Appendix 5

Traffic and Transport Assessment

Prepared by Constructive Solutions Pty Ltd

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Bungendore Sands Extension Project

Traffic and Transport Assessment

Prepared for

Grantham Park Holdings Pty Limited

January 2020

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DOCUMENT HISTORY AND STATUS

Issue	Rev	Issued To	Date	Reviewed	Approved
1	A	Internal	08/10/2019	J. Malvern	
1	0	M. Bland	16/10/2019	M. Bloem	
1	1	M. Bland	21/01/2020	M. Bloem	
1	2	M. Bland	22/01/2020	M. Bloem	M. Bloem

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Project Name:	Bungendore Sands Extension Project – Traffic and Transport Assessment
Project Number:	2019103
Name of Client:	Grantham Park Holdings Pty Limited

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Commonly Used Acronyms

Abbreviation	Description
AUL	Auxiliary Left Turn Lane
BAL	Basic Left Turn Lane
BAR	Basic Right Turn Lane
CHL	Channelised Left Turn Lane
CHR	Channelised Right Turn Lane
EIS	Environmental Impact Statement
HV	Heavy Vehicle
LGA	Local Government Area
LV	Light Vehicle
RMS	Roads and Maritime Services
SEARS	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SISD	Safe intersection Site Distance
TTA	Traffic and Transport Assessment
QPRC	Queanbeyan-Palerang Regional Council

Executive Summary

This report has been prepared for R.W. Corkery & Co. Pty Limited (RWC) on behalf of Grantham Park Holdings Pty Limited ("the Proponent") to assess traffic related impacts of the development of a new sand extraction area on Lot 1 DP 1167699, in order to increase the recoverable sand resource and extend the operational life of the existing extraction and processing operation conducted by Tobiway Crushing Pty Ltd ("the Proposal"). This report will form part of an Environmental Impact Statement (EIS) for the Proposal.

Tobiway Crushing Pty Ltd ("Tobiway") currently operates the Proposal site (referred herewith as the Quarry) under the conditions of development consent DA52/74 and DA104/92 which includes the extraction, processing, stockpiling, loading and transportation activities undertaken on Lot 31 DP 634213 (owned by Tobiway) as well as sections of Lot 1 DP 1167699 and Lot 2 DP 1167699 (leased by Tobiway from the Proponent).

The Proposal generally reflects a continuance of the current Quarry operation based on an increase in maximum production to 400,000tpa. It is anticipated by the Proponent that in order to meet future demand, no increase in current Quarry haulage vehicles will be required due to the proposed use of haulage vehicle configurations with increased capacity up to 38t which is up from the existing 33t capacity of the current haulage vehicles in use.

The purpose of this Traffic and Transport Assessment (TTA) report is to assess the existing road network, the existing operations and the proposed ongoing transportation of sand material from the Quarry.

The Quarry is located off Tarago Road approximately 6km north of the Kings Highway at Bungendore.

The assessment has been prepared in accordance with the NSW Roads and Traffic Authority's Guide to Traffic Generating Developments (2002) and Austroads Road Design Guides and addresses the Secretary's Environmental Assessment Requirements (SEARS) issued by the Department of Planning and Environment.

The scope of this TTA has been limited to the local and regional road network utilised to and from the Quarry until these roads intersect with the State road network.

An appreciation of the existing traffic situation relating to the Quarry was gained by examining the existing road network and reviewing available traffic volume data. These aspects are discussed in this report. The roads inspected and discussed in this report include the relevant sections of Tarago Road, Molonglo Street and the Kings Highway.

This assessment has concluded that the amendments to the existing transport arrangements can be successfully mitigated for the Proposal.

1 Introduction

1.1 Background

Grantham Park Holdings Pty Limited ('the Proponent") is seeking approval from Queanbeyan-Palerang Regional Council (QPRC) for the following Proposal:

- Development of a new sand extraction area on Lot 1 DP 1167699, in order to increase the recoverable sand resource and extend the operational life of the existing extraction and processing operation conducted by Tobiway ("Tobiway").

The Proposal will be assessed as Designated Development under Part 4 of the *Environmental Planning & Assessment Act 1979* and therefore assessed by Queanbeyan-Palerang Regional Council. As Designated Development for the purpose of extractive industry, the Development is also Regional Development under *State Environmental Planning Policy (SEPP) (State Regional Development) 2011* and therefore determination of the application will be by the Joint Regional Planning Panel.

1.2 Location

The Proposal site (referred herewith as the Quarry) is located approximately 6km north of the Kings Highway at Bungendore, approximately 31km northeast of Queanbeyan in NSW and 45km east-northeast of the Canberra Central Business District as shown in **Figure 1**.

1.3 Scope of Report

This Traffic and Transport Assessment (TTA) will form part of the Environmental Impact Statement (EIS) that will be prepared by R.W Corkery & Co. Pty Limited (RWC) on behalf of the Proponent and assesses the related impacts of the Proposal on the surrounding road network that would be affected for the duration of the Proposal. This report asses the Quarry traffic related impacts in accordance with the RMS's Guide to Traffic Generating Developments and the specific requirements nominated by the Secretary's Environmental Assessment Requirements (SEARs) prepared for the Proposal by the Department of Planning and Environment.

The scope limits for this TTA are roads and intersections from the Quarry access including Tarago Road, Molonglo Street and the Kings Highway within the city limits (50km/h speed zones) of Bungendore.

1.4 Project Overview

1.4.1 Existing Environment

The Quarry is located off Tarago Road approximately 6km north of the Kings Highway at Bungendore and is located on land zoned E3 – Environmental Management and RU1 - Primary Production under the Palerang Local Environment Plan 2014. Extractive industries are permissible with consent within zone RU1.

Tobiway currently operates the Quarry under the conditions of development consent DA52/74 and DA104/92 which includes the extraction, processing, stockpiling, loading and transportation activities undertaken on Lot 31 DP 634213 (owned by Tobiway) as well as sections of Lot 1 DP 1167699 and Lot 2 DP 1167699 (leased by Tobiway from the Proponent). Access to the Quarry is directly from Tarago Road and the existing unsealed internal roads within the lots (refer **Figure 2**).

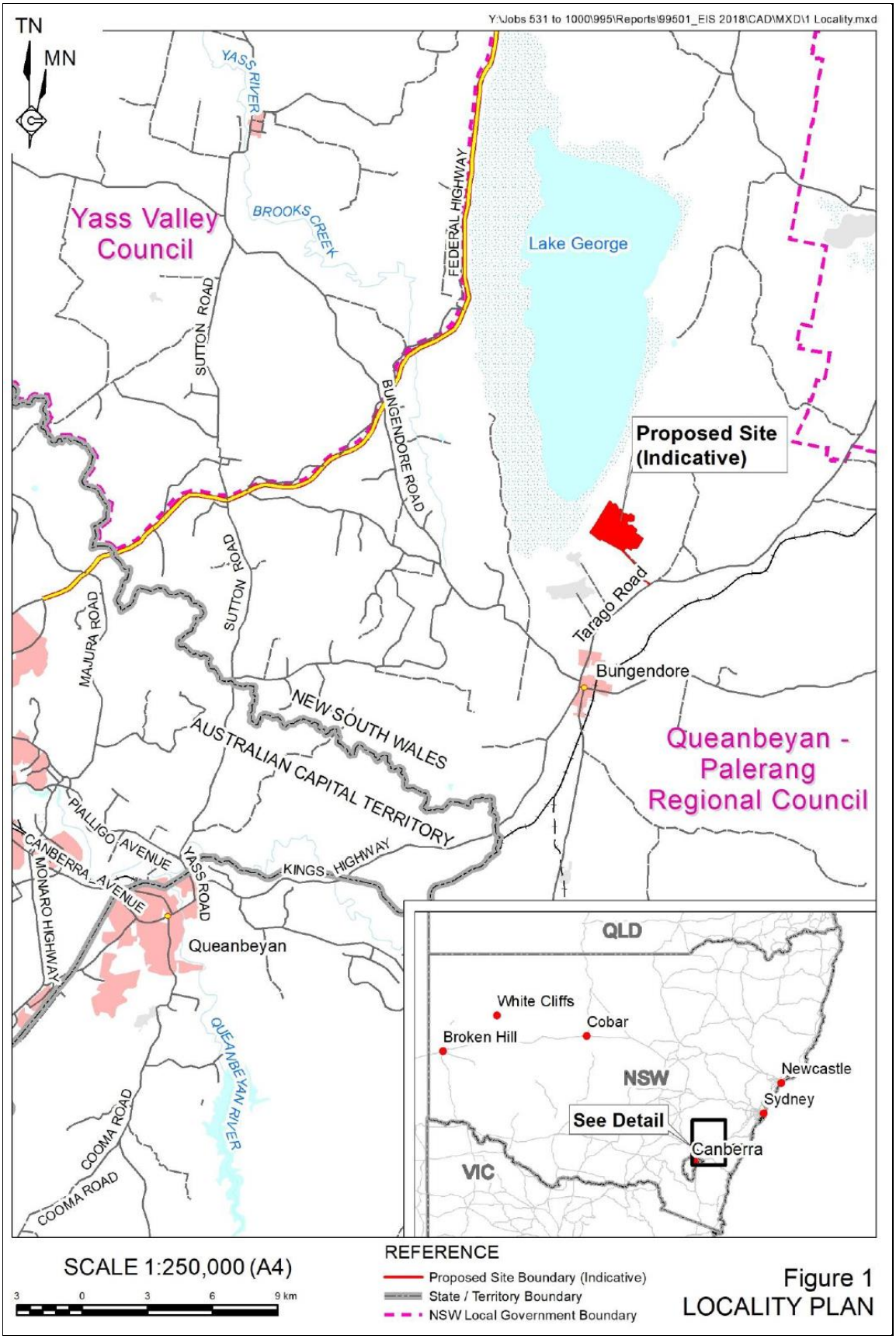


Figure 1 - Locality Plan

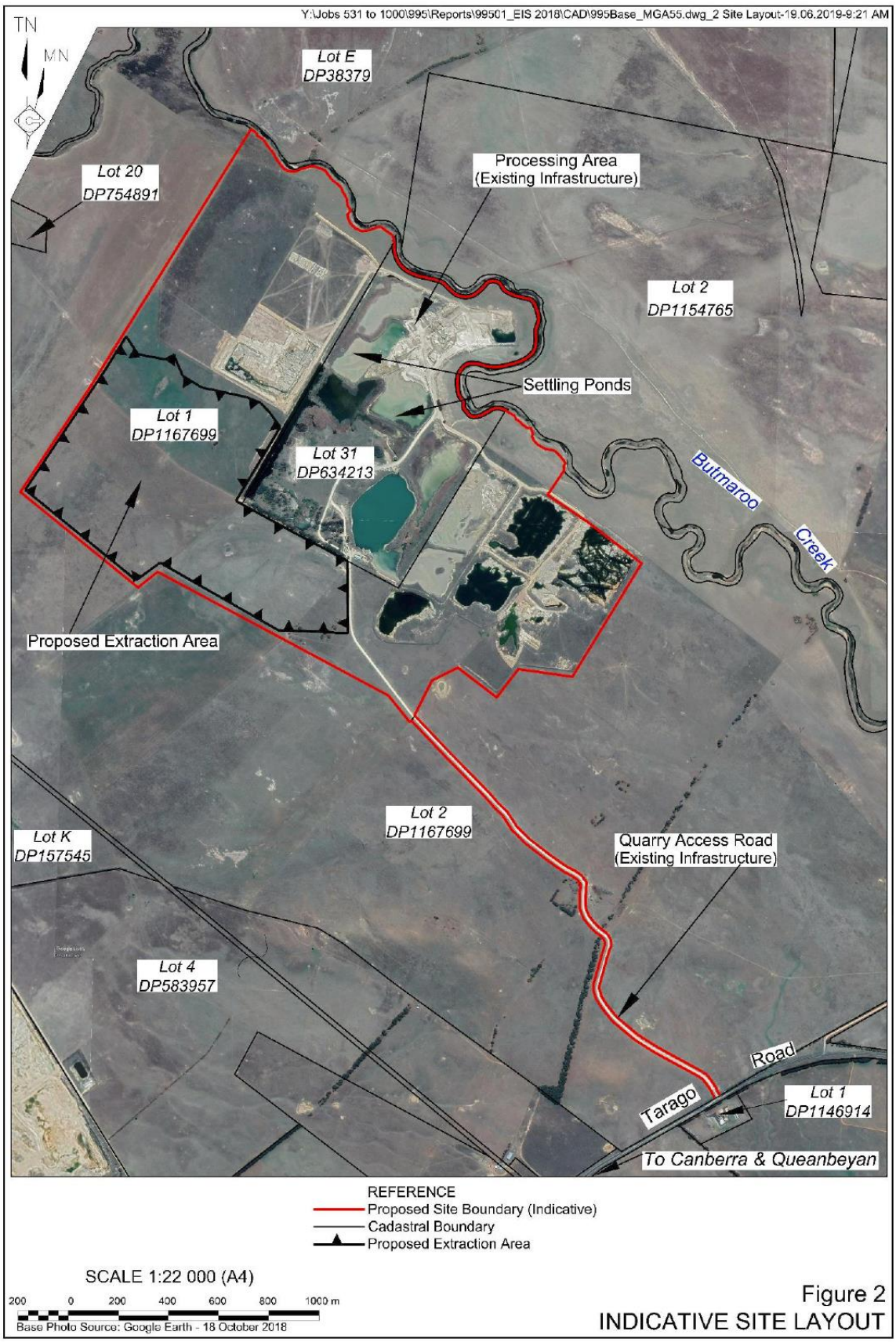


Figure 2 - Indicative Quarry Site Layout

1.4.2 Proposed Development

The proposed expansion of the extraction area is situated on Lot 1 DP1167699, as shown in **Figure 2**, would enable the Quarry to continue using the existing processing plant to extend the life of the Quarry and to continue to meet existing demand whilst accommodating the anticipated long-term increase in market demand for construction sand with the Queanbeyan and Canberra regions.

Whilst not yet finalised, the Proposal would comprise the following:

- Extraction area of approximately 75ha;
- Average extraction depth of 10m;
- Total quantity of resource to be extracted = 3.6Mt;
- Annual production of up to 400,000tpa; and
- Quarry life of approximately 20 years.

The proposed quarrying operations would comprise of the following activities:

- Soils overlying the sand would be stripped and stockpiled for future rehabilitation activities within the quarry;
- Overburden and interburden materials would be removed and used for flood protection works including flood protection bunds and land reclamation activities;
- Two extraction methods are proposed:
  - (i) Use of an excavator to extract and load material into haul trucks which would be transported to the existing processing area on Lot 31 DP 634213;
  - (ii) Use of a suction dredge to pump extracted material via a pipeline directly to the existing processing area on Lot 31 DP 634213
- Excavated material would be stockpiled adjacent to the processing plant prior to be processed.
- Processing operations would involve the following:
  - Stockpiled material is loaded into a hopper using a front-end loader for transfer to the washing and screening plant to remove separate silts and sands from oversize material and fine sand;
  - Remaining water containing sand and silt mixture is cycled through the wash plant to separate the sands and silts;
  - Separated sand and silt mixture is pumped to a settling pond;
  - Water is added to facilitate gravity settlement and recovery of sand in the classifier;
  - Classified sand is transferred to 1 of 3 stockpiles from the classifier via a radial stacker;
  - Remaining silt and water mixture is pumped to a settling pond.
- Quarry products a transported from the Quarry via the existing internal quarry road located on Lot 2 DP 1167699 before entering Tarago Road.
- Quarry products would be dispatched from the Quarry using 19m truck and dog trailers (3-axle, 33 tonne capacity which are currently the principle vehicle configuration at being used by the existing operation), rigid trucks (12 to 18 tonne capacity) and smaller rigid vehicles.
- Rehabilitation of the extraction areas will consist of establishing wetlands and pasture in the shallow void following the completion of extraction operations.

