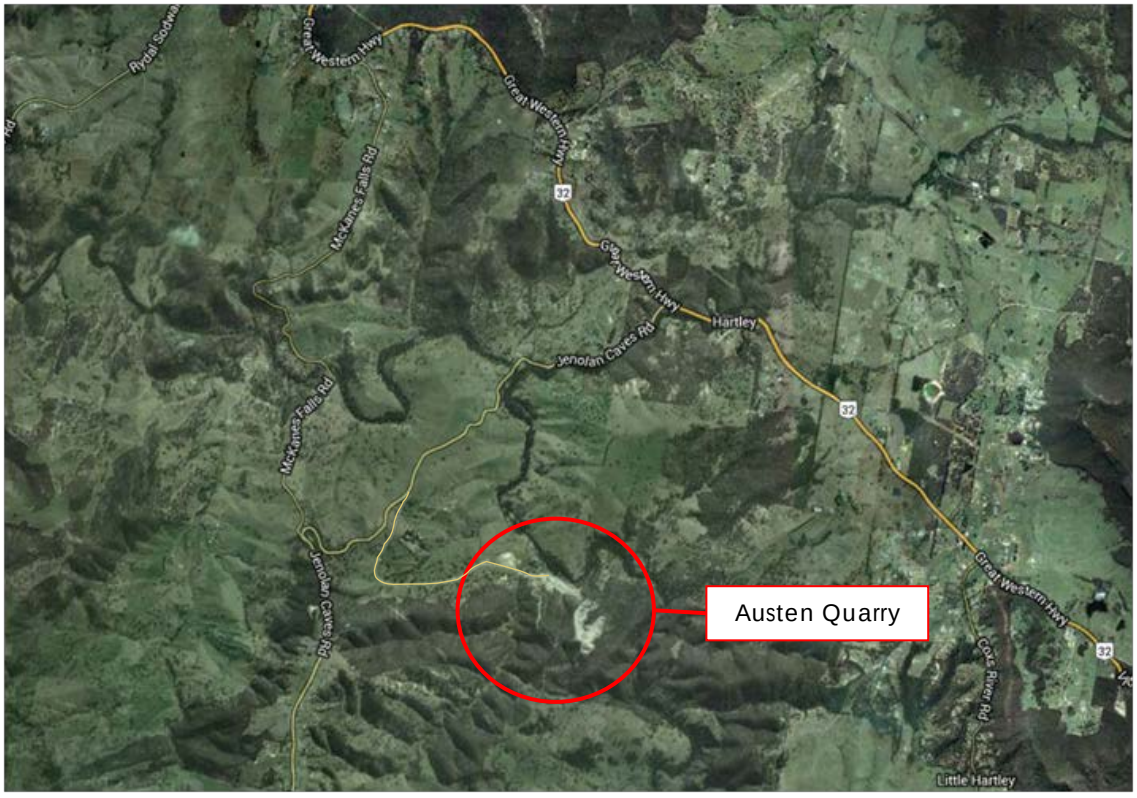
3. Existing Road Transport Environment

This section describes the existing road transport conditions in the vicinity of the Austen Quarry. It presents the results of surveys conducted during March and May 2013, and reviews the history of traffic growth in the region. The road network of direct interest to the Austen Quarry is limited to the Quarry Access Road, Jenolan Caves Road and the Great Western Highway, as no alternative access routes exist. The review of the road transport environment therefore focuses on those roads.

3.1 Road Network

The road network in the vicinity of the Austen Quarry is described below and is shown in **Figure 3.1.**

Figure 3.1: Surrounding Road Network



Source: Google Maps 2013

3.1.1 Quarry Access Road

The Quarry Access Road is a private road connecting the Austen Quarry to the local road network. It has a single travel lane in each direction with a sealed width of approximately 10 metres (m) with both incoming centre and road edge line-markings (**Plate 3.1** and **Plate 3.2**). It is approximately 3.1km long from its intersection with Jenolan Caves Road to the incoming quarry weighbridge. It is the only vehicular access for personnel and product transportation to and from the Quarry. The land adjacent to the Austen Quarry is leased to a contractor whose workforce also uses the Quarry Access Road to access that land.

At its priority-controlled intersection with Jenolan Caves Road, drivers have a good sight distance of approximately 200 m to the left and right when exiting from the Quarry Access Road. Widening of Jenolan Caves Road at the intersection assists drivers turning right from the Quarry Access Road to do so with minimal disruption to northbound through traffic, through provision of an auxiliary northbound lane

over approximately 100 m. Vehicles turning left into the Quarry Access Road use an auxiliary deceleration lane which is approximately 70 m long.

Plate 3.1: Section of Quarry Access Road West of Yorkeys Creek Stockpile Area

Plate 3.2: Section of Quarry Access Road Approaching the Quarry Entrance

3.1.2 Jenolan Caves Road

Jenolan Caves Road forms part of a classified road route (253) from the Great Western Highway near Hartley via Hampton, Jenolan Caves and Oberon to the Great Western Highway near Bathurst. It is a State road along this route, aside from the section between Kanangra Walls Road via Edith to Oberon, which is a Regional Road. Jenolan Caves Road intersects with the Great Western Highway near Hartley, approximately 11km northwest of the town of Mount Victoria. In the vicinity of the Austen Quarry, Jenolan Caves Road has a sealed width of approximately 6.5m with shoulders of varying widths, and typically has a single travel lane in each direction, with marked centre lines and edge lines. It is an approved route for use by heavy vehicles up to 19m long B-Doubles, which may use the route 24 hours per day, seven days per week. It has a posted speed limit of 80 kilometres per hour (km/h).

At its priority-controlled intersection with the Quarry Access Road, Jenolan Caves Road is widened to provide an auxiliary right turn (AUR) treatment and auxiliary left turn (AUL) treatment (**Plate 3.3** and **Plate 3.4**), which allow through traffic on Jenolan Caves Road to pass vehicles slowing to turn right or left into the Quarry. Drivers on Jenolan Caves Road have adequate sight distance when approaching the intersection from either direction to observe a vehicle turning or waiting to turn at the intersection.

Plate 3.3: Auxiliary Right and Left Turn Lanes in Jenolan Caves Road at Quarry Entrance

Plate 3.4: Auxiliary Left Turn Treatment on Jenolan Caves Road at Quarry Entrance

The intersection of Jenolan Caves Road with the Great Western Highway and Blackmans Creek Road is a four-way priority-controlled intersection. A left turn deceleration lane and a right turn bay are provided on the Great Western Highway for vehicles turning into Jenolan Caves Road.

Drivers exiting Jenolan Caves Road onto the Great Western Highway have good sight distance available of approximately 200 m to the South and 400 m to the North.

3.1.3 Great Western Highway

The Great Western Highway is the major arterial road linking the Sydney metropolitan area to the Blue Mountains, Lithgow, Bathurst and other regional centres in the central west of New South Wales (NSW). It provides the major road freight, tourist and commercial link between Sydney and the central west and western NSW, and also serves local commuting trips, local freight and industry and tourist trips.

Since 2000, RMS has been undertaking a program of road works on the Great Western Highway, of which the following works between Emu Plains and Mount Victoria have been completed:

- Warrimoo – four lane upgrade and pedestrian bridge at the railway station (completed in July 2000);
- Faulconbridge – four lane upgrade and pedestrian bridge at the railway station (completed in June 2001);
- Soldiers Pinch (Mount Victoria) – improved road alignment and overtaking lane (completed in June 2002);
- Linden – four lane upgrade with new bridges and pedestrian signals (completed in August 2003);
- Medlow Bath – improved alignment, replacement bridge and new signalised intersection (completed in December 2003);
- Shell Corner (Katoomba) – four lane upgrade, two new bridges and new traffic signals (completed in August 2004);

- Wentworth Falls West – four lane upgrade with three improved intersections and new off-road shared pedestrian/cyclist path (completed in June 2005);
- Lapstone Hill safety improvements – median barrier extended and wider shoulder for cyclists (completed in August 2005);
- Leura to Katoomba – four lane upgrade from Willow Park Avenue, Leura to Bowling Green Avenue, Katoomba (completed in March 2009);
- Wentworth Falls East – four lane upgrade with intersection upgrade and new traffic signals (completed in September 2012); and
- Lawson – four lane upgrade and realignment (completed in December 2012).

In July 2012, the Australian and NSW governments announced a $250 million revised investment program for the upgrade of the Great Western Highway between Katoomba and Lithgow, which would target specific deficiencies. The upgrade aims to improve road safety, improve road freight efficiency, cater for the mix of through, local and tourist traffic, and be sensitive to the area's natural environment, heritage and local communities.

Work already completed or underway along the Great Western Highway in the vicinity of Hartley is presented on **Figure 3.2** and includes:

- Mount Victoria and Victoria Pass
  - Road widening and installation of concrete median barrier
  - Closure of right in and out at Mitchells Lookout
  - Installation of wider centreline markings.
- Little Hartley and Hartley Valley
  - Remove trees, widen and seal shoulder and install wire rope barrier near Adams Shed and East of Mid Hartley Road
  - Remove westbound overtaking lane and provide channelized right turn facility at Mid Hartley Road.
- River Lett Hill
  - Road and shoulder widening, installation of a central concrete median safety barrier, provision of earth embankments around downhill curves and guardrail adjacent to steep embankments.
- Forty Bends
  - Installation of wire barrier westbound.

Figure 3.2: Completed and Current Works on the Great Western Highway Near Hartley

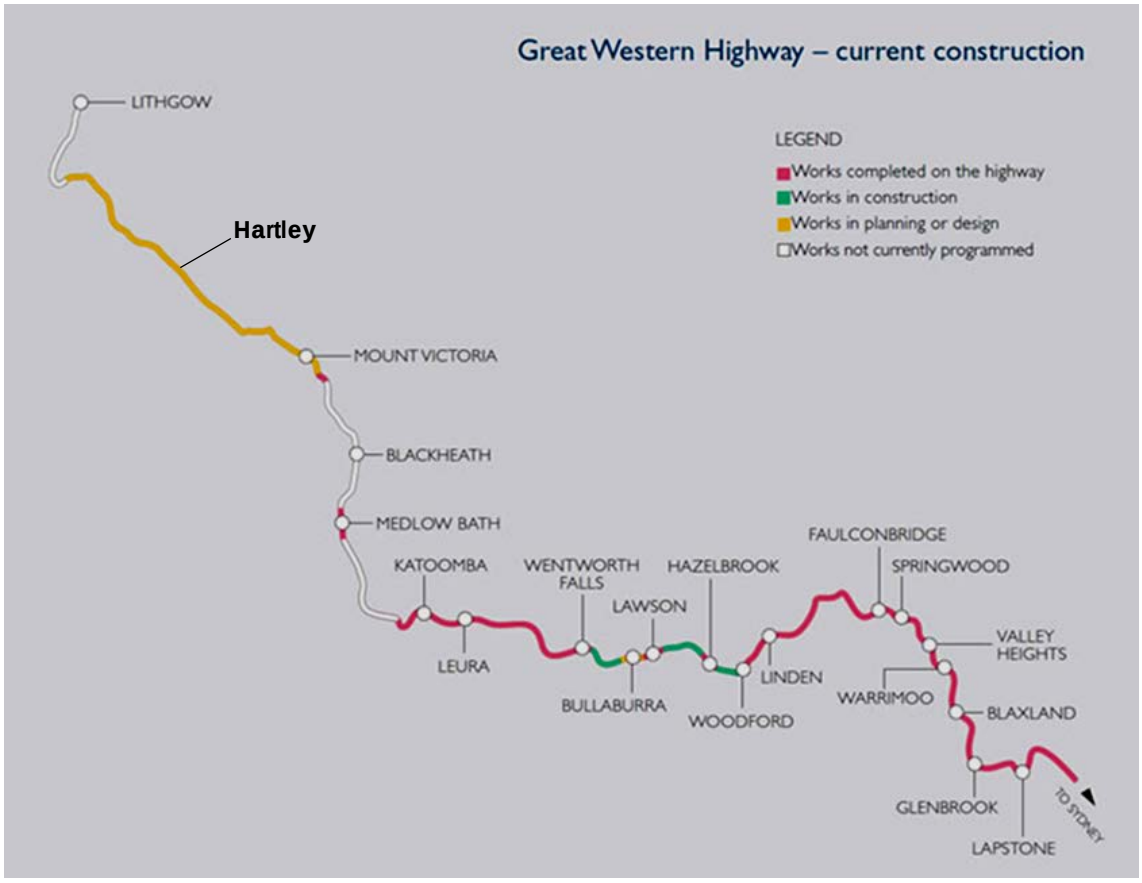
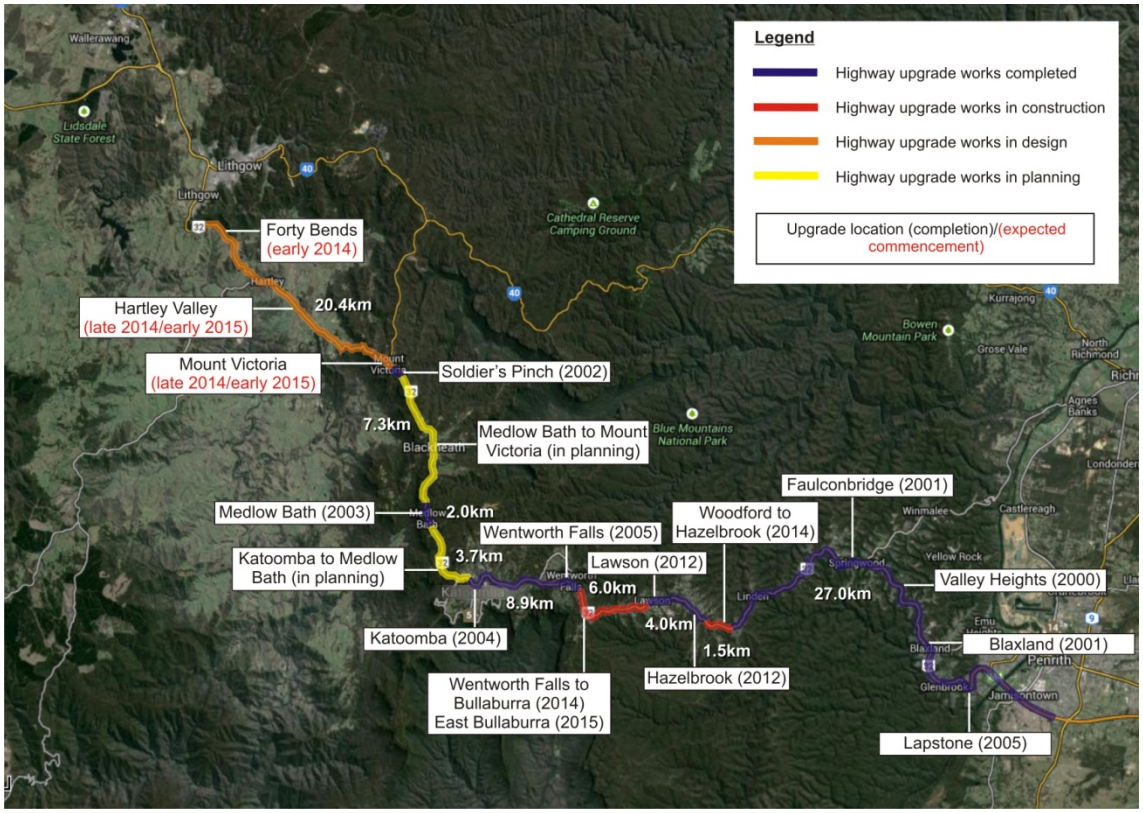


Image source: http://www.rms.nsw.gov.au/roadprojects/projects/great_western_hway/map.html

A summary of the planned, designed, in construction and completed works for the Great Western Highway upgrade is illustrated in **Figure 3.3**, including the expected date of completion or commencement of works and the length of highway upgrades at each section.

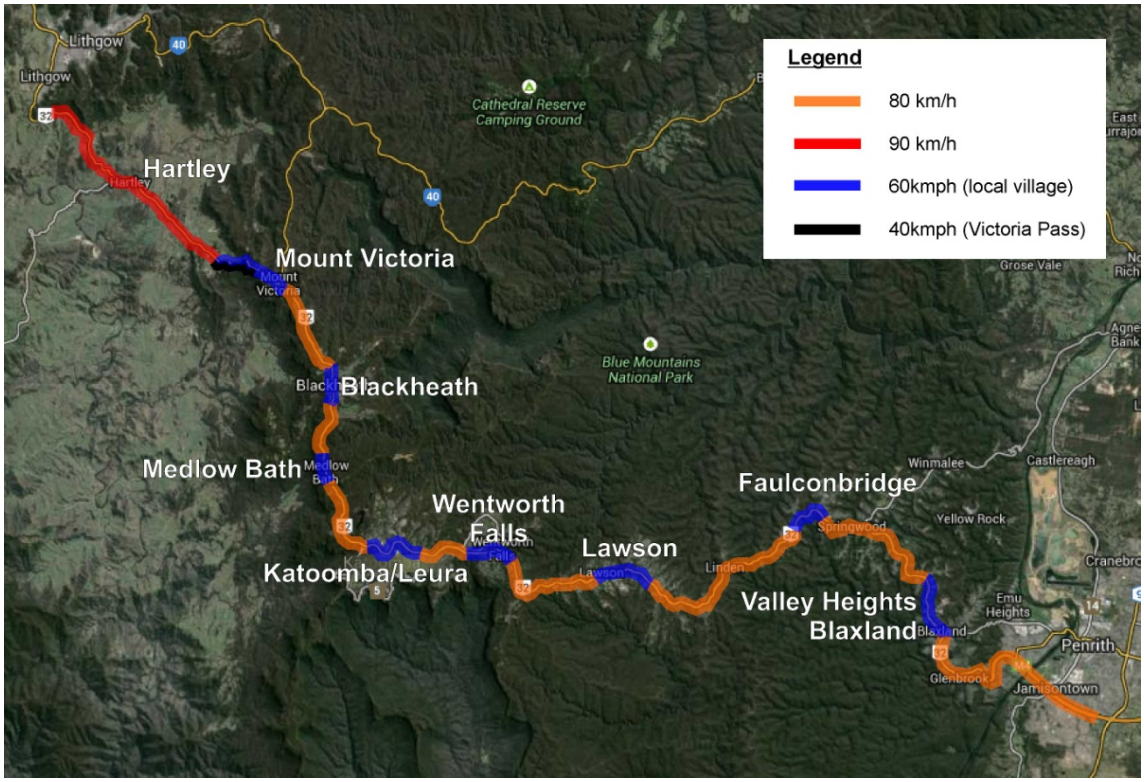
Figure 3.3: Extent of Completed and Proposed Works – Great Western Highway Upgrade



Base Map Source: Google Maps 2013, GWH Upgrade information sourced from http://www.rta.nsw.gov.au/roadprojects/projects/great_western_hway/index.html

Concept design plans published on the RMS road projects website indicate that the Great Western Highway upgrades between Katoomba and Lithgow will maintain the existing speed limits. A summary of the speed zones between Emu Plains and Lithgow is shown in **Figure 3.4.** The current speed limits are generally 80 km/h for approximately 60 percent of the highway, with 60 km/h 'village' speed zones at towns with frontages to the highway. School zones with speed limits of 40 km/h (during school zone operation hours) are located through various towns along the route within the 60 km/h speed zones, including adjacent to Mount Victoria Public School, Blackheath Public School, Blue Mountains Grammar School at Wentworth Falls, Lawson Public School, Hazelbrook Public School, Faulconbridge Public School, and Blaxland Public School.

Figure 3.4: Speed Limits on the Great Western Highway



Base Map Source: Google Maps 2013

Based on volumes[2] presented in the highway upgrade assessment review (Evans and Peck, 2012), traffic volumes on the Great Western Highway between Mount Victoria and Lithgow generally decrease towards the west, as follows:

- Victoria Pass 14,000 vehicles per day
- Little Hartley 10,400 vehicles per day
- Hartley 8,800 vehicles per day
- Forty Bends 7,900 vehicles per day.

Roads and Maritime Services (RMS) collects data on traffic volumes at certain locations on the road network. The data is expressed in terms of Annual Average Daily Traffic (AADT) which is an annualised measure of the number of axle pairs crossing a point on each road. Recent data for the Great Western Highway between Faulconbridge and Blackheath was obtained from RMS and is presented in **Table 3.1**.

Table 3.1: Recent AADT Volumes on the Great Western Highway between Faulconbridge and Blackheath

RMS Count Station	Location	Data Year	AADT Volume
99.231	Blackheath	2009	16,060
99.913	Medlow Bath	2011	18,290
99.042	Leura	2009	25,532
99.043	Bullaburra	2012	22,127
99.914	Faulconbridge	2013	27,582

These volumes demonstrate that, like the volumes between Mount Victoria and Lithgow, the traffic volumes on the Great Western Highway between Faulconbridge and Blackheath also generally decrease towards the west.

[2] Traffic volumes summarised in Appendix 4 of the Review of Great Western Highway Upgrades West of Katoomba – Independent review, Evans & Peck, (2012). The data was originally sourced from the Great Western Highway Upgrade, Mount Victoria to Lithgow Implementation Strategy, RTA Alliance, (2011).

The proportion of heavy vehicles on the Great Western Highway is reported to be between approximately 8 and 12 percent of total traffic, as follows:

- Bullaburra: Weekday average 12.0%, Saturdays 5.7%, Sundays 4.2%;
- Lawson: 8.5% (7.0% trucks, 1.5% buses) during peak periods;
- Wentworth Falls East : 10% daytime (7am to 10pm), 21% night time (10pm-7am); and
- Woodford-Hazelbrook: 12% daytime (7am to 10pm), 20% night time (10pm-7am).

3.2 Pedestrians

There are no formal pedestrian footpaths on either side of the road in the vicinity of the Quarry. However, pedestrian activity along Jenolan Caves Road and along the Quarry Access Road is negligible and formal facilities are not warranted.

3.3 Buses

There are a number of private bus operators with regular bus services operating between Mount Victoria, Lithgow and Oberon in the vicinity of the Quarry. These bus operators are:

- Blue Mountains Bus Company (school buses)
- Lithgow Bus Lines (school buses)
- NSW TrainLink.

Regular bus services along Jenolan Caves Road are summarised in **Table 3.2** below.

Table 3.2: Peak Period Bus Services on Jenolan Caves Road

Bus Operator	Number of Bus Services	
	7.00am to 9.00am	3.00pm to 5.00pm
Lithgow Bus Lines (during peak periods)	2	2
NSW TrainLink (during peak periods)	2	1
NSW TrainLink (during off-peak period)	1	2

A Blue Mountains Bus Company school bus also runs along the Great Western Highway between Lithgow and the Upper Blue Mountains in the morning and afternoon. Suburbs with schools included in the service are:

- Blackheath
- Blaxland
- Faulconbridge
- Glenbrook
- Hazelbrook
- Katoomba
- Lapstone
- Lawson
- Leura
- Lithgow
- Mount Riverview
- Mount Victoria
- Springwood
- Warrimoo
- Wentworth Falls
- Winmalee.

Approximately 60 bus routes service schools within these suburbs before and after school times. There are one to two services per route in the morning and afternoon periods.

In addition, there are a number of sight-seeing tour buses which operate to Jenolan Caves along Jenolan Caves Road and within the Blue Mountains. These operate infrequently and during off-peak times.

3.4 Historic Traffic Volumes

Historic AADT data for roads in the vicinity of the Austen Quarry are presented in **Table 3.3.**

Table 3.3: AADT Data (axle pairs per day)

Location*	1992	1996	1999	2002	2005	2005[A]
Great Western Highway						
Hartley, West of Jenolan Caves Road	6,711	8,027	7,485	8,583	8,757	7,183
Little Hartley, East of Cox River Road	8,443	9,511	9,598	10,820	10,948	9,128
East of Jenolan Caves Road	8,059	8,371	8,548	9,565	9,968	8,092
Jenolan Caves Road						
Oberon, East of Dudley Street	800	-	-	-	-	-

[A] Additional data available for Year 2005 is measured in vehicles per day rather than axle pairs per day
* See Figure 3.5 for locations

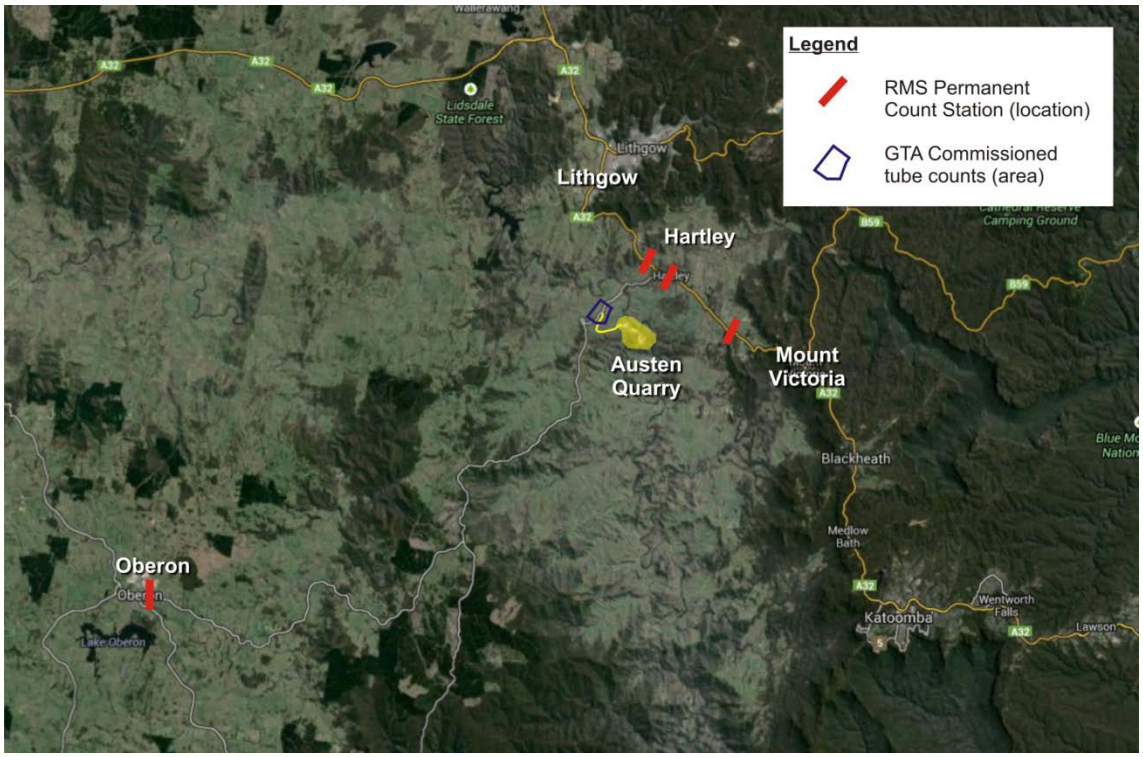
The data suggests that over the period for which the data is available, AADT volumes on the Great Western Highway have fluctuated but have generally increased steadily at an average of approximately 2 percent per annum. Insufficient data is available to establish growth on Jenolan Caves Road.

3.5 Traffic Survey Program

To quantify current traffic conditions on the immediate roads serving the Austen Quarry, a program of additional traffic surveys was commissioned by GTA Consultants.

Automatic tube count surveys were completed over two weeks between Friday 8 March 2013 and Thursday 21 March 2013. The tube count surveys collected vehicle volume, classification and speed data at hourly intervals over the two week period on the Quarry Access Road and on two locations on Jenolan Caves Road, to the north and south of the Quarry Access Road. The locations of the tube count surveys are displayed on **Figure 3.5.**

Figure 3.5: Traffic Volume Data Locations



Base Map Source: Google Maps 2013

Manual surveys of peak period vehicle turning movements were undertaken at the intersections of Jenolan Caves Road with the Quarry Access Road and the Great Western Highway on Wednesday 29 May 2013. The surveys were conducted between 7:30am and 10:00am, and 4:00pm and 6:30pm. The turning movement surveys recorded vehicle turning directions and light and heavy vehicle numbers during the peak periods on a typical weekday as obtained from the aforementioned tube counts.

As noted, the Quarry Access Road is also used by staff travelling to and from the adjacent land, which is leased to a contractor. These vehicle movements are not associated with the Austen Quarry operations but are included in the surveyed traffic on the Quarry Access Road.

3.6 Daily Traffic Volumes

The daily volumes recorded by the tube count surveys are presented in **Table 3.4**, which combines the results for the two travel directions at each location surveyed in March 2013.

Table 3.4: Surveyed Daily Two Way Traffic Volumes (vehicles/day)

Day and Date	Quarry Access Road	Jenolan Caves Road North of Quarry Access Road	Jenolan Caves Road South of Quarry Access Road
Friday 8 March	232	1,432	1,233
Saturday 9 March	108	1,964	1,866
Sunday 10 March	18	1,815	1,766
Monday 11 March	266	1,132	1,087
Tuesday 12 March	231	1,077	853
Wednesday 13 March	224	1,087	824
Thursday 14 March	240	1,052	895
Friday 15 March	258	1,301	1,096
Saturday 16 March	132	1,332	1,267
Sunday 17 March	11	1,389	1,456
Monday 18 March	285	1,169	862
Tuesday 19 March	303	1,201	814
Wednesday 20 March	272	1,165	849
Thursday 21 March	246	1,186	947
Average Weekday	**256**	**1,180**	**946**
Average Day	**202**	**1,307**	**1,130**

The surveys indicate that the Quarry Access Road carried between 11 and 303 vehicles per day (two way) over the two weeks of surveys, and an average of 256 vehicles per day on weekdays. The traffic activity at the Quarry differed significantly between weekdays and weekend days, with an average of 120 vehicles per day on the Saturdays and 15 vehicles per day on the Sundays. In contrast, the busiest days on Jenolan Caves Road were weekend days, when the Quarry traffic was at its lowest. The Quarry thus makes only a very minor contribution to weekend day traffic on Jenolan Caves Road compared with weekdays.

Jenolan Caves Road carried between 1,052 and 1,964 vehicles per day north of the Quarry Access Road, and between 814 and 1,866 vehicles per day south of the Quarry Access Road.

During the survey period, it is noted that local events caused atypically high weekend traffic volumes on Jenolan Caves Road on one of the surveyed weekends. The "Six Foot Track Marathon" was held on Saturday 9 March 2013 which hosted approximately 800 entrants as well as spectators, and concluded at Jenolan Caves. Traffic volumes on Jenolan Caves Road were noted to be significantly higher on Saturday 9 and Sunday 10 March than on the following weekend. Any analysis of weekend traffic conditions on Jenolan Caves Road should therefore be cognisant that the first weekend background traffic, i.e. traffic not associated with the Austen Quarry was abnormally high. The event did not impact on the Austen Quarry operations, thus the volume of traffic generated by the Quarry on those days would be expected to be within the normal range for a Saturday and Sunday, noting that no trucks entered or departed from Jenolan Caves Road on the Sunday.

3.7 Traffic Composition

The surveys described in **Section 3.6** also provided data on the composition of traffic on the roads, using the Austroads (2004) Vehicle Classification System. Light vehicles include motorcycles, cars, vans, 4WDs, and utilities (including those towing a trailer or caravan). Heavy vehicles include single unit "rigid" trucks and buses with two to four axles and articulated vehicles such as semitrailers, rigid trucks with trailers, B-doubles and road trains. **Table 3.5** summarises the percentage composition of the traffic on the average weekday and Saturday over the fourteen day survey period.

Table 3.5: Average Daily Traffic Composition (March 2013)

	Quarry Access Road	Jenolan Caves Road north of Austen Quarry	Jenolan Caves Road south of Austen Quarry
Vehicles per Weekday			
Light	85	823	748
Rigid	16	70	53
Articulated	153	286	145
Percent of Weekday Traffic			
Light	33.5%	69.8%	79.1%
Rigid	6.3%	5.9%	5.6%
Articulated	60.2%	24.3%	15.3%
Vehicles per Saturday			
Light	40	1,480	1,470
Rigid	0	76	70
Articulated	80	92	26
Percent of Saturday Traffic			
Light	33.3%	89.8%	93.8%
Rigid	0.0%	4.6%	4.5%
Articulated	66.7%	5.6%	1.7%

Difference between total vehicles per weekday and Table 3.4 is due to "Class 13" classification unknown vehicles

Table 3.5 demonstrates the difference between the types of vehicles on the Quarry Access Road and those on Jenolan Caves Road on the average weekday and Saturday. On the average weekday, approximately two-thirds of vehicles on the Quarry Access Road are heavy vehicles, while heavy vehicles make up approximately one-fifth to one-quarter of vehicles on Jenolan Caves Road. On the Saturdays, all heavy vehicles (including those travelling to and from Austen Quarry as well as those not associated with the Quarry) accounted for between approximately six and ten percent of total traffic on Jenolan Caves Road.

