APPENDIX E – TRAFFIC IMPACT ASSESSMENT

Transport Impact Assessment

Project:	Proposed Clay and Sand Extraction Lots 5 and 6 Great Northern Highway Bullsbrook
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1. Introduction and Background

Shawmac has been engaged by Brikmakers to undertake a Transport Impact Assessment of the proposed clay and sand extraction operation on Lots 5 and 6 Great Northern Highway (GNH) in Bullsbrook (the site).

The assessment has been undertaken in accordance with the Western Australian Planning Commission's (WAPC) *Transport Impact Assessment Guidelines for Developments: Volume 4 – Individual Developments (2016)* and includes the following:

- Assessment of existing and future traffic generation from the site.
- Review of existing and forecast traffic flows on the surrounding road network.
- Assignment of predicted traffic flows onto the road network.
- Review of relevant crash history on the surrounding road network.
- Assessment of traffic impacts to the road network at mid-block locations and at intersections.

1.1. Site Location

The site is located approximately 29 kilometres north-east of Perth as shown in Figure 1. The site address is Lot 5 (No. 1728) and Lot 6 (No. 1748) GNH, Bullsbrook as shown in Figure 2. The site area is approximately 51.62 ha.

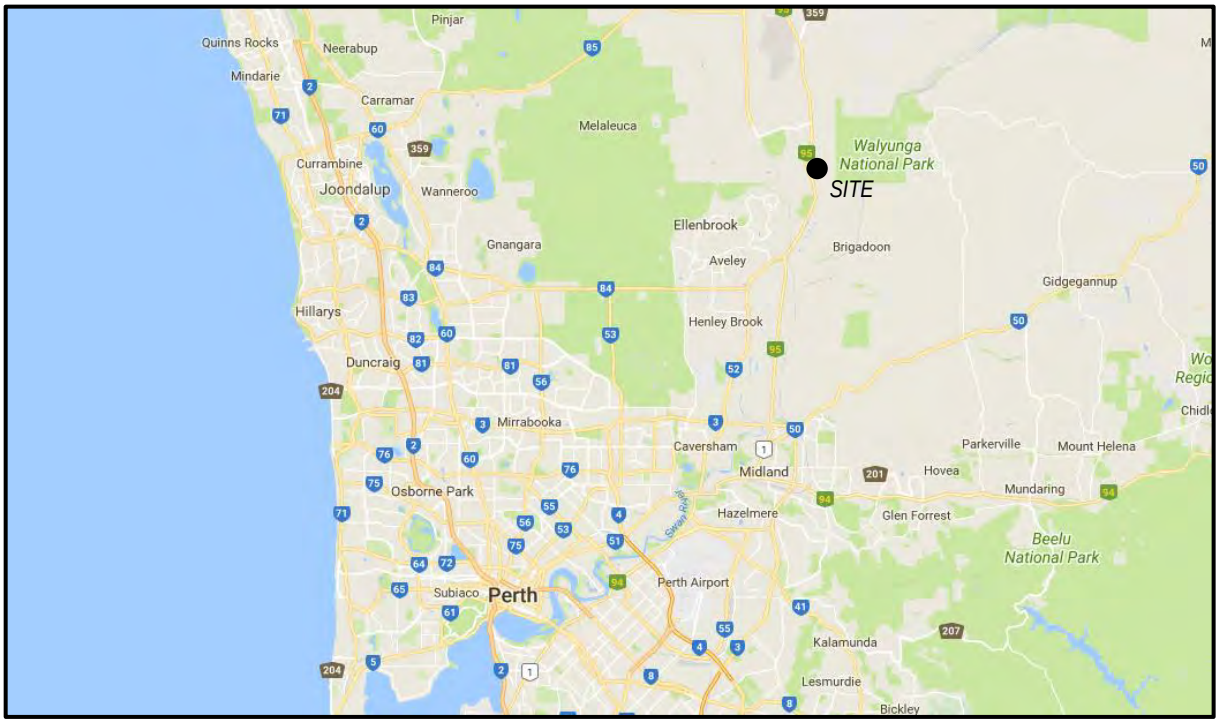


Figure 1: General Site Location

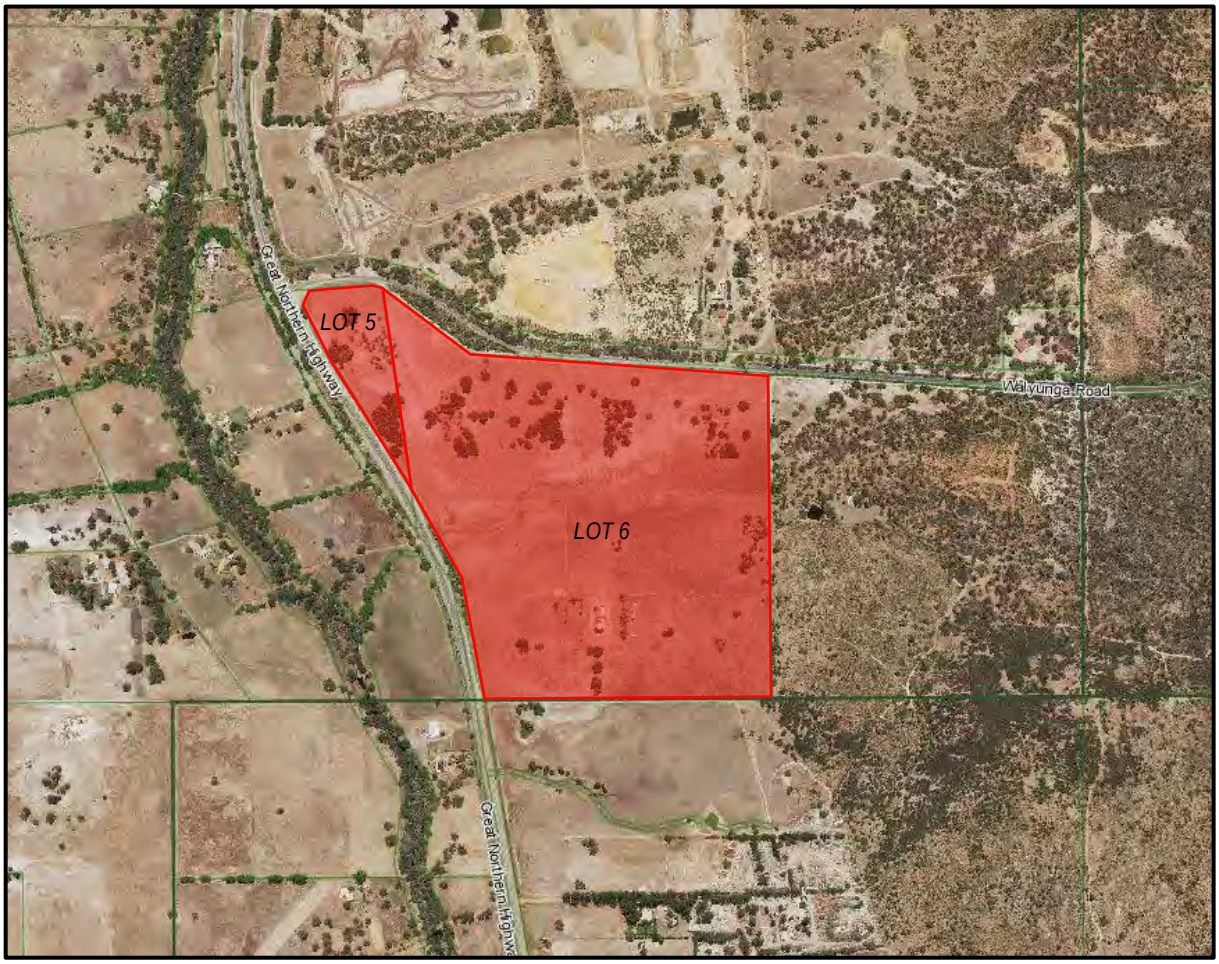


Figure 2: Lots 5 and 6 GNH, Bullsbrook

2. Existing Situation

2.1. Zoning

According to the City of Swan Local Planning Scheme No. 17 (LPS17), the site is zoned *Landscape*.