The Proposal generally reflects a continuance of the current Quarry operation based on an increase in maximum production to 400,000tpa. It is anticipated by the Proponent that in order to meet future demand, no increase in current Quarry haulage vehicles will be required due to the proposed use of haulage vehicle configurations with increased capacity up to 38t which is up from the existing 33t capacity of the current haulage vehicles in use.

2 Consultation

Consultation was undertaken by RWC. **Table 1** provides a summary of traffic and transport related SEARs for the Proposal dated 5 August 2019.

Table 1 - Traffic and Transport Related SEARS

Item 1	Description
1	Accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products
2	An assessment of potential traffic impacts on the capacity, condition of safety and efficiency of the local and state road networks, detailing the nature of the traffic generated transport routes, traffic volumes and potential impacts on local and regional roads.
3	A description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network (particularly the proposed transport routes) over the life of the development.
4	Evidence of any consultation with relevant roads authorities, regarding the establishment of agreed contributions towards road upgrades or maintenance.
5	A description of access roads, specifically in relation to nearby Crown roads and fire trails

3 Existing Road Network

3.1 Introduction

The transportation route for quarry products is described below and all access to and from the Quarry will occur via the roads detailed in **Table 2** and the intersections listed in **Table 9** are those where Quarry related traffic will be required to undertake turning manoeuvres.

An inspection of the transportation route was conducted on 12 September 2019. Observations from the inspection are outlined in the following sections.

3.2 Roads

Table 2 - Transportation Route Roads

Item	Description	Road Type	Road No.	Road Authority
1	Tarago Road	Regional Road	MR 260	QPRC
2	Molonglo Street	Regional Road	MR 260	QPRC
3	Kings Highway – East/West (Molonglo Street)	State Road	MR 51	Roads and Maritime Services (RMS)
4	Kings Highway – North/South (Malbon Street)	State Road	MR 51	RMS

3.2.1 Tarago Road

Tarago Road from the Quarry access point to the bridge over Turallo Creek is a Regional Road with QPRC as the road authority. The road is not an approved B-double route however, a section of Tarago Road from the Bungendore Waste Transfer Station Access Road heading north for approximately 11km is an *'Approved Route with Travel Conditions'* for B-doubles as defined by the RMS Restricted Access Vehicle Map[1].

The route standard for Tarago Road from the Quarry access (Chainage 0km) to the bridge over Turallo Creek (Chainage 5.3km) consists of a rural formation with longitudinal table drains on both sides with pipe culvert transverse crossings (refer **Plate 1** to **Plate 3**).

The pavement is sealed with a carriageway width of 7.5 to 8m providing 2 x 3.5m wide travel lanes. The pavement varies from fair to good with evidence of rutting, flushed seal (particularly in the wheel paths) and potholing.

Delineation generally consists of guideposts on both sides of the road and line marking. There is a centre line in place for the full length and edge lines provided on both sides of the road in only a number of segments. There are two overhead street lights, and these are located at the Elmslea Drive intersection (Chainage 4.3km) and Ashby Drive intersection (Chainage 4.6km).

A floodway with depth markers is located at Chainage 5.2km on approach to the bridge over Turallo Creek.

A summary of the Tarago Road route standard is provided in **Table 3**.

[1] RMS Restricted Access Vehicle Map (4/10/2019). (http://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/)

Table 3 - Tarago Road Route Standard

Section	Carriageway Width	Travel Lane Width	Line marking	Guideposts	Pavement Condition	Speed Zone
0km to 2.3km	8m	2 x 3.5m	Centre Line Edge Lines	Yes	Good	100km/h
2.3km to 3.6km	7.5 to 8m	2 x 3.5m	Centre Line	Yes	Fair with rutting seal flushing and potholes	100km/h
3.6km to 5.3km	7.5 to 8m	2 x 3.5m	Centre Line Edge Lines	Yes	Relatively good in sections with flushed seal in wheel paths	100km/h (3.6km to 4.1km) 80km/h (4.1km to 5.3km)

Plate 1: Chainage 2km (looking north)

Plate 2: Chainage 2.7km (looking north)

Plate 3: Chainage 4km (looking south)

There are several roads that intersect with Tarago Road in this 5.3km section as described in **Table 4.** Tarago Road has priority and Quarry related traffic will not undertake any turning manoeuvres at these locations.

Table 4 - Tarago Road Intersections

Chainage	Intersecting Road	Intersection Configuration	Control	Land Use
1.1km	Hope Drive	T-junction with Auxiliary Right (AUR) Turn Treatment	Give Way	No Through Road access for rural residential subdivision
2.0km	McDonnell Drive	T-junction with AUR Turn Treatment	Give Way	No Through Road access for rural residential subdivision
3.8km	Access Road	T-junction with Basic Right (BAR) Turn Treatment	Give Way	Bungendore Waste Transfer Station
4.3km	Elmslea Drive	T-junction with AUR Turn Treatment	Give Way	No Through Road access for rural residential subdivision
4.6km	Ashby Drive	T-junction with Channelised Right (CHR) and Auxiliary Left (AUL) Turn Treatments	Give Way	Residential Subdivision

It was considered from observations during the site inspection that each intersection as described in **Table 4** had adequate sight distance in both directions.

3.2.2 Molonglo Street

Molonglo Street from the bridge over Turallo Creek (Chainage 5.3km) to the Kings Highway (Chainage 5.9km) is a Regional Road with QPRC as the road authority. The road is not an approved B-double route.

The route standard for Molonglo Street consists of an urban formation with kerb and gutter on both sides of the road with a posted speed limit of 50km/h.

The bridge over Turallo Creek has a concrete deck and is 9m wide between the barriers (refer **Plate 4** and **Plate 5**). The road pavement through to the Kings Highway is sealed with a carriageway width of approximately 12m between the kerbs and the pavement was considered to be in reasonable condition with evidence of flushed seal and minor rutting in the wheel paths. (refer **Plate 6** to **Plate 7**).

Delineation consists of overhead street lighting, centre line and edge lines for the full length with the provision for on street kerbside parallel parking on both sides of the street. Retroreflective Raised Pavement Markers (RRPMs) were in place between the roundabout at the Bungendore Road / Gibraltar Street intersection (Chainage 5.7km) and the Kings Highway intersection (Chainage 5.9km).

Plate 4: Chainage 5.3km (looking south)

Plate 5: Chainage 5.35km (looking north)

Plate 6: Chainage 5.4km (looking south)

Plate 7: Chainage 5.8km (looking south)

There are a number of roads that intersect with Molonglo Street in this 600m section as described in **Table 5**. Molonglo Street has priority and Quarry related traffic will not undertake any turning manoeuvres at these intersections.

Table 5 - Molonglo Street

Chainage	Intersecting Road	Intersection Configuration	Control	Land Use
5.4km	Turallo Terrace	T-junction	Stop	Residential Subdivision
5.7km	Bungendore Road / Gibraltar Street	Rigid Pavement Single Lane Roundabout	Give Way	Bungendore Road (west) – rural properties Gibraltar Street (east) - residential and commercial properties

Quarry related traffic will be required to manoeuvre through the roundabout from north to south and vice versa and from observations during the inspection, the roundabout is considered to have sufficient pavement width to cater for the swept paths of the largest vehicle proposed to transport the quarry products. (refer **Plate 8** and **Plate 9**).

Plate 8: Bungendore Road / Gibraltar Street Roundabout

Plate 9: Bungendore Road / Gibraltar Street Roundabout

3.2.3 Kings Highway

At Chainage 5.9km, Molonglo Street forms part of the Kings Highway. The Kings Highway is a State Road with RMS as the roads authority. The highway is an approved 26m B-double as defined by the RMS Restricted Access Vehicle Map[2].

The Kings Highway through the village of Bungendore is characterised by two distinct directions as described in **Table 6** and shown in **Figure 3**.

Table 6 - Kings Highway Through Bungendore

Road Name	Direction	Destination from Bungendore
Molonglo Street	North / South	Queanbeyan and Canberra
Malbon Street	East / West	Batemans Bay

[2] RMS Restricted Access Vehicle Map (4/10/2019). (http://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/)

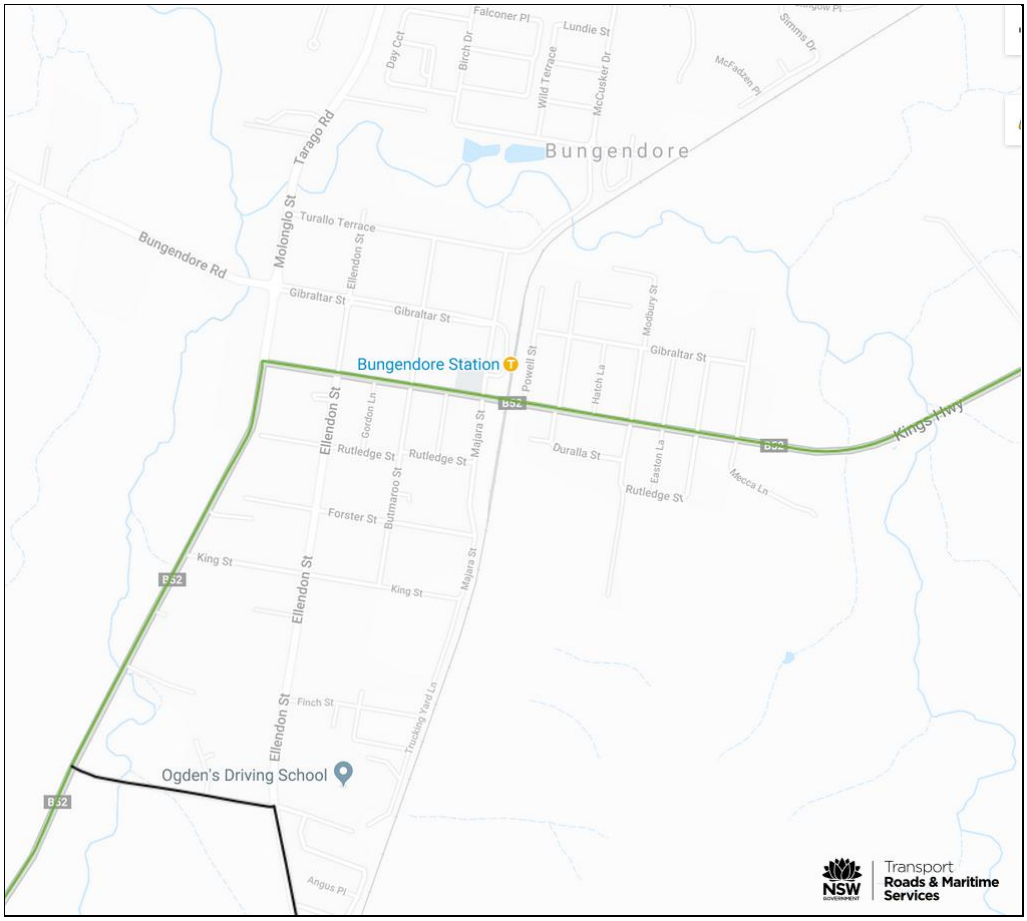


Figure 3 - Kings Highway Through Bungendore

Further details of the Kings Highway through Bungendore are provided in the following sections with the inspections limited to the city limits where the speed zone changes from 50km/h to 100km/h.

3.2.4 Kings Highway – North/South (Molonglo Street)

The route standard for Molonglo Street from the Malbon Street intersection (Chainage 5.9km) to Chainage 6.1km consists of an urban formation with kerb and gutter on both sides of the road with a posted speed limit of 50km/h.

The road pavement through to the Kings Highway is sealed with a carriageway width of approximately 12m between the kerbs and the pavement was considered to be in reasonably good condition with evidence of flushed seal and minor rutting in the wheel paths. (refer **Plate 10** to **Plate 11**).

Delineation consists of overhead street lighting, centre line, edge lines and RRPMs for the full length with the provision for on street kerbside parking on both sides of the street.

Plate 10: Chainage 6km (heading north)

Plate 11: Chainage 6km (heading south)

The route standard for Molonglo Street from Chainage 6.1km to Chainage 6.9km (end of 50km/h speed zone / start of 100km/h speed zone) consists of a rural formation with longitudinal table drains on both sides with pipe culvert transverse crossings.

The pavement is sealed with a carriageway width of up to 9m providing 2 x 3.5m wide travel lanes with 0.5 to 1m wide shoulders. The pavement was considered to be in reasonable condition with evidence of flushed seal and minor rutting in the wheel paths. (refer **Plate 12** to **Plate 13**).

Delineation generally consists of guideposts on both sides of the road and line marking. There is a centre line, edge lines provided on both sides of the road and RRPMs for the full length of the segment.

Plate 12: Chainage 6.3km (heading south)

Plate 13: Chainage 6.9km (heading north)

There is one road that intersect with the Kings Highway in this 1km section as described in **Table 7**. Kings Highway as priority and Quarry related traffic will not undertake any turning manoeuvres at these intersections.

Table 7 - Kings Highway Intersections

Chainage	Intersecting Road	Intersection Configuration	Control	Land Use
6.5km	King Street	T-junction	Give Way	Residential properties and industrial subdivision

3.2.5 Kings Highway – East/West (Malbon Street)

The route standard for Malbon Street from the Molonglo Street intersection (Chainage 0km) to the rail level crossing (Chainage 0.75km) consists of an urban formation with kerb and gutter on both sides of the road with a posted speed limit of 50km/h.

The road pavement is sealed with a carriageway width of approximately 12m between the kerbs and the pavement was considered to be in good condition with evidence of flushed seal and minor rutting in the wheel paths. (refer **Plate 14** to **Plate 15**).

Delineation consists of overhead street lighting, centre line, edge lines and RRPMs for the full length with the provision for on street kerbside parking on both sides of the street.

Pedestrian facilities include a pedestrian refuge on each approach to the Ellendon Street intersection and concrete paved footpaths on both side of the road from Molonglo Street through to Majara Street.

There are pedestrian refuges on the approaches to the Ellendon Street intersection (Chainage 0.2km), a school zone perimeter just east of the Butmaroo Street intersection (Chainage 0.4km) and a rail level crossing with active controls at Chainage 0.75km. (refer **Plate 16** to **Plate 18**.

Plate 14: Chainage 0.1km (heading west)

Plate 15: Chainage 0.5km (heading east)

Plate 16: Pedestrian Refuges

Plate 17: School Zone (heading east)

Plate 18: Rail Level Crossing

The route standard for Malbon Street from the rail level crossing (Chainage 0.75km) to Chainage 1.6km (end of 50km/h speed zone / start of 100km/h speed zone) consists of a rural formation with longitudinal table drains on both sides with pipe culvert transverse crossings.

The pavement is sealed with a carriageway width of up to 9m providing 2 x 3.5m wide travel lanes with 1m wide shoulders. The pavement was considered to be in reasonable condition with evidence of flushed seal and minor rutting in the wheel paths. (refer **Plate 19** to **Plate 20**).

Delineation consists of line marking inclusive of a centre line, edge lines and RRPMs for the full length of the segment. Overhead street lighting is provided to the Osborne Street intersection (Chainage 1.3km).

There is a pedestrian refuge to the east of the Powell Street intersection (Chainage 0.8km) and the school zone perimeter (Chainage 1.0km) located just west of the Duralla Street intersection (refer **Plate 21** and **Plate 22**).

Plate 19: Chainage 1.1km (heading west)

Plate 20: Chainage 1.2km (heading east)

Plate 21: Pedestrian Refuge

Plate 22: School Zone

There are a number of roads that intersect with the Kings Highway in this 1.6km section as described in **Table 8**. Kings Highway has priority and Quarry related traffic will not undertake any turning manoeuvres at these intersections.