3.8 Peak Hour Traffic Volumes

A review of the traffic survey results indicates that on the average weekday, the traffic generated by the Austen Quarry peaked at different times to the passing traffic on Jenolan Caves Road. **Table 3.6** presents the weekday hourly volumes measured at each of the survey locations over the hours during which the Austen Quarry operates.

Table 3.6: Average Weekday Hourly Two Way Traffic 5:00am to 10:00pm (vehicles/hour)

Hour	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
5.00 to 6.00	**11**	**14**	**25**	18	22	40	14	7	21
6.00 to 7.00	8	15	23	33	23	56	18	8	26
7.00 to 8.00	4	12	16	45	21	66	36	9	45
8.00 to 9.00	5	11	17	53	23	76	44	13	56
9.00 to 10.00	3	11	14	52	26	78	47	17	63
10.00 to 11.00	2	17	19	55	34	89	**58**	**22**	**80**
11.00 to 12.00	3	12	16	**58**	**32**	**90**	53	18	71
12.00 to 13.00	4	7	11	53	25	78	54	19	72
13.00 to 14.00	2	9	11	55	21	76	51	15	66
14.00 to 15.00	6	10	16	68	24	92	59	15	74
15.00 to 16.00	7	12	18	65	21	86	58	12	70
16.00 to 17.00	6	11	16	**75**	**21**	**96**	**72**	**12**	**83**
17.00 to 18.00	**13**	**9**	**22**	65	13	78	57	6	63
18.00 to 19.00	4	5	9	44	10	54	42	5	47
19.00 to 20.00	3	7	10	31	11	42	28	4	32
20.00 to 21.00	2	2	4	20	6	26	18	3	21
21.00 to 22.00	1	0	1	12	3	14	9	2	11

Note **bold** is the peak hours before and after midday at each survey location

The results demonstrate that on the average weekday, the Austen Quarry traffic peaks earlier in the morning and later in the evening than the traffic on Jenolan Caves Road. The variation in hourly traffic on the Quarry Access Road is however quite low throughout the average weekday, ranging between 11 and 25 vehicles per hour between 5.00am and 6.00pm. Overall peak hour volumes on Jenolan Caves Road are relatively low, with fewer than 100 vehicles per hour using the road.

As noted in Section 3.6, one of the surveyed weekends was impacted by the "Six Foot Track Marathon" which is expected to have resulted in the increased traffic volumes on Jenolan Caves Road. While this would not have impacted the traffic generated by the Austen Quarry, the background non-quarry traffic on Jenolan Caves on that weekend is considered to be abnormally high. Traffic volumes on Jenolan Caves Road on the second surveyed weekend, when the marathon was not held, were higher than many of the weekdays, suggesting that background Saturday traffic not associated with the Austen Quarry warrants review. This is because the area is subject to tourist traffic, particularly on weekends. The following discussion of Saturday traffic conditions on Jenolan Caves Road is based on the results only from the second of the two surveyed weekends.

A review of the traffic survey results indicates that on the Saturday, the traffic generated by the Austen Quarry peaked at different times to the passing traffic on Jenolan Caves Road. **Table 3.7** presents the Saturday hourly volumes measured at each of the survey locations over the hours during which the Austen Quarry operates.

Table 3.7: Saturday Hourly Two Way Traffic 5:00am to 3:00pm (vehicles/hour)

Hour	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
5.00 to 6.00	**9**	**12**	**21**	13	17	30	8	6	14
6.00 to 7.00	7	13	19	32	16	48	21	2	23
7.00 to 8.00	2	7	9	47	13	60	36	1	37
8.00 to 9.00	2	6	7	63	5	68	50	6	56
9.00 to 10.00	3	8	10	79	11	90	98	7	105
10.00 to 11.00	3	9	12	114	21	135	110	12	122
11.00 to 12.00	6	13	19	**106**	**30**	**136**	**119**	**8**	**127**
12.00 to 13.00	**5**	**7**	**11**	93	10	103	96	6	102
13.00 to 14.00	3	1	4	88	2	90	98	5	103
14.00 to 15.00	1	1	1	**107**	**6**	**113**	**103**	**5**	**108**

Note **bold** is the peak hour before and after midday at each survey location

The results demonstrate that on Saturdays, the variation in hourly traffic on the Quarry Access Road is however quite low throughout morning, ranging between 7 and 21 vehicles per hour between 5.00am and midday. After midday, the traffic on the Quarry Access Road declined to be very low during the afternoon operating hours. Overall peak hour volumes on Jenolan Caves Road are relatively low, with fewer than 140 vehicles per hour using the road during the Austen Quarry operating hours, which is higher than the average weekday peak hours (**Table 3.6**).

3.9 Intersection Surveys

The intersection turning movement surveys completed on 29 May 2013 identified the busiest hours at the intersections of Jenolan Caves Road with the Quarry Access Road and the Great Western Highway. The peak hours at the two intersections, which are those intersections most directly impacted by current/future quarry operation did not coincide. At the Quarry Access Road intersection with Jenolan Caves Road, the overall peak hours occurred from 8.45am to 9.45am, and 4.15pm to 5.15pm, and at the intersection with the Great Western Highway, the peak hours occurred from 7.30am to 8.30am and from 4.00pm to 5.00pm. These peak hours represent the hours during which the highest number of vehicles passed through each intersection during the surveyed periods, thus the times at which the operation of the intersections would be at their worst. They are not necessarily the peak hours associated with the movement of vehicles generated by the Quarry.

The full results of the turning movement surveys are presented in **Appendix A**, and the two-way volumes recorded during the peak hours on each of the intersection approaches are summarised in **Table 3.8**.

Table 3.8: Weekday Peak Hour Two Way Traffic at Intersection Approaches (vehicles/hour)

Intersection and Approach	AM Peak Hour	PM Peak Hour
Jenolan Caves Road and Great Western Highway	7:30-8:30am	4:00-5:00pm
Blackmans Creek Road	9	6
Great Western Highway (East)	527	618
Jenolan Caves Road	58	79
Great Western Highway (West)	482	553
Jenolan Caves Road and Quarry Access Road	8:45-9:45am	4:15-5:15pm
Jenolan Caves Road (North)	77	73
Quarry Access Road	19	18
Jenolan Caves Road (South)	60	61

The turning movement data at the Quarry Access Road intersection (**Appendix A**) indicates that during the 2.5 hour morning survey periods, the Quarry generated a total of 20 inbound and 15 outbound trips.

During the 2.5 hour evening survey period, the Quarry generated a total of 15 inbound and 26 outbound trips.

Over the survey period, all heavy vehicle movements in and out of the Quarry Access Road were to and from the north. Over the five hours surveyed, approximately 82 percent of light vehicles generated by the Austen Quarry travelled to and from the north, and 18 percent of light vehicles travelled to and from the south.

3.10 Austen Quarry Traffic Generation

Data obtained from the Austen Quarry weighbridge provides information on the total number of truck loads per month for the 12 months from June 2012 to May 2013 inclusive. On the basis of this data, the average number of loads per weekday and Saturday has been calculated for the period as a whole, and for the days during which the traffic surveys were conducted, taking into consideration the number of operating hours each month, the variation in operating hours between weekdays and Saturdays, and public holiday closures. The results are summarised in **Table 3.9**.

Table 3.9: Austen Quarry Truck Loads at Weighbridge 2012-13

	Total Number of Truck Loads	Average Truck Loads per Operating Hour (Monday to Saturday)	Average Truck Loads per Weekday	Average Truck Loads per Saturday
Annual	19,021	4.0	67	40
Surveyed Days March 2013	809	4.8	81	40

Throughout that year, the Austen Quarry produced an average of 67 truck loads of products per weekday, and 40 truck loads of product per Saturday, which generated an average of 134 truck trips per weekday and 80 truck trips per Saturday. This is equivalent to an average of 8 truck trips per operating hour (including despatch of loaded trucks and return of empty trucks).

Comparison between the records from the Quarry and the surveyed traffic during March 2013 (**Section 3.5**) indicates that the traffic surveys correlate well with the despatch records. The despatch records show that on those surveyed days, an average of 81 truck loads of products were despatched per weekday, generating 162 truck trips per weekday on the Quarry Access Road and Jenolan Caves Road to the north. The traffic surveys show an average of 169 heavy vehicle trips generated per weekday over the same period, being 16 rigid truck trips and 153 articulated truck trips (**Table 3.5**). The small difference of seven truck trips per weekday is likely to be truck trips which are not associated with despatch of quarry products, for example, deliveries of consumables, maintenance and repair vehicles, and contractors.

On the surveyed Saturdays, the surveyed average of 40 truck loads (80 truck trips) of product per day correlates exactly with the records from the Quarry.

Table 3.9 demonstrates that the level of activity on the surveyed weekdays of 162 truck trips per weekday (average of less than 10 truck trips per hour over the operating hours) was above the average of 134 truck trips per weekday calculated over the 12 months from June 2012 to May 2013. The surveyed weekdays can be considered to have covered a reasonably busy period over the year and are thus considered to be a reasonably robust basis for examining the existing road transport environment associated with the Austen Quarry, being both consistent with the Quarry's records and representing above average activity.

Light vehicle traffic generation by the Austen Quarry is the result of the workforce of 16 people arriving and departing each day, together with the arrival and departure of visitors and contractors. The surveyed average of 85 light vehicle trips per weekday also includes trips associated with the movement of staff to and from the adjacent leased land, which is not related to activity at the Austen Quarry. For the purpose of this assessment, the light vehicle traffic generated by the Austen Quarry is estimated as follows:

- 16 workers arriving and departing at start and end of shift = 32 vehicle trips per day

- 10 visitors or contractors arriving and departing on average weekday = 20 vehicle trips per weekday
- 4 visitors or contractors arriving and departing on Saturday = 8 vehicle trips per Saturday.

The balance of the surveyed light vehicle trips on the Quarry Access Road is assumed to be the movement of staff for the adjacent site and a number of quarry staff being required to exit and re-enter the Quarry during the day.

The surveyed traffic generated by the Austen Quarry has been assessed to estimate its contribution to traffic on Jenolan Caves Road on the average weekday. The resulting volumes are summarised in **Table 3.10** for the average weekday and Saturday total traffic and for the peak hours previously identified as being the busiest weekday hours associated with the Quarry traffic and Jenolan Caves Road traffic.

Table 3.10: Austen Quarry Traffic on Surveyed Roads March 2013 (vehicles/hour)

	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
Weekday									
5.00 to 6.00	6	14	20	5	14	19	1	0	1
10.00 to 11.00	1	17	18	1	17	18	0	0	0
11.00 to 12.00	2	12	14	2	12	14	0	0	0
16.00 to 17.00	3	11	14	3	11	14	1	0	1
17.00 to 18.00	8	9	17	7	9	16	1	0	1
Weekday Total[A]	52	169	221	43	169	212	9	0	9
Saturday									
5.00 to 6.00	8	13	21	7	13	19	1	0	1
11.00 to 12.00	6	14	19	5	14	18	1	0	1
12.00 to 13.00	4	7	11	3	7	10	1	0	1
14.00 to 15.00	1	1	1	0	1	1	0	0	0
Saturday Total[A]	40	80	120	33	80	113	7	0	7

[A] Vehicles per day

Over the two weeks of surveys, on the average weekday, the Austen Quarry contributed approximately 18 percent of the total traffic and 48 percent of heavy vehicle traffic on Jenolan Caves Road north of the Quarry Access Road, and less than 1 percent of the total traffic on Jenolan Caves Road south of the Quarry Access Road. On the Saturday, the Austen Quarry contributed less than 9 percent of the total traffic and 54 percent of heavy vehicle traffic on Jenolan Caves Road north of the Quarry Access Road, and less than 1 percent of the total traffic on Jenolan Caves Road south of the Quarry access. Thus the Austen Quarry generates approximately half of the heavy vehicles on Jenolan Caves Road north of the Quarry Access Road. Other heavy vehicles using Jenolan Caves Road include tourist coaches, buses, and some trucks associated with Oberon White Granite Quarry (Mudgee Stone Company) which has approval to generate around 90 two ways trips per day (AADT); Oberon Hardrock Quarry (Oberon Quarries) which generates traffic principally to Sydney markets at a rate of up to 400 000 tpa and the Highland Pine sawmill complex at Oberon which is reported to generate just over 100 trucks per day.

3.11 Austen Quarry Traffic Distribution

Hy-Tec has advised that on average, approximately 95 percent of quarry products are transported along the Great Western Highway to the east of Jenolan Caves Road, and 5 percent are transported along the Great Western Highway to the west of Jenolan Caves Road. This distribution can vary from day to day, such as when RMS is conducting local road works to the west of Jenolan Caves Road. These local road works tend to use smaller capacity trucks and so generate a greater number of truck trips. Transportation of products for such road works tends to occur during the morning, and is generally completed by 11am.

Thus on busy days with higher use of smaller capacity trucks, the distribution of quarry product transport traffic may be approximately 30 percent to the west and 70 percent to the east during the morning only.

The surveyed traffic volumes and quarry records provided by Hy-Tec also provide information regarding how the number of trucks despatched varies through the day. **Figure 3.6** presents the number of inbound and outbound heavy vehicle movements on the Quarry Access Road throughout the average weekday, as surveyed during March 2013.

Figure 3.6: Average Weekday Heavy Vehicles on the Quarry Access Road March 2013

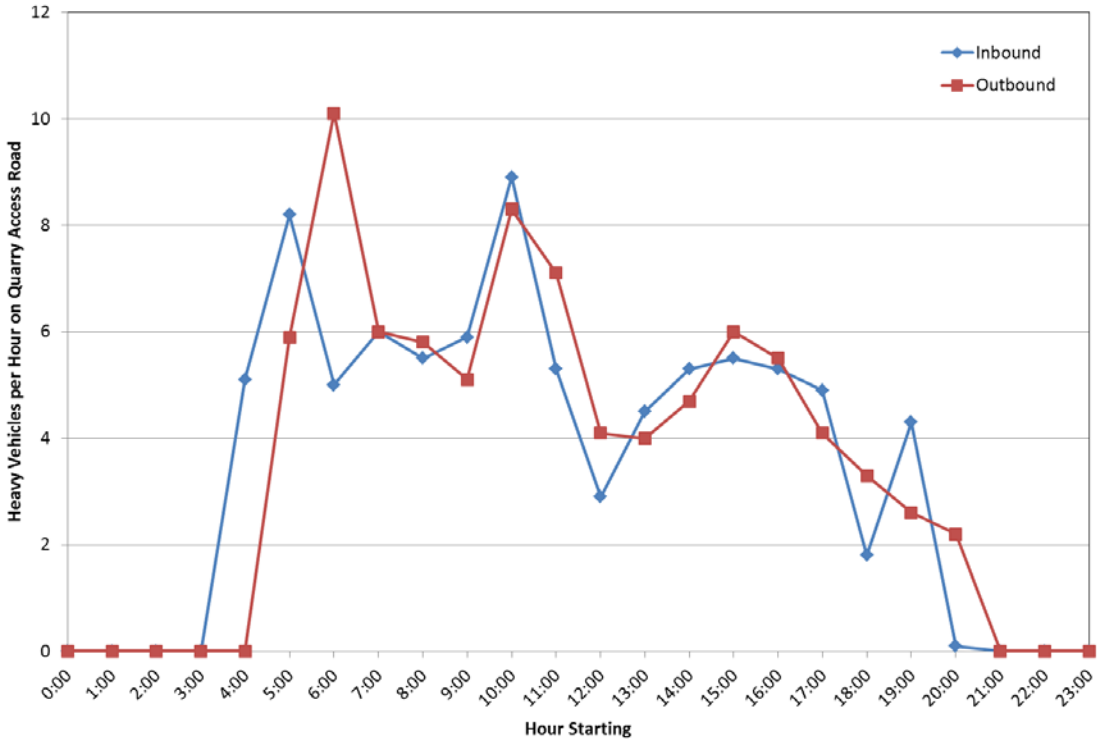


Figure 3.6 demonstrates that the distribution of truck trips through the day is similar for inbound and outbound trucks, i.e. trucks are not typically held at the Quarry waiting for despatch throughout the day. There is a notable decrease in truck trips made during the morning "commuter" peak hours, with a peak in outbound trips between 6.00am and 7.00am, followed by a decrease in outbound trips being made between 7.00am and 10.00am.

The surveys show a small number of empty trucks arrive at the Quarry prior to 5.00am due to availability of parking immediately adjacent to the Yorkeys Creek stockpile area provided by Hy-Tec in order to avoid any queuing of vehicles on Jenolan Caves Road. Trucks proceed to the incoming weighbridge after 5.00am.

School zones on the Great Western Highway operate between 8.00am and 9.30am, and between 2.30pm and 4.00pm. The extension of the Austen Quarry operating hours for product despatch from 5.00am to 10.00pm has allowed Hy-Tec to despatch trucks earlier in the morning so as to minimise the impacts of the Quarry trucks during commuter peaks and during operation of the morning school zones along the Great Western Highway. During the afternoon, the number of trucks despatched from the Quarry is generally lower than during the morning, and the number of trucks travelling on the Great Western Highway during the commuter peak and school zone periods is low.

Hy-Tec's management of despatch times benefits the local communities in Hartley and throughout the Blue Mountains by reducing the impact of the truck traffic during the more sensitive hours, but also benefits Hy-Tec by reducing the number of truck trips made at times when traffic speeds are lower due to either school zone limits or increased demand.

On the peak days at the existing despatch rate of 750,000 tpa, the transportation of Quarry products contributes approximately 285 truck trips per weekday on the Great Western Highway through the Blue Mountains, and approximately 15 truck trips per weekday on the Great Western Highway west of Jenolan Caves Road. This is equivalent to an average of 17 truck trips per hour through the Blue Mountains, and 1 truck trip per hour west of Jenolan Caves Road.

3.12 Road Safety Review

3.12.1 Hartley Area

Validated crash data was obtained from the RMS for the most recent five year period available, being from 2008 to 2012 inclusive. Provisional data for part of 2013 was also provided, however that provisional data remains incomplete and should not be relied on. The data did not include any crashes during the provisional period.

The data is based on crashes reported to the Police, and included Jenolan Caves Road between the Great Western Highway and McKanes Falls Road, a distance of approximately 6km. Over the five years, 21 crashes were reported. Of these, 19 crashes occurred between the Quarry Access Road and the Great Western Highway, including at the intersection with the Great Western Highway, and these are summarised in **Table 3.11**.

The locations of the crashes as plotted by RMS are provided in **Appendix A**. It is noted that while all crashes are included in the graphic, some are overlaid by a crash reported at the same location. In these cases, one or more crashes are not identified by their ID number and so may not be easily identified in the graphic. The crashes on Jenolan Caves Road were typically on the bends to the north of the Quarry Access Road.

Table 3.11: Reported Crash Types Jenolan Caves Road North of Quarry Access Road (2008 to 2012)

		Multiple Vehicles					Single Vehicle			
	Pedestrian	Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	Other
Total Crashes	-	-	2	-	-	-	-	-	17	-
Road Surface Condition										
Dry Road	-	-	-	-	-	-	-	-	8	-
Wet Road	-	-	2	-	-	-	-	-	9	-
Natural Lighting										
Daylight	-	-	2	-	-	-	-	-	14	-
Darkness	-	-	-	-	-	-	-	-	2	-
Dawn	-	-	-	-	-	-	-	-	1	-
Weather										
Fine	-	-	-	-	-	-	-	-	6	-
Fog or mist	-	-	-	-	-	-	-	-	1	-
Overcast	-	-	-	-	-	-	-	-	3	-
Raining	-	-	2	-	-	-	-	-	7	-
Vehicle Type										
Motorcycle	-	-	-	-	-	-	-	-	6	-
Car, 4WD	-	-	2	-	-	-	-	-	9	-
Light or Large Truck	-	-	-	-	-	-	-	-	1	-
Articulated Vehicle	-	-	2	-	-	-	-	-	1	-
Severity of Crash										
Fatal	-	-	1	-	-	-	-	-	-	-
Injury	-	-	-	-	-	-	-	-	8	-
Non-injury	-	-	1	-	-	-	-	-	9	-
Factors[A]										
Speed	-	-	-	-	-	-	-	-	17	-
Fatigue	-	-	1	-	-	-	-	-	3	-
Alcohol	-	-	-	-	-	-	-	-	-	-
None	-	-	1	-	-	-	-	-	-	-

[A] More than one factor can be nominated for a single crash

The majority of crashes involved a single vehicle leaving the carriageway and typically striking an object such as an embankment or fence. Speed was a contributing factor in all of these crash types, and all occurred on bends on Jenolan Caves Road. Half of the reported crashes of this type occurred on a wet road surface.

The two crashes between vehicles travelling in opposing directions were each head-on crashes which involved a car (or similar) and semitrailer, one of which was fatal and occurred at the intersection with the Great Western Highway. In each of these cases, the records suggest that the car (rather than the semitrailer) was travelling on the incorrect side of the road.

The reported crashes occurred between 6.20am and 8.15pm, although the majority (18 crashes) occurred between 10.45am and 6pm. This suggests that icy road conditions were not a contributing factor to crashes on Jenolan Caves Road. Fog or mist was present at the time of one of the crashes, that occurring at 6.20am, involving a semitrailer with speed nominated as a factor.

The review of the history of crashes on Jenolan Caves Road indicates that although there is no specific location (such as an intersection) with a particularly poor record, the speed of vehicles on bends to the north of Austen Quarry have resulted in drivers losing control of their vehicle.

3.12.2 Blue Mountains Area

Validated crash data was also obtained from the RMS for all crashes on the Great Western Highway between Lapstone and Lithgow for the most recent five year period available, being 1 July 2008 to 30 June 2013 inclusive. A total of 1,327 crashes were reported, as follows:

- 19 fatal crashes, which resulted in in 20 fatalities
- 579 injury crashes, which resulted in 816 people being injured
- 729 non-casualty crashes.

Crashes are identified by a coding system which groups crash types into general categories such as intersection, overtaking, off path. They are then further categorises into specific crash types, such as intersection cross traffic, overtaking cutting in, off path on straight to left, off path to left on right bend into object. Review of the data reveals the following key findings:

- The single most common general crash type was of single vehicles which lost control and left the carriageway. These accounted for 39 percent of all crashes (518 crashes).
- The next most common general crash type was intersection-type crashes, which accounted for 32 percent of all crashes (422 crashes).
- The single most common specific crash type was of single vehicles which lost control on a curve and hit an object, e.g. fence, embankment, tree. This accounted for 355 crashes, or 27 percent of all crashes.
- The next most common specific crash type was rear-end type crashes, which made up 27 percent of all crashes (364 crashes).
- 160 crashes, i.e., 12 percent of all crashes, involved a rigid or articulated truck. Of these, approximately 30 percent involved single vehicles which left the carriageway, 25 percent were rear end type crashes, 15 percent involved vehicles changing lane, and 13 percent were head on crashes.
- Pedestrians were involved in 16 crashes.
- Speed was nominated as a contributing factor in 36 percent of crashes, and fatigue was nominated as a contributing factor in 9 percent of crashes, noting these factors are not mutually exclusive.
- 39 percent of crashes (515 crashes) occurred on a wet road surface and 0.5 percent (6 crashes) occurred on a snow or iced road surface.
- 29 percent (389) crashes occurred during rain, 11 percent (151 crashes) occurred when overcast, and 2 percent (32 crashes) occurred during fog or mist.
- 30 percent of crashes occurred on weekend days, and 70 percent on weekdays.
- The worst hours of the day for crashes were 3.00pm to 4.00pm (9.4 percent), 4.00pm to 5.00pm (7.6 percent), 12.00pm to 1.00pm (7.2 percent) and 5.00pm to 6.00pm (6.9 percent).

The locations of all crashes along the Great Western Highway between Lapstone and Lithgow are also presented in **Appendix A**.

3.13 Roadway Capacity and Efficiency

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, C and D describe 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.

Austroads (2013) provides guidelines for the capacity of two lane, two-way rural roads, which in turn, refers to the *Highway Capacity Manual* (Transportation Research Board [TRB], 2010). TRB (2010) distinguishes between different categories of two lane two-way roads, with Class I being roads 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.

On this basis, Jenolan Caves Road and the Quarry Access Road would be considered Class II roads. The LOS for Class II roads is defined only in terms of percent-time-spent-following (PTSF). The LOS criteria for Class II two-lane highways are as shown in **Table 3.12**.

Table 3.12: Level of Service Criteria for Class II Two Lane Highways

Level of Service	Percent-Time-Spent-Following
A	≤ 40
B	> 40-55
C	> 55-70
D	> 70-85
E	≥ 85

TRB (2010) presents detailed methods for calculating the PTSF, however it also presents a basic relationship between traffic flow rate and PTSF for base conditions on a two way road. This indicates that below a two way peak hourly two way volume of around 650 vehicles per hour, the PTSF would typically be below 40 percent, and LOS would be A for Class II roads (refer to **Table 3.12**). Nevertheless, the PTSF for Jenolan Caves Road and Quarry Access Road has been assessed based on the surveyed traffic conditions.

The PTSF is estimated from the demand traffic volumes, the directional distribution of that traffic, and the percentage of no-passing zones. As a general review of the existing Levels of Service on the subject roads, the following assumptions/estimates have been made in calculating the PTSF:

- The passenger-car equivalent for heavy vehicles for calculation of PTSF 1.8 – this is a factor which is used to take into account the influence of heavy vehicles on the flow of traffic on a road, assessing each heavy vehicle as a multiple of passenger cars. This factor applies where two way traffic volumes are below 600 passenger car units per hour (pc/hr), and assumes that the terrain causes heavy vehicles to reduce their speeds substantially below that of passenger cars, but not to operate at crawl speeds for any significant length of time or at frequent intervals.
- 100 percent no-passing opportunities along the routes, i.e. along the route, drivers would be restricted from passing another vehicle for the whole length of Jenolan Caves Road between the Quarry Access Road and the Great Western Highway. Jenolan Caves Road has a single travel lane in each direction with no overtaking lanes between the Quarry Access Road and the Great Western Highway, so restrictions on overtaking would generally be as a result of centre line marking which prevents drivers from crossing to the wrong side of the carriageway to overtake due to sight distance or other constraints.
- Peak 15 minute volumes 33 percent of peak hourly volumes based on the average 15 minute to peak hour ratio from the intersection surveys.

On this basis, the surveyed volumes have been converted to passenger-car units, and the PTSF and Levels of Service results estimated in **Table 3.13**.

Table 3.13: PTSF and Levels of Service March 2013

Location	AM Peak Hour				PM Peak Hour			
	Hour Starting	pc/hr	PTSF	LOS	Hour Starting	pc/hr	PTSF	LOS
Weekday								
Quarry Access Road south of Jenolan Caves Rd	5:00	36	29.6	A	17:00	30	27.1	A
Jenolan Caves Road South of Austen Quarry	10:00	98	36.2	A	16:00	93	33.9	A
Jenolan Caves Road North of Austen Quarry	11:00	116	36.2	A	16:00	112	35.9	A
Saturday								
Quarry Access Road south of Jenolan Caves Rd	5.00	30	28.9	A	12.00	16	27.4	A
Jenolan Caves Road South of Austen Quarry	9.00	135	43.0	B	14.00	85	32.2	A
Jenolan Caves Road North of Austen Quarry	10.00	153	44.8	B	14.00	165	41.1	B

The results in **Table 3.13** indicate that based on the assumptions discussed above, the surveyed locations would be expected to experience good Levels of Service with regard to roadway efficiency and delays during the busiest hours.

It should be noted that this LOS is a general measure of the vehicle operating conditions on the roads with regard to the number of vehicles and their potential for interaction with each other. It does not reflect the existing road pavement conditions.

3.14 Intersection Operation

The operating performance of the two key intersections near the Austen Quarry have been assessed using SIDRA INTERSECTION[3] (SIDRA), a computer-based modelling package which calculates intersection performance characteristics, 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 operating characteristics can be compared with the performance criteria set out in **Table 3.14**. It is noted that average delay per vehicle is expressed in seconds per vehicle and is measured for the movement with the highest average delay per vehicle at priority intersections such as the two surveyed intersections on Jenolan Caves Road.

[3] Program used under license from Akcelik & Associates Pty Ltd.

Table 3.14: SIDRA Level of Service Criteria

Level of Service (LOS)	Average Delay per 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 spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Table 3.15 presents a summary of the existing operation of the two intersections, with full results presented in **Appendix C** of this report.

Table 3.15: Weekday Intersection Operating Conditions March 2013

Intersection	X-value		Average Delay (sec/veh)		Level of Service	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Great Western Highway/Jenolan Caves Road	0.12	0.18	34.7	28.5	C	C
Jenolan Caves Road/Quarry Access Road	0.02	0.02	14.9	11.2	B	B

On the basis of the above assessment, both intersections currently operate at satisfactory levels of service. The average delays reported in **Table 3.15** at the intersection of Jenolan Caves Road with the Great Western Highway are experienced by the drivers of vehicles turning right out of Jenolan Caves Road during the morning peak hour (19 vehicles per hour), and left out of Jenolan Caves Road during the evening peak hour (2 vehicles per hour). It is noted that a large component (approximately 17 seconds per vehicle) of the reported delays is the delay associated with physically negotiating the turn rather than the delay waiting for a gap in the traffic.

4. Future Road Transport Environment

Changes can be expected to occur to the operation of the road network currently used by vehicles travelling to and from the Austen Quarry which are unrelated to the Proposal, and so would occur regardless of the status of the Proposal. These are discussed in this section, which considers the future road network conditions, i.e. until and beyond March 2020. Without the new development consent being sought, the Austen Quarry would cease operating in March 2020, and thus, the review of future traffic conditions in this section assumes theoretical cessation of Austen Quarry activity in March 2020.

4.1 Traffic Growth

The technical paper (Mount Victoria to Lithgow Alliance, 2012b) prepared as part of the assessment process for the works along the Great Western Highway as described in **Section 3.1** presented the following forecasts of expected traffic volumes on the Great Western Highway near Forty Bends.

Table 4.1: Traffic Forecasts on the Great Western Highway near Forty Bends

Year	Daily (vehicles/day)		AM Peak (vehicles/hour)		PM Peak (vehicles/hour)	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
2011	3,950	3,950	220	260	350	300
2015	4,200	4,200	230	270	380	320
2025	4,950	4,950	270	320	450	380
2035	5,900	5,900	320	390	530	450

Source: Mount Victoria to Lithgow Alliance (2012b)

These forecasts suggest that over the period from 2011 to 2035, traffic volumes on the Great Western Highway are expected to increase by an average of approximately 2 percent per year. Traffic counts over the six years to 2012 indicate that heavy vehicle movements have been growing at a rate of about 1.3 percent per annum and light vehicle movement have been growing at a rate of about 1.7 percent per annum (Mt Victoria to Lithgow Alliance, 2012c). Adoption of a 2 percent per annum growth rate for both light and heavy vehicles is therefore considered to be robust.

Based on the existing traffic volumes on the Great Western Highway at various locations presented in **Section 3.1**, and the daily and peak hour forecasts for the Great Western Highway at Forty Bends (**Table 4.1**) from the RMS work for the highway upgrade program, two way traffic volumes at locations on the Great Western Highway have been developed and are presented below. **Table 4.2** presents the daily and peak hour forecasts for the same years as the RMS forecasts (2015, 2025 and 2035), as well as interpolated results for years 2013 and 2020.

Table 4.2: General Traffic Forecasts on the Great Western Highway between Mount Victoria and Lithgow

Location	2011[AB]	2013	2015[A]	2020	2025[A]	2035[A]
Daily (vehicles/day)						
Forty Bends	7,900	8,150	8,400	9,150	9,900	11,800
Hartley	8,800	9,100	9,400	10,250	11,100	13,200
Little Hartley	10,400	10,750	11,100	12,100	13,100	15,600
Victoria Pass	14,000	14,450	14,900	16,250	17,600	21,000
AM Peak (vehicles/hour)						
Forty Bends	480	490	500	550	590	710
Hartley	530	550	560	610	660	790
Little Hartley	630	650	660	720	780	940
Victoria Pass	850	870	890	970	1,050	1,260
PM Peak (vehicles/hour)						
Forty Bends	650	680	700	770	830	980
Hartley	720	750	780	860	930	1,100
Little Hartley	860	900	930	1,020	1,100	1,300
Victoria Pass	1,150	1,200	1,240	1,360	1,480	1,740

A RMS daily forecasts
B RMS peak hourly forecasts

A number of reports prepared by or for RMS (GHD 2006, Transport & Urban Planning 2009, Roads and Traffic Authority 2006, and GHD 2002) were reviewed to obtain traffic forecasts along the Great Western Highway to the east of the Austen Quarry. It is noted that the reports were prepared between 2002 and 2009, and so predate the forecasts in **Table 4.1**, and the observed growth rates of 1.3 and 1.7 percent per annum for light and heavy vehicles respectively discussed above. The reports suggested that the likely traffic growth on the Great Western Highway between Woodford and Wentworth Falls would be about 2.2 to 2.4 percent per annum until 2030. The data has been interpolated or extrapolated where required to generate forecasts for the same future time horizons as in **Table 4.2**. An extract showing the original forecasts from each of the reports are presented in **Appendix D**.