2.2. Land Use

The site has a dwelling and ancillary buildings in the southern half of Lot 6. The northern half is undeveloped and has trees scattered across the site.

2.3. Road Network

2.3.1. Roads

Walyunga Road runs generally in an east-west direction along the north boundary of the site from GNH to a point approximately 4.0 kilometres to the east. The road consists of a sealed pavement about 7.7 metres wide near the GNH intersection with 1.0 metre wide unsealed shoulders. Further east, the road width is about 7.4 metres with 1.0 metre shoulders. According to the Main Roads WA *Road Information Mapping System*, Walyunga Road is classified as an Access Road. Walyunga has an open speed limit up to 110km/h that applies outside built up areas.

Walyunga Road is part of the Restricted Access Vehicle (RAV) network allowing vehicles up to Category 4 Tandem Drive with a maximum concessional loading level 3 (Tandem Drive Network 4.3) and Category 1 Tri Drive with maximum concessional loading level 3 (Tri Drive Network 1.3). Conditions apply to Walyunga Road which requires permitted vehicles to carry and produce on demand a current written approval from the City of Swan permitting use of the road.

GNH runs generally north-south along the western boundary of the site. In the vicinity of the site, GNH is a sealed, two-lane, single carriageway road with approximately 3.5 metre wide traffic lanes and 1.0m wide sealed shoulders. GNH is classified as a Primary Distributor and is a state road under the control of Main Roads WA. GNH has a posted speed limit of 100 km/hr.

GNH is also part of the RAV network allowing vehicles up to Category 7 Tandem Drive with a maximum concessional loading Level 3 (Tandem Drive Network 7.3) and Category 4 Tri Drive with maximum concessional loading level 3 (Tri Drive Network 4.3).

2.3.2. Intersections

GNH intersects with Walyunga Road via a priority controlled (give-way) 'T' intersection as shown in Figure 3.

The intersection has been widened to include a channelised right turn lane from GNH and a left turn slip lane and acceleration lane for vehicles heading southbound from Walyunga Road.

Figure 3: GNH / Walyunga Road intersection

2.4. Traffic Volumes

The latest available traffic data for the adjacent road network was obtained from Main Roads WA and the City of Swan as summarised in Table 1. The detailed traffic counts are attached in Appendix A.

Table 1: Traffic Data

Road and Location	Average Weekday Traffic (vehicles per day)	Source	Date
GNH – North of Apple Street (2.8km south of Walyunga Road)	15,706 vpd (29.7% Heavy Vehicles)	Main Roads WA	February 2016
GNH – South of Bullsbrook Road (6.9km north of Walyunga Road)	14,370 vpd (23.0% Heavy Vehicles)	Main Roads WA	February 2016
Walyunga Road – east of GNH	495 vpd (62% Heavy Vehicles)	City of Swan	September 2015

3. Development Proposal

3.1. Land Use

The proposal involves the use of the site for clay and sand extraction. The material will then be transported to construction sites (sand) and brick making sites (clay) towards the south via GNH. The proposed hours of operations will be from 7am to 7pm Monday to Saturday.

3.2. Vehicle Access

Vehicular access to and from the site will be from Walyunga Road via a new crossover proposed directly opposite the existing access to the extraction site on the north side of Walyunga Road. The crossover location is shown in Figure 4.