Table 8 - Kings Highway Intersections

Chainage	Intersecting Road	Intersection Configuration	Control	Land Use
0.2km	Ellendon Street	Four Way	Give Way	Residential and commercial properties
0.3km	Gordon Lane	Layback	Give Way	Rear access laneway for residential properties
0.4km	Butmaroo Street	Four Way	Give Way	Residential properties
0.5km	Champions Lane	Layback	Give Way	Rear access laneway for residential properties
0.7km	Majara Street	Four Way	Give Way	Residential properties
0.8km	Powell Street	T-junction	Give Way	Residential properties
0.9km	Duralla Street	Four Way	Give Way	Residential properties
1.0km	Hatch Lane	Gravel Access	Give Way	Rear access laneway for residential properties
1.1km	Modbury Street	Four Way	Give Way	Residential properties
1.2km	Easton Lane	Four Way (Gravel Access)	Give Way	Rear access laneway for residential properties
1.3km	Osborne Street	Four Way	Give Way	Residential properties
1.4km	Mecca Lane	T-junction (north side) Gravel Access (south side)	Give Way	North side – residential properties South side – rural properties

3.3 Intersections

The intersections listed in **Table 9** are those where Quarry traffic will be required to undertake turning manoeuvres.

Table 9 - Transportation Route Intersections

Item	Description	Road Type	Road No.	Road Authority
1	Tarago Road and Quarry Access	Regional Road	MR 260	QPRC
2	Molonglo Street and Malbon Street (Kings Highway)	State Road	MR 51	RMS

3.3.1 Tarago Road and Quarry Access

The intersection of Tarago Road and the Quarry Access is a rural type access located within a 100km/h speed zone on the northern side of Tarago Road. The access is sealed to the single lane cattle grid which is set back approximately 30m from the edge line on Tarago Road (refer **Plate 23** and **Plate 24**). The internal road is unsealed.

Plate 23: Quarry Access

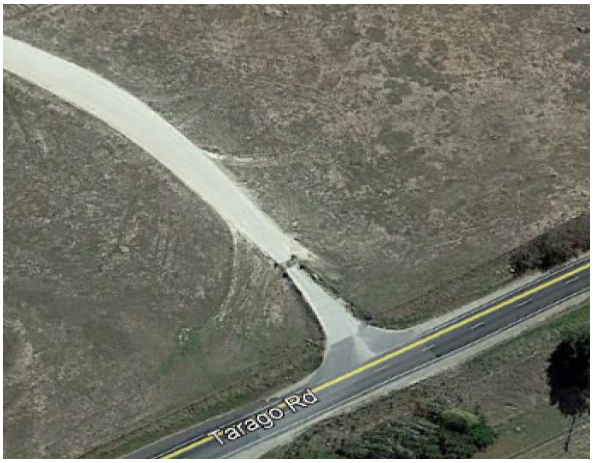


Plate 24: Quarry Access Aerial View

The route standard for Tarago Road at this location consists of a rural formation with longitudinal table drains on both sides with a pipe culvert transverse crossing located immediately to the south-west of the Quarry access point. The pavement is sealed with a carriageway width of 8m providing 2 x 3.5m wide travel lanes delineated by a centre line and edge lines provided on both sides of the road.

Approximately 80m the southwest of the Quarry access, a 3m wide by 100m long sealed Basic Right (BAR) turn treatment has been installed adjacent to the northbound lane for the access to the wastewater treatment facility. This BAR turn treatment is not used for left turn manoeuvres into the Quarry as the existing pipe culvert just before the Quarry access has not been extended. (refer **Plate 25**).

Plate 25: BAR turn treatment for the wastewater facility access

The pavement of Tarago Road is considered to be in reasonably good condition with evidence of minor rutting and flushed seal in the wheel paths. There are advanced truck warning signs located on Tarago Road on both approaches to the Quarry access. (refer **Plate 26** to **Plate 29**).

The sight distance is approximately 350m to the north and greater than 400m to the south-west. Safe Intersection Sight Distance (SISD) is the minimum distance which should be provided on the major road at any intersection. The *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* provides, for a design speed of 100km/h at a 2.0 second reaction, that the required SISD is 248m. As a result, the available sight distance is considered to be adequate.

Plate 26: Sight Distance (north-east)

Plate 27: Sight Distance (south-west)

Plate 28: Advanced Warning Sign (northbound lane)

Plate 29: Advanced Warning Sign (southbound lane)

3.3.2 Kings Highway (Molonglo Street and Malbon Street Intersection)

The intersection of Molonglo Street and Malbon Street has a T-junction configuration within an urban road formation. There is a widened shoulder adjacent to the northbound lane that could be described as an informal Basic Right (BAR) turn lane however, this is diminished somewhat due to the adjacent property accesses and given there are no on street parking restrictions in place.

Molonglo Street is the priority road and the posted speed limit is 50km/h. The pavement is sealed between the kerbs and the pavement is considered to be in reasonably good condition. Delineation consists of centre line and edge line markings providing 2 x 3.5m travel lanes as well as overhead street lighting. Advanced warning of the intersection along Molonglo Street is provided by guide signs. Give Way control is provided on Malbon Street with Give Way signs and a faded hold line. (refer **Plate 30** to **Plate 34**).

The sight distance is greater than 150m to the north and south. The *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* provides, for a design speed of 50km/h at a 2.0 second reaction, that the required SISD is 97m. As s a result, the available sight distance is considered to be adequate.

Plate 30: Looking East along Malbon Street

Plate 31: Looking west from Malbon Street

Plate 32: Looking North along Molonglo Street

Plate 33: Looking South along Molonglo Street

Plate 34: Aerial View

3.4 Traffic Volumes

3.4.1 Current and Forecast Traffic Volumes

2019 traffic data for Tarago Road, Molonglo Street and the Kings Highway was obtained from QPRC. An analysis of the available traffic data was undertaken to estimate the 10 year traffic forecasts (2029) based on a 1% growth rate for Tarago Road and Molonglo Street and a 2% growth rate for the Kings Highway. **Table 10** provides a summary of the existing and estimated forecast traffic as annual average daily traffic (AADT) including percentage of heavy vehicles (HV%).

Table 10 - Background and 10 Year Forecast Traffic Volumes

		Background Traffic (2019)		Forecast Traffic (2029)	
Road	**Site**	**AADT**	**HV%**	**AADT**	**HV%**
Kings Highway (Malbon Street)	Between Molonglo St and Ellendon St	6874	6%	7593	6%
Kings Highway (Molonglo Street)	South of Malbon Street	8424	9.1%	9305	9.1%
Molonglo Street	Between Malbon Street and Bungendore Road	6335	8.5%	6998	8.5%
Tarago Road	Approximately 3.5km northeast of the Project site access	1667	10.6%	1841	10.6%

Based on the traffic data, the morning (Peak AM) and afternoon (Peak PM) vehicles per hour (vph) occur at varying times depending on the location. A summary of the Peak AM and Peak PM times is provided in **Table 11**.

Table 11 - Summary of Peak AM and Peak PM Vehicles Per Hour

Road	Site	AM Peak Hour	vph	PM Peak Hour	vph
Kings Highway (Malbon Street)	Between Molonglo St and Ellendon St	10-11am	477	5–6pm	647
Kings Highway (Molonglo Street)	South of Malbon Street	7–8am	671	4–5pm	762
Molonglo Street	Between Malbon Street and Bungendore Road	7–8am	505	4–5pm	538
Tarago Road	Approximately 3.5km northeast of the Project site access	7-8am	154	5–6pm	165

3.5 Crash History

Using the NSW Government Centre for Road Safety Interactive Crashed Website[3], 15 crashes were recorded on the transportation route as defined in this report. Details of these crashes are provided in **Table 12.**

Table 12 - Crash History along the Transportation Route

Crash ID	Degree of Crash	Location	Year	Accident Description	Day or Night	No of Injuries
Tarago Road						
1080664	Moderate Injury	North of Hope Drive (2 way-undivided)	2015	Off carriageway to the right	Day	1
1171361	Fatal	South of McDonnell Drive (2 way-undivided)	2018	Rear end	Day	1
1122722	Minor Injury	North of the Waste Transfer Station (2 way-undivided)	2016	Right off carriageway into parked vehicle / object	Darkness	1
1117377	Minor Injury	Ashby Drive Intersection (T-junction)	2016	Rear end	Day	1
1033131	Non-casualty	Ashby Drive Intersection (T-junction)	2014	Rear end	Day	-
Molonglo Street						
1171838	Moderate Injury	Malbon Street intersection (T-junction)	2018	Off carriageway left on right bend into object / parked vehicle	Night	1
Malbon Street						
1033252	Minor Injury	Ellendon Street intersection (x-intersection)	2014	Right through	Day	1
1038628	Minor Injury	Ellendon Street intersection	2014	Cross traffic	Day	2

[3] RMS Centre for Road Safety Website – Interactive crash statistics (4/10/2019). (http://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html?tablga=4)

Crash ID	Degree of Crash	Location	Year	Accident Description	Day or Night	No of Injuries
		(x-intersection)				
1081994	Non-casualty	Ellendon Street intersection (x-intersection)	2015	Left off carriageway into parked vehicle / object	Day	-
10377745	Non-casualty	Butmaroo Street intersection (x-intersection)	2014	Cross traffic	Day	-
1132163	Moderate Injury	West of Majara Street intersection (footpath)	2017	From footpath	Day	1
1115555	Minor Injury	West of Majara Street intersection (footpath)	2016	From footpath	Day	1
1141317	Minor Injury	Modbury Street intersection (T-junction)	2017	Right rear	Day	2
1036598	Moderate Injury	East of Modbury Street intersection (2 way-undivided)	2014	Right off carriageway into parked vehicle / object	Dusk	1
1161544	Non-casualty	At 50/100 km/h speed zone change (2 way-undivided)	2018	Off carriageway left on right bend	Day	-

There is no distinct pattern with regard to the number of crashes reported however 10 of these crashes have been recorded in the 50km/h zones along the Kings Highway.

3.6 School Bus Services

School bus services for the Bungendore Public School are provided by Stevens Charter Service.

There are three services that operate Monday to Friday as described in **Table 13**.

Table 13 - School Bus Service Routes and Times

Route	Bus Routes	Times
Northern	Malbon Street, Molonglo Street, Tarago Road **One service each morning and afternoon**	8:40am to 9.00am 3:15pm to 3:30pm
Southern	Malbon Street, Molonglo Street (Kings Highway – north/south) **Two Services each morning and afternoon**	6.25am to 7:30am 8:00am to 9:00am 3:10pm to 4:00pm 4:30pm to 5:50pm

3.7 Public Transport

3.7.1 Buses

A public bus service (Qcity Transit) operates between Queanbeyan and Bungendore along part of the transportation route on weekdays only. A copy of the existing bus route is provided in **Figure 4**.

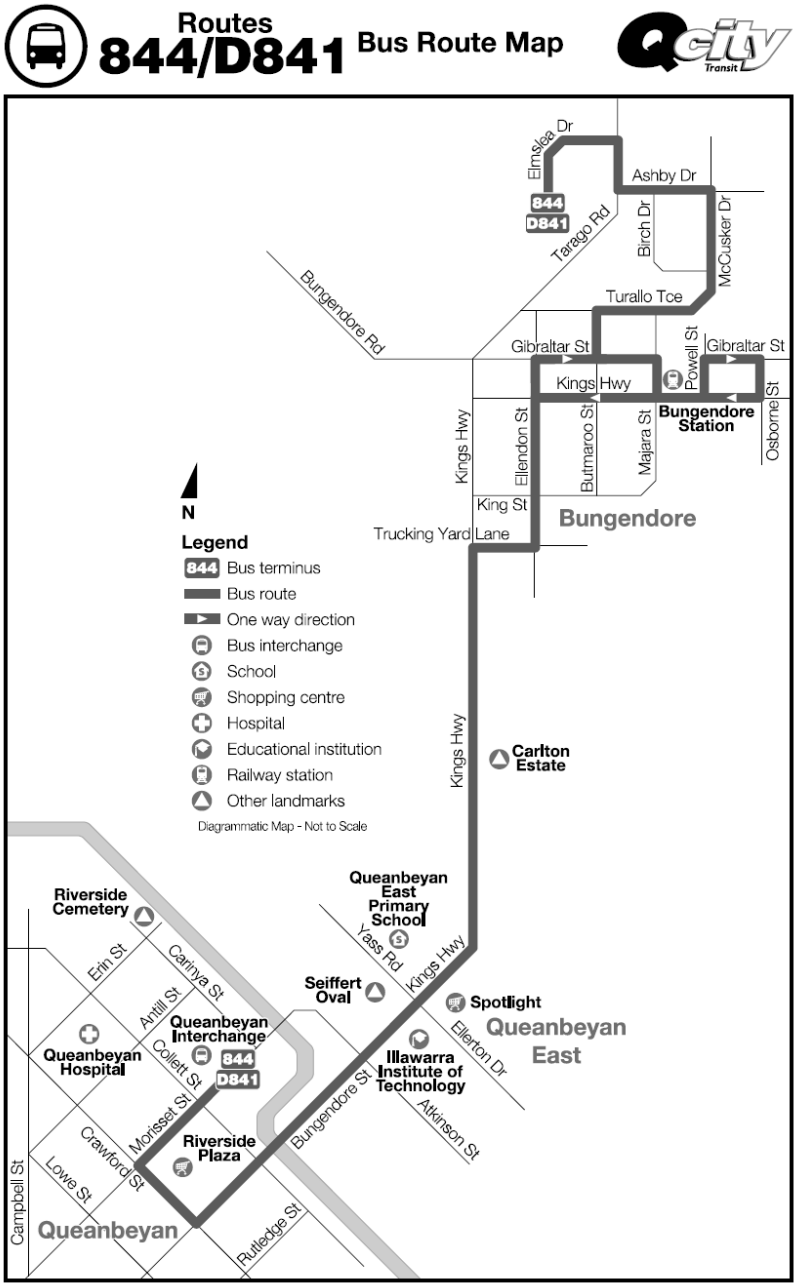


Figure 4 - Qcity Transit Bus Route Map

(Source: https://qcitytransit.com.au/timetables-h/bus-maps-h - 20/12/2019)

3.7.2 Rail

Transport for NSW operates daily train services between Sydney and Canberra which pass through Bungendore utilising the rail level crossing on the Kings Highway (east/west).

3.8 Pedestrian and Cycling Activity

3.8.1 Tarago Road

Whilst there were no pedestrians or cyclists observed during the inspection, it would be expected that there would be some pedestrian and cyclist activity along Tarago Road, particularly on the southern section given the increased number of residential properties in this area.

3.8.2 Molonglo Street including the Kings Highway

There were numerous pedestrians observed walking along Molonglo Street to either access commercial or residential properties in Bungendore. There are no paved footpaths however the footway area for pedestrians is defined by the verge.

No cyclists were observed during the site inspection however, it would be expected that cyclists would use both the road pavement and verge in this area.

3.8.3 Malbon Street (Kings Highway)

Molonglo Street to Rail Level Crossing

Pedestrian facilities include a pedestrian refuge on each approach to the Ellendon Street intersection and concrete paved footpaths on both side of the road from Molonglo Street through to Majara Street. There are no formal bike paths. Given the commercial area, adjacent residential area and public school, pedestrian and cycling activity would be expected to be commonplace with numerous pedestrians and cyclists observed during the site inspection.