Table 4.3 summarises the AADT forecasts for the daily and peak hourly flows at four locations on the Great Western Highway through the Blue Mountains to the east of Jenolan Caves Road, and also presents forecasts at the five additional locations which are listed in **Table 3.1**, adopting a 2 percent growth rate per annum to generate forecasts for the same future time horizons as in **Table 4.2**.

Table 4.3: General Traffic Forecasts on the Great Western Highway Through the Blue Mountains

Location	2015	2020	2025	2030	2035
Daily (vehicles/day)					
Blackheath* (99.231)	17,990	19,590	21,200	22,810	24,410
Medlow Bath* (99.913)	19,750	21,580	23,410	25,240	27,070
Leura* (99.042)	28,600	31,150	33,700	36,260	38,810
Wentworth Falls East	30,070#	32,850	35,630#	38,410	41,190#
Bullaburra* (99.043)	23,460	25,670	27,880	30,090	32,310
Bullaburra	26,520#	29,000#	31,480#	33,960#	36,450
Lawson	28,900#	31,340	33,810#	36,280	38,750
Woodford-Hazelbrook	28,510	31,020	33,530	36,040	38,550
Faulconbridge* (99.914)	28,690	31,440	34,200	36,960	39,720
Peak Hourly (vehicles/hour)^					
Blackheath* (99.231)	1,800	1,960	2,120	2,280	2,440
Medlow Bath* (99.913)	1,980	2,160	2,340	2,520	2,710
Leura* (99.042)	2,860	3,120	3,370	3,630	3,880
Wentworth Falls East	2400#	2,620	2860#	3,080	3300#
Bullaburra* (99.043)	2,350	2,570	2,790	3,010	3,230
Bullaburra	2,650	2,900	3,150	3,400	3,650
Lawson	2,280#	2,480	2,680#	2,860	3,060
Woodford-Hazelbrook	2,280	2,480	2,680	2,880	3,080
Faulconbridge* (99.914)	2,870	3,140	3,420	3,700	3,970

Notes: Volumes are rounded to the nearest ten vehicles; # Interpolated flows; (99.231) RMS Count Station Numbers;
* Volumes from **Table 3.1** with 2% per annum growth; ^ RMS reported only one directional flows with 50/50 split, reported volumes are double the one way volumes.

These are general forecasts which do not specifically consider the Austen Quarry traffic or the relative levels of activity at the Quarry. It is considered that these forecasts in **Table 4.2** and **Table 4.3** should be assumed to relate to average day traffic associated with the Austen Quarry, i.e. generation of 166 truck trips per day in 2013 with approximately 95 percent (158 trips per weekday) on the Great Western Highway east of Jenolan Caves Road. Furthermore, it is assumed that these general forecasts assume the transport task of the Austen Quarry would not change significantly over time.

4.2 Changes to the Road Network

RMS has published concept designs for a program of upgrades to the Great Western Highway between Mount Victoria and Lithgow. This falls under the Australian and State Governments' plans for upgrades to the highway between Emu Plains and Lithgow. Currently many sections of the highway have been widened and upgraded or are under construction between Emu Plains and Katoomba and around Medlow Bath.

4.2.1 Great Western Highway Mount Victoria to Lithgow

RMS has published the following program of works to be completed by mid-2016:

- widening and re-alignment of the Great Western Highway to three lanes at the Forty Bends, east of Lithgow
- delivery of the Safety Enhancement Program between Lithgow and Mount Victoria, including Little Hartley, Hartley and the Jenolan Caves Road intersection where major works were previously proposed
- finalising concept design of the highway upgrade from Lithgow to Mount Victoria
- further planning for highway upgrades between Katoomba and Mount Victoria.

Generally, the Great Western Highway upgrades between Mount Victoria and Lithgow include locations of road widening to three lanes, realignment at Victoria Pass, upgraded intersection treatments with turning bays, separation of opposing traffic lanes, increased shoulder widths and warning signs as well as revised speed zones.

The Hartley Valley safety upgrading Review of Environmental Factors (REF) (SKM, 2013) identifies options for the treatment of the intersection of the Great Western Highway with Jenolan Caves Road and Blackmans Creek Road. The preferred option includes retention of the existing alignment of the intersection, however the diverge point from one to two lanes for westbound traffic would be relocated to the west of the intersection. The existing dedicated left and right turn lanes would be retained, and the right turn lane would be extended to provide additional deceleration length for heavy vehicles turning into Jenolan Caves Road from the west. It is noted that the final design is not yet known, with consultation and design development continuing for the Hartley Valley safety upgrade.

Options for provision of an interchange to replace the at-grade intersection of Jenolan Caves Road with the Great Western Highway and Blackmans Creek Road have been considered by the Mount Victoria to Lithgow Alliance (2012c) as part of the Great Western Highway Upgrade concept design. The preferred interchange option would provide a new alignment for the Great Western Highway, and the existing highway would be utilised in part for a westbound off ramp to Jenolan Caves Road and a westbound onramp from Jenolan Caves Road. Access to Jenolan Caves Road from the west would be via a new off-ramp and roadway commencing to the west of Jenolan Caves Road, which would pass to the north of the Great Western Highway and pass under the new highway to connect to Jenolan Caves Road. Access to the Great Western Highway eastbound from Jenolan Caves Road would be via this same roadway, thus vehicles would travel north on Jenolan Caves Road under the highway, then west to a new on-ramp to access the highway eastbound.

It is noted that the final design for any treatment in this area is not yet known, with community consultation having been undertaken and design development and environmental assessments continuing for the Hartley Valley safety upgrade.

4.2.2 Great Western Highway Emu Plains to Mount Victoria

RMS has commenced the following works on the Great Western Highway between Emu Plains and Mount Victoria:

- widening the existing two lane highway to a four lane, divided highway between Ridge Street, Lawson and 400m west of Genevieve Road, Bullaburra (completion is expected in 2015)
- widening the existing two lane highway to a four lane, divided highway between 400m west of Genevieve Road, Bullaburra and Tableland Road, Wentworth Falls (completion is expected in late 2014)
- widening the existing highway to a four lane, divided road between Winbourne Road, Hazelbrook and Station Street, Woodford.

4.2.3 Pedestrian and Cyclist Facilities

RMS indicates that pedestrian safety improvements along Great Western Highway completed and/or planned include:

- new or upgraded pedestrian signals in towns
- pedestrian refuges along some sections of the highway
- pedestrian over or underpasses
- off road shared paths, and
- new pedestrian bridges at Blaxland, Warrimoo, Valley Heights, Faulconbridge, Hazelbrook, Leura and Shell Corner.

Cyclists have benefited from the completed upgrade works along the Great Western Highway, and will benefit from those works still to be completed. RMS indicates that features of the Great Western Highway upgrades which benefit cyclists include:

- reduced speed limits in towns
- widening of the highway
- provision of overtaking lanes
- improvements to intersections crossing the highway in townships
- provision of bicycle facilities along the highway
- turning lanes to provide safer turns between the highway and local roads
- elimination of dangerous bends by realigning or widening the highway
- extra lanes and separation of opposing traffic flows
- consistent line-marking and signposting, and
- widening of bridges.

In some areas along Great Western Highway, progressive upgrade works and maintenance will result in sealed shoulders for cyclists, as well as connections with local cycleways in towns. In its Potential Treatments Report for the section of the highway between Katoomba and Mount Victoria, RMS suggests that improvements to pedestrian and cyclist facilities may include off-road shared paths or tracks, particularly in townships, and widening of road shoulders to minimum of two metres for cyclist access.

4.3 Austen Quarry Traffic Generation to March 2020

Under the current development consent, the Austen Quarry will continue to operate until March 2020, after which it would be decommissioned, unless a further development consent is approved. For the purpose of this assessment, it has been assumed that the Austen Quarry could operate at its highest permitted despatch level until March 2020, generating some 1.1 Mtpa of quarry products per year, compared with its current level of 750,000 tpa.

On this basis, the transportation of quarry products from the Austen Quarry could generate an average of approximately 250 trucks trips per weekday, and an estimated peak of 360 truck trips on a weekday until March 2020. On Saturdays, the Austen Quarry could generate an average of approximately 148 truck trips per Saturday, and an estimated peak of 210 truck trips per day until March 2020. These trips would be associated with the transportation of quarry products. As noted previously, this is considered to be a conservatively high estimate of peak future conditions, and would occur on approximately five days throughout the year. The assessment which follows is based on this peak day activity, i.e. 360 truck trips on a weekday and 210 truck trips on a Saturday, with the majority of customers located in the Sydney metropolitan area, i.e. larger trucks are used for transporting quarry products and the majority of trips are to and from the east along the Great Western Highway.

For peak days with local customers, the transportation of quarry products would generate an average of 300 truck trips on a weekday and an estimated peak of 500 truck trips on a weekday. This would occur on only one or two days throughout the year. As this level of activity would be so infrequent, a full assessment of its impacts is not warranted. The implications of these occasional peak local activity days are however discussed in Section 5.8 of this report.

The increase in product despatch from the current level to the peak level of 1.1 Mtpa would require up to four additional employees, and is assumed to increase the number of visitors and contactors visiting the site each day, which would increase the light vehicle traffic generation , i.e.:

- 20 workers arriving and departing at start and end of shift = 40 vehicle trips per day
- 12 visitors or contractors arriving and departing = 24 vehicle trips per weekday
- 5 visitors or contractors arriving and departing = 10 vehicle trips per Saturday.

The higher level of activity than surveyed at the Austen Quarry would be likely to also result in an increase in trips generated by heavy vehicles not associated directly with product transport. This assessment assumes an increase in such trips from seven "other" trips per weekday as surveyed in March 2013, associated with an average 162 product truck trips per day (**Section 3.10**), to 11 heavy vehicle "other" trips per average weekday with an average of 250 product truck trips per day. Peak days of transportation of products are not expected to further increase the "other" heavy vehicle trips which are associated with visitors and deliveries.

Table 4.4 summarises the future peak weekday and Saturday traffic generated by the Austen Quarry and its distribution on Jenolan Caves Road during the peak hours previously identified. This assumes that the Quarry traffic is spread through the day as it is at present.

Table 4.4: Peak Day Austen Quarry Traffic Year 2014 to 2020 (vehicles/hour)

	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
Weekday									
5.00 to 6.00	8	31	39	6	31	37	1	0	1
10.00 to 11.00	1	38	39	1	38	39	0	0	0
11.00 to 12.00	2	27	29	2	27	29	0	0	0
16.00 to 17.00	4	24	28	3	24	27	1	0	1
17.00 to 18.00	10	20	29	8	20	28	2	0	2
Weekday Total (vehicles/day)	64	370	434	52	370	422	12	0	12
Saturday									
5.00 to 6.00	10	33	43	8	33	41	2	0	2
11.00 to 12.00	7	35	42	6	35	41	1	0	1
12.00 to 13.00	5	17	22	4	17	21	1	0	1
14.00 to 15.00	1	1	2	1	1	2	0	0	0
Saturday Total (vehicles/day)	50	210	260	41	210	251	9	0	9

Peak day with Austen Quarry operating at 1.1 Mpta, up to year 2020, peak expected to occur approximately 5 times per year

On the peak day, the transportation of Quarry products would contribute approximately 342 truck trips per day on the Great Western Highway through the Blue Mountains, and approximately 18 truck trips per day on the Great Western Highway west of Jenolan Caves Road. Comparing this with the existing peak day at the current despatch rate of 750,000 tpa, this represents an increase of 57 truck trips per day on the Great Western Highway through the Blue Mountains and three truck trips per day west of Jenolan Caves Road. On average, the increase would be three truck trips per hour through the Blue Mountains, and less than one truck trip per hour west of Jenolan Caves Road.

4.4 Future Traffic Volumes to 2020

The volume of traffic on the road network can be expected to increase due to general growth in the road transport task demand. As a guide to the potential future traffic volumes on Jenolan Caves Road, a growth rate of 2 percent per annum has been applied to the background traffic which is not associated with the Austen Quarry. This is consistent with the forecasts presented by RMS on the Great Western Highway (**Table 4.2** and **Table 4.3**) up to year 2035. The resulting traffic volumes on the Quarry Access Road and Jenolan Caves Road are summarised in **Table 4.5** for weekday and Saturday conditions for the final year of operations at the Austen Quarry under its current development consent (Year 2020).

This assumes that any growth in non-quarry traffic would occur across the day in proportion to the existing traffic volumes, i.e. a 14 percent increase in total weekday traffic would result in a 14 percent increase in hourly traffic for each and every hour of the day. In reality, additional traffic is more likely to spread through the day, lengthening the time over which peak volumes occur rather than proportionally increasing the peak volume.

It is assumed that the weekday traffic currently generated by the adjacent leased land would continue in the future while the Austen Quarry operates, and would increase at the same rate of 2 percent per annum as the other traffic not associated with the Austen Quarry operations.

Table 4.5: Peak Day Two Way Traffic in 2020 (vehicles/hour)

	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
Weekday									
5.00 to 6.00	13	31	43	21	40	61	16	8	24
10.00 to 11.00	2	38	40	63	57	119	66	25	91
11.00 to 12.00	4	27	31	66	49	116	61	20	81
16.00 to 17.00	7	24	30	86	35	121	82	13	95
17.00 to 18.00	16	20	36	75	24	99	65	7	72
Weekday Total (vehicles/day)	102	370	472	943	583	1,526	853	226	1,079
Saturday									
5.00 to 6.00	10	33	43	16	38	53	9	7	16
11.00 to 12.00	7	35	42	121	54	176	136	9	145
12.00 to 13.00	5	17	22	106	21	127	110	7	116
14.00 to 15.00	1	1	2	122	8	130	117	6	123
Saturday Total (vehicles/day)	50	210	260	1,352	289	1,641	1,348	97	1,445

Peak day with the Austen Quarry operating at 1.1 Mtpa, expected to occur approximately 5 times per year plus background growth

Table 4.5 demonstrates that with the combined effects of background growth and peak day activity at the Austen Quarry, Jenolan Caves Road would carry up to approximately 1,530 vehicles per day on a weekday and 1,640 vehicles per day on a Saturday to the north of Austen Quarry in 2020.

Hy-Tec has advised that there is generally a maximum of 20 truck loads of quarry products (typically of 32.5 t per load) able to be despatched in any one hour (generating up to 40 heavy vehicle trips in that hour), however this can be exceeded under certain circumstances, i.e. when loading and despatching the smaller 15t capacity rigid trucks, when up to 25 truck loads may be despatched in an hour, generating 50 truck trips per hour, albeit to local destinations. The results in **Table 4.5** remain within the typical capacity of 40 truck trips per hour.

Table 4.6 presents indicative future traffic volumes on the Great Western Highway in 2020. These are based on the forecasts on the Great Western Highway presented by RMS, and adjusted to reflect only the increased truck trips associated with the transportation of quarry product, as this is the major component of traffic generated by the Quarry. Vehicle trips associated with the movement of employees and contractors are assumed to be included in the background forecasts presented by RMS (**Table 4.2**) and no adjustments have been made for changes in those vehicle trips over time. The quarry products transported to the east are assumed to travel to the Sydney metropolitan area, i.e. through the Blue Mountains, via the Great Western Highway.

Table 4.6: Indicative Peak Day Traffic Volumes on the Great Western Highway 2020

Location	AM Peak (vehicles/hour)	PM Peak (vehicles/hour)	Daily (vehicles/day)
Forty Bends	550	770	9,160
Hartley	620	870	10,434
Little Hartley	730	1,030	12,284
Victoria Pass	980	1,370	16,434
Blackheath	1,970	1,970	19,774
Medlow Bath	2,170	2,170	21,764
Leura	3,130	3,130	31,334
Wentworth Falls East	2,630	2,630	33,034
Bullaburra (Stn 99.043)	2,580	2,580	25,854
Bullaburra	2,910	2,910	29,184
Lawson	2,490	2,490	31,524
Woodford-Hazelbrook	2,490	2,490	31,204
Faulconbridge	3,150	3,150	31,624

Austen Quarry operating at 1.1Mtpa, peak day expected to occur approximately 5 times per year.

Table 4.6 indicates that traffic volumes on the Great Western Highway would be expected to increase to approximately 16,440 vehicles per day at Victoria Pass on a peak operating day at the Austen Quarry in 2020.

Assuming that the aforementioned general forecasts of total traffic on the Great Western Highway included an average of 12 percent heavy vehicles on the Great Western Highway, the contribution of the Quarry to heavy vehicles on the Great Western Highway on a peak day in 2020 is summarised in **Table 4.7**.

Table 4.7: Indicative Peak Day Heavy Vehicle Traffic on the Great Western Highway 2020

Location	Peak Hour (heavy vehicles/hour)		Daily (heavy vehicles/day)	
	Total	Quarry	Total	Quarry
Forty Bends	92	1	1,108	18
Hartley	113	20	1,414	342
Little Hartley	132	20	1,636	342
Victoria Pass	173	20	2,134	342
Blackheath	245	20	2,535	342
Medlow Bath	269	20	2,774	342
Leura	384	20	3,922	342
Wentworth Falls East	324	20	4,126	342
Bullaburra (Stn 99.043)	318	20	3,264	342
Bullaburra	358	20	3,664	342
Lawson	308	20	3,945	342
Woodford-Hazelbrook	308	20	3,906	342
Faulconbridge	387	20	3,957	342

Austen Quarry operating at 1.1Mtpa, peak day expected to occur approximately 5 times per year.
Assumes background weekday traffic is 12 percent heavy vehicles

These results demonstrate that the contribution of the Austen Quarry to total heavy vehicles on the Great Western Highway on peak days would decrease through the Blue Mountains to the east. The overall proportion of heavy vehicles on the Great Western Highway would remain at a similar level to the existing situation, with an increase from 12 percent to approximately 13 percent heavy vehicles on the peak days of activity at the Austen Quarry, expected approximately five times per year.

4.5 Future Traffic Volumes Beyond 2020

Under the current development consent, the Austen Quarry will continue to operate until March 2020, after which it would be decommissioned, unless a new development consent is approved. For the purpose of this assessment and for comparison with future conditions with the Proposal, it has been assumed that the Austen Quarry would theoretically cease operating in March 2020.

As above, a growth rate of 2 percent per annum has been applied, which is consistent with forecasts presented by RMS on the Great Western Highway (**Table 4.2**) up to year 2035. This future horizon was selected as it includes the effects of longer term growth for 15 years beyond the end of the current Austen Quarry approval. It is noted that this is longer than the ten years' growth typically assessed for a development, and thus is considered to ensure a robust review of the potential future traffic on the key routes. The resulting traffic volumes on Jenolan Caves Road are summarised in **Table 4.8** for weekday and Saturday conditions for the long term scenario (Year 2035).

This assumes that any growth in non-quarry traffic would occur across the day in proportion to the existing traffic volumes, i.e. a 14 percent increase in total weekday traffic would result in a 14 percent increase in hourly traffic for each and every hour of the day. In reality, additional traffic is more likely to spread through the day, lengthening the time over which peak volumes occur rather than proportionally increasing the peak volume.

It is assumed that with the theoretical closure of the Austen Quarry, the weekday traffic currently generated by the adjacent leased land would also cease in 2020.

Table 4.8: Two Way Traffic in 2035 (vehicles/hour)*

	Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total
Weekday						
5.00 to 6.00	13	12	25	18	10	28
10.00 to 11.00	77	24	101	83	32	115
11.00 to 12.00	80	28	108	76	25	101
16.00 to 17.00	102	14	116	102	17	119
17.00 to 18.00	78	6	84	79	9	88
Weekday Total (vehicles/day)	1,085	269	1,354	1,054	286	1,340
Saturday						
5.00 to 6.00	9	6	16	9	9	18
11.00 to 12.00	146	24	170	170	12	181
12.00 to 13.00	129	5	134	137	9	146
14.00 to 15.00	153	8	161	148	7	155
Saturday Total (vehicles/day)	1,656	99	1,756	1,692	122	1,814

* Assumes that Austen Quarry theoretically ceases operating in 2020

Table 4.8 demonstrates that with the combined effects of background growth and theoretical cessation of the Austen Quarry operations, Jenolan Caves Road would carry up to approximately 1,360 vehicles per day on a weekday and 1,760 vehicles per day on a Saturday to the north of Austen Quarry in 2020.

Table 4.9 presents indicative future traffic volumes on the Great Western Highway in 2035. These are based on the forecasts on the Great Western Highway presented by RMS, and adjusted to reflect only the removal of truck trips associated with the transportation of quarry products from the Austen Quarry after its theoretical closure in 2020.

Table 4.9: Indicative Traffic Volumes on the Great Western Highway 2035*

Location	AM Peak (vehicles/hour)	PM Peak (vehicles/hour)	Daily (vehicles/day)
Forty Bends	709	979	11,792
Hartley	780	1,090	13,042
Little Hartley	930	1,290	15,442
Victoria Pass	1,250	1,730	20,842
Blackheath	2,430	2,430	24,252
Medlow Bath	2,700	2,700	26,912
Leura	3,870	3,870	38,652
Wentworth Falls East	3,290	3,290	41,032
Bullaburra (Stn 99.043)	3,220	3,220	32,152
Bullaburra	3,640	3,640	36,292
Lawson	3,050	3,050	38,592
Woodford-Hazelbrook	3,070	3,070	38,392
Faulconbridge	3,960	3,960	39,562

* Assumes that Austen Quarry theoretically ceases operating in 2020

Table 4.9 indicates that traffic volumes on the Great Western Highway would be expected to increase to approximately 20,840 vehicles per day at Victoria Pass in 2035 and in the order of 40 000 vehicles per day at Faulconbridge. With the theoretical cessation of activity at the Austen Quarry, it is expected that background traffic on the Great Western Highway would include 8 to 12 percent heavy vehicles.

4.6 Future Roadway Capacity and Efficiency to 2020

As a general indication of the effects of background growth on the Level of Service experienced by drivers along Jenolan Caves Road, the PTSF has been recalculated for a peak day during the final year of the existing approved operation of the Austen Quarry, i.e. 2020. The results are summarised in **Table 4.10.**

Table 4.10: Future Peak Day Midblock Levels of Service 2020

Location	AM Peak Hour				PM Peak Hour			
	Hour Start	pc/hr	PTSF	LOS	Hour Start	pc/hr	PTSF	LOS
Weekday								
Jenolan Caves Road South of Quarry Access Road	10:00	111	37.6	A	16:00	106	35.2	A
Jenolan Caves Road North of Quarry Access Road	11:00	155	39.2	A	16:00	148	38.6	A
Saturday								
Jenolan Caves Road South of Quarry Access Road	9:00	126	38.2	A	14:00	128	37.5	A
Jenolan Caves Road North of Quarry Access Road	10:00	197	49.0	B	14:00	136	37.3	A

Austen Quarry operating at 1.1 Mtpa up to year 2020, peak expected to occur approximately 5 times per year

These results indicate that the traffic volumes on Jenolan Caves Road would remain sufficiently low with background growth in traffic that drivers would continue to experience good levels of service when driving along it on both a weekday and Saturday with peak activity at the Austen Quarry.

Along the Great Western Highway, a number of complex factors will influence the capacity and perceived service levels experienced by drivers. Drivers' expectations would vary significantly between sections of road within Blue Mountains villages (and from one village to another) and those between the villages. Austroads (2013) presents a general guide to Levels of Service for uninterrupted traffic flow on multi-lane roads, i.e. outside of the influences of signals and intersections. The LOS guide is based on travel speeds and vehicle densities to develop thresholds for maximum service flow rates per lane for various speed environments. These have been compared with the estimated traffic volumes presented in

Table 4.6 to provide a guide to expected future LOS during peak hours along the Great Western Highway. This assumes vehicles travel at a free-flow speed of 8 to 10 km/h above the posted speed limit, as suggested by Austroads (2013).

Table 4.11: Indicative Future Peak Day Levels of Service on the Great Western Highway 2020

Location	Total Vehicles per Hour	Number of Lanes	Speed Limit	Level of Service
Forty Bends	770	3	80	A
Hartley	870	3	90	A
Little Hartley	1,030	3	90	A
Victoria Pass	1,370	3	60	A
Leura	3,130	4	80	B
Wentworth Falls East	2,630	4	70	B
Bullaburra	2,910	4	80	B
Lawson	2,490	4	80	B
Woodford-Hazelbrook	2,490	4	80	B
Faulconbridge	3,150	4	70	B

Levels of Service from Table 4.4 of Austroads (2013)

The results demonstrate that in 2020, levels of service along the Great Western Highway are expected to be B on a peak day for the Austen Quarry.

4.7 Future Roadway Capacity and Efficiency Beyond 2020

As an indication of the effects of longer term background growth on the Level of Service experienced by drivers along Jenolan Caves Road, the PTSF has been recalculated for a weekday and Saturday in 2035. The results are summarised in **Table 4.12.**

Table 4.12: Future Midblock Levels of Service 2035*

Location	AM Peak Hour				PM Peak Hour			
	Hour Start	pc/hr	PTSF	LOS	Hour Start	pc/hr	PTSF	LOS
Weekday								
Jenolan Caves Road South of Quarry Access Road	10:00	140	40.5	B	16:00	132	37.9	A
Jenolan Caves Road North of Quarry Access Road	11:00	131	37.8	A	16:00	127	37.4	A
Saturday								
Jenolan Caves Road South of Quarry Access Road	9:00	158	41.4	B	14:00	161	40.8	B
Jenolan Caves Road North of Quarry Access Road	10:00	192	54.5	B	14:00	168	40.4	B

* Assumes that Austen Quarry theoretically ceases operating in 2020

These results indicate that the traffic volumes on Jenolan Caves Road would remain sufficiently low with background growth in traffic that drivers would continue to experience good levels of service when driving along it on both a weekday and Saturday in the longer term after the theoretical cessation of activity at the Austen Quarry under the current development consent.

Indicative Levels of Service along the Great Western Highway in 2035 are presented in **Table 4.13**, based on the highest estimated peak hour traffic volumes presented in **Table 4.9** to provide a guide to expected future LOS during peak hours along the Great Western Highway.

Table 4.13: Indicative Future Peak Day Levels of Service on the Great Western Highway 2035*

Location	Total Vehicles per Hour	Number of Lanes	Speed Limit	Level of Service
Forty Bends	979	3	80	A
Hartley	1,090	3	90	A
Little Hartley	1,290	3	90	A
Victoria Pass	1,730	3	60	B
Leura	3,870	4	80	C
Wentworth Falls East	3,290	4	70	B
Bullaburra	3,640	4	80	B
Lawson	3,050	4	80	B
Woodford-Hazelbrook	3,070	4	80	B
Faulconbridge	3,960	4	70	C

* Assumes that Austen Quarry theoretically ceases operating in 2020
Levels of Service from Table 4.4 of Austroads (2013)

The results demonstrate that in 2035, levels of service along the Great Western Highway are expected to be C.

4.8 Future Intersection Operation to 2020

The weekday peak hour operating characteristics of the surveyed intersections have been reassessed to quantify the future conditions in the final year of operations at the Austen Quarry under the current approval. The results are summarised in **Table 4.14**, and the results by movement are presented in **Appendix C**. As noted, the forecast turning movements at the intersections assume that growth in background traffic will increase the volume in each hour of the day pro rata to the daily increase. The SIDRA assessment does not take into account any upgrades which may occur to the layout of the intersection.

Table 4.14: Future Peak Weekday Intersection Operating Conditions 2020

Intersection	X-value		Average Delay (sec/veh)		Level of Service	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Great Western Highway/Jenolan Caves Road	0.24	0.28	49.6	35.8	D	C
Jenolan Caves Road/Quarry Access Road	0.04	0.03	16.5	11.8	B	A

Peak day with the Austen Quarry operating at 1.1 Mtpa, peak expected to occur approximately 5 times per year

The results in **Table 4.14** indicate that the intersections would operate satisfactorily, noting that Level of Service D is the upper limit for acceptable Level of Service. At the intersection of the Great Western Highway and Jenolan Caves Road, the movements with the highest average delay per vehicle would be the right turn out of Jenolan Caves Road during the morning peak, and the left turn out of Jenolan Caves Road during the evening peak. It is noted that the volume turning left during the evening peak hour is only four vehicles per hour.

Comparing these results with the existing conditions (**Table 3.15**), the results suggest that the average delays experienced by these drivers would increase noticeably, although the increase in the number of vehicles on those movements would be very low. This is partly due to the assumed high proportion of heavy vehicles, which take longer to turn and require longer gaps in the opposing traffic. A significant proportion of the reported delays is the forecast delay associated with physically negotiating the turn rather than the delay waiting for a suitable gap in the traffic.

4.9 Future Intersection Operation Beyond 2020

The weekday peak hour operating characteristics of the surveyed intersections have been reassessed to quantify the future conditions in the longer term after the theoretical cessation of activity at the Austen Quarry under the current approval. The results are summarised in **Table 4.15**, and the results by movement are presented in **Appendix C**. As noted, the forecast turning movements at the intersections assume that growth in background traffic will increase the volume in each hour of the day pro rata to the daily increase. The SIDRA assessment does not take into account any upgrades which may occur to the layout of the intersection.

Table 4.15: Future Peak Weekday Intersection Operating Conditions 2035*

Intersection	X-value		Average Delay (sec/veh)		Level of Service	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Great Western Highway/Jenolan Caves Road	0.22	0.31	47.6	39.3	D	C
Jenolan Caves Road/Quarry Access Road	0.02	0.02	10.3	10.2	A	A

* Assumes that Austen Quarry theoretically ceases operating in 2020

The results in **Table 4.15** indicate that the intersections would operate satisfactorily in the longer term, noting that Level of Service D is the upper limit for acceptable Level of Service. At the intersection of the Great Western Highway and Jenolan Caves Road, the movements with the highest average delay per vehicle would be the right turn out of Jenolan Caves Road during the morning peak, and the left turn out of Jenolan Caves Road during the evening peak. It is noted that the volume turning left during the evening peak hour is only six vehicles per hour, thus this delay would be experienced by only a small number of vehicles. A significant proportion of the reported delays is the forecast delay associated with physically negotiating the turn rather than the delay waiting for a gap in the traffic.

4.10 Future Pedestrians, Cyclists and Buses

The expected changes to the road network and traffic volumes described in this section are not expected to result in any significant change to the number of pedestrians, cyclists or buses operating in the local region. The number of pedestrians travelling along or across Jenolan Caves Road in proximity to the Quarry would remain negligible, and there is not expected to be a significant increase in demand for cyclist activity in the immediate area. The bus transport task is expected to remain at similar levels to the existing, with any future increase in demand being met by additional services operated by the existing service providers.

The number of truck trips generated by the Austen Quarry on a peak day, once spread over the operating hours of the Quarry and taking into account Hy-Tec's management of despatch times (**Section 3.11**), would have a negligible effect on the delays experienced by pedestrians crossing the Great Western Highway through the villages of the Blue Mountain, nor on exposure between cyclists and trucks. Hy-Tec's management of despatch times also minimises the potential interaction between quarry traffic and school buses.

4.11 Peak Local Customer Activity to 2020

As discussed (**Section 2.2**), when quarry products are required for local road works customers, smaller 15t capacity rigid trucks are used for the local trips rather than the larger articulated vehicles. As the capacity of the rigid trucks is less than that of the articulated trucks, the same tonnage of quarry products generates additional truck trips when the smaller trucks are used.

With a combination of Sydney and local customers, the average day quarry activity is estimated to increase from an average of 125 loads per day to an average of 150 loads per day, generating 300 truck

trips per day. On a peak day with local customers, it may increase to 250 loads per day, generating 500 truck trips per day. This higher trip generation would only occur on one or two days per year, and so is not considered a reasonable basis for assessment of the typical implications of the proposal, however its implications are broadly reviewed below.