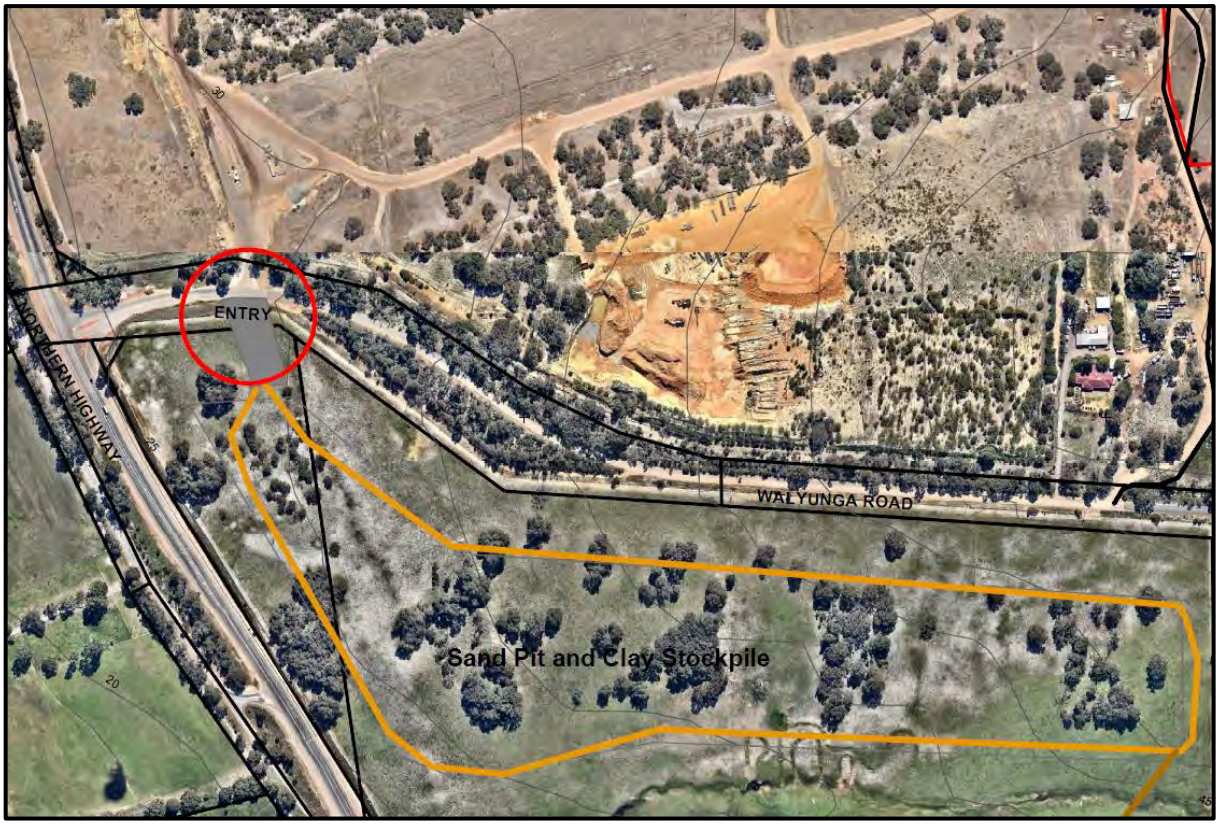


Figure 4: Proposed Site Access

3.3. Parking

No formalised parking is proposed on the site. A designated area will be set aside for staff parking.

4. Changes to Surrounding Transport Networks

4.1. Northlink WA

Northlink WA is a proposed major transport link between Morley and Muchea with the alignment of the central section passing to the west side of Ellenbrook. Northlink WA, as illustrated in Figure 5 will reduce traffic on GNH by shifting the majority (around 80%) of heavy vehicles over to the new route. Construction commenced in June 2016 and the completion is planned for late-2019.

As proposed operations from the subject site are likely to commence before Northlink is completed, this assessment has not assumed any reduction in traffic flows along GNH resulting from the completion of the Northlink connection.