Rail Level Crossing to Bungendore Town Limits

There are no formal pedestrian facilities in place between the rail level crossing and town limits to the east, except for a pedestrian refuge located just east of the Powel Street intersection. Given the adjacent residential area pedestrian and cycling activity would be expected to be commonplace with numerous pedestrians observed during the site inspection.

4 Proposal Related Traffic

4.1 Development Generated Traffic

The Quarry currently operates under the conditions of development consent DA52/74 and DA104/92. This Proposal to modify development consent generally reflects a continuance of the current Quarry operation based on an increase in maximum production to 400,000tpa. No increase in current Quarry haulage vehicle volumes will be required for this Proposal due to the proposed use of General Mass Limit (GML) semi-trailers (capacity up to 38t) which is an increase from the existing current haulage vehicles in use which consist of 19m truck and dog trailer (33t capacity) and smaller rigid trucks (12t to 18t capacity).

4.2 Operating Hours

The Quarry operates 5½ days per week over a 48 week period each year. The hours of operation are detailed in **Table 14**.

Table 14 - Quarry Hours of Operation

Activity	Monday to Friday	Saturday	Sunday
Extraction	6:00am – 5:00pm	6:00am – 2:00pm	-
Processing	6:00am – 5:00pm	6:00am – 2:00pm	-
Loading and Transportation	6:00am – 5:00pm	6:00am – 2:00pm	-
Rehabilitation	6:00am – 5:00pm	6:00am – 2:00pm	7:00am – 6:00pm
Maintenance	6:00am – 5:00pm	6:00am – 2:00pm	7:00am – 6:00pm

4.3 Vehicle Movements

The Quarry currently generates HV traffic with average loads of 33t as per the current consent as follows:

- An average of 30 to 35 trips per day (i.e.: 60 to 70 movements).
- Occasionally there will be a maximum of 70 trips per day.
- The maximum number of trips is no more than 8 per hour.

Employee and visitor access to the Quarry is up to 10 LV trips per day (i.e.: 20 LV movements).

The origin and destination of all vehicles is anticipated to be approximately 5% from the north along Tarago Road with the remaining 95% from the south along Tarago Road.

It is expected that the vehicle movements and origins as described above will be the same for this Proposal.

4.4 Operational Traffic Impacts

Peak traffic movements in and out of the Quarry are expected to occur during the start of shifts at 6:00am and the end of shifts at 5:00pm.

4.5 Peak Hour Volumes

As this Proposal is not adding any additional traffic, the peak hour volumes provided in **Table 11** represents background traffic inclusive of Quarry related traffic.

A summary of the peak hour volumes for background traffic and the 10 year horizon are presented in **Table 15**.

Table 15 - Peak Hour Calculations

Road	Site	Background Traffic (2019)		Forecast Traffic (2029)	
		Peak AM (vph)	Peak PM (vph)	Peak AM (vph)	Peak PM (vph)
Kings Highway (Malbon Street)	Between Molonglo St and Ellendon St	477	647	527	715
Kings Highway (Molonglo Street)	South of Malbon Street	671	762	741	842
Molonglo Street	Between Malbon Street and Bungendore Road	505	538	558	594
Tarago Road	Approximately 3.5km northeast of the Project site access	154	165	170	182

5 Assessment and Recommendations

The following subsections review the anticipated impacts of the Quarry on the road network. Discussions relevant to the recommendations for impact mitigation or other controls are also included, where appropriate.

5.1 Roads

5.1.1 Capacity

As this Proposal is not adding any additional traffic, the Proposal will not impact on the existing capacity of any of the roads along the transportation route.

5.1.2 Tarago Road

As described in **Section 2.2.1**, the pavement along Tarago Road varies from fair to good with evidence of rutting, flushed seal (particularly in the wheel paths) and potholing. As the Quarry is not adding any additional traffic, it is considered that any ongoing maintenance and rehabilitation along Tarago Road would be the responsibility of QPRC. Funding for this work may be inclusive of any Section 94 contributions to be calculated as a result of the Proposal.

5.1.3 Molonglo Street

As described in **Section 2.2.2**, the pavement along Molonglo Street from the bridge over Turallo Creek to the Kings Highway was considered to be in reasonable condition with evidence of flushed seal and minor rutting in the wheel paths. As the Quarry is not adding any additional traffic, it is considered that any ongoing maintenance and rehabilitation along Molonglo Street would be the responsibility of QPRC. Funding for this work may be inclusive of any Section 94 contributions to be calculated as a result of the Proposal.

5.1.4 Kings Highway

As described in **Section 2.2.4** and **Section 2.2.5**, the road pavement along the Kings Highway (North/South) and (East/West) considered to be in reasonably good condition with evidence of flushed seal and minor rutting in the wheel paths. As the Quarry is not adding any additional traffic, it is considered that any ongoing maintenance and rehabilitation along the Kings Highway (a State controlled road) would be funded by and be the responsibility of RMS.

5.2 Intersections

Turning movements associated with Quarry related traffic only occur at the Quarry access on Tarago Road and the Kings Highway (Molonglo Street and Malbon Street) intersections. As a result, analysis of only these two intersections has been undertaken.

5.2.1 Quarry Access

The Quarry access is located on the northern side of Tarago Road as described in **Section 2.3.1.** The following section outlines the assessment process for determining the type of access required and associated turn treatments that may be necessary.

The existing Quarry access is generally in accordance with the dimensions of a rural property access to cater for articulated vehicles as defined in Figure 7.4 of *AUSTROADS Guide to Road Design – Part 4: Intersections and Crossings* (refer **Figure 5**).

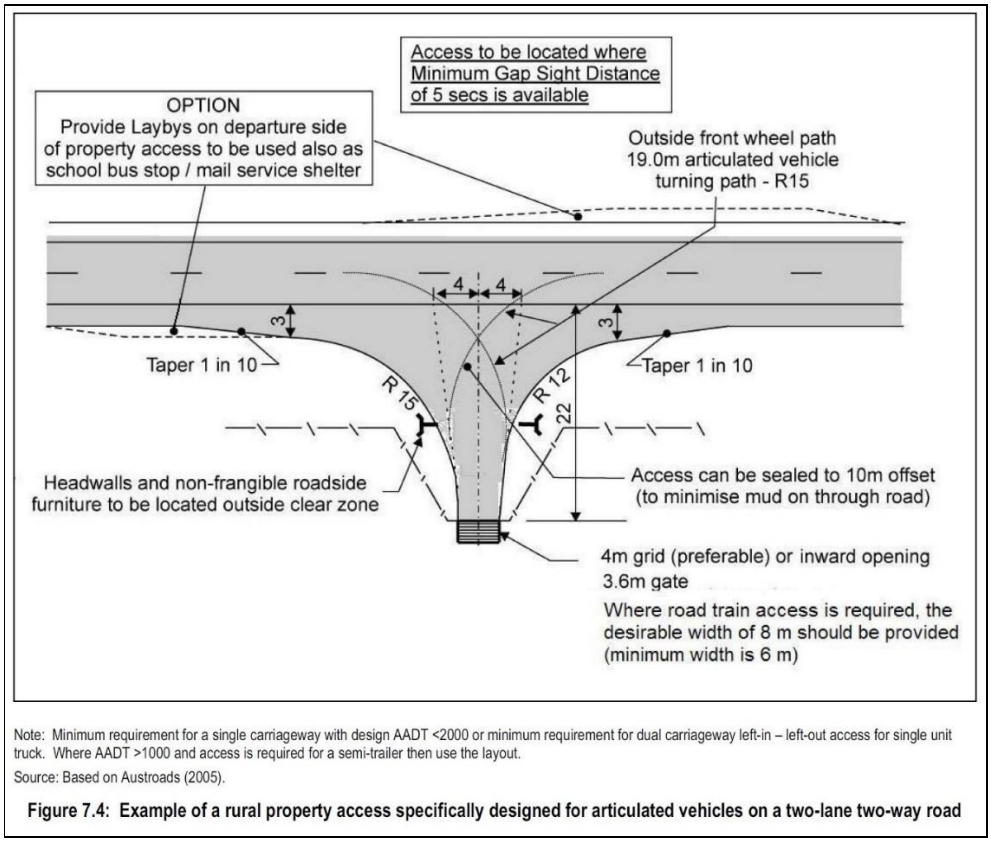


Figure 5 - Rural Property Access

Given the existing rural property access arrangement, it is considered that no further upgrades are required to the current arrangement.

5.2.2 Warrants for Basic, Auxiliary and Channelised Turn Treatments

Figure A10(a) of *AUSTROADS Guide to Road Design – Part 4: Intersections and Crossings General,* specifies warrants for providing left and right turn treatments at unsignalised intersections including property access points. The graph reproduced below as **Figure 6** shows the volumes of traffic at an intersection subject to speed limits equal to and greater than 100km/h.

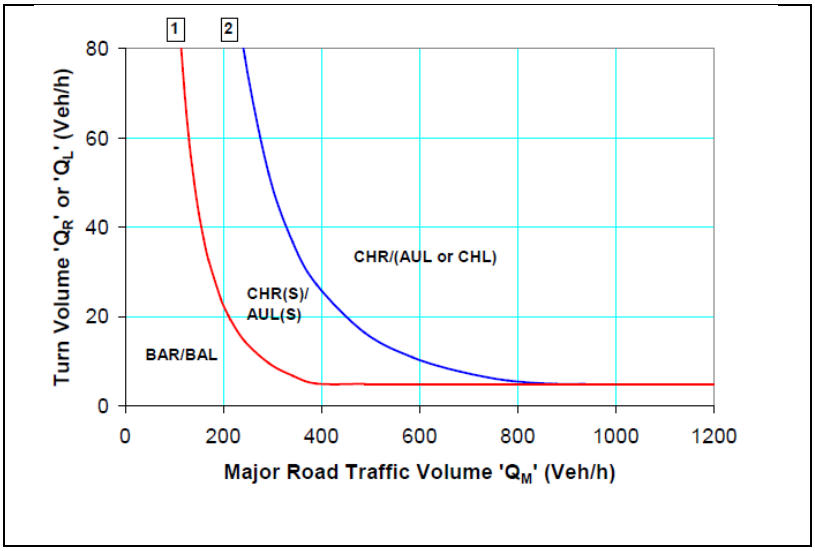
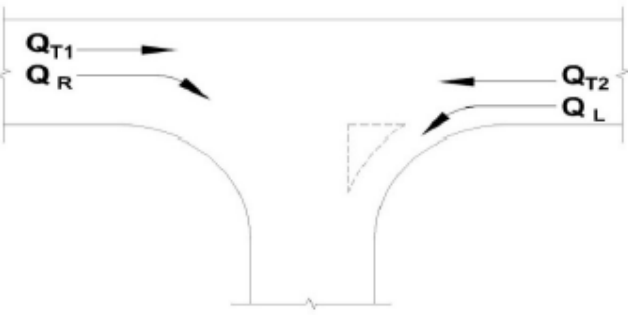


Figure 6 - Warrants for turn treatments – Design speed ≥ 100km/h

Figure A11 of *AUSTROADS Guide to Road Design – Part 4: Intersections and Crossings General* defines the traffic and turn volume parameters and this has been reproduced as **Figure 7**.



Turn type	*Splitter island*	*Q_m (veh/h)*
Right	*No*	*= Q_{T1} + Q_{T2}+Q_L*
Right	*Yes*	*= Q_{T1} + Q_{T2}*
Left	*No/yes*	*= Q_{T2}*

Source: Arndt and Troutbeck (2006).

Figure 7 - Traffic and Turn Volume Parameters

Traffic volume parameters have been calculated for the Peak AM hour and Peak PM hour periods for (year 0 - 2019) and the 10 year operational phase (year 10 - 2029). These parameters have been listed in **Table 16.**

Table 16 - Traffic Parameters (vehicles per hour)

Parameter	AM Peak		PM Peak	
	Year 0 (2019)	Year 10 (2029)	Year 0 (2019)	Year 10 (2029)
	Peak Hour (vph)	Peak Hour (vph)	Peak Hour (vph)	Peak Hour (vph)
Q_{T1}	107	130	57	70
Q_{T2}	38	46	82	100
Q_R	1	1	1	1
Q_L	7	7	7	7
$Q_{M\ (R)}$	152	185	146	178
$Q_{M\ (L)}$	38	46	82	100

Figure 8 to **Figure 11** shows the traffic volume parameters diagrammatically for the Quarry access. These parameters have then been used to determine the warrant for turn treatments by plotting them on the Austroads graph for background traffic (2019) and the 10 year horizon (2029) for both the Peak AM and Peak PM times.

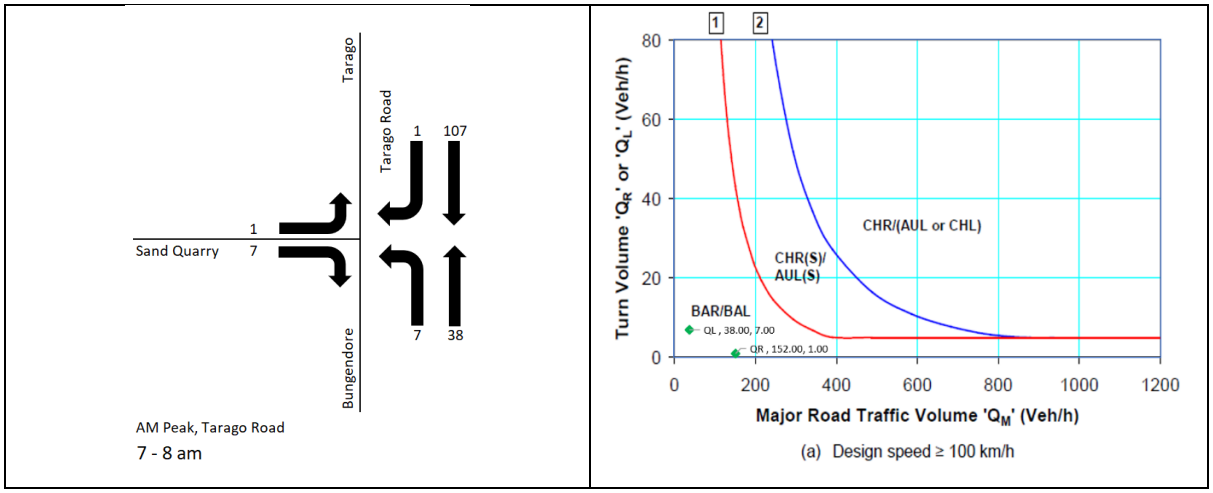


Figure 8 - Peak AM Hour Flows (2019)

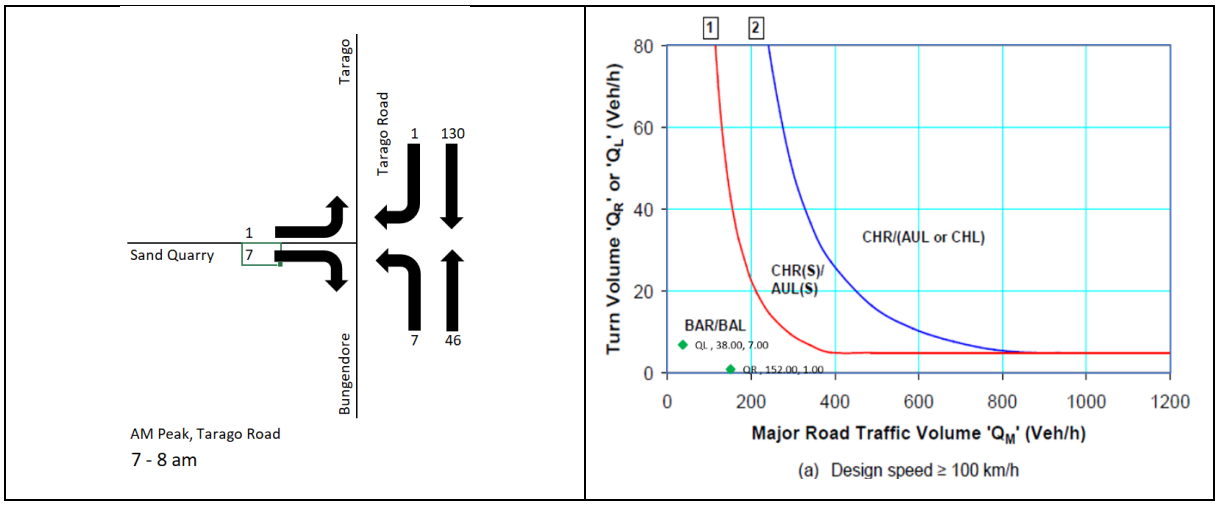


Figure 9 - Peak AM Hour Flows (2029)