The peak local day activity on a weekday would generate an additional 140 truck trips per day on Jenolan Caves Road above that assessed above. The resulting Levels of Service experienced along Jenolan Caves Road east of Austen Quarry on a weekday in 2020 are summarised in **Table 4.16**.

Table 4.16: Jenolan Caves Road East of Austen Quarry PTSF and LOS – Peak Local Customers 2020

	Hour Start	pc/hr	PTSF	LOS
Weekday AM Peak	11:00	174	41.0	B
Weekday PM Peak	16:00	165	40.1	B

Austen Quarry operating at 1.1 Mtpa with local customers, peak expected to occur approximately 1 to 2 times per year

The results demonstrate that drivers on Jenolan Caves Road would continue to experience good levels of service on the very busiest one or two days per year expected at the Austen Quarry.

With local customers, the distribution of quarry truck traffic at the intersection of Jenolan Caves Road with the Great Western Highway may vary from the typical day in which the majority of trips are made to and from the east. To review the implications of the potential variation in distribution, the operation of the intersection has been reassessed assuming the higher number of truck trips per day and that the majority of those trips are made to and from the west. The results of the analysis are summarised in **Table 4.17**, which do not take into account any possible upgrading of the intersection.

Table 4.17: Jenolan Caves Road/Great Western Highway Intersection – Peak Local Customers 2020

	X-value	Average Delay (sec/veh)	Level of Service
Weekday AM Peak	0.16	36.3	C
Weekday PM Peak	0.22	32.0	C

Austen Quarry operating at 1.1 Mtpa with local customers, peak expected to occur approximately 1 to 2 times per year

The results demonstrate that the intersection would operate satisfactorily on the busiest one or two days per year with local customers in 2020. Despite the higher number of trucks travelling to and from the Quarry, the change in the distribution of those truck trips would take advantage of available capacity at the intersection.

5. Road Environment Impacts of the Proposal

The Proposal would extend the operation of the Austen Quarry beyond March 2020. This section reviews the impacts of the extension of the Quarry operations by considering the potential peak day activity in the future.

5.1 Austen Quarry Traffic Generation Beyond 2020

As discussed in **Section 2.2**, the Austen Quarry has been operating at below its approved peak operating capacity, and the Proposal would not increase the permissible amount of quarry products able to be despatched from the Quarry per year. The volume of traffic generated by the Quarry would therefore not be altered by the Proposal, rather it would permit the Quarry to continue operating beyond 2020. The routes used by quarry trucks would not be altered by the Proposal.

At the maximum permitted despatch rate of 1.1 Mtpa, the transportation of quarry products would generate an average of 250 trips per day and a peak of 360 trips per day on weekdays. On Saturdays, the transport of quarry products would generate an average of 148 trips per day and a peak of 210 trips per day. With the Proposal, this rate of trip generation may continue beyond 2020. The peak day conditions represent the expected busiest days during which customers are predominantly located in the Sydney metropolitan area, i.e. larger trucks are used for transporting quarry products and the majority of trips are to and from the east along the Great Western Highway. The implications of peak day activity with local road works customers are discussed in **Section 5.8**.

With regard to light vehicle trip generation, the Proposal would not result in any further increase in the number of workers on the site or contractor trips above that described in **Section 4.3** which would occur up to 2020 with transportation of up to 1.1 Mtpa of products. The number of employee and contractor trips beyond 2020 with the Proposal is therefore expected to be as follows:

- 20 workers arriving and departing at start and end of shift = 40 vehicle trips per day
- 12 visitors or contractors arriving and departing = 24 vehicle trips per weekday
- 5 visitors or contractors arriving and departing = 10 vehicle trips per Saturday.

Table 5.1 summarises the expected volumes of traffic associated with the Austen Quarry over the peak weekday and Saturday and during the peak hours previously identified with the Proposal beyond 2020.

Table 5.1: Peak Day Austen Quarry Traffic 2020 to 2050 (vehicles/hour)

	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
Weekday									
5.00 to 6.00	8	31	39	6	31	37	1	0	1
10.00 to 11.00	1	38	39	1	38	39	0	0	0
11.00 to 12.00	2	27	29	2	27	29	0	0	0
16.00 to 17.00	4	24	28	3	24	27	1	0	1
17.00 to 18.00	10	20	29	8	20	28	2	0	2
Weekday Total[A]	64	370	434	52	370	422	12	0	12
Saturday									
5.00 to 6.00	10	33	43	8	33	41	2	0	2
11.00 to 12.00	7	35	42	6	35	41	1	0	1
12.00 to 13.00	5	17	22	4	17	21	1	0	1
14.00 to 15.00	1	1	2	1	1	2	0	0	0
Saturday Total[A]	50	210	260	41	210	251	9	0	9

Austen Quarry operating at 1.1 Mtpa, peak expected to occur approximately 5 times per year

These results assume that the spread of traffic through the day would remain the same as existing, with peaks occurring at the same times as existing (**Table 3.10**). In reality, increases may occur by spreading the additional heavy vehicle trips over the times which are currently generating fewer trips, due to limitations on the number of trucks which may be loaded at any one time.

The general maximum of 20 truck loads of quarry products able to be despatched in any one hour, generating 40 truck trips per hour would not be exceeded during the peak hours.

5.2 Future Traffic Volumes Beyond 2020

Table 5.2 presents the forecast two way traffic volumes in 2035 with the Proposal, i.e. with continued operation of the Austen Quarry beyond 2020. These results assume that the current weekday use of the Quarry Access Road by vehicles travelling to and from the adjacent land would continue with continued operation of the Austen Quarry.

Table 5.2: Future Peak Day Two Way Traffic 2035 (vehicles/hour)

	Quarry Access Road			Jenolan Caves Road North of Quarry Access Road			Jenolan Caves Road South of Quarry Access Road		
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total
Weekday									
5.00 to 6.00	12	31	43	23	43	66	20	10	30
10.00 to 11.00	2	38	39	79	62	140	83	32	115
11.00 to 12.00	4	27	31	83	55	138	76	25	102
16.00 to 17.00	6	24	30	107	38	144	103	17	120
17.00 to 18.00	15	20	35	90	25	116	82	9	90
Weekday Total[A]	98	370	468	1,165	639	1,804	1,072	286	1,357
Saturday									
5.00 to 6.00	10	33	43	17	39	57	11	9	20
11.00 to 12.00	7	35	42	152	59	211	171	12	183
12.00 to 13.00	5	17	22	133	22	155	138	9	147
14.00 to 15.00	1	1	2	154	9	163	148	7	156
Saturday Total[B]	50	210	260	1,697	309	2,007	1,701	122	1,823

Peak day with the Austen Quarry operating at 1.1 Mtpa, peak expected to occur approximately 5 times per year

This demonstrates that with the combined effects of background growth in traffic and the increase in heavy vehicle movements associated with the Proposal peak day activity, the weekday and Saturday peak hourly volumes on Jenolan Caves Road would remain below 150 and 220 vehicles per hour in 2035 respectively. Daily volumes to the north of the Quarry would be approximately 1,800 and 2,000 vehicles per day on weekdays and Saturdays respectively in 2035.

5.3 Roadway Capacity and Efficiency Beyond 2020

The implications of the ongoing operation of the Austen Quarry beyond 2020 have been assessed with regard to the expected PTSF on Jenolan Caves Road on a peak operating day in 2035. **Table 5.3** summarises the results.

Table 5.3: Future Peak Day Midblock Levels of Service 2035

Location	AM Peak Hour				PM Peak Hour			
	Hour Start	pc/hr	PTSF	LOS	Hour Start	pc/hr	PTSF	LOS
Weekday								
Jenolan Caves Road South of Quarry Access Road	10:00	141	40.6	B	16:00	133	38.0	A
Jenolan Caves Road North of Quarry Access Road	11:00	182	41.8	B	16:00	175	41.1	B
Saturday								
Jenolan Caves Road South of Quarry Access Road	9:00	159	41.5	B	14:00	161	40.8	B
Jenolan Caves Road North of Quarry Access Road	10:00	237	52.0	B	14:00	160	40.6	B

Austen Quarry operating at 1.1 Mtpa, peak expected to occur approximately 5 times per year

The results demonstrate that the combined effects of the additional traffic associated with background growth and continued operations at the Quarry on a peak day in 2035 would not result in any change to the worst Level of Service experienced on Jenolan Caves Road. The PTSF would remain below 55 percent, which is the upper threshold of for LoS B for Class II roads (refer to **Table 3.12**), thus the assessment shows that the forecast changes in PTSF would not result in any significant change in the service level experienced by drivers.

It is noted that the Glenroy Bridge on Jenolan Caves Road lies between the Austen Quarry and the Great Western Highway. The approaches (north and south of the bridge) were re-profiled in early 2012 to remove general depressions. This was conducted as an agreed arrangement with Lithgow City Council and RMS. It is acknowledged that Jenolan Caves Road is a State controlled road, and any further potential work on the Glenroy Bridge would need to be sponsored by RMS.

5.4 Impacts on Intersection Operation Beyond 2020

The operating characteristics of the surveyed intersections have been reassessed using SIDRA assuming continued peak day operation of the Austen Quarry. The results are summarised in **Table 5.4** and the results by movement are presented in **Appendix C**. The SIDRA assessment does not take into account any upgrades which may occur to the layout of the intersection.

Table 5.4: Peak Day Intersection Operating Conditions 2035

Intersection	X-value		Average Delay (sec/veh)		Level of Service	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Great Western Highway/Jenolan Caves Road	0.42	0.50	76.3	53.0	F	D
Jenolan Caves Road/Quarry Access Road	0.04	0.03	17.3	11.8	B	A

Peak day with the Austen Quarry operating at 1.1 Mtpa, peak expected to occur approximately 5 times per year

The results demonstrate that in 2035, assuming no upgrade of the intersection is done, the delays experienced by drivers turning right from Jenolan Caves Road to the Great Western Highway during the morning peak hour would increase to unacceptable levels with the combined influences of background growth and peak day activity at the Austen Quarry.

The actual increase in the number of vehicles turning right during the morning peak hour above the number surveyed in 2013 is modest, at 10 additional vehicles per hour, of which four vehicles would relate to peak day activity at the Austen Quarry and six would relate to background growth not associated with the Quarry. However the slower turning characteristics of heavy vehicles result in a requirement for longer gaps in the opposing traffic, thus the relatively small increase in the number of turning vehicles has a

significant impact on the delays experienced by those drivers. The drivers on the Great Western Highway would continue to experience only short average delays per vehicle.

Interpolation of the 2013 and 2035 results suggests that the Great Western Highway/Jenolan Caves Road intersection may go overcapacity in around 2024. However, this results from the traffic growth along the main road as opposed to the Quarry traffic.

As stated earlier, these results do not reflect any upgrade which may occur to the intersection of Jenolan Caves Road and the Great Western Highway. As discussed (**Section 4.1**), upgrading of the intersection is planned by RMS, however details of the layout or timing are not yet known.

5.5 Impacts on Great Western Highway Beyond 2020

Based on the previous indicative forecasts of background traffic volumes on the Great Western Highway **without** trucks travelling to and from the Austen Quarry (**Table 4.9**), the future traffic volumes on the Great Western Highway **with** the Proposal is summarised in **Table 5.5**, which considers only the truck trips associated with the transportation of quarry products, as this is the major component of traffic generated by the Quarry. Vehicle trips associated with the movement of employees and contractors are assumed to be included in the background forecasts presented by RMS (**Table 4.2**) and no adjustments have been made for changes in those vehicle trips over time. Due to the distances involved with travel along the Great Western Highway, these forecasts assume that the trips associated with the transportation of quarry products are spread evenly across the operating hours of the Austen Quarry. The quarry product trucks travelling laden to the east are assumed to travel to the Sydney metropolitan area, i.e. through the Blue Mountains via the Great Western Highway.

Table 5.5: Indicative Peak Day Traffic Volumes on the Great Western Highway 2035

Location	AM Peak (vehicles/hour)	PM Peak (vehicles/hour)	Daily (vehicles/day)
Forty Bends	710	980	11,810
Hartley	800	1,110	13,384
Little Hartley	950	1,310	15,784
Victoria Pass	1,270	1,750	21,184
Blackheath	2,450	2,450	24,594
Medlow Bath	2,720	2,720	27,254
Leura	3,890	3,890	38,994
Wentworth Falls East	3,310	3,310	41,374
Bullaburra (Stn 99.043)	3,240	3,240	32,494
Bullaburra	3,660	3,660	36,634
Lawson	3,070	3,070	38,934
Woodford-Hazelbrook	3,090	3,090	38,734
Faulconbridge	3,980	3,980	39,904

Austen Quarry operating at 1.1Mtpa, peak day expected to occur approximately 5 times per year.

Should the Proposal be approved, the traffic volumes beyond 2020 would be comparable with those prior to 2020, with a maximum of 342 heavy vehicles per day and an average of 20 heavy vehicles per hour on a peak operating day travelling to and from the Austen Quarry on the Great Western Highway east of Jenolan Caves Road i.e., through the Blue Mountains. The peak day is expected to occur on approximately five occasions each year.

The Proposal itself would thus not have a significant impact on the traffic volumes on the Great Western Highway, noting that the Proposal would not alter the maximum permitted despatch of product from that currently permitted. The changes in traffic resulting from the continued operations at the Austen Quarry would not significantly alter the overall traffic demand on the Great Western Highway, noting the completed and planned upgrades on the Great Western Highway will increase its overall capacity.

As at present, it is expected that Hy-Tec would continue to manage the despatch of trucks from the Quarry so as to minimise to the extent possible, the impacts of truck traffic on commuter peak hour traffic and school zone periods.

Assuming that the aforementioned general forecasts of total traffic on the Great Western Highway included an average of 12 percent heavy vehicles on the Great Western Highway, the contribution of the Quarry to heavy vehicles on the Great Western Highway on a peak day in 2035 is summarised in **Table 5.6**.

Table 5.6: Indicative Peak Day Heavy Vehicle Traffic on the Great Western Highway 2035

Location	Peak Hour (heavy vehicles/hour)		Daily (heavy vehicles/day)	
	Total	Quarry	Total	Quarry
Forty Bends	118	1	1,408	18
Hartley	142	20	1,426	342
Little Hartley	166	20	1,714	342
Victoria Pass	219	20	2,362	342
Blackheath	303	20	3,113	342
Medlow Bath	335	20	3,432	342
Leura	476	20	4,841	342
Wentworth Falls East	406	20	5,127	342
Bullaburra (Stn 99.043)	398	20	4,061	342
Bullaburra	448	20	4,558	342
Lawson	377	20	4,834	342
Woodford-Hazelbrook	380	20	4,810	342
Faulconbridge	486	20	4,950	342

Austen Quarry operating at 1.1Mtpa, peak day expected to occur approximately 5 times per year.
Assumes background weekday traffic is 12 percent heavy vehicles

These results demonstrate that the contribution of the Austen Quarry to total heavy vehicles on the Great Western Highway on peak days would decrease through the Blue Mountains to the east. The overall proportion of heavy vehicles on the Great Western Highway would remain at a similar level to the existing situation, at between approximately 12 and 13 percent heavy vehicles on the peak days of activity at the Austen Quarry, expected approximately five times per year.

Based on the Austroads (2013) guide and the forecast peak hourly volumes, indicative Levels of Service along the Great Western Highway are presented in **Table 5.7**.

Table 5.7: Indicative Future Peak Day Levels of Service on the Great Western Highway 2035

Location	Total Vehicles per Hour	Number of Lanes	Speed Limit	Level of Service
Forty Bends	980	3	80	A
Hartley	1,110	3	90	A
Little Hartley	1,310	3	90	A
Victoria Pass	1,750	3	60	B
Leura	3,890	4	80	C
Wentworth Falls East	3,310	4	70	B
Bullaburra	3,660	4	80	B
Lawson	3,070	4	80	B
Woodford-Hazelbrook	3,090	4	80	B
Faulconbridge	3,980	4	70	C

Austen Quarry operating at 1.1Mtpa, peak day expected to occur approximately 5 times per year.
Levels of Service from Table 4.4 of Austroads (2013)

The results demonstrate that with continued operation at the Austen Quarry, peak day activity at the Quarry would result in levels of service C on the Great Western Highway in 2035. Level of Service C reflects an acceptable level of comfort and convenience within the zone of stable traffic flow, with drivers

restricted to some extent in their freedom to select their desired speed and manoeuvre within the traffic stream.

5.6 Impacts on Pedestrians, Cyclists and Buses

The Proposal is not expected to generate any additional demand for pedestrian activity or bus patronage in the immediate area. The number of pedestrians walking along or across Jenolan Caves Road in the vicinity of the Quarry would remain negligible, thus no additional specific facilities are warranted.

The Proposal is not expected to generate any additional demand for cyclist activity in the immediate area. The number of trucks permitted to be despatched from the Quarry would not increase with the Proposal, thus it would not result in any increase in exposure between cyclists and vehicles on Great Western Highway and the surrounding road network. The Proposal would therefore not warrant any additional cyclist facilities noting that the completed and planned upgrade works on Great Western Highway will result in improved conditions for cyclists, irrespective of the Austen Quarry operations.

The number of truck trips generated by the Austen Quarry on a peak day, once spread over the operating hours of the Quarry and taking into account Hy-Tec's management of despatch times (**Section 3.11**), would have a negligible effect on the delays experienced by pedestrians crossing the Great Western Highway through the villages of the Blue Mountains. Hy-Tec's management of despatch times would also minimise the potential interaction between quarry traffic and school buses.

5.7 Impacts on Road Safety

The Proposal would result in the continuance of truck movements along the Great Western Highway, primarily through the Blue Mountains to and from the east of Jenolan Caves Road. This is the most appropriate route for such vehicles, being the major arterial route and carrying freight between Sydney and western NSW. The ongoing upgrading program for the Great Western Highway is progressively improving the route to meet the current and future road transport demands along it, with the various upgrades aiming to improve traffic flow and reduce the risk of crashes. The design of all the road works take into consideration the specific needs of heavy vehicles, such as their slower acceleration and braking capabilities.

Hy-Tec's Road Truck Traffic Management Plan aims to maximise the safety of road users both inside the Quarry and on public roads, and continued compliance with that Plan will reduce the risk of incidents associated with the quarry trucks.

5.8 Peak Local Customer Activity Beyond 2020

As discussed (**Sections 2.2 and 4.11**), with a high proportion of products being delivered to roadworks between Mt Victoria and Lithgow as well as to Sydney, the traffic generation of the Quarry is estimated to increase to a peak of 250 loads per day, generating 500 truck trips per day. This higher trip generation would only occur on one or two days per year, and so is not considered a reasonable basis for assessment of the typical implications of the proposal, however its implications are broadly reviewed below for the period beyond 2020.

The peak local day activity on a weekday would generate an additional 140 truck trips per day on Jenolan Caves Road above that assessed. The resulting Levels of Service experienced along Jenolan Caves Road east of Austen Quarry on a weekday with peak local customer activity are summarised in **Table 5.8** for year 2035.

Table 5.8: Jenolan Caves Road East of Austen Quarry PTSF and LOS – Peak Local Customers 2035

	Hour Start	pc/hr	PTSF	LOS
Weekday AM Peak	11:00	201	43.6	B
Weekday PM Peak	16:00	192	42.7	B

Austen Quarry operating at 1.1 Mtpa with local customers, peak expected to occur approximately 1 to 2 times per year

The results demonstrate that drivers on Jenolan Caves Road would continue to experience good levels of service on the very busiest one or two days per year expected at the Austen Quarry in 2035.

To review the implications of the potential variation in distribution, the operation of the intersection of the Great Western Highway and Jenolan Caves Road has been reassessed assuming the higher number of truck trips per day and that the majority of those trips are made to and from the west. The results of the analysis are summarised in **Table 5.9**, which does not take into account any possible upgrading of the intersection.

Table 5.9: Jenolan Caves Road/Great Western Highway Operation – Peak Local Customers 2035

	X-value	Average Delay (sec/veh)	Level of Service
Weekday AM Peak	0.27	48.3	D
Weekday PM Peak	0.38	42.3	C

Austen Quarry operating at 1.1 Mtpa with local customers, peak expected to occur approximately 1 to 2 times per year

The results demonstrate that the intersection would operate satisfactorily on the busiest one or two days per year with local customers in 2035. Despite the higher number of trucks travelling to and from the Quarry, the change in the distribution of those truck trips would take advantage of available capacity at the intersection.

6. Mitigation Measures

The assessment in Section 5 demonstrates that the levels of service experienced along Jenolan Caves Road are expected to remain good in the long term with the combined effects of background growth and peak day activity at the Austen Quarry. Heavy vehicles do not appear to contribute to the history of crashes along the route. No additional measures are therefore considered to be warranted along Jenolan Caves Road to accommodate the Proposal.

The analysis of the operating conditions at the intersection of Jenolan Caves Road and the Great Western Highway demonstrates that on a peak day in the long term (i.e. 2035), unacceptable delays may result, particularly during the morning peak as a result of increases in heavy vehicles turning right from Jenolan Caves Road into the Great Western Highway. As noted, upgrading of this intersection may increase the capacity for these movements, hence the delays forecast by SIDRA may not result. As the details of the upgrade are not known, it is recommended that in the longer term, the operation of the intersection should be monitored with particular regard to the delays and safety of vehicles exiting Jenolan Caves Road to the Great Western Highway, and to what extent the Austen Quarry contributes to the demand for this movement. If unacceptable delays are experienced during peak hours, and it is supported by monitoring data that the vehicles from the Austen Quarry are significantly contributing to the delays when considered in the context of other heavy vehicle traffic on Jenolan Caves Road, consideration may then be given to placing a limit on the number of heavy vehicles exiting the Austen Quarry during any one hour, or during specific hours of the day. Such a limit should apply to the truck and dog combinations and B-Doubles, rather than smaller capacity rigid trucks as these have the greatest impact on delays at the intersection due to their need for longer gaps in opposing traffic. A further option is for the Quarry to seek approval for a greater spread of transport hours, noting that Jenolan Caves Road is a gazetted B Double route for 24 hours per day, seven days per week.

This is potentially a concern only in the longer term (i.e. 2035) which is beyond the typical 10 year post opening assessment usually required by RMS, and beyond the 2020 horizon before which the Proposal would not alter traffic conditions from those already approved. It is therefore considered appropriate that a monitoring program be instated after 2020, with monitoring occurring possibly once every two years. The timing and method of the monitoring would clearly need to take into account the planned upgrade of the intersection of the Great Western Highway with Jenolan Caves Road (once known), as this would alter the operating characteristics of the intersection.

The Hy-Tec driver and vehicle check system standard, *Hy-Tec Chain of Responsibility – Driver/Vehicle Checks,* should continue to apply to all people involved in the various activities consigning; loading; driving; operating a business which controls the use of a commercial vehicle and receiving goods or freight.

The establishment and maintenance of this system has been demonstrated to reduce the number of truck drivers who do not comply with fatigue laws, reducing the risk of incidents on the transport route. The continuance of this system, together with the Road Truck Traffic Management Plan (**Section 2.2**), is therefore commended as a means to mitigate potential impacts of the proposal, particularly with regard to heavy vehicle driver behaviour.

7. Summary and Conclusions

7.1 Summary

- Austen Quarry is located 3.5km south-southwest of Hartley village and is accessed from the Quarry Access Road off Jenolan Caves Road.
- Austen Quarry has approval to despatch up to 1.1 Mtpa of product until March 2020. It currently operates below this capacity, despatching in the region of 750,000 tpa.
- The Austen Quarry generates heavy vehicle trips associated with product despatch (and return of unladen vehicles), light vehicle trips as a result of the workforce arriving at and departing from the Quarry, and other light and heavy trips associated with deliveries, visitors and contractors.
- Analysis of traffic surveys conducted during March 2013, indicates that the levels of service experienced along Jenolan Caves Road during peak hours are good. The intersection of Jenolan Caves Road and the Great Western Highway operates satisfactorily.
- A review of the history of crashes on Jenolan Caves Road indicates that speed of vehicles on bends to the north of the Austen Quarry has resulted in drivers losing control of their vehicle. Heavy vehicles do not appear to be a contributing factor to road crashes.
- Assessment of the road transport implications of continuation of the Austen Quarry without the Proposal but operating at its maximum approved rate of 1.1 Mtpa until 2020, indicates that levels of service along Jenolan Caves Road would continue to be good, while delays to turning vehicles at the intersection of Jenolan Caves Road and the Great Western Highway would increase but remain within acceptable levels of service.
- Hy-Tec proposes to maintain the existing maximum level of product despatch at 1.1 Mtpa with an extension of the life of the Quarry through to 2050. The Proposal would result in a small increase in the workforce, with increases in the number of contractors would also be likely.
- Assessment of the road transport implications of the Proposal indicates that levels of service along Jenolan Caves Road would continue to be good, while delays to turning vehicles at the intersection of Jenolan Caves Road and the Great Western Highway would increase to unacceptable levels after 2020, noting that details of the planned upgrade of the intersection are not yet known.
- It is recommended that the operation of the intersection of Jenolan Caves Road and the Great Western Highway be monitored after 2020, to determine if a limit on the number of trucks despatched from the Austen Quarry during any one hour or specific hours should be implemented or transport hours extended to allow opportunity to reduce movements during peak times.

7.2 Conclusions

This study has found that the Austen Quarry Proposal would be accommodated on the surrounding road network with typically acceptable impacts on the capacity, efficiency and safety of the road network. In the longer term, unacceptable delays may occur for heavy vehicles turning at the intersection of the Great Western Highway and Jenolan Caves Road, depending on the future expected upgrading of the intersection. It is recommended that this be monitored after 2020 to determine if a limit on the number of articulated vehicle departures from the Austen Quarry is appropriate to maintain acceptable delays at the intersection.

8. References

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Appendix A

Traffic Survey Results

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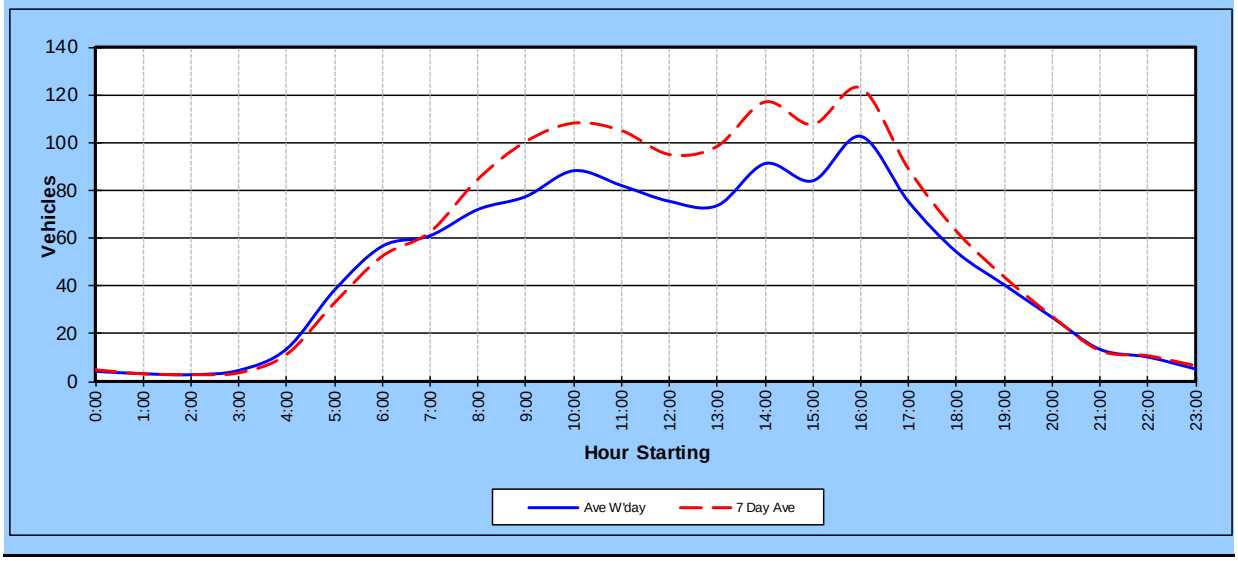
Road	3 Jenolan Caves Road
Location	North of Quarry Access Road
Site No.	1
Start Date	Friday 8-Mar-13
Direction	Combined

Average Weekday	1156
7 Day Average	1366
Weekday Heavy	29.8%
7 Day Heavy	20.8%

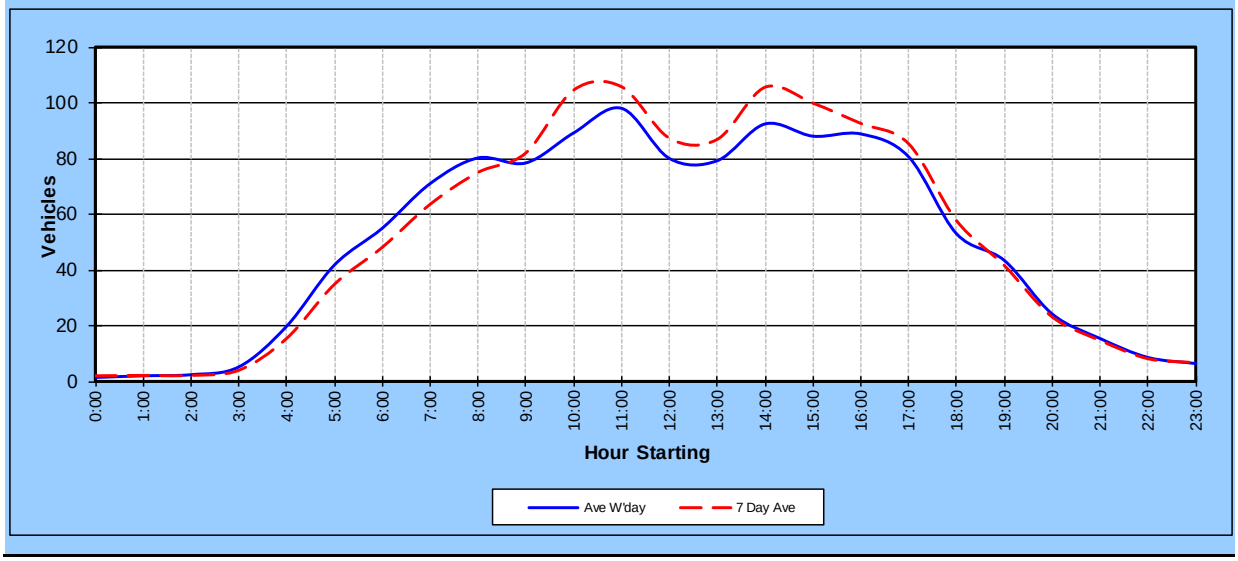
	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
Time	11-Mar	12-Mar	13-Mar	14-Mar	8-Mar	9-Mar	10-Mar	W'day	Ave
AM Peak	104	87	99	81	120	167	188		
PM Peak	108	95	97	98	126	196	173		
0:00	3	1	5	7	5	8	5	4	5
1:00	7	1	2	4	2	2	4	3	3
2:00	3	3	2	5	1	5	1	3	3
3:00	3	2	7	9	2	2	0	5	4
4:00	11	9	19	13	16	6	5	14	11
5:00	40	40	48	43	20	30	9	38	33
6:00	64	69	53	49	48	61	23	57	52
7:00	77	65	43	60	60	89	44	61	63
8:00	80	87	64	52	77	152	81	72	85
9:00	76	81	75	81	74	167	149	77	100
10:00	104	80	99	38	120	142	174	88	108
11:00	88	69	77	80	96	137	188	82	105
12:00	75	67	70	81	84	136	152	75	95
13:00	60	62	70	63	113	161	160	74	98
14:00	85	86	97	90	98	196	167	91	117
15:00	68	60	81	85	126	170	163	84	108
16:00	108	95	89	98	123	174	173	103	123
17:00	67	82	71	61	95	123	123	75	89
18:00	44	48	45	45	89	80	89	54	63
19:00	28	29	35	39	71	60	44	40	44
20:00	26	24	14	22	48	19	38	27	27
21:00	5	12	8	9	33	11	12	13	13
22:00	6	5	10	10	20	17	7	10	11
23:00	4	0	3	8	11	16	4	5	7
Total	1132	1077	1087	1052	1432	1964	1815	1156	1366
% Heavies	30.3%	32.3%	35.0%	31.4%	22.6%	9.4%	4.4%	29.8%	20.8%



Road	3 Jenolan Caves Road
Location	East of Quarry Access Road
Site No.	1
Start Date	Thursday 21-Mar-13
Direction	Combined