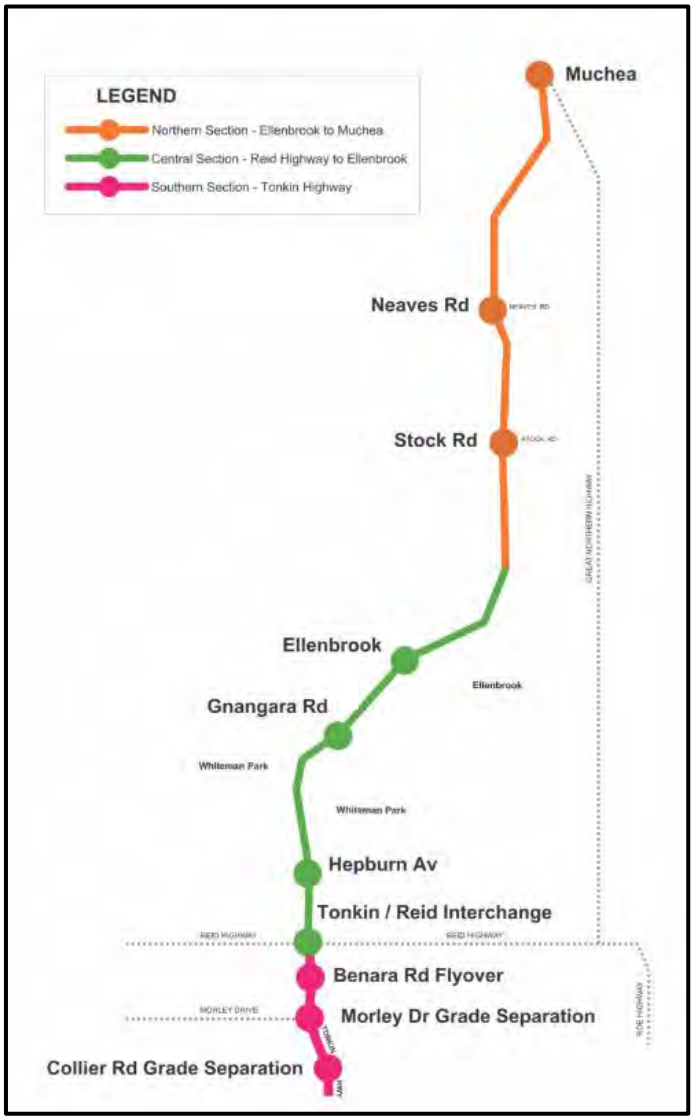


Figure 5: Northlink WA Alignment

5. Assessment Parameters

5.1. Assessment Years

The assessment has been based on current road network conditions.

5.2. Time Periods for Assessment

The time periods adopted for assessment are the morning and afternoon peak hours on the adjacent road network as these represent the worst conditions on the road network. Traffic data indicates that the morning peak hour is from 7 to 8 am and the afternoon peak hour is from 4 to 5 pm as indicated by the traffic data.

5.3. Other Haulage Activities

There are existing haulage activities at Walyunga Quarry (Lot 5 Walyunga Road) and the traffic impact of these activities are assessed by a separate transport impact assessment by Shawmac on 16th May 2016 which is attached in Appendix D.

According to the Transport Impact Assessment, the previously proposed clay and sand extraction in Walyunga Quarry generates 300 vehicles movements per day and 30 truck trips per hour. Other traffic from the adjacent quarry are assumed to be contained within City of Swan's most up-to-date traffic count (2015).

It should be noted that, apart from the above-mentioned activities, there were transport proposals to cart various aggregates from Walyunga Quarry to deliver to MRWA's Northlink Stage 2 Project (NLS2), however as advised by the client, these proposals did not proceed and will not be considered as a part of this assessment.

6. Development Generation and Distribution

6.1. Site Traffic Generation

Potential traffic flows from the site were calculated based on the extraction rate and cartage details as advised by the proponent.

6.1.1. Clay Trucks

Clay will be extracted during 1 to 2 month excavation campaigns approximately twice annually. The clay is stockpiled onsite for mixing and later cartage.

Cartage campaigns typically occur 2 to 3 days per month. The frequency will vary depending on market demand. An approximate maximum of 4,000 tonnes will be carted per day during cartage campaigns.

Clay will be carted using several truck and trailer combinations as shown in Table 2. The typical fleet breakdown and associated number of daily truck trips is also shown. The typical truck configurations are attached in Appendix B.