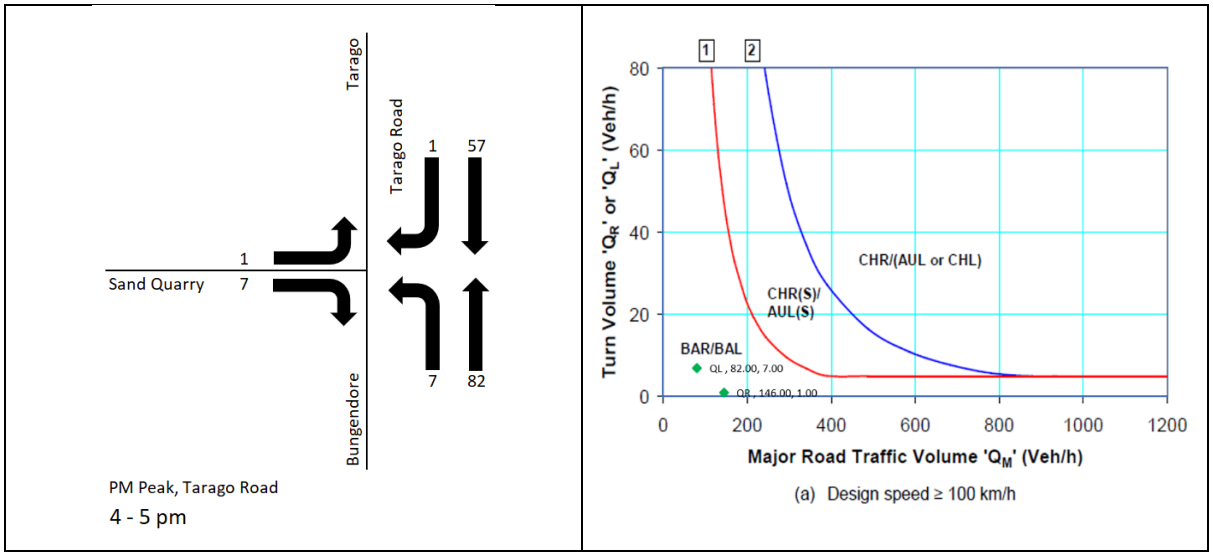


Figure 10 - Peak AM Hour Flows (2029)

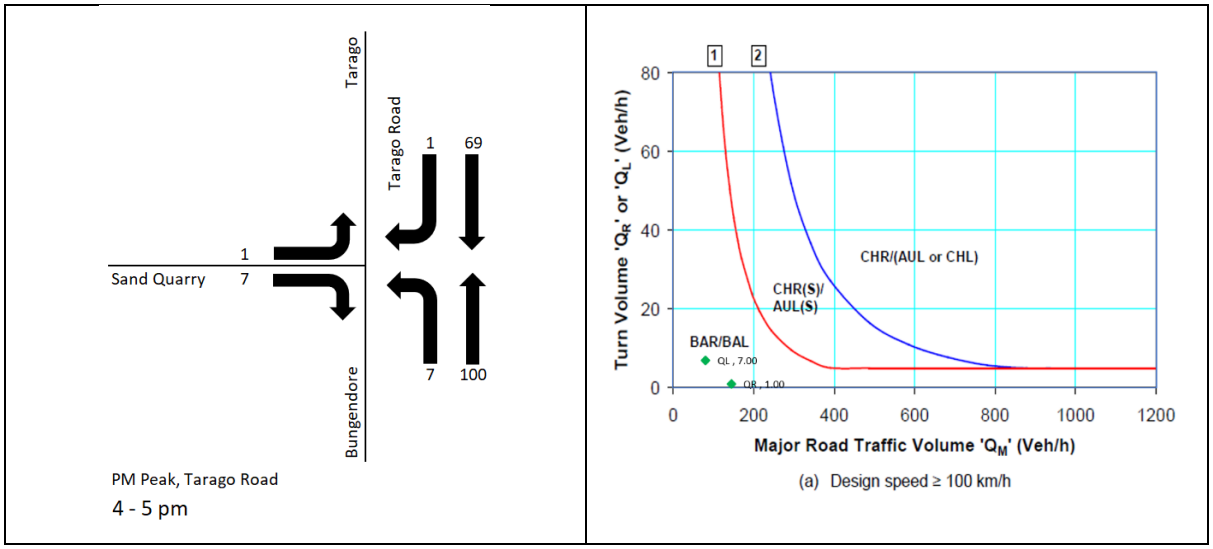


Figure 11 - Peak PM Hour Flows (2029)

The resultant warrant for turn treatments is that the Quarry access requires shoulder widening on Tarago Road to provide Basic Left (BAL) and Basic Right (BAR) turn treatments.

With regard to the provision of auxiliary lanes such as an acceleration lane for HVs entering Tarago Road, given the relatively low traffic volumes there are sufficient gaps and sight distance for HVs to enter Tarago Road safely. Therefore, provision of an acceleration lane is considered to be unnecessary.

5.2.3 Kings Highway Intersection (Molonglo Street and Malbon Street intersection)

As described in **Section 2.3.2**, the intersection of Molonglo Street and Malbon Street has a T-junction configuration within an urban road formation. There is a widened shoulder adjacent to the northbound lane that could be described as an informal Basic Right (BAR) turn lane however, this is diminished somewhat due to the adjacent property accesses and given there are no on street parking restrictions in place.

With reference to **Section 3.3**, 95% of the Quarry related traffic enters the intersection from the north with 10% then turning left into Malbon Street (as advised by the Proponent) and the remaining 85% continuing south. As a result, Quarry related traffic only undertakes the following turning movements at the intersection:

- Left turn from Molonglo Street into Malbon Street; and
- Right turn from Malbon Street into Molonglo Street.

5.2.3.1 Intersection Capacity Analysis

The Kings Highway intersection was modelled using an intersection performance simulation software namely, SIDRA Intersection 8 modelling software. SIDRA simulates the performance of each intersection based upon the traffic volumes of each turning movement, approach speed limits and geometric properties of the intersection. The performance of the intersection is summarised by four performance indicators:

- Level of Service (LoS);
- Degree of Saturation (DoS);
- Queue length; and
- Average delay per vehicle.

LoS is a qualitative measure describing operational conditions within a traffic stream and takes into account service measures such as speed and travel time, freedom to manoeuvre, traffic interruptions, safety, comfort and convenience. LoS is directly related to the delays experienced by traffic using the intersection and ranges between LoS A and LoS F. LoS A indicates the intersection is operating with spare capacity, LoS E indicates the intersection is operating above capacity, with LoS D considered to be the long term desirable LoS for an intersection.

Table 17 indicates the LoS criteria for intersections as defined in the RMS Guide for Traffic Generating Developments and these criteria have been used in the SIDRA modelling software.

Table 17 - Level of Service (LoS) Criteria

LoS	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way and Stop Sign
A	< 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 roundabouts: require other control mode	At capacity, requires other mode of control

Source: RMS Guide to Traffic Generating Developments

DoS is defined as the ratio of demand flow to capacity. As it approaches 1, extensive delays and queues would be expected. For a satisfactory situation, the DoS should be less than the nominated practical degree of saturation, usually 0.9.

Queue length is the number of vehicles waiting at the hold line and is usually quoted as the 95th percentile back of the queue, which is the value below which 95% of all observed queue lengths fall.

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from the stop, as well as delays experienced by all vehicles negotiating the intersection. At sign controlled intersections the average delay for the worst movement is reported.

Given the nature of the available traffic data (i.e.: lane volumes), the following assumptions have been used to calculate the turn volumes for the SIDRA analysis:

- For the Peak AM hour (7-8 AM) – assumption is that that 80% of traffic coming from the northern leg of the intersection are commuting south towards Canberra.
- For the Peak PM hour (5-6 PM) – assumption is that 55% of the traffic arriving from the south leg (Canberra) continuing north.

The analysis was completed for the 2019 Background Traffic and 2029 Forecast Traffic using the peak flow traffic data from **Table 10.**

The performance of the Kings Highway intersection is summarised in **Table 18** for the 2019 Background Traffic and **Table 19** for the 2029 Forecast Traffic**.** Detailed SIDRA outputs for the intersection are provided in **Appendix 1 and Appendix 2.**

Table 18 - SIDRA Analysis for All Vehicles (2019 Background Traffic)

Peak Hour	DoS	Delays (Sec)	LoS	Queue (m)
7:00am to 8:00am	0.25	3.0	A	8.0
5:00pm to 6:00pm	0.37	3.8	A	15.7

Table 19 - SIDRA Analysis for All Vehicles (2029 Forecast Traffic)

Peak Hour	DoS	Delays (Sec)	LoS	Queue (m)
7:00am to 8:00am	0.34	3.4	A	12.3
5:00pm to 6:00pm	0.46	4.4	A	27.6

SIDRA analysis results show that the intersection operates at LoS A at all times. LoS A represents the minimal delay condition and that the intersection is operating well below capacity. Therefore no additional improvements to the Kings Highway intersection due to the Proposal are warranted.

5.3 Impact on School Bus Services

As described in **Section 3.6**, there are three school bus services that operate along the transport route. As this Proposal is not adding any additional traffic, it is considered that the Proposal will not impact upon these existing school bus services.

5.4 Impact on Public Transport

As described in **Section 3.7**, there are public bus services that operate along part of the transportation route as well as train services that utilise the rail level crossing on the Kings Highway (east/west). As this Proposal is not adding any additional traffic, it is considered that the Proposal will not impact upon these existing public bus and train services.

5.5 Impact on Pedestrians and Cyclists

As described in **Section 3.7**, there is pedestrian and cycling activity along the transport route. As this Proposal is not adding any additional traffic, it is considered that the Proposal will not increase the impact on pedestrians and cyclists.

5.6 Impact on Road Safety

Whilst a road safety audit was not included as part of this TTA, from observations during the site inspection, no major road safety deficiencies were identified along the transportation route.

5.7 Assessment of Traffic Noise

No formal assessment of traffic noise was completed as part of the TTA. As this Proposal is not adding any additional traffic, it is considered that the Proposal will not result in increased traffic noise beyond existing levels.

5.8 Cumulative Traffic Impacts

As this Proposal is not adding any additional traffic, the cumulative impact with other potential developments likely to affect the roads considered in this report will be negligible.

5.9 Drivers and Haulage Vehicles

A Drivers Code of Conduct should be developed to reflect the Quarry operations. As a minimum the following should be encompassed:

- Vehicle checking and maintenance procedures.
- Vehicle operational requirements (e.g.: covered loads)
- School bus routes and pick up and drop off locations.
- Applicable chain of responsibility requirements.

The drivers of the haulage vehicles need to be suitably qualified and suitably experienced. Records pertaining to these requirements need to be kept. The Drivers Code of Conduct should clearly outline the expectations of the haulage vehicle drivers, their responsibility whilst operating the haulage vehicles and the consequences of not adhering to a suitable code of conduct.

The above measures should be incorporated into a system of auditable procedures, inspections and records which can be used to validate compliance with the Driver's Code of Conduct and inspection regimes.

It would also be considered advantageous for the Quarry operator to develop an Operations Traffic Management Plan encompassing the aspects discussed in this section to ensure an integrated approach is taken to address the risks associated with the haulage operations.

5.10 Road Maintenance

Maintenance of roads associated with the transportation route would be an ongoing requirement of QPRC and RMS as the respective road authorities. Development Consent DA52/74 includes a condition regarding road maintenance contributions and DA104/92 includes a condition regarding the payment of Section 94 contributions. It is considered that Section 94 contributions based on the appropriate current Section 94 plan of QPRC would be applicable to the Proposal.

6 Conclusion

Matters relating to traffic and transport for the Proposal have been addressed in this report with the transportation route comprising of the following:

- Tarago Road from the Quarry access to the bridge over Turallo Creek;
- Molonglo Street from the bridge over Turallo Creek to Malbon Street (Kings Highway);
- Malbon Street / Kings Highway (east/west) from Molonglo Street to the Bungendore town limits (east); and
- Kings Highway (north/south) from Malbon Street to the Bungendore town limits (south).

The Proposal generally reflects a continuance of the current Quarry operation based on an increase in maximum production to 400,000tpa. In order to meet future demand, no increase in current Quarry haulage vehicles will be required due to the proposed use of haulage vehicle configurations with increased capacity up to 38t which is up from the existing 33t capacity of the current haulage vehicles in use.

The analysis and discussions presented in this report are summarised as follows:

- As the Proposal is not adding any additional traffic, the Proposal does not:
  - impact on the existing capacity of any of the roads along the transportation route.
  - warrant any road upgrades along the transport route.
  - warrant any upgrade of the Kings Highway intersection based on the outcomes of the SIDRA intersection capacity analysis.
  - adversely impact on road safety along the transportation route.
  - adversely impact on the school bus services and public transport bus and rail services.
  - adversely impact on pedestrian and cyclists.
  - increase traffic noise beyond existing levels.
- Based on the analysis of available traffic data and current Austroads Guides, the following roadworks are recommended for the Tarago Road and Quarry access intersection:
  - Provision of shoulder widening on Tarago Road to provide a Basic Right (BAR) and Basic Left (BAL) rural turn treatments.
- Provision of a Driver Code of Conduct and Operations Traffic Management Plan is considered desirable to ensure an integrated approach is taken to address the risks associated with the haulage operations.
- Provision of Section 94 contributions to QPRC to assist with funding required for the ongoing maintenance and rehabilitation of the transportation route.

It is concluded that subject to the recommendations outlined above, there are no Quarry related traffic and transport issues which would prevent the Proposal from proceeding.

7 References

RTA Publication (2002), 'Guide to Traffic Generating Developments'

Austroads (2017), 'Guide to Road Design – Part 3 Geometric Design'

Austroads (2017), 'Guide to Road Design – Part 4 Intersections and Crossings – General'

Austroads (2017), 'Guide to Road Design – Part 4A Unsignalised and Signalised Intersections'

Australian Standard AS 1742.2, 'Manual of uniform traffic control devices Part 2: Traffic control devices for general use'.