Average Weekday	1204
7 Day Average	1249
Weekday Heavy	30.5%
7 Day Heavy	23.3%

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	25-Mar	26-Mar	27-Mar	21-Mar	22-Mar	23-Mar	24-Mar		
AM Peak	105	102	91	102	100	136	151		
PM Peak	89	95	107	110	107	113	164		
0:00	2	2	2	0	1	4	3	1	2
1:00	3	1	2	3	1	2	3	2	2
2:00	2	2	2	3	3	0	3	2	2
3:00	7	3	8	3	5	2	0	5	4
4:00	18	15	23	22	21	7	2	20	15
5:00	42	48	38	40	41	30	5	42	35
6:00	44	78	50	57	46	48	14	55	48
7:00	92	70	81	61	51	60	30	71	64
8:00	85	74	69	85	88	68	56	80	75
9:00	77	83	74	88	70	90	92	78	82
10:00	90	88	87	81	100	135	151	89	105
11:00	105	102	91	102	90	136	114	98	106
12:00	73	74	54	110	89	103	108	80	87
13:00	80	69	76	78	93	90	122	79	87
14:00	89	90	96	80	107	113	164	92	106
15:00	79	95	107	67	92	107	152	88	100
16:00	79	78	88	95	104	82	122	89	93
17:00	86	72	79	79	87	94	100	81	85
18:00	41	60	49	46	69	77	62	53	58
19:00	27	50	43	43	54	32	42	43	42
20:00	17	26	18	19	41	17	24	24	23
21:00	15	4	18	11	29	15	11	15	15
22:00	9	13	3	6	12	7	7	9	8
23:00	7	4	7	7	7	13	2	6	7
Total	1169	1201	1165	1186	1301	1332	1389	1204	1249
% Heavies	31.9%	29.2%	31.6%	33.6%	26.6%	11.2%	3.5%	30.5%	23.3%

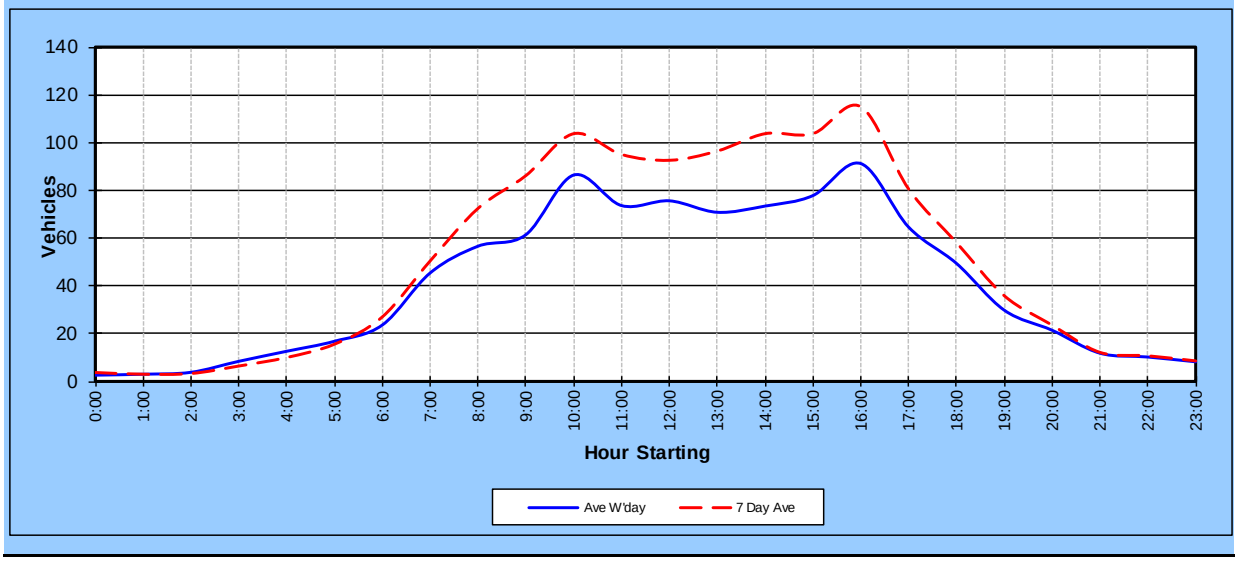


GTAconsultants

Road	1 Jenolan Caves Rd		
Location	Betw een Mckanes Falls Rd and Quarry Access Rd		
Site No.	1		
Start Date	Friday	8-Mar-13	
Direction	Combined		

Average Weekday	978
7 Day Average	1218
Weekday Heavy	19.7%
7 Day Heavy	13.2%

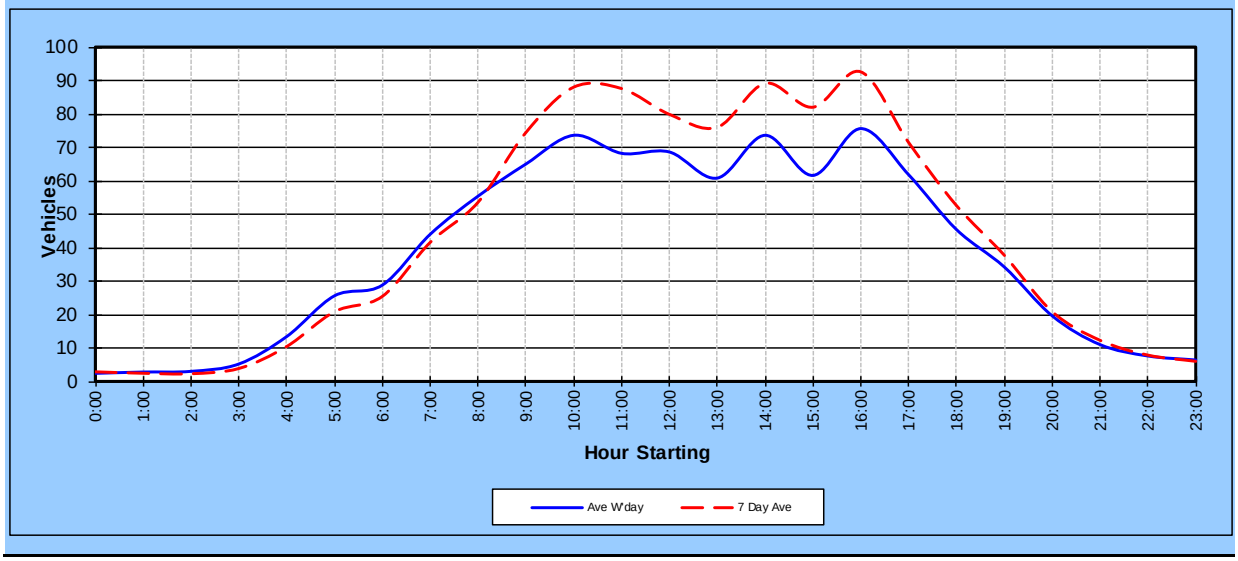
	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	11-Mar	12-Mar	13-Mar	14-Mar	8-Mar	9-Mar	10-Mar		
AM Peak	95	86	72	81	98	154	175		
PM Peak	132	73	65	95	116	191	172		
0:00	3	2	0	3	5	8	5	3	4
1:00	1	3	6	3	2	2	4	3	3
2:00	4	6	5	3	1	3	1	4	3
3:00	14	6	10	6	6	3	0	8	6
4:00	6	10	14	22	11	4	3	13	10
5:00	27	20	13	15	9	16	9	17	16
6:00	33	17	19	15	34	49	22	24	27
7:00	70	32	43	40	42	84	42	45	50
8:00	74	49	54	46	60	146	78	57	72
9:00	71	51	60	66	59	154	142	61	86
10:00	95	86	72	81	98	129	165	86	104
11:00	86	74	57	67	84	122	175	74	95
12:00	81	56	63	95	83	125	145	76	93
13:00	72	65	55	63	99	161	160	71	96
14:00	72	73	65	70	87	191	168	73	104
15:00	86	64	64	64	111	173	164	78	104
16:00	132	60	59	89	116	177	172	91	115
17:00	67	66	64	43	83	119	122	65	81
18:00	50	46	34	42	75	79	81	49	58
19:00	14	31	25	22	57	58	44	30	36
20:00	13	13	19	16	46	19	39	21	24
21:00	6	5	6	9	33	11	15	12	12
22:00	4	6	11	9	21	17	7	10	11
23:00	6	12	6	6	11	16	3	8	9
Total	1087	853	824	895	1233	1866	1766	978	1218
% Heavies	18.2%	21.2%	21.0%	26.4%	14.3%	5.7%	3.2%	19.7%	13.2%



Road	1 Jenolan Caves Rd
Location	Between Mckanes Falls Rd and Quarry Access Rd
Site No.	1 - Week 2
Start Date	Friday 15-Mar-13
Direction	Combined

Average Weekday	914
7 Day Average	1042
Weekday Heavy	22.3%
7 Day Heavy	15.9%

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	18-Mar	19-Mar	20-Mar	21-Mar	15-Mar	16-Mar	17-Mar		
AM Peak	92	66	72	85	79	127	145		
PM Peak	77	73	75	82	90	112	164		
0:00	3	3	3	0	3	6	2	2	3
1:00	7	1	2	3	1	2	1	3	2
2:00	3	3	2	5	2	0	1	3	2
3:00	4	3	7	4	8	1	0	5	4
4:00	7	10	16	18	16	5	1	13	10
5:00	19	26	31	26	26	14	4	26	21
6:00	42	30	16	26	30	23	11	29	25
7:00	38	47	37	55	43	37	34	44	42
8:00	62	55	49	68	43	56	42	55	54
9:00	69	55	59	77	65	105	91	65	74
10:00	92	66	66	65	79	122	126	74	88
11:00	64	51	72	85	69	127	145	68	88
12:00	64	50	60	82	87	102	114	69	80
13:00	52	56	62	64	70	103	125	61	76
14:00	67	68	75	75	83	108	148	74	89
15:00	53	48	52	70	85	112	154	62	82
16:00	77	73	73	65	90	106	164	76	93
17:00	53	65	58	50	83	69	122	62	71
18:00	38	45	40	37	67	63	78	45	53
19:00	18	28	30	37	58	48	45	34	38
20:00	15	15	15	15	38	25	23	20	21
21:00	6	10	9	10	20	17	14	11	12
22:00	5	6	11	5	11	10	7	8	8
23:00	4	0	4	5	19	6	4	6	6
Total	862	814	849	947	1096	1267	1456	914	1042
% Heavies	21.6%	21.1%	27.1%	23.7%	18.9%	6.7%	3.6%	22.3%	15.9%

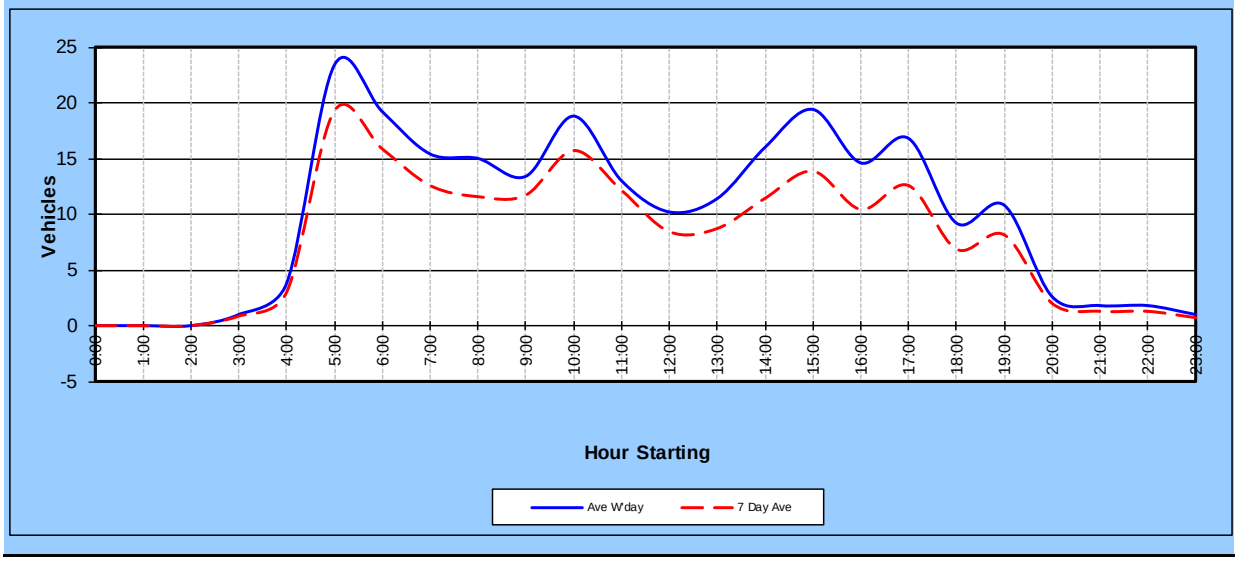


GTAconsultants

Road	2 Quarry Access rd		
Location	East of Jenolan Caves Rd		
Site No.	2		
Start Date	Friday	8-Mar-13	
Direction	Combined		

Average Weekday	239
7 Day Average	188
Weekday Heavy	66.6%
7 Day Heavy	65.4%

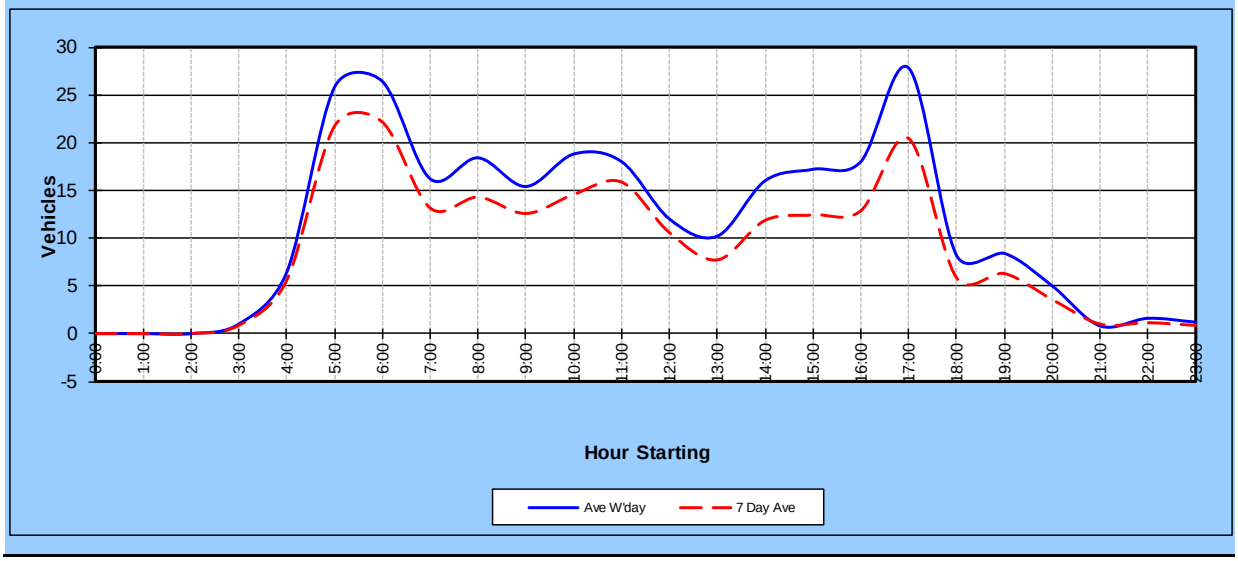
	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	11-Mar	12-Mar	13-Mar	14-Mar	8-Mar	9-Mar	10-Mar		
AM Peak	26	27	21	26	24	18	6		
PM Peak	26	22	25	18	21	8	2		
0:00	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	1	1	1	1	1	1	0	1	1
4:00	5	4	4	4	2	2	0	4	3
5:00	26	27	20	25	19	18	0	23	19
6:00	17	17	21	20	21	15	0	19	16
7:00	18	10	11	14	24	8	3	15	13
8:00	15	12	8	26	14	6	0	15	12
9:00	14	15	9	16	13	9	6	13	12
10:00	18	20	20	17	19	16	0	19	16
11:00	13	10	13	12	17	16	4	13	12
12:00	12	11	10	8	10	8	0	10	8
13:00	10	17	8	10	12	4	0	11	9
14:00	15	22	13	18	12	0	0	16	11
15:00	18	16	25	17	21	0	0	19	14
16:00	21	8	22	13	9	0	0	15	10
17:00	26	14	19	17	8	2	2	17	13
18:00	10	4	7	11	14	0	2	9	7
19:00	13	15	9	6	11	3	0	11	8
20:00	5	4	1	1	2	0	1	3	2
21:00	5	2	1	1	0	0	0	2	1
22:00	3	0	0	3	3	0	0	2	1
23:00	1	2	2	0	0	0	0	1	1
Total	266	231	224	240	232	108	18	239	188
% Heavies	66.5%	62.8%	61.6%	76.7%	64.7%	61.1%	16.7%	66.6%	65.4%



Road	2 Quarry Access Rd
Location	East of Jenolan Caves Rd
Site No.	2
Start Date	Friday 15-Mar-13
Direction	Combined

Average Weekday	273
7 Day Average	215
Weekday Heavy	65.9%
7 Day Heavy	65.8%

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	18-Mar	19-Mar	20-Mar	21-Mar	15-Mar	16-Mar	17-Mar		
AM Peak	31	31	33	26	22	23	0		
PM Peak	25	26	30	37	22	14	4		
0:00	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	1	1	1	1	1	1	0	1	1
4:00	4	4	8	6	10	7	0	6	6
5:00	27	27	33	26	16	23	0	26	22
6:00	31	29	29	21	22	23	0	26	22
7:00	27	16	15	10	13	11	0	16	13
8:00	13	31	14	17	17	8	0	18	14
9:00	12	24	15	12	14	11	0	15	13
10:00	17	19	18	20	20	8	0	19	15
11:00	22	16	18	13	21	21	0	18	16
12:00	6	13	14	14	13	14	0	12	11
13:00	5	13	11	10	12	3	0	10	8
14:00	22	18	12	9	19	2	1	16	12
15:00	19	17	22	6	22	0	1	17	12
16:00	25	20	16	18	11	0	0	18	13
17:00	24	26	30	37	22	0	4	28	20
18:00	8	8	4	9	12	0	0	8	6
19:00	9	12	6	7	8	0	2	8	6
20:00	7	6	3	4	5	0	0	5	4
21:00	1	1	1	1	0	0	3	1	1
22:00	3	2	2	1	0	0	0	2	1
23:00	2	0	0	4	0	0	0	1	1
Total	285	303	272	246	258	132	11	273	215
% Heavies	60.7%	64.0%	59.2%	75.2%	72.1%	69.7%	9.1%	65.9%	65.8%



GTAconsultants

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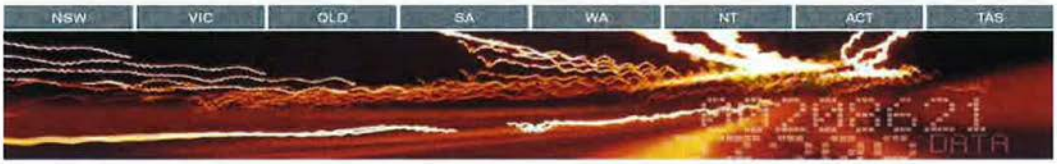
NSW | VIC | QLD | SA | WA | NT | ACT | TAS



5902 - Jenolan Caves Road Intersection Count - IC

May-13

JOB NUMBER	5902
JOB NAME	Jenolan Caves Road Intersection Count
CLIENT	GTA
SURVEY LOCATIONS	1. Jenolan Caves Road and Quarry Access Road 2. Great Western Highway and Jenolan Caves Road
SURVEY TYPE	Intersection Count
SURVEY DATE	Wednesday, 29 May 2013
SURVEY PERIOD	07:30 AM - 10:00 AM 04:00 PM - 06:30 PM
WEATHER	Fine

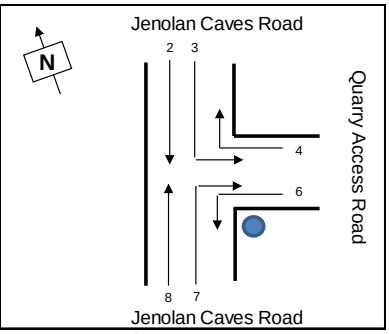
Austraffic (NSW) - 41/7 Sefton Road, Thornleigh, NSW 2120 - Ph: (02) 9484 8808- Fax: (02) 9484 0085

Intersection of Jenolan Caves Road and Quarry Access Road

Wednesday, 29 May 2013

Austraffic

Survey Start	**7:30 AM 16:00 PM**
Intersection Type	T Junction
Intersection No.	**1**
North Approach	**Jenolan Caves Road**
East Approach	**Quarry Access Road**
South Approach	**Jenolan Caves Road**
West Approach	
Date	**29/05/13**
Classification	**Light Heavy**



TIME PERIOD	VEHICLE MOVEMENT 2			3			4			6			VEHICLE MOVEMENT 7			8			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:30 - 7:45	3	0	3	0	1	1	0	0	0	0	0	0	0	0	0	3	2	5	6	3	9
7:45 - 8:00	8	4	12	1	1	2	1	1	2	0	0	0	0	0	0	1	0	1	11	6	17
8:00 - 8:15	5	3	8	1	1	2	0	2	2	0	0	0	0	0	0	5	2	7	11	8	19
8:15 - 8:30	1	6	7	0	1	1	0	0	0	0	0	0	0	0	0	2	1	3	3	8	11
8:30 - 8:45	1	0	1	0	2	2	1	0	1	0	0	0	1	0	1	2	0	2	5	2	7
8:45 - 9:00	4	2	6	1	0	1	0	2	2	0	0	0	0	0	0	4	0	4	9	4	13
9:00 - 9:15	3	1	4	1	1	2	0	1	1	0	0	0	1	0	1	4	2	6	9	5	14
9:15 - 9:30	8	1	9	0	5	5	1	1	2	0	0	0	0	0	0	4	5	9	13	12	25
9:30 - 9:45	8	3	11	2	0	2	1	2	3	0	0	0	0	0	0	9	1	10	20	6	26
9:45 - 10:00	3	1	4	0	0	0	0	2	2	0	0	0	0	0	0	4	2	6	7	5	12
Σ	44	21	65	6	12	18	4	11	15	0	0	0	2	0	2	38	15	53	94	59	153

TIME PERIOD	VEHICLE MOVEMENT 2			3			4			6			VEHICLE MOVEMENT 7			8			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
16:00 - 16:15	7	1	8	0	0	0	4	2	6	0	0	0	0	0	0	7	1	8	18	4	22
16:15 - 16:30	2	1	3	0	0	0	0	1	1	0	0	0	0	0	0	11	1	12	13	3	16
16:30 - 16:45	7	0	7	2	1	3	1	0	1	0	0	0	0	0	0	6	2	8	16	3	19
16:45 - 17:00	6	0	6	1	0	1	1	0	1	0	0	0	0	0	0	7	1	8	15	1	16
17:00 - 17:15	6	2	8	0	0	0	7	1	8	2	0	2	1	0	1	6	0	6	22	3	25
17:15 - 17:30	4	0	4	0	1	1	0	0	0	1	0	1	1	0	1	7	1	8	13	2	15
17:30 - 17:45	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	7	0	7
17:45 - 18:00	2	0	2	0	1	1	1	0	1	0	0	0	0	0	0	5	0	5	8	1	9
18:00 - 18:15	2	0	2	0	1	1	2	1	3	0	0	0	0	0	0	5	0	5	9	2	11
18:15 - 18:30	3	1	4	0	1	1	1	1	2	0	0	0	0	0	0	3	0	3	7	3	10
Σ	42	5	47	3	5	8	17	6	23	3	0	3	2	0	2	61	6	67	128	22	150

TIME PERIOD	VEHICLE MOVEMENT 2			3			4			6			VEHICLE MOVEMENT 7			8			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:30 - 8:30	17	13	30	2	4	6	1	3	4	0	0	0	0	0	0	11	5	16	31	25	56	
7:45 - 8:45	15	13	28	2	5	7	2	3	5	0	0	0	1	0	1	10	3	13	30	24	54	
8:00 - 9:00	11	11	22	2	4	6	1	4	5	0	0	0	1	0	1	13	3	16	28	22	50	
8:15 - 9:15	9	9	18	2	4	6	1	3	4	0	0	0	2	0	2	12	3	15	26	19	45	
8:30 - 9:30	16	4	20	2	8	10	2	4	6	0	0	0	2	0	2	14	7	21	36	23	59	
8:45 - 9:45	**23**	**7**	**30**	**4**	**6**	**10**	**2**	**6**	**8**	**0**	**0**	**0**	**1**	**0**	**1**	**21**	**8**	**29**	**51**	**27**	**78**	**Peak**
9:00 - 10:00	22	6	28	3	6	9	2	6	8	0	0	0	1	0	1	21	10	31	49	28	77	

TIME PERIOD	VEHICLE MOVEMENT 2			3			4			6			VEHICLE MOVEMENT 7			8			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
16:00 - 17:00	22	2	24	3	1	4	6	3	9	0	0	0	0	0	0	31	5	36	62	11	73	
16:15 - 17:15	**21**	**3**	**24**	**3**	**1**	**4**	**9**	**2**	**11**	**2**	**0**	**2**	**1**	**0**	**1**	**30**	**4**	**34**	**66**	**10**	**76**	**Peak**
16:30 - 17:30	23	2	25	3	2	5	9	1	10	3	0	3	2	0	2	26	4	30	66	9	75	
16:45 - 17:45	19	2	21	1	1	2	8	1	9	3	0	3	2	0	2	24	2	26	57	6	63	
17:00 - 18:00	15	2	17	0	2	2	8	1	9	3	0	3	2	0	2	22	1	23	50	6	56	
17:15 - 18:15	11	0	11	0	3	3	3	1	4	1	0	1	1	0	1	21	1	22	37	5	42	
17:30 - 18:30	10	1	11	0	3	3	4	2	6	0	0	0	0	0	0	17	0	17	31	6	37	

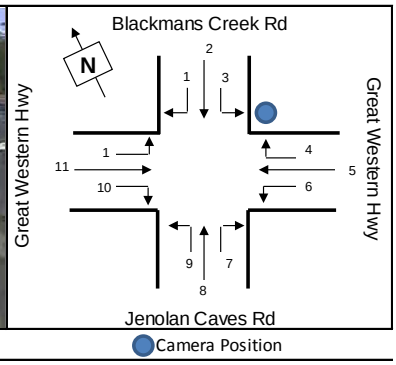
GTAconsultants

Intersection of Great Western Highway and Jenolan Caves Road

Wednesday, 29 May 2013

Austraffic

Survey Start	**7:30 AM 16:00 PM**
Intersection Type	Cross Junction
Intersection No.	**2**
North Approach	**Blackmans Creek Rd**
East Approach	**Great Western Hwy**
South Approach	**Jenolan Caves Rd**
West Approach	**Great Western Hwy**
Date	**29/05/13**
Classification	**Light Heavy**



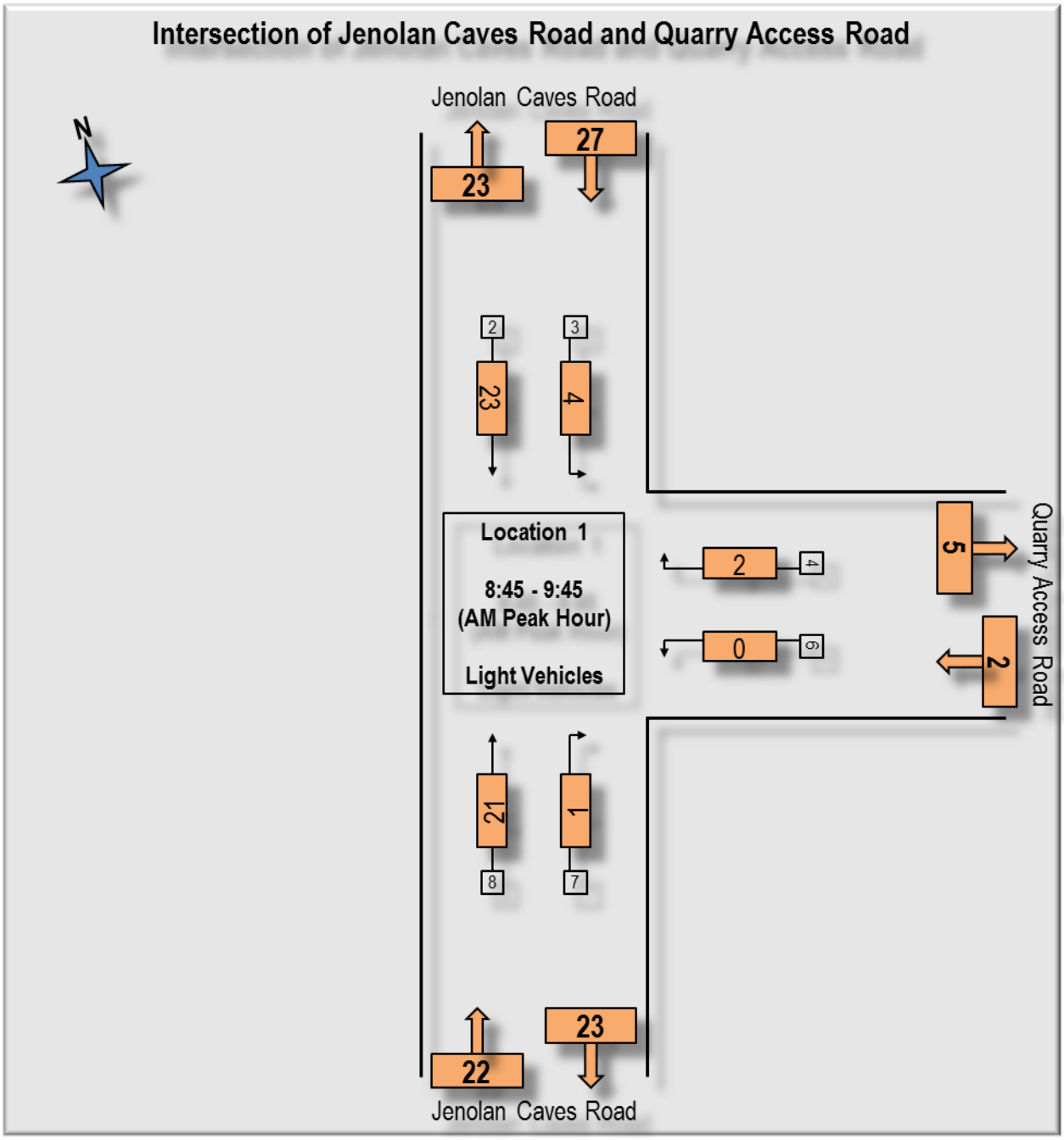
TIME PERIOD			VEHICLE MOVEMENT																								GRAND TOTAL		
			1			2			3			4			5			6			7			8			9			10			11			12					
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:30	-	7:45	0	0	0	0	0	0	2	0	2	0	0	0	62	13	75	7	3	10	3	1	4	0	0	0	1	0	1	0	0	0	27	10	37	0	0	0	102	27	129
7:45	-	8:00	0	0	0	0	0	0	0	0	0	1	0	1	47	11	58	7	2	9	0	2	2	0	0	0	0	0	0	0	0	0	31	15	46	0	0	0	86	33	119
8:00	-	8:15	1	0	1	0	0	0	2	0	2	0	0	0	63	5	68	3	2	5	6	3	9	1	0	1	0	0	0	1	0	1	37	12	49	0	0	0	115	22	137
8:15	-	8:30	0	0	0	0	0	0	1	0	1	0	0	0	60	13	73	1	5	6	2	2	4	0	0	0	2	0	2	0	0	0	53	13	66	1	0	1	118	35	153
8:30	-	8:45	0	0	0	0	0	0	1	0	1	0	0	0	58	10	68	2	2	4	1	0	1	0	0	0	2	0	2	0	0	0	31	8	39	0	0	0	95	20	115
8:45	-	9:00	0	0	0	0	0	0	1	0	1	0	0	0	39	7	46	5	1	6	5	1	6	0	0	0	0	1	1	0	0	0	44	8	52	0	0	0	94	19	113
9:00	-	9:15	0	0	0	0	0	0	0	0	0	0	0	0	48	8	56	4	3	7	4	3	7	0	0	0	1	2	3	0	2	2	30	7	37	0	0	0	89	21	110
9:15	-	9:30	2	0	2	0	0	0	0	0	0	1	0	1	51	12	63	8	5	13	2	1	3	0	0	0	0	2	2	1	0	1	42	12	54	1	0	1	108	32	140
9:30	-	9:45	1	0	1	0	0	0	0	0	0	0	0	0	45	8	53	5	4	9	12	1	13	0	0	0	0	0	0	1	1	2	23	8	31	0	0	0	87	22	109
9:45	-	10:00	0	0	0	0	0	0	0	0	0	0	0	0	51	9	60	4	2	6	3	3	6	0	0	0	0	0	0	1	0	1	48	12	60	0	1	1	107	27	134
Σ			4	0	4	0	0	0	7	0	7	2	0	2	524	96	620	46	29	75	38	17	55	1	0	1	5	3	8	6	7	13	366	105	471	2	1	3	1001	258	1259