Table 2: Daily Transport Metrics for Clay Haulage

Vehicle Type	Payload (tonnes)	Number Running	Trips Per Day	Tonnes Carted	Total Trips
Truck and Dog Trailer	40	10	6	2,400	60
Pocket Road Train	50	2	5	500	10
Semi and Pig Trailer	38	5	6	1,140	30
Total				4,040	100

As above, the estimated number of clay truck trips is 100 trips (100 outbound movements and 100 inbound movements).

6.1.2. Sand Trucks

The sand will be carted throughout the year using Truck and Dog trailers with a 40 tonne payload. Based on a daily cartage of 2,000 tonnes, the number of truck trips is estimated to be 50 trips per day (50 outbound movements and 50 inbound movements).

6.1.3. Light Vehicles

The proposed operations will also generate light vehicle movements from staff trips to site in the morning and from the site in the evening. Based on an estimated 25 staff, the number of light vehicle trips is 25 trips per day.

6.1.4. Total Site Generated Traffic

The peak site traffic scenario would occur when both clay and sand is being carted from the site. The total number of trips would be 150 truck trips (300 truck movements) and 25 light vehicle trips (50 light vehicle movements) per day.

The truck trips would be generated at regular intervals over the working day from 7am to 7pm. Based on the 12 hour working day, the number of trips generated during the morning and afternoon peak hours would be 13 truck trips. As the light vehicle movements are likely to occur outside of the peak periods of traffic on the road network, these have been excluded from the peak hour assessment.

6.2. Traffic Distribution

The clay and sand truck movements will be generated exclusively to and from the south via GNH. As such, the predicted increase in traffic volumes on the road network are as calculated in Table 3. The truck movements generated by the existing clay and sand operations to the north of Walyunga Road (Walyunga Quarry) were derived from the traffic assessment undertaken by Shawmac for this site in May 2016 (attached as Appendix D). It is assumed conservatively that both operations would occur concurrently. It is most likely however, that clay cartage will only occur from one of the two sites on any one day (either the Walyunga Quarry to the north or the subject site) on any one day. This is because the receiving brick factory can only process a certain quantity of clay each day.

Table 3: Comparison of Pre- and Post-Development Traffic Volumes

Road	Time Period	Pre-development Traffic	Change	Post-development Traffic	Walyunga Quarry Traffic	Post-development Traffic including Walyunga Quarry Traffic
GNH – North of Apple Street	Daily (vpd)	15,706	350	16,056	300	16,356
	AM Peak (vph)	1,264	26	1,290	30	1,320
	PM Peak (vph)	1,267	26	1,293	30	1,323
Walyunga Road – east of GNH	Daily (vpd)	495	350	845	300	1,145
	AM Peak (vph)	46	26	72	30	102
	PM Peak (vph)	53	26	79	30	109

7. Analysis of Development Access

7.1. Traffic Capacity

During the peak hours, the predicted traffic movements at the proposed site access will be approximately 13 inbound truck movements and 13 outbound truck movements. The access is considered to have sufficient capacity to accommodate this number of movements.

7.2. Sight Distance

The sight distance at the proposed access and at the Walyunga Road / GNH intersection has been assessed in accordance with Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (AGRD04A).

The minimum required Safe Intersection Sight Distance (SISD) for trucks has been calculated using Equation 2 of AGRD04A (shown in Figure 6) and the parameters below. A 60 km/h operating speed has been assumed as vehicles travelling along Walyunga Road near the proposed access will have either slowed down on approach to GNH or will have already slowed down after turning in from GNH.

- Decision Time D_T = observation time (s) + reaction time (s) = 3.0 + 2.0 = 5.0 s
- Operating Speed V = 60 km/h (10 km/h above posted speed limit)
- Coefficient of deceleration d = 0.24
- Longitudinal grade a = 0%

$$SISD = \frac{D_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)}$$

Figure 6: Safe Intersection Sight Distance Formula (Austroads)

The minimum required SISD is 142m.

A desktop review of sight distances from the proposed access location are shown in Figure 7, Figure 8 and Figure 9.