RMS Australian Standard Supplements (July 2013), 'Australian Standard AS 1742 – Manual of uniform traffic control devices Parts 1 to 15'

Appendix 1: SIDRA Outputs (2019 Background Traffic)

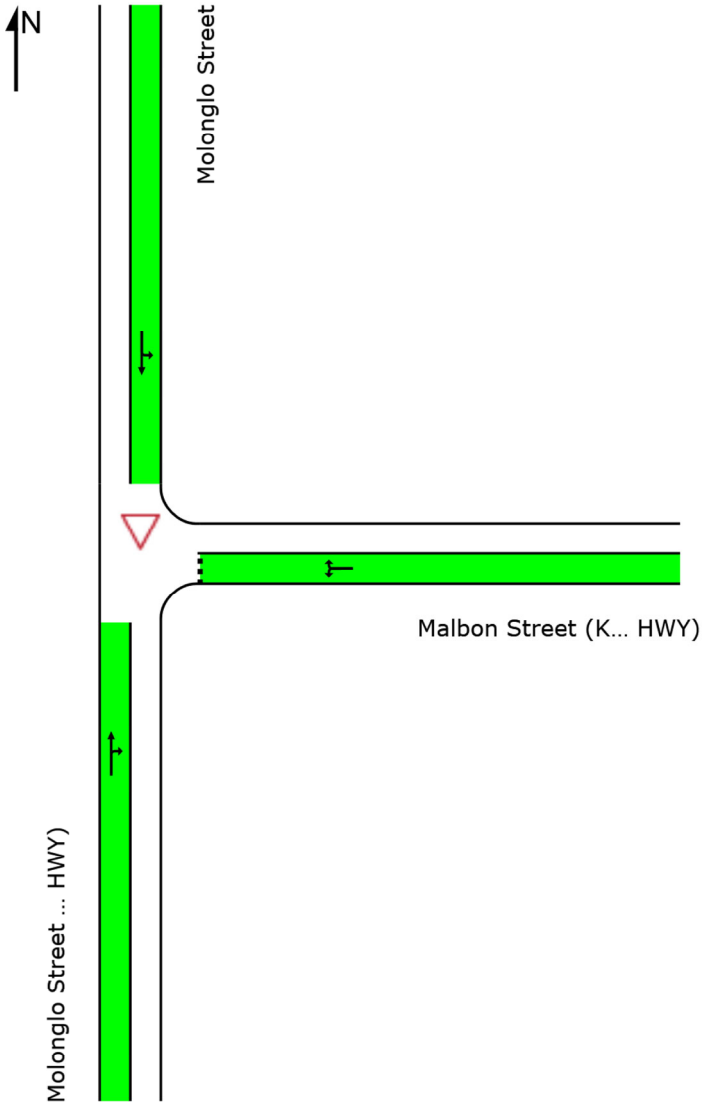
DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

	Approaches			Intersection
	South	East	North	
Degree of Saturation	0.09	0.25	0.22	0.25



Colour code based on Degree of Saturation

[< 0.6] [0.6 – 0.7] [0.7 – 0.8] [0.8 – 0.9] [0.9 – 1.0] [> 1.0]

Sidra\bungendore_sand_quarry_2020.sip8

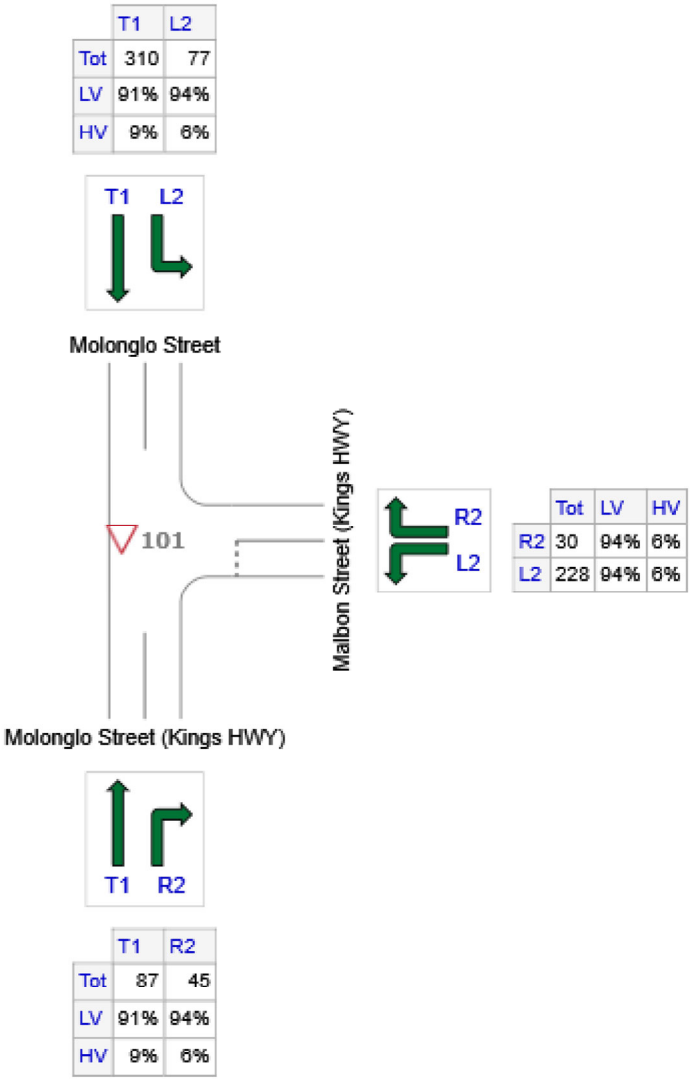
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Molonglo Street (Kings HWY)	132	121	11
E: Malbon Street (Kings HWY)	258	243	15
N: Molonglo Street	387	354	33
Total	777	718	59

INTERSECTION SUMMARY

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	44.6	km/h	44.6	km/h
Travel Distance (Total)	337.4	veh-km/h	404.9	pers-km/h
Travel Time (Total)	7.6	veh-h/h	9.1	pers-h/h
Demand Flows (Total)	818	veh/h	981	pers/h
Percent Heavy Vehicles (Demand)	7.5	%		
Degree of Saturation	0.252			
Practical Spare Capacity	217.9	%		
Effective Intersection Capacity	3251	veh/h		
Control Delay (Total)	0.69	veh-h/h	0.83	pers-h/h
Control Delay (Average)	3.0	sec	3.0	sec
Control Delay (Worst Lane)	6.3	sec		
Control Delay (Worst Movement)	7.7	sec	7.7	sec
Geometric Delay (Average)	2.3	sec		
Stop-Line Delay (Average)	0.8	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	1.1	veh		
95% Back of Queue - Distance (Worst Lane)	8.0	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	252	veh/h	303	pers/h
Effective Stop Rate	0.31		0.31	
Proportion Queued	0.21		0.21	
Performance Index	11.2		11.2	
Cost (Total)	219.83	$/h	219.83	$/h
Fuel Consumption (Total)	36.1	L/h		
Carbon Dioxide (Total)	86.5	kg/h		
Hydrocarbons (Total)	0.006	kg/h		
Carbon Monoxide (Total)	0.072	kg/h		
NOx (Total)	0.222	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 40.0% 17.5% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	392,590	veh/y	471,107	pers/y
Delay	332	veh-h/y	398	pers-h/y
Effective Stops	121,112	veh/y	145,335	pers/y
Travel Distance	161,945	veh-km/y	194,334	pers-km/y
Travel Time	3,631	veh-h/y	4,357	pers-h/y
Cost	105,520	$/y	105,520	$/y
Fuel Consumption	17,350	L/y		

Carbon Dioxide	41,506	kg/y
Hydrocarbons	3	kg/y
Carbon Monoxide	34	kg/y
NOx	106	kg/y

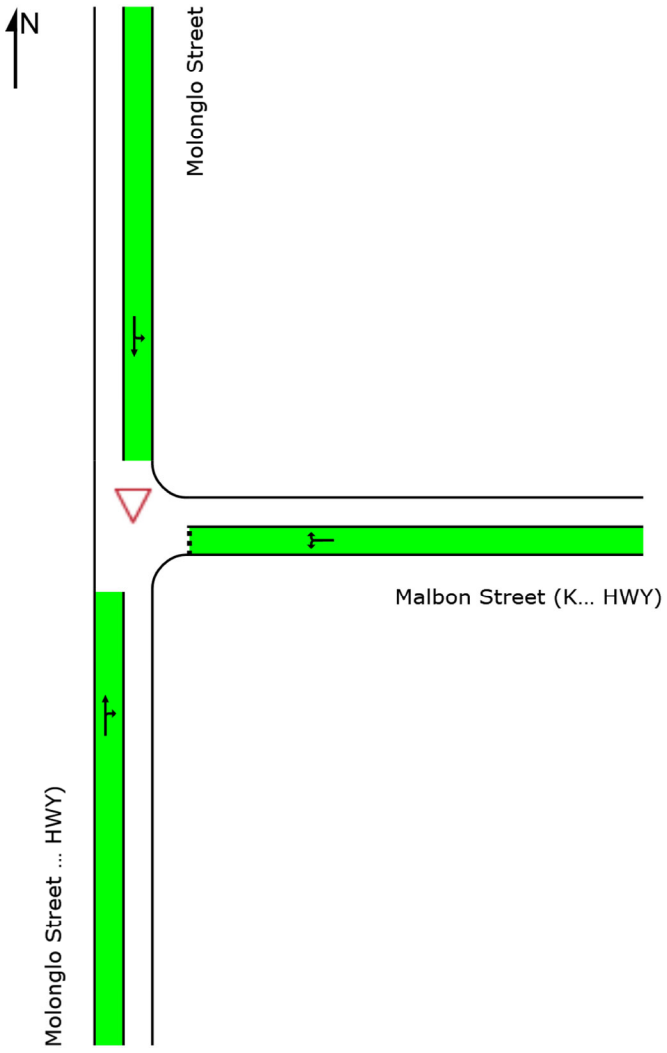
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

	Approaches			Intersection
	South	East	North	
LOS	NA	A	NA	NA



Colour code based on Level of Service

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

LANE SUMMARY

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Molonglo Street (Kings HWY)													
Lane 1	139	8.0	1518	0.092	100	2.8	LOS A	0.4	2.9	Full	200	0.0	0.0
Approach	139	8.0		0.092		2.8	NA	0.4	2.9				
East: Malbon Street (Kings HWY)													
Lane 1	272	6.0	1079	0.252	100	6.3	LOS A	1.1	8.0	Full	200	0.0	0.0
Approach	272	6.0		0.252		6.3	LOS A	1.1	8.0				
North: Molonglo Street													
Lane 1	407	8.4	1849	0.220	100	0.9	LOS A	0.0	0.0	Full	200	0.0	0.0
Approach	407	8.4		0.220		0.9	NA	0.0	0.0				
Intersection	818	7.5		0.252		3.0	NA	1.1	8.0				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Molonglo Street (Kings HWY)												
2	T1	92	9.0	0.092	1.0	LOS A	0.4	2.9	0.35	0.22	0.35	45.4
3	R2	47	6.0	0.092	6.4	LOS A	0.4	2.9	0.35	0.22	0.35	43.4
Approach		139	8.0	0.092	2.8	NA	0.4	2.9	0.35	0.22	0.35	44.7
East: Malbon Street (Kings HWY)												
4	L2	240	6.0	0.252	6.1	LOS A	1.1	8.0	0.45	0.66	0.45	40.2
6	R2	32	6.0	0.252	7.7	LOS A	1.1	8.0	0.45	0.66	0.45	39.5
Approach		272	6.0	0.252	6.3	LOS A	1.1	8.0	0.45	0.66	0.45	40.1
North: Molonglo Street												
7	L2	81	6.0	0.220	4.6	LOS A	0.0	0.0	0.00	0.11	0.00	47.1
8	T1	326	9.0	0.220	0.0	LOS A	0.0	0.0	0.00	0.11	0.00	48.4
Approach		407	8.4	0.220	0.9	NA	0.0	0.0	0.00	0.11	0.00	48.2
All Vehicles		818	7.5	0.252	3.0	NA	1.1	8.0	0.21	0.31	0.21	44.6

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

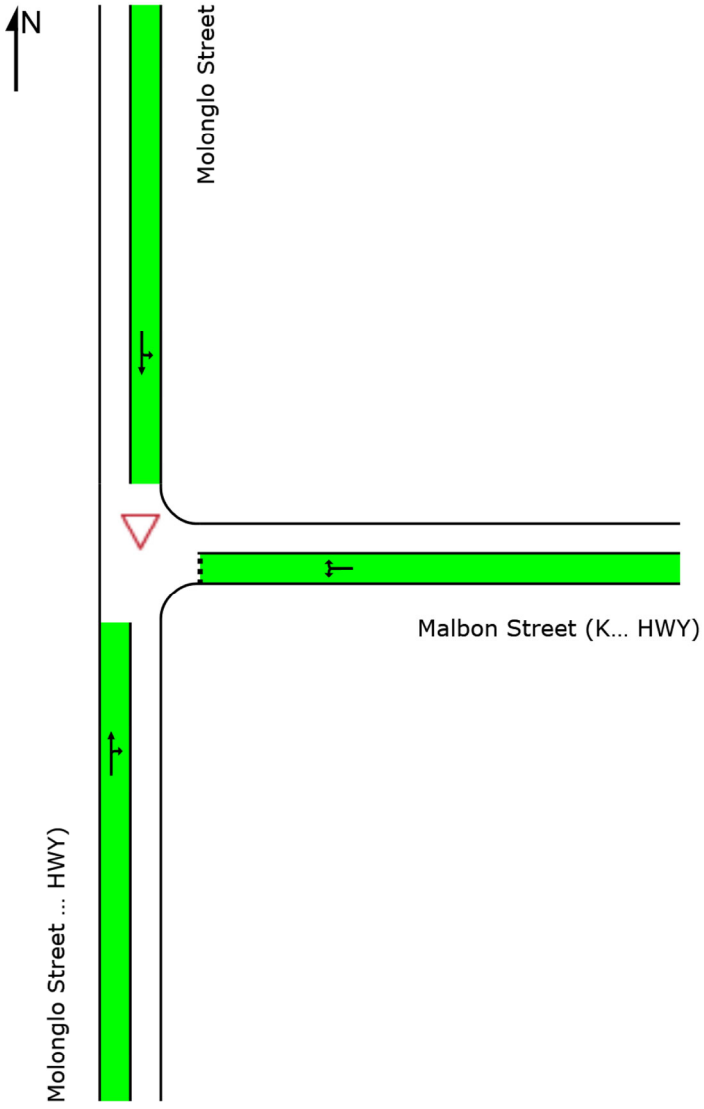
DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

	Approaches			Intersection
	South	East	North	
Degree of Saturation	0.37	0.20	0.13	0.37



Colour code based on Degree of Saturation

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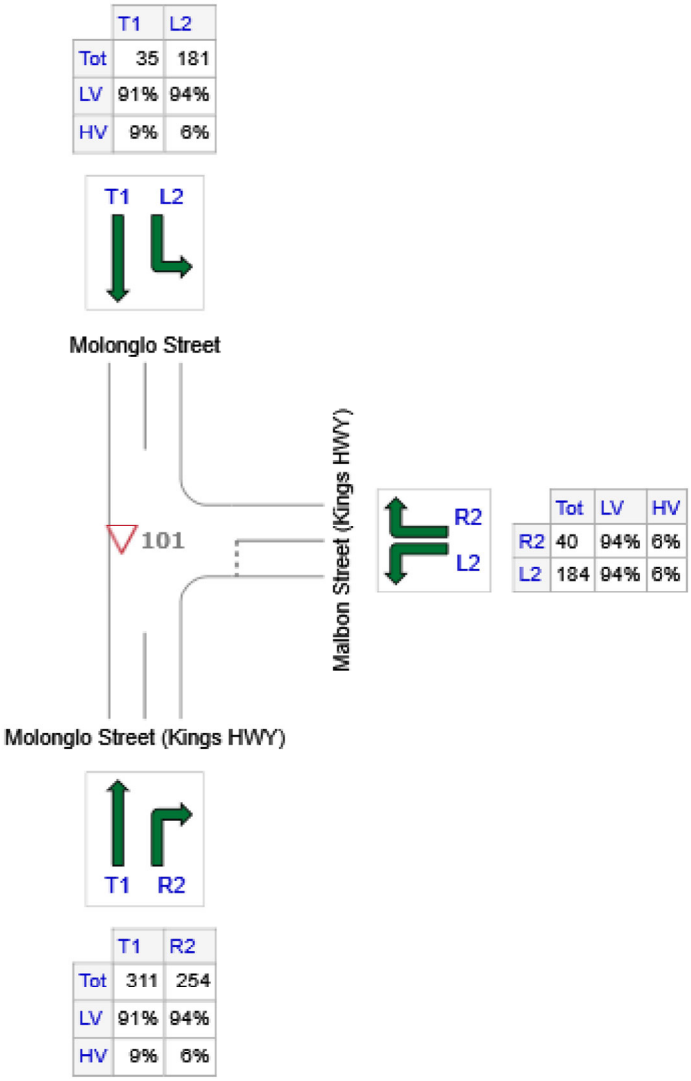
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Molonglo Street (Kings HWY)	565	522	43
E: Malbon Street (Kings HWY)	224	211	13
N: Molonglo Street	216	202	14
Total	1005	934	71