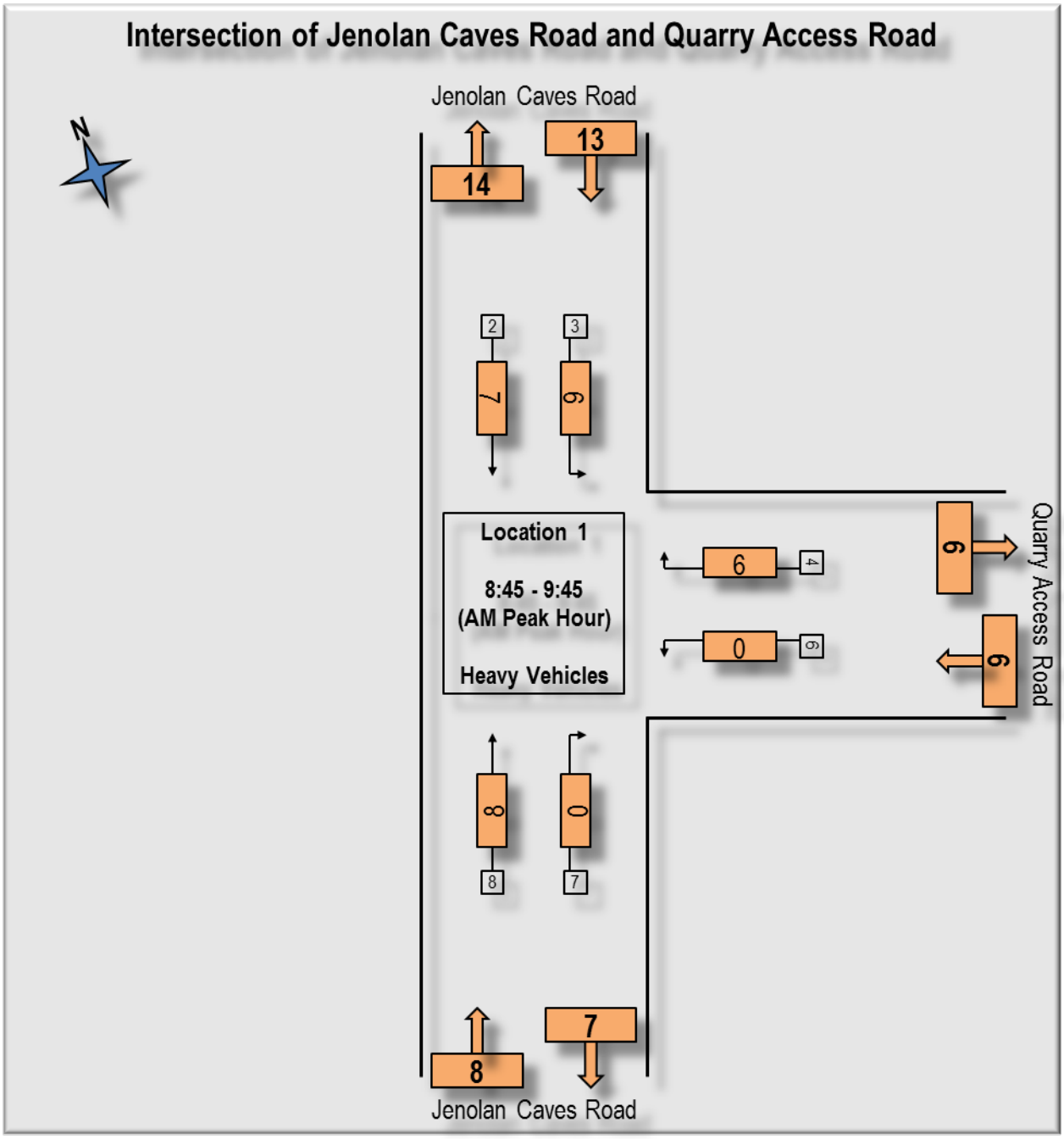
TIME PERIOD			VEHICLE MOVEMENT																								GRAND TOTAL		
			1			2			3			4			5			6			7			8			9			10			11			12					
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
16:00	-	16:15	1	0	1	0	0	0	0	0	0	0	0	0	58	10	68	10	1	11	9	0	9	0	0	0	1	0	1	0	0	0	74	10	84	0	0	0	153	21	174
16:15	-	16:30	0	0	0	0	0	0	0	0	0	0	0	0	40	12	52	3	1	4	12	3	15	0	0	0	0	2	2	0	1	1	64	6	70	1	0	1	120	25	145
16:30	-	16:45	0	0	0	0	0	0	0	0	0	1	0	1	41	10	51	6	0	6	6	1	7	0	0	0	0	0	0	2	0	2	83	8	91	0	0	0	139	19	158
16:45	-	17:00	0	0	0	0	0	0	1	0	1	2	0	2	52	6	58	8	1	9	8	2	10	0	0	0	1	0	1	1	0	1	60	9	69	0	0	0	133	18	151
17:00	-	17:15	0	0	0	0	0	0	0	0	0	0	0	0	60	6	66	5	1	6	8	0	8	1	0	1	4	1	5	0	0	0	48	7	55	0	0	0	126	15	141
17:15	-	17:30	1	0	1	0	0	0	1	0	1	1	0	1	53	7	60	4	0	4	4	1	5	0	0	0	1	0	1	0	1	1	68	12	80	0	0	0	133	21	154
17:30	-	17:45	1	0	1	0	0	0	0	1	1	0	0	0	40	4	44	4	0	4	7	0	7	0	0	0	1	0	1	0	0	0	49	4	53	1	0	1	103	9	112
17:45	-	18:00	0	0	0	0	0	0	1	0	1	1	0	1	41	7	48	1	1	2	5	0	5	0	0	0	1	0	1	0	0	0	51	7	58	1	0	1	102	15	117
18:00	-	18:15	0	0	0	0	0	0	0	0	0	0	0	0	43	8	51	5	1	6	6	1	7	0	0	0	2	0	2	0	0	0	46	11	57	0	0	0	102	21	123
18:15	-	18:30	0	0	0	0	0	0	0	0	0	1	0	1	33	6	39	2	2	4	3	0	3	0	0	0	2	0	2	0	0	0	42	6	48	0	0	0	83	14	97
Σ			3	0	3	0	0	0	3	1	4	6	0	6	461	76	537	48	8	56	68	8	76	1	0	1	13	3	16	3	2	5	585	80	665	3	0	3	1194	178	1372

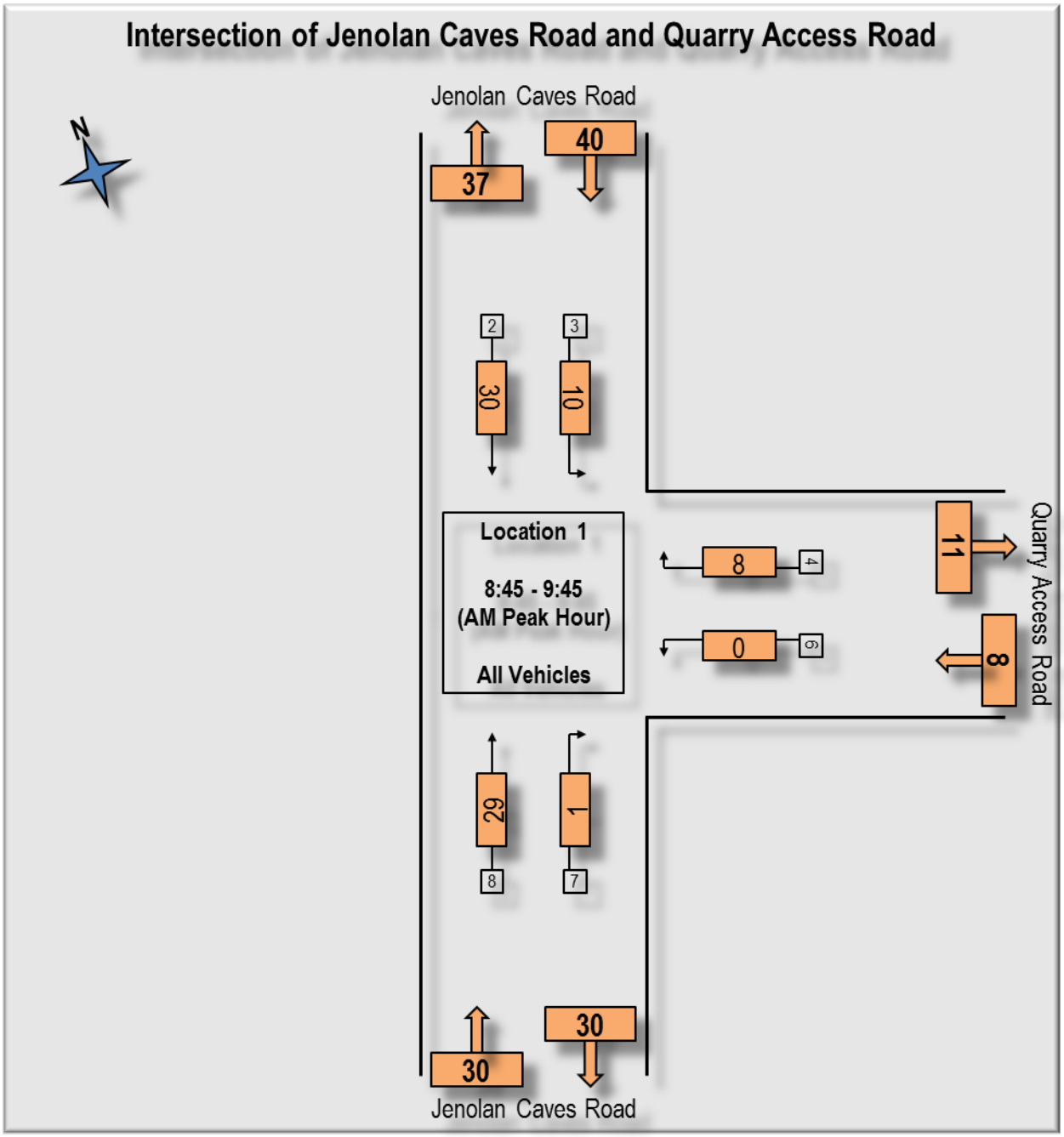
GTAconsultants

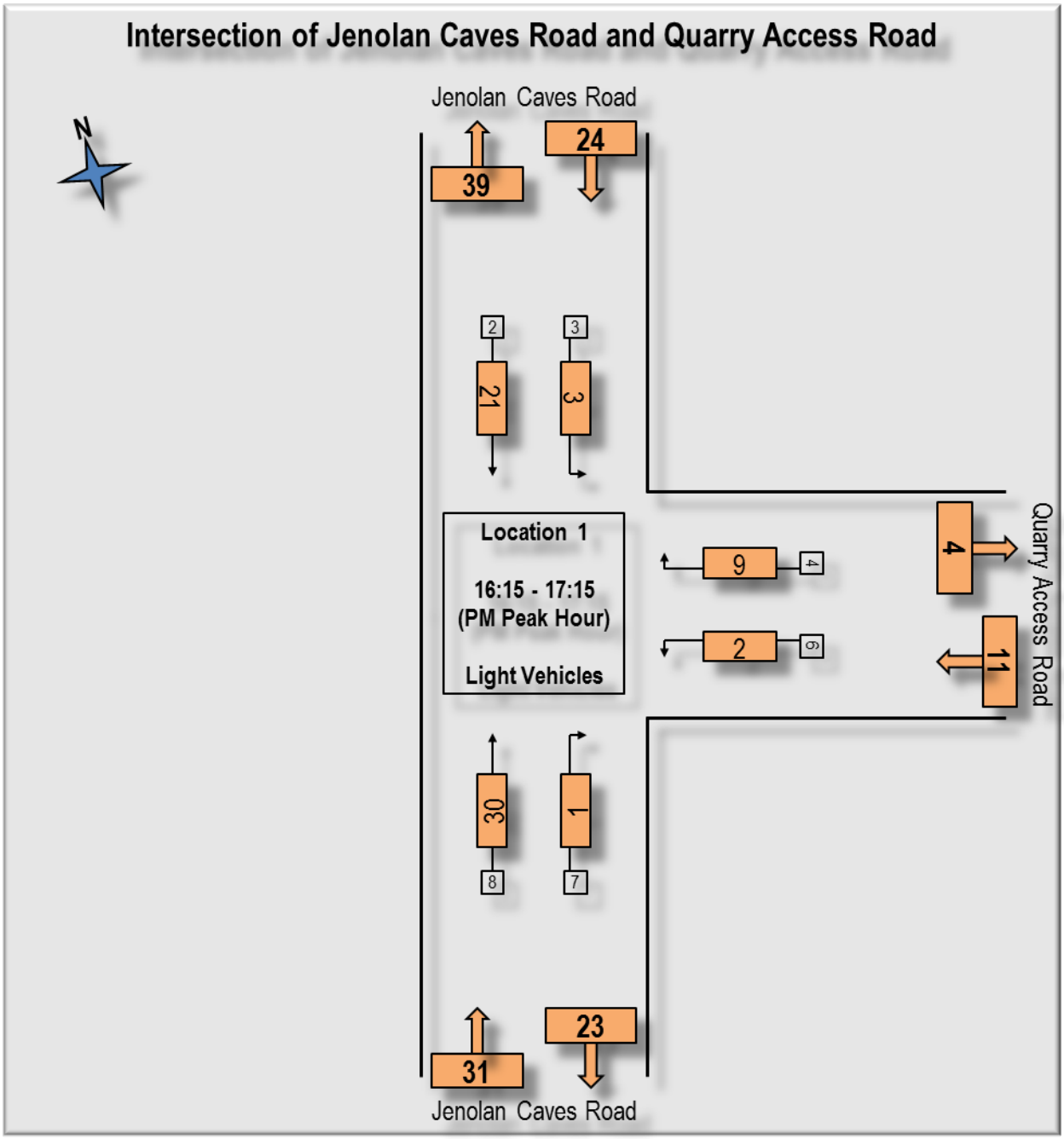
TIME PERIOD			VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
			1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:30	**-**	**8:30**	**1**	**0**	**1**	**0**	**0**	**0**	**5**	**0**	**5**	**1**	**0**	**1**	**232**	**42**	**274**	**18**	**12**	**30**	**11**	**8**	**19**	**1**	**0**	**1**	**2**	**0**	**2**	**1**	**5**	**6**	**148**	**50**	**198**	**1**	**0**	**1**	**421**	**117**	**538**	**Peak**
7:45	-	8:45	1	0	1	0	0	0	4	0	4	1	0	1	228	39	267	13	11	24	9	7	16	1	0	1	3	0	3	1	5	6	152	48	200	1	0	1	414	110	524	
8:00	-	9:00	1	0	1	0	0	0	5	0	5	0	0	0	220	35	255	11	11	22	14	6	20	1	0	1	3	0	3	1	3	4	165	41	206	1	0	1	422	96	518	
8:15	-	9:15	0	0	0	0	0	0	3	0	3	0	0	0	205	38	243	12	11	23	12	6	18	0	0	0	3	1	4	2	3	5	158	36	194	1	0	1	396	95	491	
8:30	-	9:30	2	0	2	0	0	0	2	0	2	1	0	1	196	37	233	19	11	30	12	5	17	0	0	0	3	3	6	3	1	4	147	35	182	1	0	1	386	92	478	
8:45	-	9:45	3	0	3	0	0	0	1	0	1	1	0	1	183	35	218	22	13	35	23	6	29	0	0	0	1	3	4	4	2	6	139	35	174	1	0	1	378	94	472	
9:00	-	10:00	3	0	3	0	0	0	0	0	0	1	0	1	195	37	232	21	13	34	21	8	29	0	0	0	1	3	4	5	1	6	143	39	182	1	1	2	391	102	493	

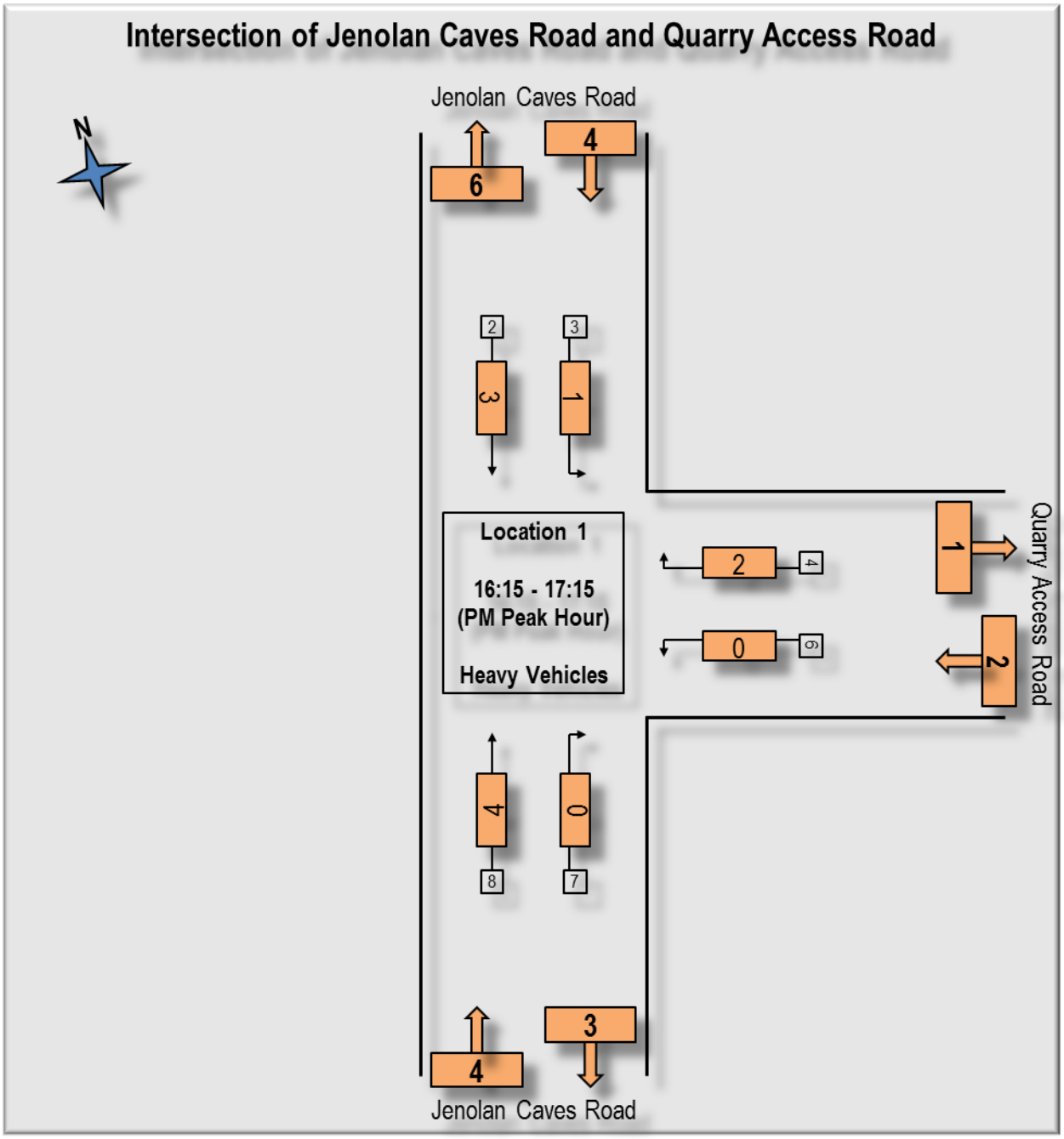
TIME PERIOD			VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
			1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
16:00	**-**	**17:00**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**3**	**0**	**3**	**191**	**38**	**229**	**27**	**3**	**30**	**35**	**6**	**41**	**0**	**0**	**0**	**2**	**2**	**4**	**3**	**1**	**4**	**281**	**33**	**314**	**1**	**0**	**1**	**545**	**83**	**628**	**Peak**
16:15	-	17:15	0	0	0	0	0	0	1	0	1	3	0	3	193	34	227	22	3	25	34	6	40	1	0	1	5	3	8	3	1	4	255	30	285	1	0	1	518	77	595	
16:30	-	17:30	1	0	1	0	0	0	2	0	2	4	0	4	206	29	235	23	2	25	26	4	30	1	0	1	6	1	7	3	1	4	259	36	295	0	0	0	531	73	604	
16:45	-	17:45	2	0	2	0	0	0	2	1	3	3	0	3	205	23	228	21	2	23	27	3	30	1	0	1	7	1	8	1	1	2	225	32	257	1	0	1	495	63	558	
17:00	-	18:00	2	0	2	0	0	0	2	1	3	2	0	2	194	24	218	14	2	16	24	1	25	1	0	1	7	1	8	0	1	1	216	30	246	2	0	2	464	60	524	
17:15	-	18:15	2	0	2	0	0	0	2	1	3	2	0	2	177	26	203	14	2	16	22	2	24	0	0	0	5	0	5	0	1	1	214	34	248	2	0	2	440	66	506	
17:30	-	18:30	1	0	1	0	0	0	1	1	2	2	0	2	157	25	182	12	4	16	21	1	22	0	0	0	6	0	6	0	0	0	188	28	216	2	0	2	390	59	449	

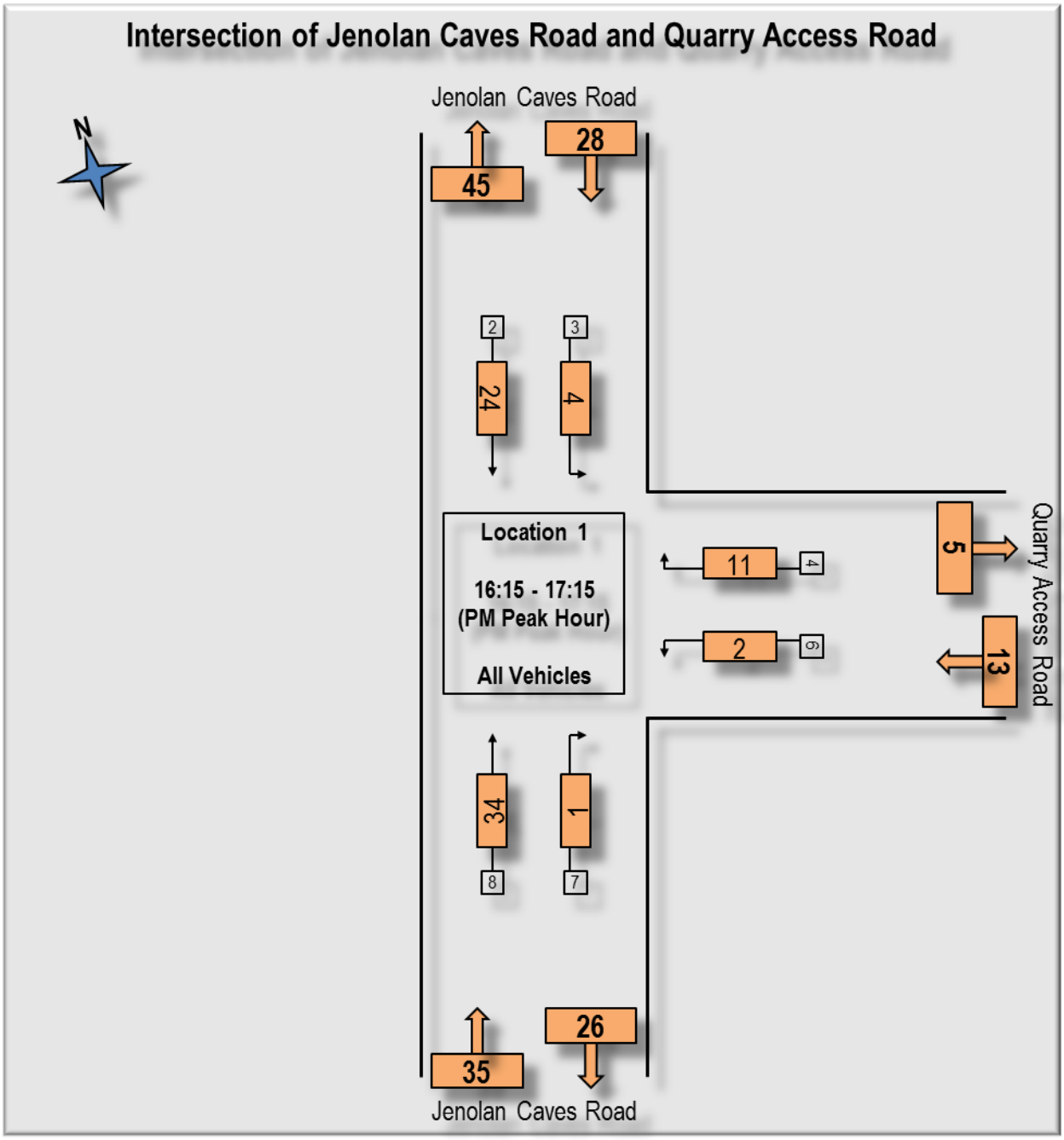

Intersection of Jenolan Caves Road and Quarry Access Road
Jenolan Caves Road
N
23
27
2
23
3
4
Location 1
8:45 - 9:45
(AM Peak Hour)
Light Vehicles
2
4
0
6
5
2
Quarry Access Road
21
8
1
7
22
23
Jenolan Caves Road

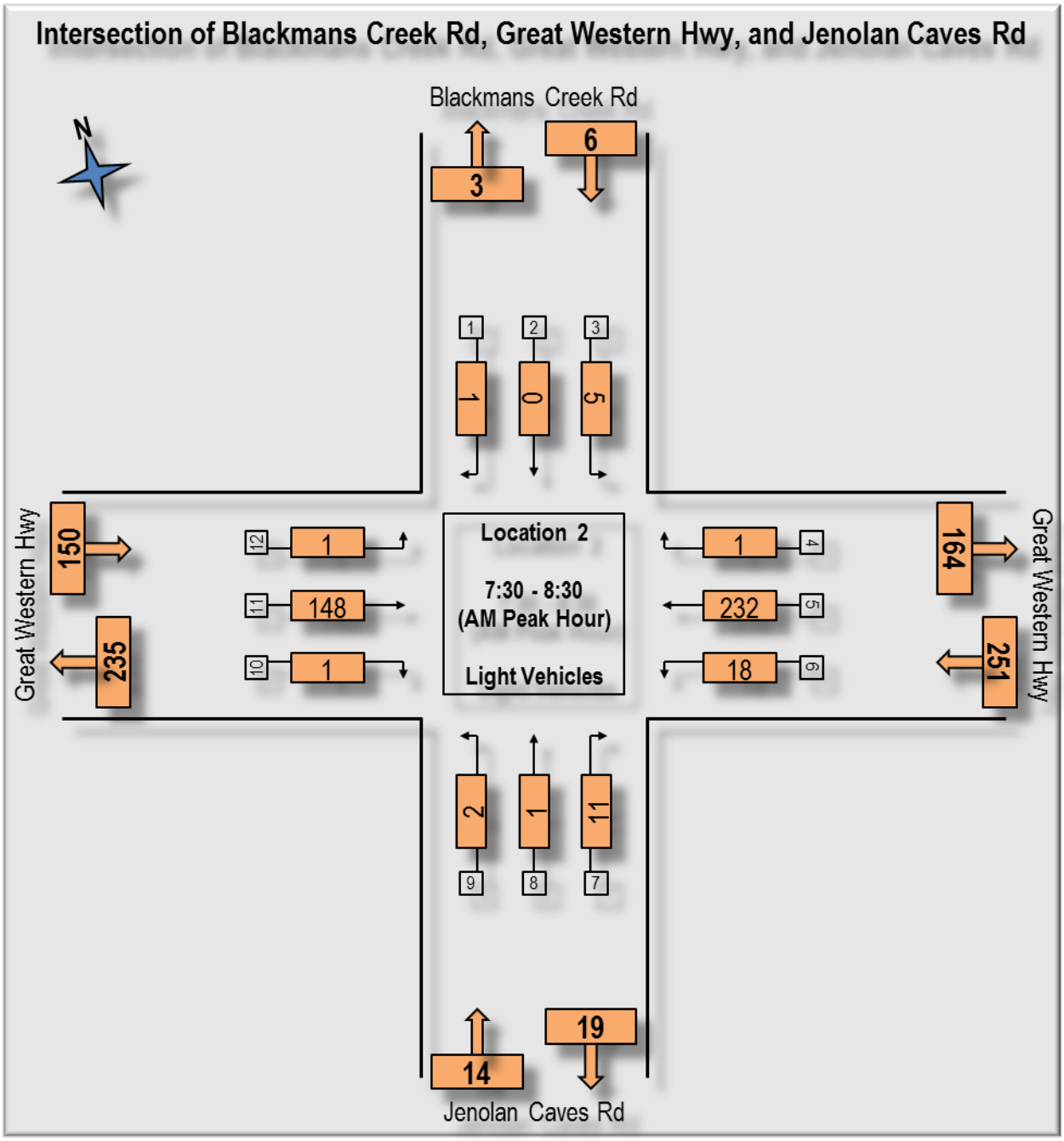

Intersection of Jenolan Caves Road and Quarry Access Road
Jenolan Caves Road
N
14
13
2
7
3
6
Location 1
8:45 - 9:45
(AM Peak Hour)
Heavy Vehicles
6
4
0
6
6
6
Quarry Access Road
8
8
0
7
8
7
Jenolan Caves Road

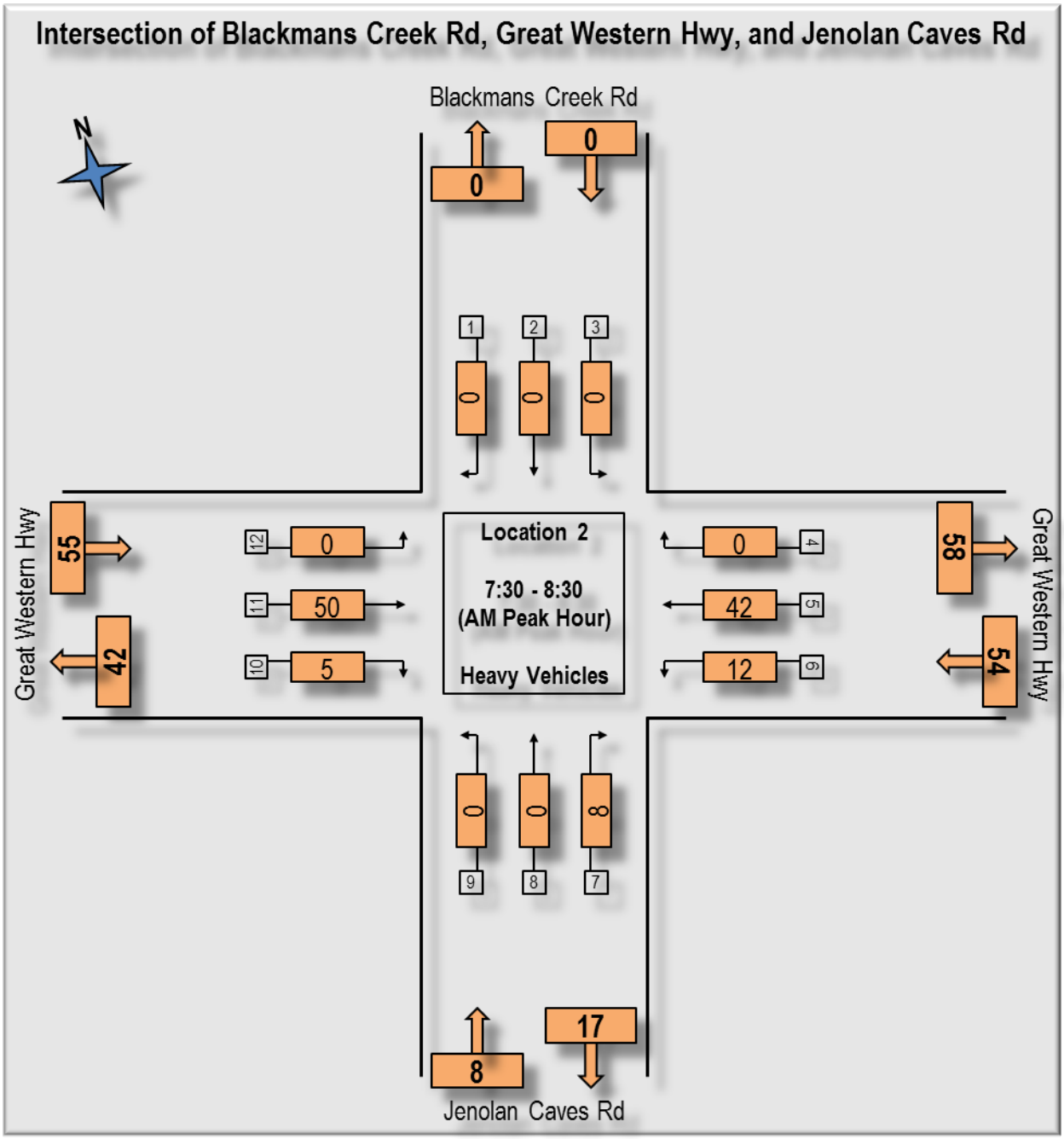

Intersection of Jenolan Caves Road and Quarry Access Road
Jenolan Caves Road
N
37
40
2
30
3
10
Location 1
8:45 - 9:45
(AM Peak Hour)
All Vehicles
8
4
0
6
11
8
Quarry Access Road
62
8
1
7
30
30
Jenolan Caves Road