INTERSECTION SUMMARY

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	43.0	km/h	43.0	km/h
Travel Distance (Total)	436.4	veh-km/h	523.6	pers-km/h
Travel Time (Total)	10.2	veh-h/h	12.2	pers-h/h
Demand Flows (Total)	1058	veh/h	1269	pers/h
Percent Heavy Vehicles (Demand)	7.0	%		
Degree of Saturation	0.369			
Practical Spare Capacity	165.4	%		
Effective Intersection Capacity	2865	veh/h		
Control Delay (Total)	1.13	veh-h/h	1.35	pers-h/h
Control Delay (Average)	3.8	sec	3.8	sec
Control Delay (Worst Lane)	5.7	sec		
Control Delay (Worst Movement)	10.1	sec	10.1	sec
Geometric Delay (Average)	3.0	sec		
Stop-Line Delay (Average)	0.8	sec		
Idling Time (Average)	0.2	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	2.1	veh		
95% Back of Queue - Distance (Worst Lane)	15.7	m		
Queue Storage Ratio (Worst Lane)	0.03			
Total Effective Stops	388	veh/h	465	pers/h
Effective Stop Rate	0.37		0.37	
Proportion Queued	0.23		0.23	
Performance Index	16.8		16.8	
Cost (Total)	322.07	$/h	322.07	$/h
Fuel Consumption (Total)	52.4	L/h		
Carbon Dioxide (Total)	125.1	kg/h		
Hydrocarbons (Total)	0.010	kg/h		
Carbon Monoxide (Total)	0.105	kg/h		
NOx (Total)	0.333	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 35.6% 12.1% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	507,789	veh/y	609,347	pers/y
Delay	541	veh-h/y	649	pers-h/y
Effective Stops	186,082	veh/y	223,298	pers/y
Travel Distance	209,451	veh-km/y	251,341	pers-km/y
Travel Time	4,872	veh-h/y	5,847	pers-h/y
Cost	154,592	$/y	154,592	$/y
Fuel Consumption	25,141	L/y		

Carbon Dioxide	60,034	kg/y
Hydrocarbons	5	kg/y
Carbon Monoxide	50	kg/y
NOx	160	kg/y

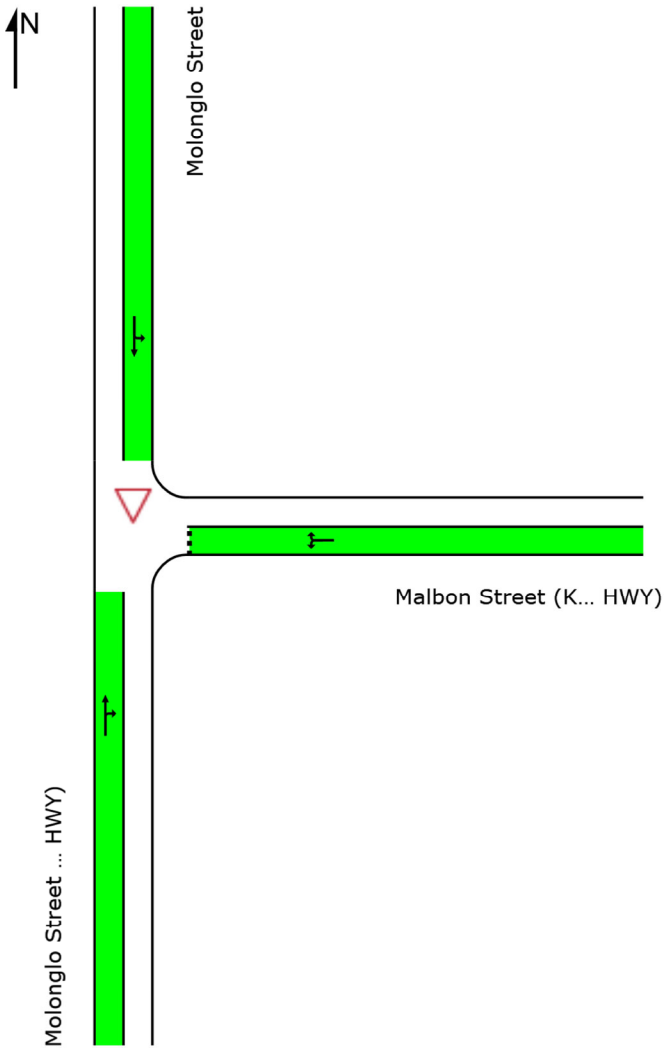
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

	Approaches			Intersection
	South	East	North	
LOS	NA	A	NA	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Organisation: CONSTRUCTIVE SOLUTIONS PTY LTD | Processed: Monday, 20 January 2020 10:13:31 PM
Project: C:\Users\jerome\Dropbox (CSPL)\CSPL Projects\2019103 - RWC - Bungendore Sand Quarry Expansion TIA\3. Working Documents\5. Sidra\bungendore_sand_quarry_2020.sip8

LANE SUMMARY

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Molonglo Street (Kings HWY)													
Lane 1	595	7.7	1610	0.369	100	3.1	LOS A	2.1	15.7	Full	200	0.0	0.0
Approach	595	7.7		0.369		3.1	NA	2.1	15.7				
East: Malbon Street (Kings HWY)													
Lane 1	236	6.0	1160	0.203	100	5.7	LOS A	0.8	6.2	Full	200	0.0	0.0
Approach	236	6.0		0.203		5.7	LOS A	0.8	6.2				
North: Molonglo Street													
Lane 1	227	6.5	1809	0.126	100	3.9	LOS A	0.0	0.0	Full	200	0.0	0.0
Approach	227	6.5		0.126		3.9	NA	0.0	0.0				
Intersection	1058	7.0		0.369		3.8	NA	2.1	15.7				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2019]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Molonglo Street (Kings HWY)												
2	T1	327	9.0	0.369	0.8	LOS A	2.1	15.7	0.37	0.27	0.37	44.6
3	R2	267	6.0	0.369	5.8	LOS A	2.1	15.7	0.37	0.27	0.37	42.7
Approach		595	7.7	0.369	3.1	NA	2.1	15.7	0.37	0.27	0.37	43.7
East: Malbon Street (Kings HWY)												
4	L2	194	6.0	0.203	4.7	LOS A	0.8	6.2	0.09	0.52	0.09	41.1
6	R2	42	6.0	0.203	10.1	LOS B	0.8	6.2	0.09	0.52	0.09	40.3
Approach		236	6.0	0.203	5.7	LOS A	0.8	6.2	0.09	0.52	0.09	40.9
North: Molonglo Street												
7	L2	191	6.0	0.126	4.6	LOS A	0.0	0.0	0.00	0.45	0.00	43.2
8	T1	37	9.0	0.126	0.0	LOS A	0.0	0.0	0.00	0.45	0.00	44.3
Approach		227	6.5	0.126	3.9	NA	0.0	0.0	0.00	0.45	0.00	43.4
All Vehicles		1058	7.0	0.369	3.8	NA	2.1	15.7	0.23	0.37	0.23	43.0

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

Appendix 2: SIDRA Outputs (2029 Forecast Traffic)

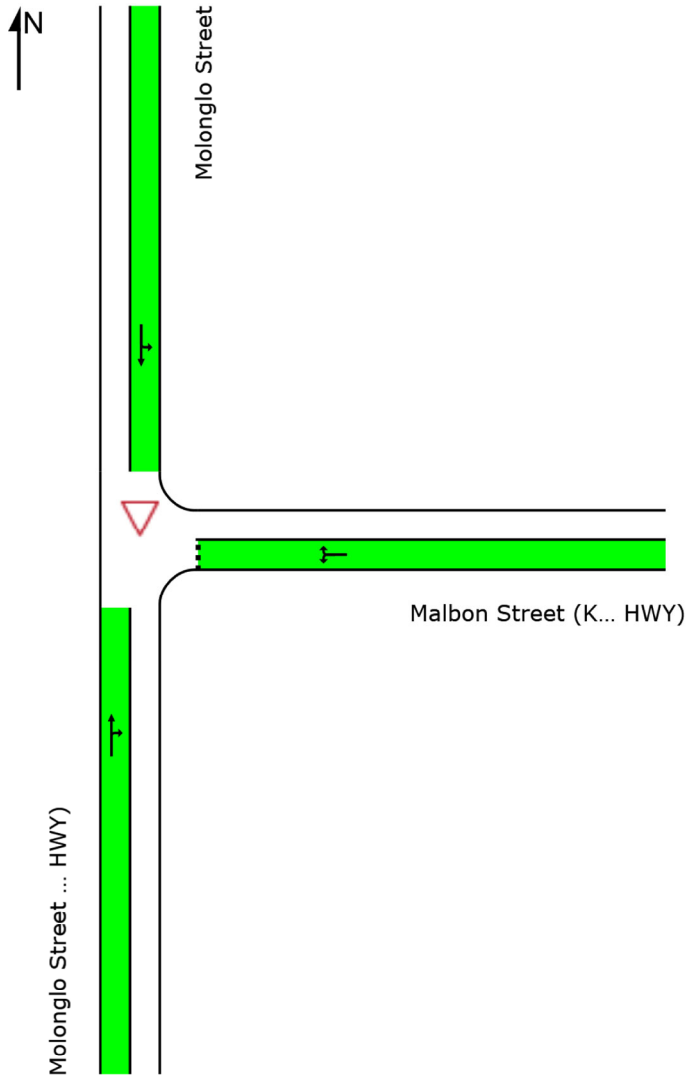
DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

	Approaches			Intersection
	South	East	North	
Degree of Saturation	0.12	0.34	0.27	0.34



Colour code based on Degree of Saturation

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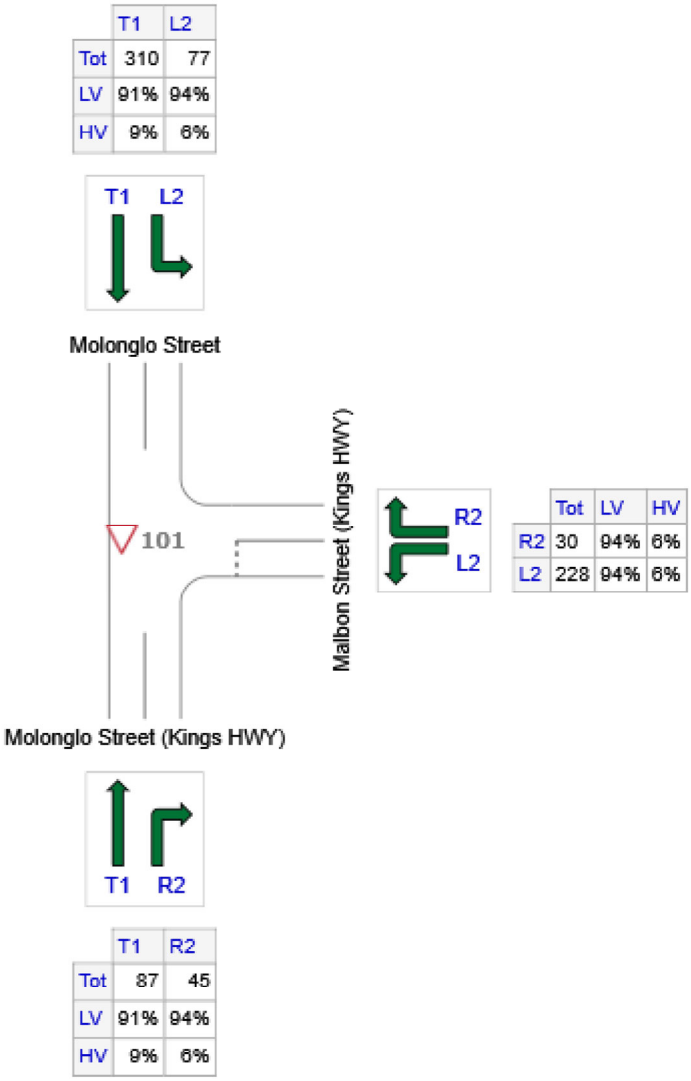
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Molonglo Street (Kings HWY)	132	121	11
E: Malbon Street (Kings HWY)	258	243	15
N: Molonglo Street	387	354	33
Total	777	718	59

INTERSECTION SUMMARY

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	44.2	km/h	44.2	km/h
Travel Distance (Total)	411.3	veh-km/h	493.5	pers-km/h
Travel Time (Total)	9.3	veh-h/h	11.2	pers-h/h
Demand Flows (Total)	997	veh/h	1196	pers/h
Percent Heavy Vehicles (Demand)	7.5	%		
Degree of Saturation	0.337			
Practical Spare Capacity	137.3	%		
Effective Intersection Capacity	2958	veh/h		
Control Delay (Total)	0.95	veh-h/h	1.14	pers-h/h
Control Delay (Average)	3.4	sec	3.4	sec
Control Delay (Worst Lane)	7.2	sec		
Control Delay (Worst Movement)	9.3	sec	9.3	sec
Geometric Delay (Average)	2.3	sec		
Stop-Line Delay (Average)	1.2	sec		
Idling Time (Average)	0.1	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	1.7	veh		
95% Back of Queue - Distance (Worst Lane)	12.3	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	341	veh/h	409	pers/h
Effective Stop Rate	0.34		0.34	
Proportion Queued	0.24		0.24	
Performance Index	14.6		14.6	
Cost (Total)	272.58	$/h	272.58	$/h
Fuel Consumption (Total)	44.5	L/h		
Carbon Dioxide (Total)	106.4	kg/h		
Hydrocarbons (Total)	0.008	kg/h		
Carbon Monoxide (Total)	0.089	kg/h		
NOx (Total)	0.273	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 45.4% 21.9% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	478,564	veh/y	574,277	pers/y
Delay	455	veh-h/y	546	pers-h/y
Effective Stops	163,790	veh/y	196,548	pers/y
Travel Distance	197,410	veh-km/y	236,892	pers-km/y
Travel Time	4,468	veh-h/y	5,361	pers-h/y
Cost	130,836	$/y	130,836	$/y

Fuel Consumption	21,356	L/y
Carbon Dioxide	51,086	kg/y
Hydrocarbons	4	kg/y
Carbon Monoxide	43	kg/y
NOx	131	kg/y