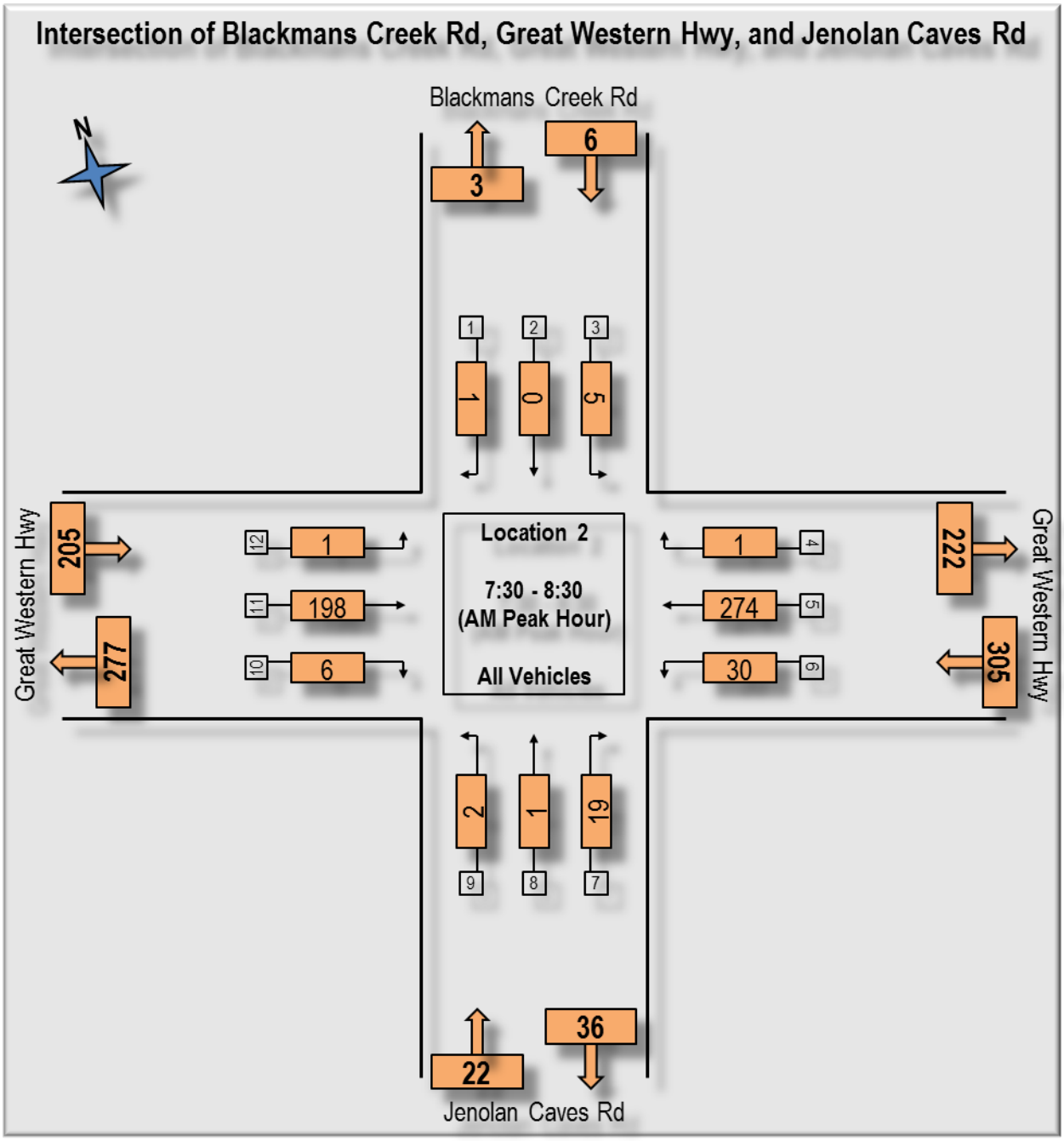

Intersection of Jenolan Caves Road and Quarry Access Road
Jenolan Caves Road
N
39
24
2
21
3
3
Location 1
16:15 - 17:15
(PM Peak Hour)
Light Vehicles
9
4
2
6
4
11
Quarry Access Road
30
8
1
7
31
23
Jenolan Caves Road

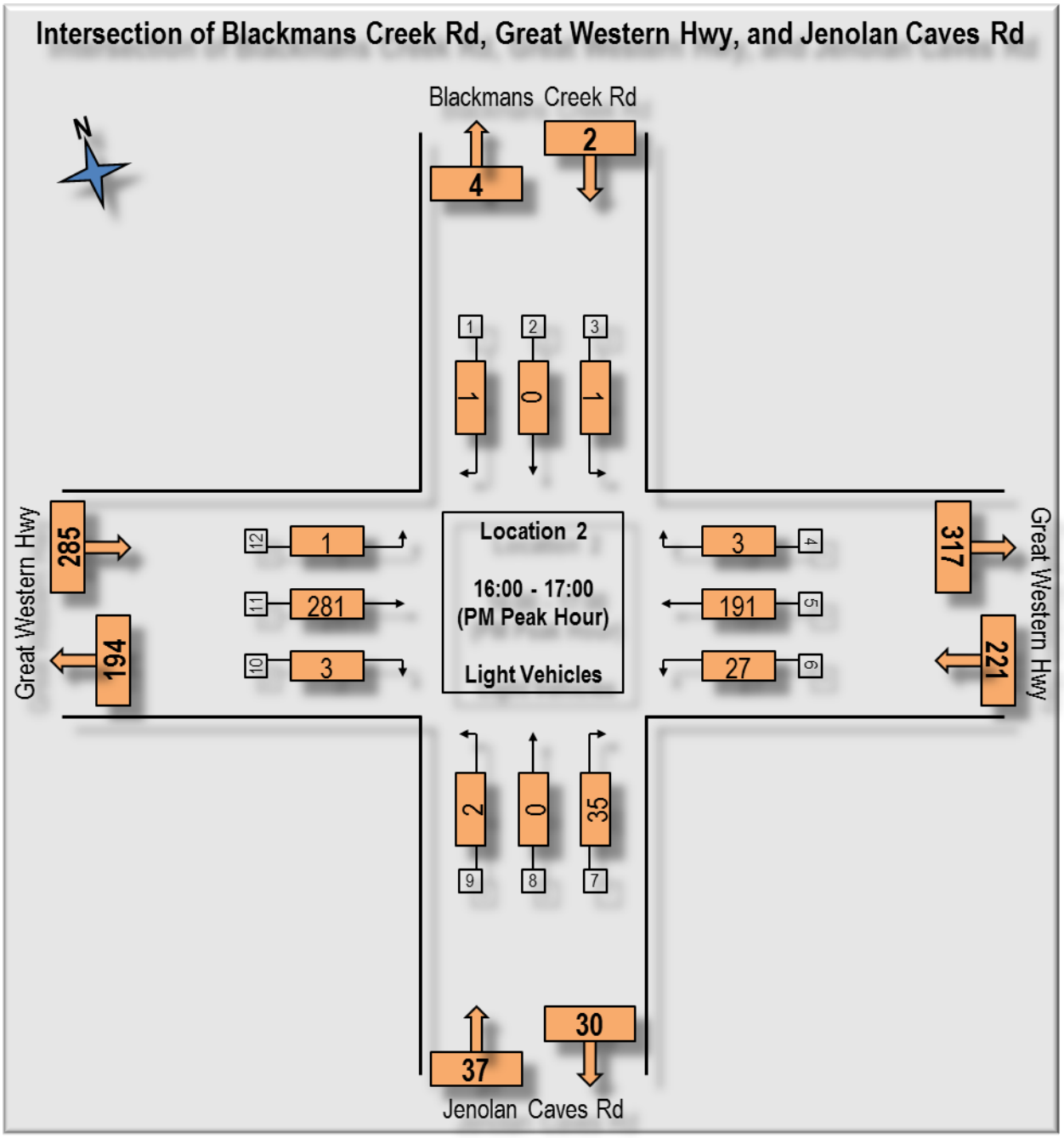

Intersection of Jenolan Caves Road and Quarry Access Road
Jenolan Caves Road
N
6
4
2
3
3
1
Location 1
16:15 - 17:15
(PM Peak Hour)
Heavy Vehicles
2
4
0
6
1
2
Quarry Access Road
4
8
0
7
4
3
Jenolan Caves Road

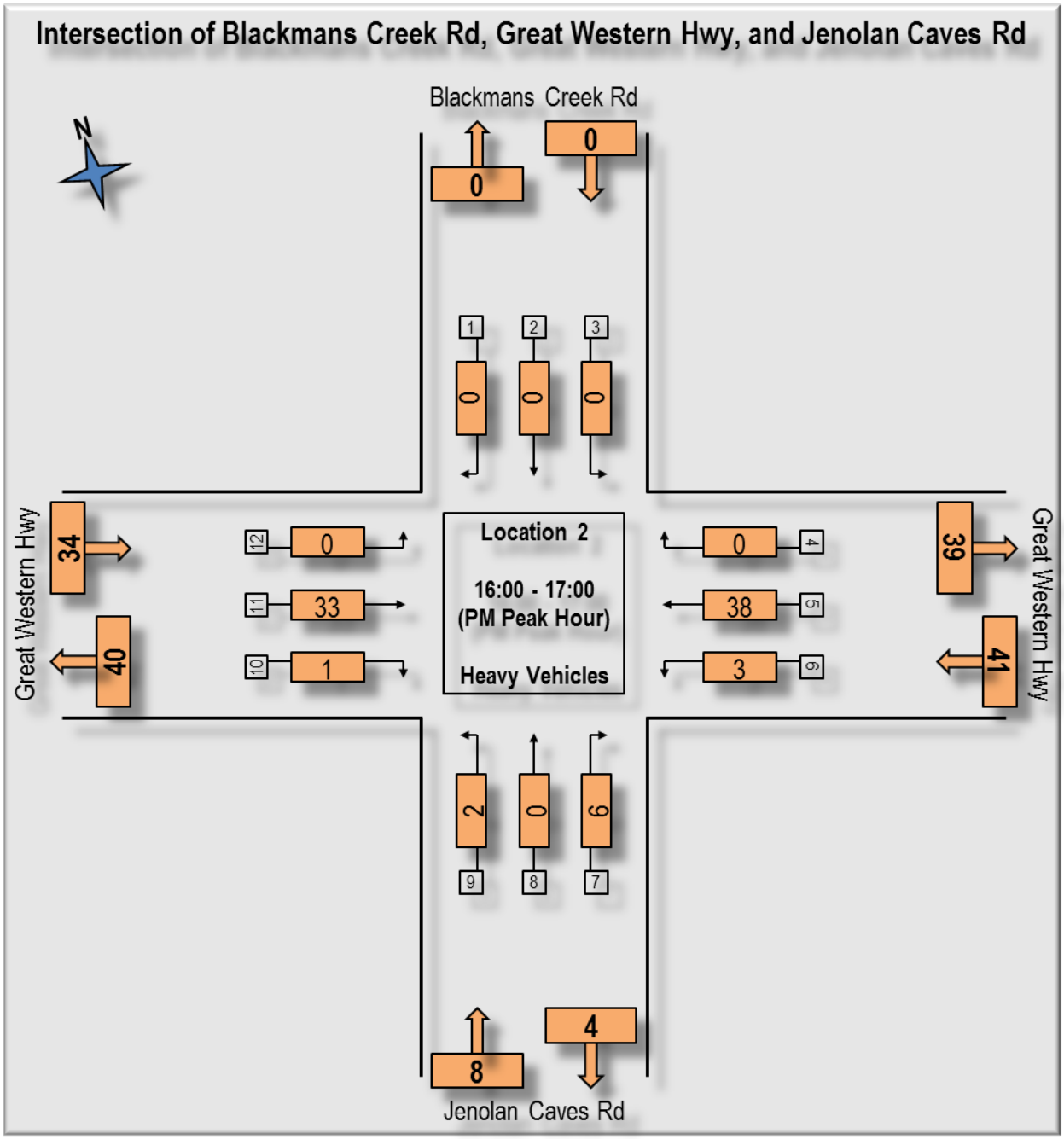

Intersection of Jenolan Caves Road and Quarry Access Road
N
Jenolan Caves Road
45
28
2
24
3
4
Location 1
16:15 - 17:15
(PM Peak Hour)
All Vehicles
11
4
2
6
5
13
Quarry Access Road
34
8
1
7
35
26
Jenolan Caves Road

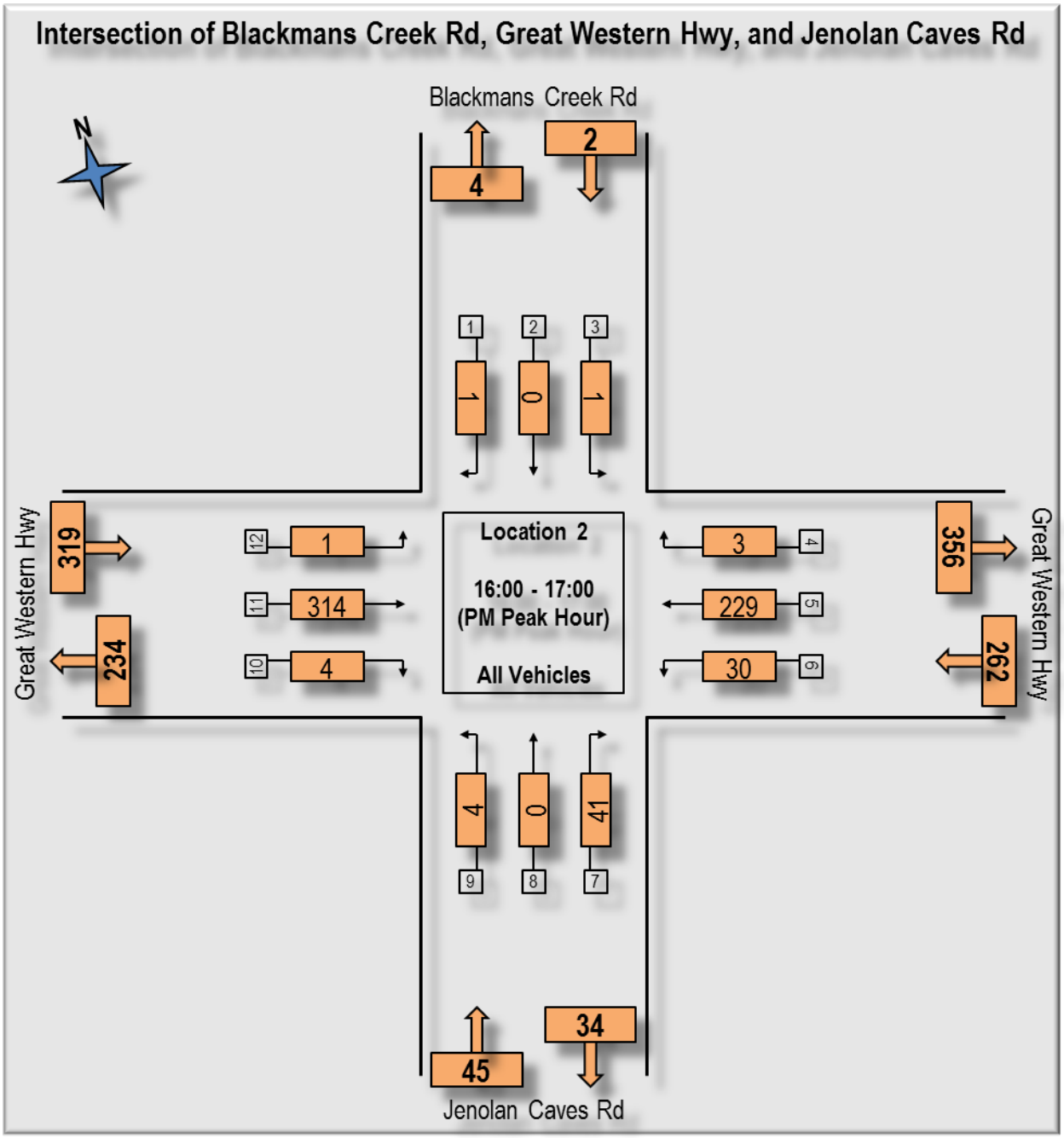

Intersection of Blackmans Creek Rd, Great Western Hwy, and Jenolan Caves Rd
Blackmans Creek Rd
N
3
6
1
2
3
1
0
5
Great Western Hwy
150
235
12
1
11
148
10
1
Location 2
7:30 - 8:30
(AM Peak Hour)
Light Vehicles
1
4
232
5
18
6
164
251
Great Western Hwy
2
1
11
9
8
7
14
19
Jenolan Caves Rd


Intersection of Blackmans Creek Rd, Great Western Hwy, and Jenolan Caves Rd
Blackmans Creek Rd
0
0
N
1
2
3
0
0
0
Great Western Hwy
55
42
12
0
50
5
Location 2
7:30 - 8:30
(AM Peak Hour)
Heavy Vehicles
0
42
12
4
5
6
58
54
Great Western Hwy
0
0
8
9
8
7
8
17
Jenolan Caves Rd


Intersection of Blackmans Creek Rd, Great Western Hwy, and Jenolan Caves Rd
Blackmans Creek Rd
N
3
6
1
2
3
1
0
5
Great Western Hwy
205
277
12
1
11
198
10
6
Location 2
7:30 - 8:30
(AM Peak Hour)
All Vehicles
1
4
274
5
30
6
222
305
Great Western Hwy
2
1
19
9
8
7
22
36
Jenolan Caves Rd


Intersection of Blackmans Creek Rd, Great Western Hwy, and Jenolan Caves Rd
Blackmans Creek Rd
N
4
2
1
2
3
1
0
1
Great Western Hwy
285
194
12
1
11
281
10
3
Location 2
16:00 - 17:00
(PM Peak Hour)
Light Vehicles
3
4
191
5
27
6
317
221
Great Western Hwy
2
9
0
8
35
7
37
30
Jenolan Caves Rd


Intersection of Blackmans Creek Rd, Great Western Hwy, and Jenolan Caves Rd
Blackmans Creek Rd
N
0
0
1
2
3
0
0
0
Great Western Hwy
34
40
12
0
11
33
10
1
Location 2
16:00 - 17:00
(PM Peak Hour)
Heavy Vehicles
0
4
38
5
3
6
39
41
Great Western Hwy
2
0
6
9
8
7
8
4
Jenolan Caves Rd


Intersection of Blackmans Creek Rd, Great Western Hwy, and Jenolan Caves Rd
Blackmans Creek Rd
N
4
2
1
2
3
1
0
1
Great Western Hwy
319
234
12
1
11
314
10
4
Location 2
16:00 - 17:00
(PM Peak Hour)
All Vehicles
3
4
229
5
30
6
356
262
Great Western Hwy
4
0
41
9
8
7
45
34
Jenolan Caves Rd

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Appendix B

Reported Crashes 2008-2012

The following graphic was provided by RMS, and it is noted that some individual crash locations are difficult to identify as they are overlaid by a crash at the same or similar location. Detailed information was provided for each crash, which references the ID numbers on this graphic.

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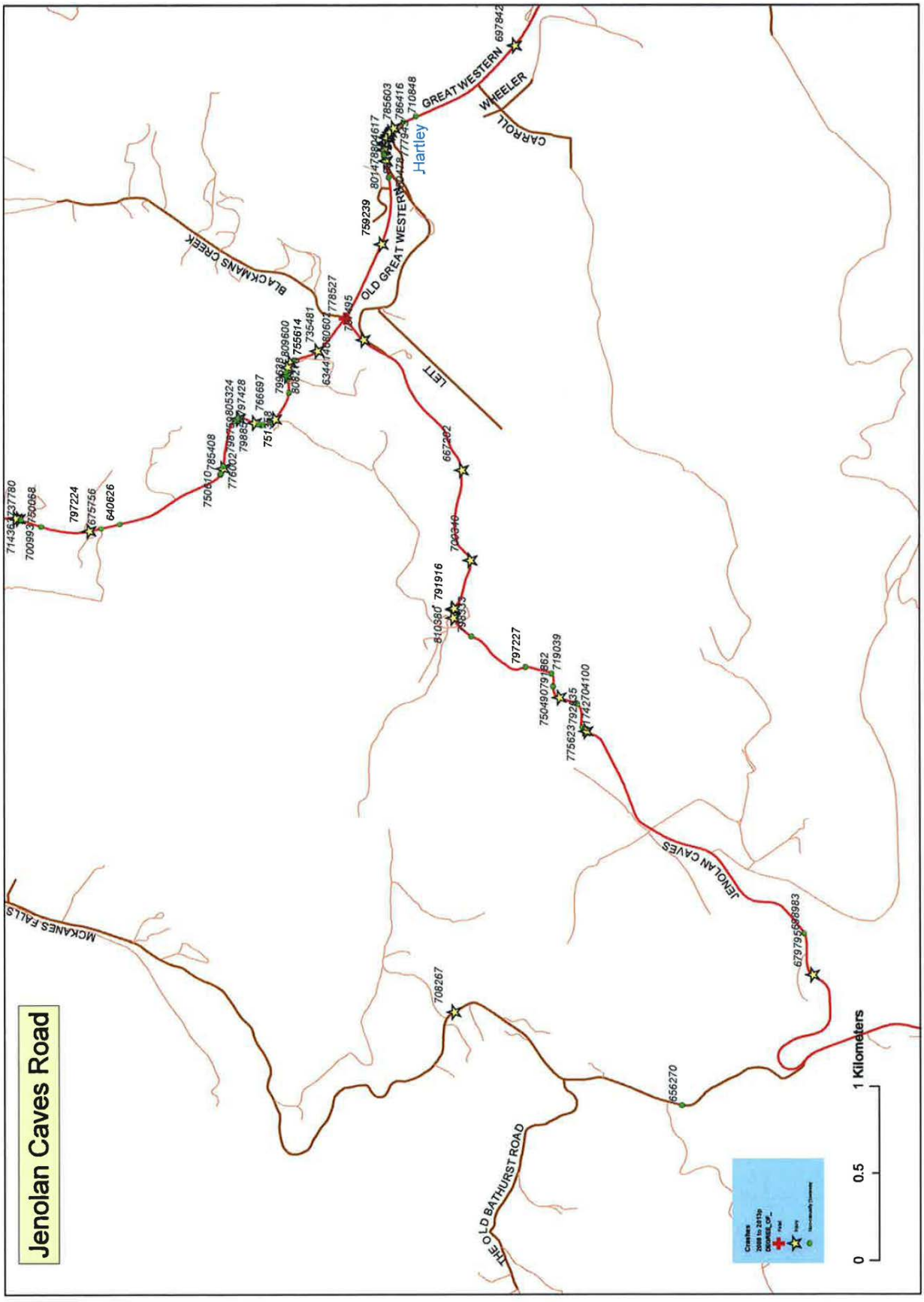
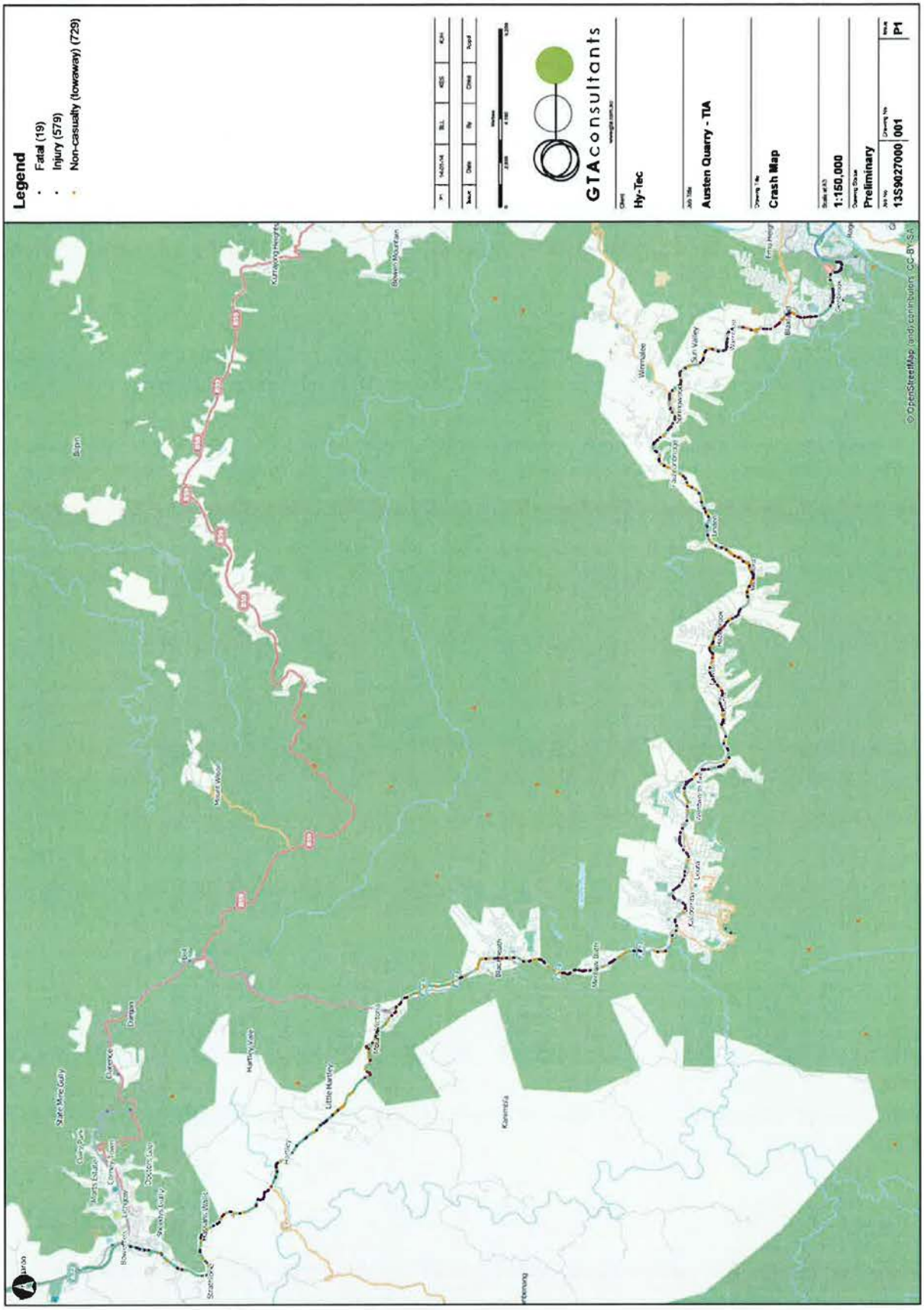

Jenolan Caves Road
Hartley
GREAT WESTERN
WHEELER
CARROLL
OLD GREAT WESTERN
BLACKMANS CREEK
LEFT
JENOLAN CAVES
MCKANES FALLS
THE OLD BATHURST ROAD
0
0.5
1 Kilometers


Legend
Fatal (19)
Injury (579)
Non-casualty (towaway) (729)
GTAconsultants
Hy-Tec
Austen Quarry - TIA
Crash Map
1:150,000
Preliminary
13S9027000 001
P1
© OpenStreetMap (and) contributors, CC-BY-SA

Appendix C

SIDRA Results by Movement

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MOVEMENT SUMMARY

Site: JCR-QAR-2013-AM

Jenolan Caves Road and Quarry Access Road
8.45-9.45am
Surveyed 2013
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	1	0.0	0.020	11.1	LOS A	0.1	0.8	0.27	0.58	49.1
3	R	8	75.0	0.020	14.9	LOS B	0.1	0.8	0.27	0.67	49.1
Approach		9	66.7	0.020	14.4	LOS A	0.1	0.8	0.27	0.66	49.1
East: Jenolan Caves Road - E											
4	L	11	60.0	0.008	12.7	LOS A	0.0	0.0	0.00	0.71	57.1
5	T	32	23.3	0.019	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		42	32.5	0.019	3.2	NA	0.0	0.0	0.00	0.18	73.4
West: Jenolan Caves Road - W											
11	T	31	27.6	0.012	0.1	LOS A	0.0	0.3	0.05	0.00	78.1
12	R	1	0.0	0.012	10.3	LOS A	0.0	0.3	0.14	1.38	57.8
Approach		32	26.7	0.012	0.4	NA	0.0	0.3	0.05	0.05	77.3
All Vehicles		83	34.2	0.020	3.4	NA	0.1	0.8	0.05	0.18	70.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2013-PM

Jenolan Caves Road and Quarry Access Road
4.15-5.15pm
Surveyed 2013
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	2	0.0	0.018	9.8	LOS A	0.1	0.5	0.18	0.60	50.3
3	R	12	18.2	0.018	10.7	LOS A	0.1	0.5	0.18	0.66	50.3
Approach		14	15.4	0.018	10.6	LOS A	0.1	0.5	0.18	0.65	50.3
East: Jenolan Caves Road - E											
4	L	4	25.0	0.003	11.2	LOS A	0.0	0.0	0.00	0.73	57.1
5	T	25	12.5	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		29	14.3	0.014	1.6	NA	0.0	0.0	0.00	0.10	76.1
West: Jenolan Caves Road - W											
11	T	36	11.8	0.013	0.0	LOS A	0.0	0.3	0.04	0.00	78.5
12	R	1	0.0	0.013	10.2	LOS A	0.0	0.3	0.11	1.44	57.6
Approach		37	11.4	0.013	0.3	NA	0.0	0.3	0.04	0.04	77.8
All Vehicles		80	13.2	0.018	2.5	NA	0.1	0.5	0.05	0.17	70.7

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2020-AM-PEAK

Jenolan Caves Road and Quarry Access Road
8.45-9.45am
Future Peak Day Traffic (2020)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	1	0.0	0.042	12.1	LOS A	0.2	1.9	0.34	0.57	48.1
3	R	16	86.7	0.042	16.5	LOS B	0.2	1.9	0.34	0.69	48.1
Approach		17	81.2	0.042	16.2	LOS B	0.2	1.9	0.34	0.68	48.1
East: Jenolan Caves Road - E											
4	L	18	76.5	0.015	13.5	LOS A	0.0	0.0	0.00	0.71	57.1
5	T	36	23.5	0.021	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		54	41.2	0.021	4.5	NA	0.0	0.0	0.00	0.24	71.3
West: Jenolan Caves Road - W											
11	T	35	27.3	0.014	0.1	LOS A	0.0	0.3	0.06	0.00	77.7
12	R	1	0.0	0.014	10.4	LOS A	0.0	0.3	0.17	1.37	58.0
Approach		36	26.5	0.014	0.4	NA	0.0	0.3	0.06	0.04	77.0
All Vehicles		106	42.6	0.042	5.0	NA	0.2	1.9	0.07	0.24	67.9

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2020-PM-PEAK

Jenolan Caves Road and Quarry Access Road
4.15-5.15pm
Future Peak Day Traffic (2020)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	2	0.0	0.026	10.1	LOS A	0.1	0.8	0.21	0.60	50.1
3	R	16	26.7	0.026	11.4	LOS A	0.1	0.8	0.21	0.66	50.1
Approach		18	23.5	0.026	11.3	LOS A	0.1	0.8	0.21	0.65	50.1
East: Jenolan Caves Road - E											
4	L	5	40.0	0.004	11.8	LOS A	0.0	0.0	0.00	0.71	57.1
5	T	28	11.1	0.016	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		34	15.6	0.016	1.8	NA	0.0	0.0	0.00	0.11	75.8
West: Jenolan Caves Road - W											
11	T	41	12.8	0.015	0.0	LOS A	0.0	0.3	0.04	0.00	78.4
12	R	1	0.0	0.015	10.2	LOS A	0.0	0.3	0.12	1.46	57.7
Approach		42	12.5	0.015	0.3	NA	0.0	0.3	0.04	0.04	77.8
All Vehicles		94	15.7	0.026	2.9	NA	0.1	0.8	0.06	0.18	69.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2035-AM-CLOSED