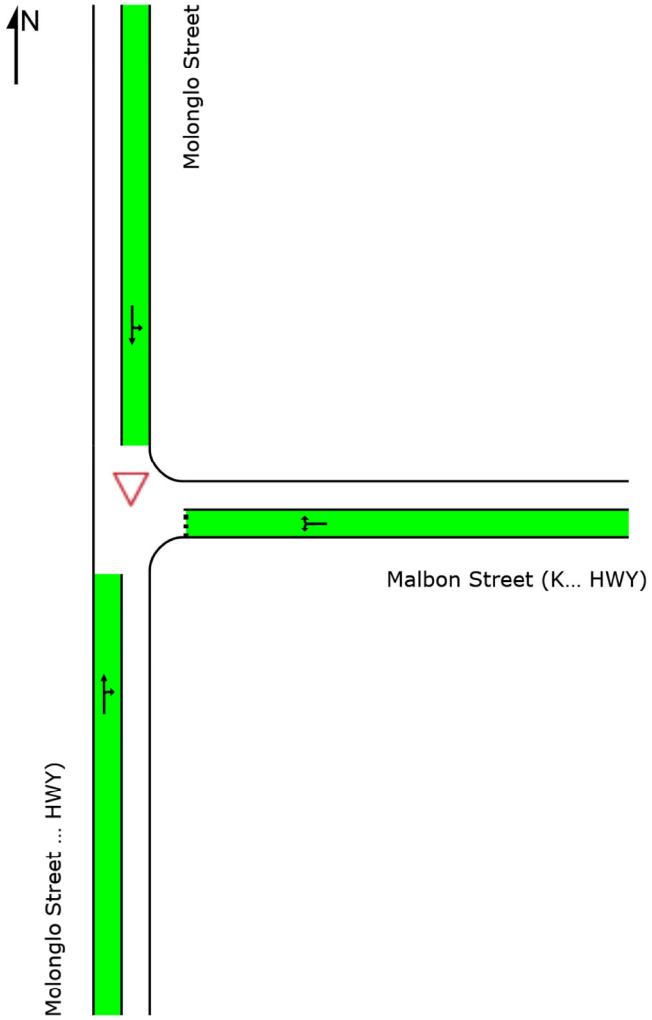
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

	Approaches			Intersection
	South	East	North	
LOS	NA	A	NA	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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Project: C:\Users\jerome\Dropbox (CSPL)\CSPL Projects\2019103 - RWC - Bungendore Sand Quarry Expansion TIA\3. Working Documents\5. Sidra\bungendore_sand_quarry_2020.sip8

LANE SUMMARY

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Molonglo Street (Kings HWY)													
Lane 1	169	8.0	1437	0.118	100	3.3	LOS A	0.5	4.0	Full	200	0.0	0.0
Approach	169	8.0		0.118		3.3	NA	0.5	4.0				
East: Malbon Street (Kings HWY)													
Lane 1	331	6.0	982	0.337	100	7.2	LOS A	1.7	12.3	Full	200	0.0	0.0
Approach	331	6.0		0.337		7.2	LOS A	1.7	12.3				
North: Molonglo Street													
Lane 1	497	8.4	1849	0.269	100	0.9	LOS A	0.0	0.0	Full	200	0.0	0.0
Approach	497	8.4		0.269		0.9	NA	0.0	0.0				
Intersection	997	7.5		0.337		3.4	NA	1.7	12.3				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Molonglo & Malbon St AM Peak 7-8 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Molonglo Street (Kings HWY)												
2	T1	112	9.0	0.118	1.4	LOS A	0.5	4.0	0.40	0.23	0.40	44.9
3	R2	58	6.0	0.118	7.0	LOS A	0.5	4.0	0.40	0.23	0.40	42.9
Approach		169	8.0	0.118	3.3	NA	0.5	4.0	0.40	0.23	0.40	44.2
East: Malbon Street (Kings HWY)												
4	L2	293	6.0	0.337	6.9	LOS A	1.7	12.3	0.53	0.75	0.59	39.4
6	R2	38	6.0	0.337	9.3	LOS A	1.7	12.3	0.53	0.75	0.59	38.7
Approach		331	6.0	0.337	7.2	LOS A	1.7	12.3	0.53	0.75	0.59	39.3
North: Molonglo Street												
7	L2	99	6.0	0.269	4.6	LOS A	0.0	0.0	0.00	0.11	0.00	47.1
8	T1	398	9.0	0.269	0.0	LOS A	0.0	0.0	0.00	0.11	0.00	48.4
Approach		497	8.4	0.269	0.9	NA	0.0	0.0	0.00	0.11	0.00	48.2
All Vehicles		997	7.5	0.337	3.4	NA	1.7	12.3	0.24	0.34	0.26	44.2

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

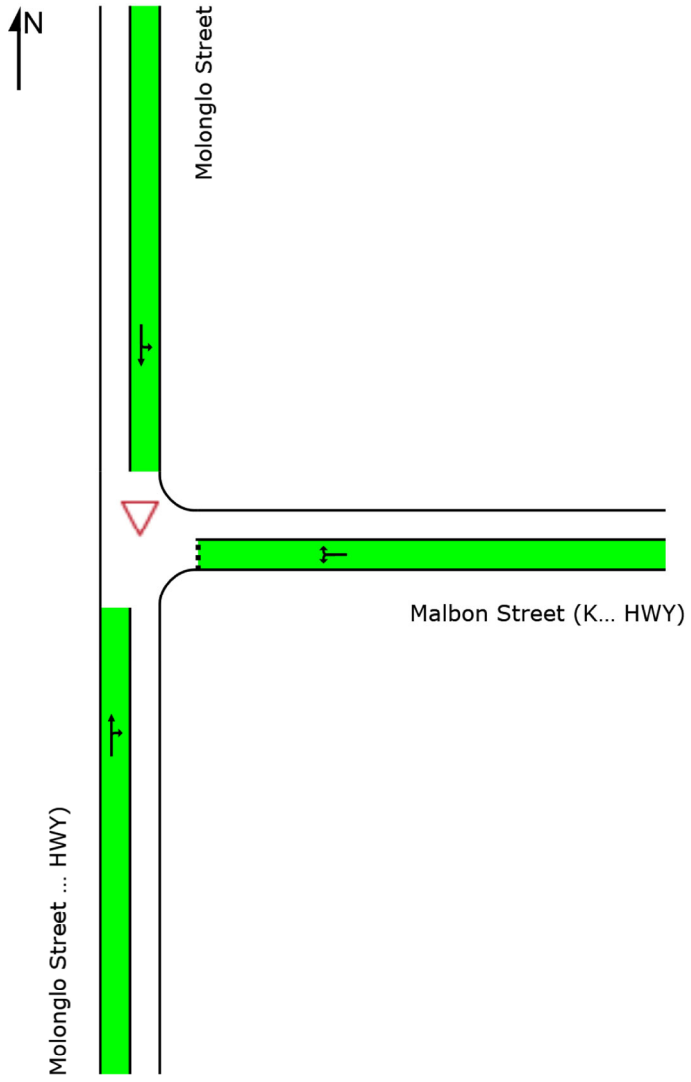
DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

	Approaches			Intersection
	South	East	North	
Degree of Saturation	0.46	0.28	0.15	0.46



Colour code based on Degree of Saturation

[< 0.6] [0.6 – 0.7] [0.7 – 0.8] [0.8 – 0.9] [0.9 – 1.0] [> 1.0]

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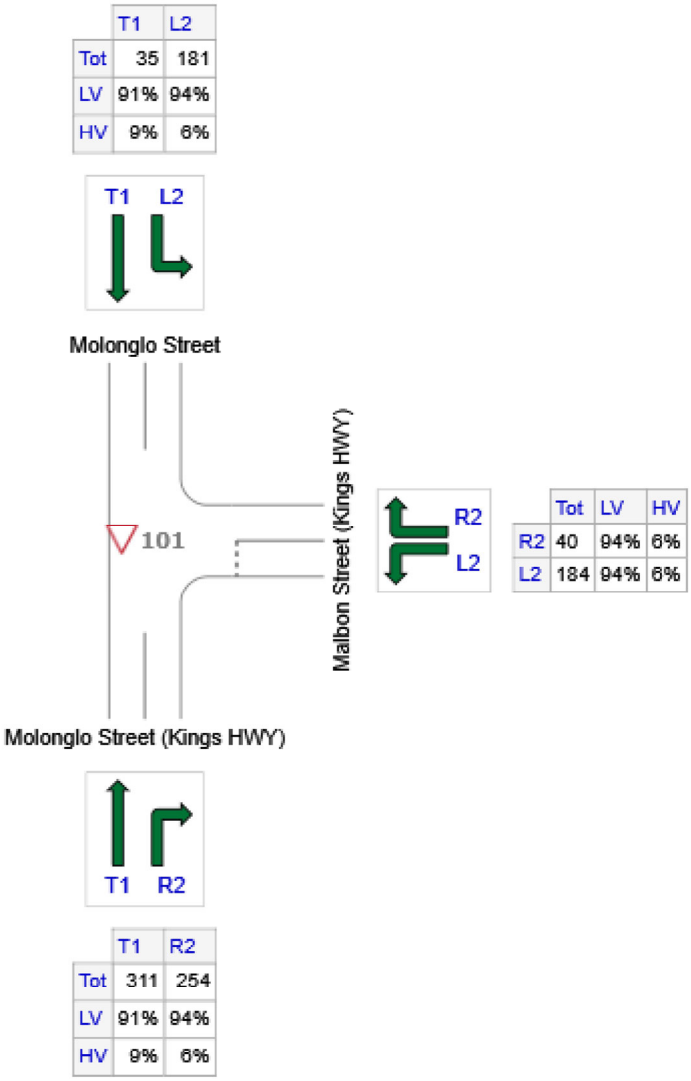
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Molonglo Street (Kings HWY)	565	522	43
E: Malbon Street (Kings HWY)	224	211	13
N: Molonglo Street	216	202	14
Total	1005	934	71

INTERSECTION SUMMARY

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	42.6	km/h	42.6	km/h
Travel Distance (Total)	531.9	veh-km/h	638.3	pers-km/h
Travel Time (Total)	12.5	veh-h/h	15.0	pers-h/h
Demand Flows (Total)	1290	veh/h	1547	pers/h
Percent Heavy Vehicles (Demand)	7.0	%		
Degree of Saturation	0.463			
Practical Spare Capacity	111.6	%		
Effective Intersection Capacity	2785	veh/h		
Control Delay (Total)	1.57	veh-h/h	1.88	pers-h/h
Control Delay (Average)	4.4	sec	4.4	sec
Control Delay (Worst Lane)	6.3	sec		
Control Delay (Worst Movement)	13.0	sec	13.0	sec
Geometric Delay (Average)	3.0	sec		
Stop-Line Delay (Average)	1.4	sec		
Idling Time (Average)	0.3	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	3.7	veh		
95% Back of Queue - Distance (Worst Lane)	27.6	m		
Queue Storage Ratio (Worst Lane)	0.06			
Total Effective Stops	501	veh/h	602	pers/h
Effective Stop Rate	0.39		0.39	
Proportion Queued	0.28		0.28	
Performance Index	22.8		22.8	
Cost (Total)	402.26	$/h	402.26	$/h
Fuel Consumption (Total)	65.1	L/h		
Carbon Dioxide (Total)	155.4	kg/h		
Hydrocarbons (Total)	0.012	kg/h		
Carbon Monoxide (Total)	0.130	kg/h		
NOx (Total)	0.418	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 42.2% 14.6% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	618,992	veh/y	742,791	pers/y
Delay	754	veh-h/y	905	pers-h/y
Effective Stops	240,608	veh/y	288,730	pers/y
Travel Distance	255,319	veh-km/y	306,383	pers-km/y
Travel Time	6,000	veh-h/y	7,199	pers-h/y
Cost	193,087	$/y	193,087	$/y

Fuel Consumption	31,239	L/y
Carbon Dioxide	74,587	kg/y
Hydrocarbons	6	kg/y
Carbon Monoxide	63	kg/y
NOx	200	kg/y

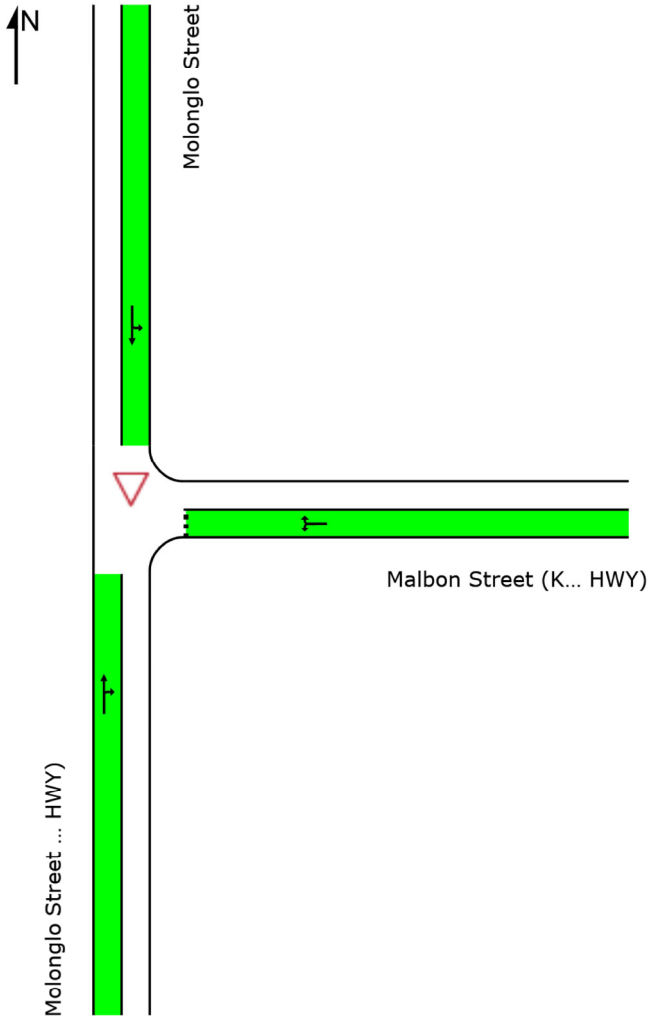
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

	Approaches			Intersection
	South	East	North	
LOS	NA	A	NA	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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LANE SUMMARY

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Molonglo Street (Kings HWY)													
Lane 1	725	7.7	1566	0.463	100	3.8	LOS A	3.7	27.6	Full	200	0.0	0.0
Approach	725	7.7		0.463		3.8	NA	3.7	27.6				
East: Malbon Street (Kings HWY)													
Lane 1	287	6.0	1039	0.277	100	6.3	LOS A	1.2	8.5	Full	200	0.0	0.0
Approach	287	6.0		0.277		6.3	LOS A	1.2	8.5				
North: Molonglo Street													
Lane 1	277	6.5	1809	0.153	100	3.9	LOS A	0.0	0.0	Full	200	0.0	0.0
Approach	277	6.5		0.153		3.9	NA	0.0	0.0				
Intersection	1290	7.0		0.463		4.4	NA	3.7	27.6				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Molonglo & Malbon St PM Peak 5-6 2029]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Molonglo Street (Kings HWY)												
2	T1	399	9.0	0.463	1.5	LOS A	3.7	27.6	0.46	0.31	0.53	44.1
3	R2	326	6.0	0.463	6.7	LOS A	3.7	27.6	0.46	0.31	0.53	42.2
Approach		725	7.7	0.463	3.8	NA	3.7	27.6	0.46	0.31	0.53	43.2
East: Malbon Street (Kings HWY)												
4	L2	236	6.0	0.277	4.8	LOS A	1.2	8.5	0.12	0.52	0.12	40.4
6	R2	51	6.0	0.277	13.0	LOS B	1.2	8.5	0.12	0.52	0.12	39.7
Approach		287	6.0	0.277	6.3	LOS A	1.2	8.5	0.12	0.52	0.12	40.3
North: Molonglo Street												
7	L2	232	6.0	0.153	4.6	LOS A	0.0	0.0	0.00	0.45	0.00	43.2
8	T1	45	9.0	0.153	0.0	LOS A	0.0	0.0	0.00	0.45	0.00	44.3
Approach		277	6.5	0.153	3.9	NA	0.0	0.0	0.00	0.45	0.00	43.4
All Vehicles		1290	7.0	0.463	4.4	NA	3.7	27.6	0.28	0.39	0.32	42.6

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

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