Jenolan Caves Road and Quarry Access Road
8.45-9.45am
Future Traffic Quarry Closed (2035)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	1	0.0	0.002	9.7	LOS A	0.0	0.1	0.18	0.61	50.3
3	R	1	0.0	0.002	9.7	LOS A	0.0	0.1	0.18	0.65	50.4
Approach		2	0.0	0.002	9.7	LOS A	0.0	0.1	0.18	0.63	50.3
East: Jenolan Caves Road - E											
4	L	3	0.0	0.005	10.1	LOS A	0.0	0.0	0.00	1.07	57.1
5	T	45	23.3	0.024	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		48	21.7	0.024	0.7	NA	0.0	0.0	0.00	0.07	78.2
West: Jenolan Caves Road - W											
11	T	44	28.6	0.017	0.1	LOS A	0.0	0.4	0.05	0.00	78.0
12	R	1	0.0	0.017	10.3	LOS A	0.0	0.4	0.15	1.43	57.9
Approach		45	27.9	0.017	0.3	NA	0.0	0.4	0.05	0.03	77.5
All Vehicles		96	24.2	0.024	0.7	NA	0.0	0.4	0.03	0.06	76.9

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2035-PM-CLOSED

Jenolan Caves Road and Quarry Access Road
4.15-5.15pm
Future Traffic Quarry Closed (2035)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	1	0.0	0.009	9.8	LOS A	0.0	0.2	0.20	0.60	50.2
3	R	6	0.0	0.009	9.8	LOS A	0.0	0.2	0.20	0.65	50.3
Approach		7	0.0	0.009	9.8	LOS A	0.0	0.2	0.20	0.64	50.2
East: Jenolan Caves Road - E											
4	L	1	0.0	0.003	10.1	LOS A	0.0	0.0	0.00	1.33	57.1
5	T	36	11.8	0.017	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		37	11.4	0.017	0.3	NA	0.0	0.0	0.00	0.04	79.2
West: Jenolan Caves Road - W											
11	T	52	12.2	0.018	0.0	LOS A	0.1	0.4	0.04	0.00	78.3
12	R	1	0.0	0.018	10.2	LOS A	0.1	0.4	0.12	1.49	57.7
Approach		53	12.0	0.018	0.3	NA	0.1	0.4	0.05	0.03	77.8
All Vehicles		97	10.9	0.018	1.0	NA	0.1	0.4	0.04	0.08	75.2

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2035-AM-PEAK

Jenolan Caves Road and Quarry Access Road
8.45-9.45am
Future Peak Day Traffic (2035)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	1	0.0	0.045	12.9	LOS A	0.2	2.0	0.38	0.57	47.3
3	R	16	86.7	0.045	17.3	LOS B	0.2	2.0	0.38	0.70	47.4
Approach		17	81.2	0.045	17.0	LOS B	0.2	2.0	0.38	0.69	47.4
East: Jenolan Caves Road - E											
4	L	19	72.2	0.015	13.3	LOS A	0.0	0.0	0.00	0.71	57.1
5	T	45	23.3	0.027	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		64	37.7	0.027	3.9	NA	0.0	0.0	0.00	0.21	72.2
West: Jenolan Caves Road - W											
11	T	44	28.6	0.017	0.1	LOS A	0.0	0.4	0.07	0.00	77.5
12	R	1	0.0	0.017	10.4	LOS A	0.0	0.4	0.19	1.39	58.1
Approach		45	27.9	0.017	0.3	NA	0.0	0.4	0.07	0.03	77.0
All Vehicles		126	40.0	0.045	4.4	NA	0.2	2.0	0.07	0.21	69.0

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: JCR-QAR-2035-PM-PEAK

Jenolan Caves Road and Quarry Access Road
4.15-5.15pm
Future Peak Day Traffic (2035)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quarry access road - S											
1	L	2	0.0	0.028	10.3	LOS A	0.1	0.9	0.24	0.59	49.9
3	R	17	25.0	0.028	11.5	LOS A	0.1	0.9	0.24	0.66	49.9
Approach		19	22.2	0.028	11.4	LOS A	0.1	0.9	0.24	0.65	49.9
East: Jenolan Caves Road - E											
4	L	5	40.0	0.004	11.8	LOS A	0.0	0.0	0.00	0.75	57.1
5	T	36	11.8	0.019	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		41	15.4	0.019	1.5	NA	0.0	0.0	0.00	0.10	76.5
West: Jenolan Caves Road - W											
11	T	52	12.2	0.018	0.1	LOS A	0.1	0.4	0.05	0.00	78.2
12	R	1	0.0	0.018	10.3	LOS A	0.1	0.4	0.13	1.47	57.8
Approach		53	12.0	0.018	0.3	NA	0.1	0.4	0.05	0.03	77.7
All Vehicles		113	15.0	0.028	2.6	NA	0.1	0.9	0.06	0.16	70.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2013-AM

Great Western Highway and Jenolan Caves Road
7.30-8.30am
Surveyed 2013
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	2	0.0	0.121	30.1	LOS C	0.4	3.8	0.74	0.84	41.4
2	T	1	0.0	0.121	29.8	LOS C	0.4	3.8	0.74	1.01	38.9
3	R	20	42.1	0.121	34.7	LOS C	0.4	3.8	0.74	1.00	42.9
Approach		23	36.4	0.121	34.0	LOS C	0.4	3.8	0.74	0.99	42.6
East: Great Western Highway - E											
4	L	32	40.0	0.034	13.8	LOS A	0.1	1.1	0.07	0.66	61.4
5	T	288	15.3	0.081	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	1	0.0	0.001	12.2	LOS A	0.0	0.0	0.33	0.64	58.4
Approach		321	17.7	0.081	2.4	NA	0.1	1.1	0.01	0.13	81.3
North: Blackmans Creek Road											
7	L	5	0.0	0.011	14.4	LOS A	0.0	0.3	0.41	0.82	48.7
8	T	1	0.0	0.011	15.0	LOS B	0.0	0.3	0.41	0.91	46.4
9	R	1	0.0	0.011	14.4	LOS A	0.0	0.3	0.41	0.92	46.7
Approach		7	0.0	0.011	14.5	LOS A	0.0	0.3	0.41	0.84	48.1
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	208	25.3	0.124	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	6	83.3	0.014	21.4	LOS B	0.1	0.6	0.50	0.74	55.8
Approach		216	26.8	0.124	0.7	NA	0.1	0.6	0.01	0.03	88.4
All Vehicles		567	21.7	0.124	3.2	NA	0.4	3.8	0.05	0.13	80.1

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2013-PM

Great Western Highway and Jenolan Caves Road
4.00-5.00pm
Surveyed 2013
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	4	50.0	0.173	28.5	LOS C	0.6	5.0	0.69	0.91	45.8
2	T	1	0.0	0.173	24.0	LOS B	0.6	5.0	0.69	1.01	43.3
3	R	43	14.6	0.173	26.3	LOS B	0.6	5.0	0.69	1.00	47.4
Approach		48	17.4	0.173	26.4	LOS B	0.6	5.0	0.69	0.99	47.2
East: Great Western Highway - E											
4	L	32	10.0	0.026	12.2	LOS A	0.1	0.7	0.03	0.68	61.6
5	T	241	16.6	0.068	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	3	0.0	0.003	12.6	LOS A	0.0	0.1	0.39	0.66	58.0
Approach		276	15.6	0.068	2.5	NA	0.1	0.7	0.01	0.14	80.6
North: Blackmans Creek Road											
7	L	1	0.0	0.007	17.2	LOS B	0.0	0.2	0.55	0.78	46.5
8	T	1	0.0	0.007	17.8	LOS B	0.0	0.2	0.55	0.87	44.3
9	R	1	0.0	0.007	17.3	LOS B	0.0	0.2	0.55	0.88	44.6
Approach		3	0.0	0.007	17.4	LOS B	0.0	0.2	0.55	0.84	45.1
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	331	10.5	0.181	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	4	25.0	0.005	14.5	LOS B	0.0	0.2	0.38	0.67	59.9
Approach		336	10.7	0.181	0.2	NA	0.0	0.2	0.00	0.01	89.4
All Vehicles		663	13.2	0.181	3.2	NA	0.6	5.0	0.06	0.14	80.3

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2020-AM-PEAK

Great Western Highway and Jenolan Caves Road
7.30-8.30am
Future Peak Day Traffic (2020)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	2	0.0	0.238	44.1	LOS D	0.8	8.2	0.84	0.93	33.5
2	T	1	0.0	0.238	43.8	LOS D	0.8	8.2	0.84	1.03	31.2
3	R	26	52.0	0.238	49.6	LOS D	0.8	8.2	0.84	1.02	35.0
Approach		29	46.4	0.238	49.0	LOS D	0.8	8.2	0.84	1.01	34.8
East: Great Western Highway - E											
4	L	40	47.4	0.046	14.2	LOS A	0.2	1.6	0.08	0.66	61.3
5	T	328	15.4	0.093	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	1	0.0	0.001	12.3	LOS A	0.0	0.0	0.35	0.64	58.2
Approach		369	18.8	0.093	2.5	NA	0.2	1.6	0.01	0.13	81.0
North: Blackmans Creek Road											
7	L	6	0.0	0.013	14.7	LOS B	0.0	0.3	0.44	0.82	48.4
8	T	1	0.0	0.013	15.3	LOS B	0.0	0.3	0.44	0.92	46.1
9	R	1	0.0	0.013	14.8	LOS B	0.0	0.3	0.44	0.93	46.5
Approach		8	0.0	0.013	14.8	LOS B	0.0	0.3	0.44	0.85	47.9
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	238	25.2	0.142	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	7	85.7	0.018	22.7	LOS B	0.1	0.8	0.53	0.76	54.5
Approach		246	26.9	0.142	0.7	NA	0.1	0.8	0.02	0.03	88.3
All Vehicles		654	22.9	0.238	4.1	NA	0.8	8.2	0.05	0.14	78.1

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2020-PM-PEAK

Great Western Highway and Jenolan Caves Road
4.00-5.00pm
Future Peak Day Traffic (2020)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	4	50.0	0.278	35.8	LOS C	1.1	8.9	0.78	1.00	40.5
2	T	1	0.0	0.278	31.3	LOS C	1.1	8.9	0.78	1.04	38.0
3	R	53	20.0	0.278	34.1	LOS C	1.1	8.9	0.78	1.03	42.0
Approach		58	21.8	0.278	34.2	LOS C	1.1	8.9	0.78	1.03	41.8
East: Great Western Highway - E											
4	L	37	11.4	0.031	12.3	LOS A	0.1	0.8	0.03	0.68	61.6
5	T	275	16.5	0.078	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	3	0.0	0.003	12.9	LOS A	0.0	0.1	0.42	0.67	57.7
Approach		315	15.7	0.078	2.5	NA	0.1	0.8	0.01	0.15	80.5
North: Blackmans Creek Road											
7	L	1	0.0	0.008	18.5	LOS B	0.0	0.2	0.59	0.79	45.4
8	T	1	0.0	0.008	19.2	LOS B	0.0	0.2	0.59	0.89	43.3
9	R	1	0.0	0.008	18.6	LOS B	0.0	0.2	0.59	0.90	43.5
Approach		3	0.0	0.008	18.8	LOS B	0.0	0.2	0.59	0.86	44.1
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	377	10.6	0.207	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	4	25.0	0.005	14.8	LOS B	0.0	0.2	0.40	0.67	59.6
Approach		382	10.7	0.207	0.2	NA	0.0	0.2	0.00	0.01	89.4
All Vehicles		758	13.6	0.278	3.8	NA	1.1	8.9	0.07	0.15	78.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2020-AM-LOCAL

Great Western Highway and Jenolan Caves Road
7.30-8.30am
Future Peak Day Local Traffic (2020)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	12	81.8	0.159	36.3	LOS C	0.5	5.4	0.73	1.00	41.8
2	T	1	0.0	0.159	29.1	LOS C	0.5	5.4	0.73	1.01	39.3
3	R	19	33.3	0.159	33.2	LOS C	0.5	5.4	0.73	1.00	43.4
Approach		32	50.0	0.159	34.2	LOS C	0.5	5.4	0.73	1.00	42.7
East: Great Western Highway - E											
4	L	31	31.0	0.031	13.5	LOS A	0.1	1.0	0.13	0.65	60.9
5	T	328	15.4	0.093	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	1	0.0	0.001	12.3	LOS A	0.0	0.0	0.35	0.64	58.2
Approach		360	16.7	0.093	2.2	NA	0.1	1.0	0.01	0.12	81.6
North: Blackmans Creek Road											
7	L	6	0.0	0.014	14.9	LOS B	0.0	0.3	0.44	0.82	48.2
8	T	1	0.0	0.014	15.5	LOS B	0.0	0.3	0.44	0.93	46.0
9	R	1	0.0	0.014	15.0	LOS B	0.0	0.3	0.44	0.94	46.3
Approach		8	0.0	0.014	15.0	LOS B	0.0	0.3	0.44	0.85	47.7
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	238	25.2	0.142	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	20	94.7	0.053	24.2	LOS B	0.2	2.5	0.55	0.82	53.4
Approach		259	30.5	0.142	1.9	NA	0.2	2.5	0.04	0.07	85.7
All Vehicles		659	23.5	0.159	3.8	NA	0.5	5.4	0.06	0.15	79.0

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2020-PM-LOCAL

Great Western Highway and Jenolan Caves Road
4.00-5.00pm
Future Peak Day Local Traffic (2020)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	14	84.6	0.215	32.0	LOS C	0.8	6.8	0.69	1.00	45.4
2	T	1	0.0	0.215	24.5	LOS B	0.8	6.8	0.69	1.02	42.8
3	R	45	7.0	0.215	26.1	LOS B	0.8	6.8	0.69	1.01	46.9
Approach		60	24.6	0.215	27.4	LOS B	0.8	6.8	0.69	1.01	46.5
East: Great Western Highway - E											
4	L	35	6.1	0.028	12.0	LOS A	0.1	0.7	0.05	0.67	61.5
5	T	275	16.5	0.078	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	3	0.0	0.003	12.9	LOS A	0.0	0.1	0.42	0.67	57.7
Approach		313	15.2	0.078	2.4	NA	0.1	0.7	0.01	0.14	80.7
North: Blackmans Creek Road											
7	L	1	0.0	0.008	18.8	LOS B	0.0	0.2	0.60	0.78	45.3
8	T	1	0.0	0.008	19.4	LOS B	0.0	0.2	0.60	0.89	43.1
9	R	1	0.0	0.008	18.9	LOS B	0.0	0.2	0.60	0.91	43.4
Approach		3	0.0	0.008	19.0	LOS B	0.0	0.2	0.60	0.86	43.9
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	377	10.6	0.207	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	7	57.1	0.012	18.2	LOS B	0.0	0.5	0.45	0.71	57.8
Approach		385	11.5	0.207	0.4	NA	0.0	0.5	0.01	0.02	89.0
All Vehicles		761	14.0	0.215	3.4	NA	0.8	6.8	0.07	0.15	79.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2035-AM-CLOSED

Great Western Highway and Jenolan Caves Road
7.30-8.30am
Future Traffic Quarry Closed (2035)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	3	0.0	0.215	43.9	LOS D	0.7	6.2	0.85	0.96	33.7
2	T	1	0.0	0.215	43.5	LOS D	0.7	6.2	0.85	1.02	31.4
3	R	22	33.3	0.215	47.6	LOS D	0.7	6.2	0.85	1.01	35.1
Approach		26	28.0	0.215	47.0	LOS D	0.7	6.2	0.85	1.01	34.8
East: Great Western Highway - E											
4	L	38	33.3	0.039	13.5	LOS A	0.1	1.2	0.08	0.66	61.3
5	T	415	15.2	0.117	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	1	0.0	0.001	12.7	LOS A	0.0	0.0	0.40	0.64	57.9
Approach		454	16.7	0.117	2.2	NA	0.1	1.2	0.01	0.12	81.7
North: Blackmans Creek Road											
7	L	7	0.0	0.017	15.9	LOS B	0.1	0.4	0.50	0.83	47.5
8	T	1	0.0	0.017	16.5	LOS B	0.1	0.4	0.50	0.96	45.3
9	R	1	0.0	0.017	15.9	LOS B	0.1	0.4	0.50	0.97	45.6
Approach		9	0.0	0.017	15.9	LOS B	0.1	0.4	0.50	0.86	47.1
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	300	25.3	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	8	87.5	0.025	25.3	LOS B	0.1	1.1	0.59	0.82	51.6
Approach		309	26.9	0.179	0.7	NA	0.1	1.1	0.02	0.02	88.3
All Vehicles		799	20.8	0.215	3.2	NA	0.7	6.2	0.04	0.12	79.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2035-PM-CLOSED

Great Western Highway / Jenolan Caves Road
4.00-5.00pm
Future Traffic Quarry Closed (2035)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	6	50.0	0.314	39.3	LOS C	1.2	9.3	0.83	1.05	38.3
2	T	1	0.0	0.314	34.7	LOS C	1.2	9.3	0.83	1.04	35.9
3	R	52	8.2	0.314	36.5	LOS C	1.2	9.3	0.83	1.03	39.8
Approach		59	12.5	0.314	36.7	LOS C	1.2	9.3	0.83	1.04	39.6
East: Great Western Highway - E											
4	L	41	7.7	0.033	12.1	LOS A	0.1	0.9	0.04	0.68	61.6
5	T	347	16.7	0.099	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	4	0.0	0.005	13.5	LOS A	0.0	0.1	0.48	0.69	56.8
Approach		393	15.5	0.099	2.4	NA	0.1	0.9	0.01	0.14	80.9
North: Blackmans Creek Road											
7	L	1	0.0	0.011	22.4	LOS B	0.0	0.3	0.70	0.80	42.8
8	T	1	0.0	0.011	23.0	LOS B	0.0	0.3	0.70	0.92	40.7
9	R	1	0.0	0.011	22.5	LOS B	0.0	0.3	0.70	0.95	40.9
Approach		3	0.0	0.011	22.6	LOS B	0.0	0.3	0.70	0.89	41.5
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	477	10.6	0.261	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	5	20.0	0.007	14.9	LOS B	0.0	0.2	0.45	0.69	59.0
Approach		483	10.7	0.261	0.2	NA	0.0	0.2	0.00	0.01	89.5
All Vehicles		938	12.8	0.314	3.5	NA	1.2	9.3	0.06	0.13	79.5

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2035-AM-PEAK

Great Western Highway and Jenolan Caves Road
7.30-8.30am
Future Peak Day Traffic (2035)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	3	0.0	0.422	71.2	LOS F	1.5	14.6	0.92	1.08	24.5
2	T	1	0.0	0.422	70.9	LOS F	1.5	14.6	0.92	1.07	22.6
3	R	31	48.3	0.422	76.3	LOS F	1.5	14.6	0.92	1.05	25.7
Approach		35	42.4	0.422	75.7	LOS F	1.5	14.6	0.92	1.06	25.5
East: Great Western Highway - E											
4	L	48	45.7	0.055	14.1	LOS A	0.2	1.9	0.08	0.66	61.2
5	T	415	15.2	0.117	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	1	0.0	0.001	12.7	LOS A	0.0	0.0	0.40	0.64	57.9
Approach		464	18.4	0.117	2.5	NA	0.2	1.9	0.01	0.13	81.1
North: Blackmans Creek Road											
7	L	7	0.0	0.017	15.9	LOS B	0.1	0.4	0.50	0.83	47.5
8	T	1	0.0	0.017	16.5	LOS B	0.1	0.4	0.50	0.96	45.3
9	R	1	0.0	0.017	15.9	LOS B	0.1	0.4	0.50	0.97	45.6
Approach		9	0.0	0.017	15.9	LOS B	0.1	0.4	0.50	0.86	47.1
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	300	25.3	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	8	87.5	0.025	25.3	LOS B	0.1	1.1	0.59	0.82	51.6
Approach		309	26.9	0.179	0.7	NA	0.1	1.1	0.02	0.02	88.3
All Vehicles		818	22.4	0.422	5.1	NA	1.5	14.6	0.06	0.14	75.8

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2035-PM-PEAK

Great Western Highway and Jenolan Caves Road
4.00-5.00pm
Future Peak Day Traffic (2035)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	6	50.0	0.497	53.0	LOS D	2.1	17.1	0.89	1.11	31.6
2	T	1	0.0	0.497	48.4	LOS D	2.1	17.1	0.89	1.09	29.4
3	R	64	18.0	0.497	51.1	LOS D	2.1	17.1	0.89	1.08	33.0
Approach		72	20.6	0.497	51.2	LOS D	2.1	17.1	0.89	1.08	32.8
East: Great Western Highway - E											
4	L	45	11.6	0.038	12.3	LOS A	0.1	1.0	0.04	0.68	61.6
5	T	347	16.7	0.099	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	4	0.0	0.005	13.5	LOS A	0.0	0.1	0.48	0.69	56.8
Approach		397	15.9	0.099	2.5	NA	0.1	1.0	0.01	0.14	80.6
North: Blackmans Creek Road											
7	L	1	0.0	0.011	22.4	LOS B	0.0	0.3	0.70	0.80	42.8
8	T	1	0.0	0.011	23.0	LOS B	0.0	0.3	0.70	0.92	40.7
9	R	1	0.0	0.011	22.5	LOS B	0.0	0.3	0.70	0.95	40.9
Approach		3	0.0	0.011	22.6	LOS B	0.0	0.3	0.70	0.89	41.5
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	477	10.6	0.261	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	5	20.0	0.007	14.9	LOS B	0.0	0.2	0.45	0.69	59.0
Approach		483	10.7	0.261	0.2	NA	0.0	0.2	0.00	0.01	89.5
All Vehicles		955	13.6	0.497	5.0	NA	2.1	17.1	0.08	0.15	76.0

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2035-AM-LOCAL

Great Western Highway and Jenolan Caves Road
7.30-8.30am
Future Peak Day Local Traffic (2035)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	13	75.0	0.270	48.3	LOS D	1.0	9.3	0.83	1.03	34.5
2	T	1	0.0	0.270	41.7	LOS C	1.0	9.3	0.83	1.03	32.2
3	R	23	31.8	0.270	45.6	LOS D	1.0	9.3	0.83	1.02	36.0
Approach		37	45.7	0.270	46.4	LOS D	1.0	9.3	0.83	1.03	35.4
East: Great Western Highway - E											
4	L	39	32.4	0.040	13.6	LOS A	0.1	1.3	0.13	0.65	60.8
5	T	415	15.2	0.117	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	1	0.0	0.001	12.7	LOS A	0.0	0.0	0.40	0.64	57.9
Approach		455	16.7	0.117	2.2	NA	0.1	1.3	0.01	0.12	81.6
North: Blackmans Creek Road											
7	L	7	0.0	0.018	16.1	LOS B	0.1	0.4	0.51	0.83	47.3
8	T	1	0.0	0.018	16.7	LOS B	0.1	0.4	0.51	0.96	45.1
9	R	1	0.0	0.018	16.2	LOS B	0.1	0.4	0.51	0.98	45.4
Approach		9	0.0	0.018	16.2	LOS B	0.1	0.4	0.51	0.86	46.9
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	300	25.3	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	21	95.0	0.069	27.0	LOS B	0.3	3.2	0.61	0.88	50.3
Approach		322	29.7	0.179	1.8	NA	0.3	3.2	0.04	0.06	85.8
All Vehicles		823	22.9	0.270	4.2	NA	1.0	9.3	0.07	0.15	78.0

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

MOVEMENT SUMMARY

Site: GWH-JCR-2035-PM-LOCAL

Great Western Highway and Jenolan Caves Road
4.00-5.00pm
Future Peak Local Day Traffic (2035)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Jenolan Caves Road - S											
1	L	16	80.0	0.379	42.3	LOS C	1.5	12.9	0.82	1.07	38.0
2	T	1	0.0	0.379	35.2	LOS C	1.5	12.9	0.82	1.06	35.6
3	R	57	7.4	0.379	36.9	LOS C	1.5	12.9	0.82	1.05	39.5
Approach		74	22.9	0.379	38.0	LOS C	1.5	12.9	0.82	1.06	39.2
East: Great Western Highway - E											
4	L	43	7.3	0.035	12.1	LOS A	0.1	0.9	0.06	0.67	61.4
5	T	347	16.7	0.099	1.1	LOS A	0.0	0.0	0.00	0.07	84.3
6	R	4	0.0	0.005	13.5	LOS A	0.0	0.1	0.48	0.69	56.8
Approach		395	15.5	0.099	2.4	NA	0.1	0.9	0.01	0.14	80.7
North: Blackmans Creek Road											
7	L	1	0.0	0.011	22.7	LOS B	0.0	0.3	0.70	0.80	42.5
8	T	1	0.0	0.011	23.4	LOS B	0.0	0.3	0.70	0.93	40.5
9	R	1	0.0	0.011	22.8	LOS B	0.0	0.3	0.70	0.95	40.7
Approach		3	0.0	0.011	23.0	LOS B	0.0	0.3	0.70	0.89	41.2
West: Great Western Highway - W											
10	L	1	0.0	0.001	11.2	LOS A	0.0	0.0	0.00	0.73	60.4
11	T	477	10.6	0.261	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	8	50.0	0.015	18.4	LOS B	0.1	0.6	0.50	0.74	56.9
Approach		486	11.3	0.261	0.3	NA	0.1	0.6	0.01	0.01	89.1
All Vehicles		958	13.8	0.379	4.2	NA	1.5	12.9	0.07	0.15	78.0

Level of Service (LOS) Method: Delay (RTA NSW).
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 used.

Appendix D

Extracts of Forecast Flows from RMS Reports

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Transport and Urban Planning (2009) Traffic Study of Proposed Widening of Great Western Highway, Bullaburra (Pages 120-121)

5.3 Future Traffic Volumes in Great Western Highway at Bullaburra

Traffic growth in the Great Western Highway at Bullaburra would be expected to increase by 1.9% - 2.2% per annum between 2007 and 2032. Given the land use changes at Lawson, the higher traffic growth of 2.2% per annum is considered to better reflect the future land use changes.

The daily traffic volume and classification counts undertaken in late November / early December 2007 provided daily (7 day AADT) volumes in the Great Western Highway of:

- 22,552 vpd near Kalinda Road (east)
- 22,312 vpd east of Genevieve Road.

Adopting a linear average traffic growth rate of 2.2% per annum provides the following future traffic volume projections for the Great Western Highway for the years 2008, 2012, 2022 and 2032.

TABLE 5.1

PROJECTED DAILY (7 DAY AADT) TRAFFIC VOLUMES GREAT WESTERN HIGHWAY AT BULLABURRA

Year	Near Kalinda Road (east)	East of Genevieve Road
2007	22,552	22,312
2008	23,048	22,803
2012	25,033	24,766
2022	29,994	29,675
2032	34,956	34,584

Future traffic growth in the local streets in Bullaburra that intersect with the Great Western Highway will be incremental and, based on the future increases in the population and the number of dwellings between 2006 – 2021 in the Bullaburra / Lawson area, could be expected to be up to 14% over the next 10-15 years. The adoption of 2.2% linear growth per year for the future peak hour traffic volumes using the local roads that intersect with the Great Western Highway would provide a conservative or higher rate of traffic growth that would take into account population growth plus other changes such as an increase in the number of drivers in the area, from smaller house sizes and more younger adults.

Roads and Traffic Authority (2006) The Great Western Highway Upgrade Lawson Section 1A Traffic, Transport and Accessibility Report (page 9)

2. Future traffic volume projections

Traffic volumes for five year intervals between 2005 and 2030 were estimated by projection from historical data. Linear and exponential regressions were compared. The linear regression line indicated a growth rate of approximately 2.3% per annum (based on year 2002 traffic volume), which is considered reasonable for this type of road given its location with respect to major population centres and the relatively long 30 year analysis period.

Consequently, the traffic volumes shown in Table 2.1 have been predicted for the Great Western Highway upgrade between Ferguson Avenue and Bass Street.

Table 2.1 Traffic volume projections

Year	AADT** Both Directions (vpd)	AADT* One Direction (vpd)	Peak Hourly Volume One Direction (vpd)
2002	21851	10926	863
2005	23937	11968	945
2010	26406	13203	1043
2015	28875	14437	1141
2020	31344	15672	1238
2025	33813	16906	1336
2030	36282	18141	1433

** Based on a conversion rate of 1.15 axle pairs / vehicle
* Assumes 50/50 directional split

This table indicates, for example, that ten years after the proposed upgrade is complete i.e. 2020, the estimated vehicles per day using the Highway (in both directions) is approximately 31,300 or equivalent to a 31% increase in traffic compared with current (2005) traffic volumes.

GHD (2006) The Great Western Highway Upgrade Wentworth Falls East Review of Environmental Factors Volume 1 – Main Report (pages 114-115)

13.2 Future traffic volume projections

Traffic volumes on the Great Western Highway for 2008, 2018, 2028 and 2038 were estimated by projection from historical data. A growth rate of approximately 556 vpd per annum (based 2002 traffic volumes) is projected, which is considered reasonable for this type of road given its location with respect to major population towns i.e. Sydney. Table 13.3 illustrates the projected weekday traffic volumes.

Table 13.3 Weekday traffic volume projections

Year	AADT Both Directions (vpd)	AADT* One Direction (vpd)	Peak Hourly Volume One Direction (vpd)
2006	25,063	12,532	1,003
2008**	26,175	13,088	1,047
2010	27,287	13,644	1,091
2018	31,735	15,868	1,269
2020	32,847	16,424	1,314
2028	37,295	18,648	1,492
2030	38,407	19,204	1,536
2038	42,855	21,428	1,714

**Assumes 50/50 directional split*

***Assumed completion date.*

Table 13.3 indicates that ten years after the proposed upgrade is complete i.e. 2018, it is estimated that approximately 31,735 vehicles will be using the highway each day (in both directions) is, which is approximately 39% increase in daily traffic from 2002.

GHD (2002) Upgrade of the Great Western Highway – Woodford to Hazelbrook Review of Environmental Factors Volume 1 – Main Report (pages 25-26)

13.2 Future Traffic Volume Projections

Traffic volumes for 2000, 2010, 2020 and 2030 were estimated by projection from historical data. Linear and exponential regressions were compared. The linear regression line indicated a growth rate of approximately 2.4% per annum or 502 vehicles per day per year (based on year 1999 traffic volume), which is considered reasonable for this type of road given its location with respect to major population towns i.e. Sydney and the relatively long 30 year analysis period.

Consequently, the traffic volumes shown in Table 13.7 have been predicted for the Woodford-Hazelbrook section of the Great Western Highway.

This table indicates, for example, that ten years after the proposed upgrade is complete i.e. 2017, the estimated number of vehicles per day using the highway (in both directions) is approximately 29,518 which is equivalent to a 35% increase in traffic volume over year 2002 volumes.

Table 13.7 Traffic Volume Projections

Year	AADT Both Directions (vpd)	AADT One Direction (vpd)	Peak Hourly Volume One Direction (vpd)
1999	20,485	10,242	819
2000	20,986	10,493	839
2001	21,488	10,744	860
2002	21,990	10,995	880
2003	22,492	11,246	900
2004	22,994	11,497	920
2005	23,496	11,748	940
2006	23,998	11,999	960
2007	24,500	12,250	980
2008	25,001	12,501	1,000
2009	25,503	12,752	1,020
2010	26,005	13,003	1,040
2011	26,507	13,254	1,060
2012	27,009	13,504	1,080
2013	27,511	13,755	1,100
2014	28,013	14,006	1,121
2015	28,514	14,257	1,141
2016	29,016	14,508	1,161
2017	29,518	14,759	1,181
2018	30,020	15,010	1,201
2019	30,522	15,261	1,221
2020	31,024	15,512	1,241
2021	31,526	15,763	1,261
2022	32,028	16,014	1,281
2023	32,529	16,265	1,301
2024	33,031	16,516	1,321
2025	33,533	16,767	1,341
2026	34,035	17,018	1,361
2027	34,537	17,268	1,381
2028	35,039	17,519	1,402
2029	35,541	17,770	1,422
2030	36,043	18,021	1,442
2031	36,544	18,272	1,462
2032	37,046	18,523	1,482

* Assumes 50/50 directional split

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