Figure 7: Sight Distance Looking East from Proposed Access

Figure 8: Sight Distance Looking West from Proposed Access

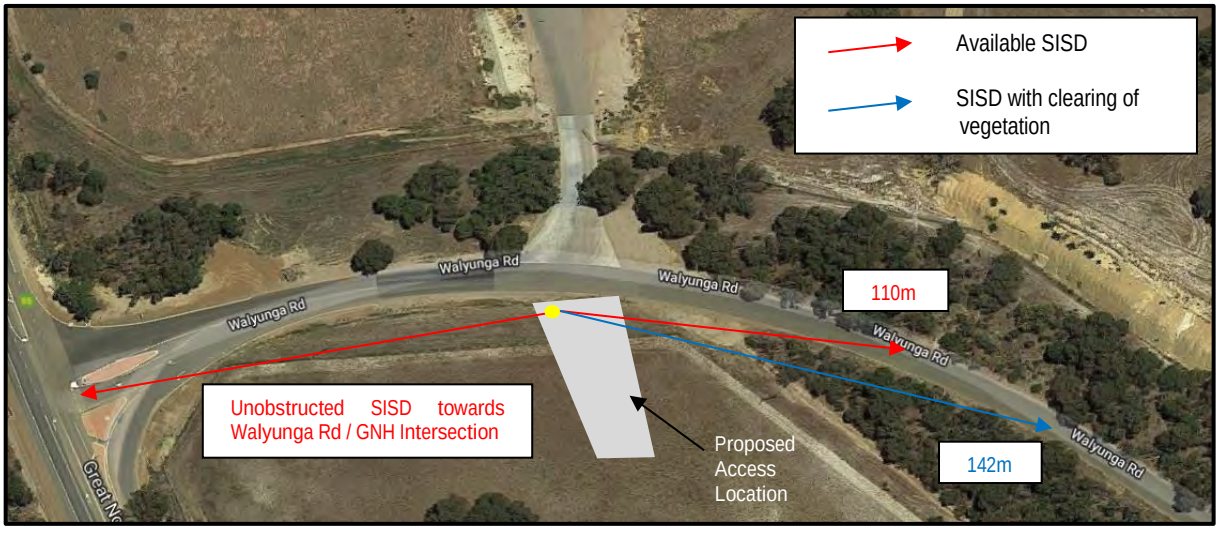


Figure 9: Sight Distance Measurements - Proposed Access

As shown, the proposed crossover is located on the inside curve of Walyunga Road and the SISD towards east is not sufficient to achieve minimum SISD in accordance with AGRD04A. Some clearing within the road reserve will be required to achieve SISD as indicated in Figure 9. In order to minimise the risk of crashes, it is

recommended to install 'Truck Entering' east of the proposed access. Although westbound vehicles on Walyunga Road should already be slowing down on approach to GNH, consideration could be given to enforcing a lower speed limit along this section of road.

7.3. Access Geometry

As the largest vehicle used for the proposed haulage is pocket road train (RAV 4), the access will need to be designed to accommodate the turning movement for 27.5m RAV 4 trucks. The need for turn treatments at the access location has also been assessed in accordance with AGRD04A. Figure 4.9a and Figure 4.10 of AGRD04A, shown as Figure 10 and Figure 11 respectively, are used to determine the warrants for turn treatments on the through road at unsignalised intersections.

Based on the peak hour through and turning traffic volumes at the future access, the major road traffic volume for through traffic (including left turn into Lot 5 Walyunga Road) and right turns are 42 and 13 veh/h respectively. The warranted turning treatment would be a basic right (BAR) turn treatment on Walyunga Road in the form of a widened shoulder to allow through vehicles to pass trucks turning right into the access. Although the volumes warrant a BAR turn treatment, in this instance a shoulder widening is not recommended due to the relatively low traffic volumes of through movement and turning movement and it is preferable for through vehicles to wait behind turning trucks rather than overtaking.

The access will need to be designed to accommodate the swept path of 27.5m RAV 4 trucks and no changes to the geometry of Walyunga Road are recommended.

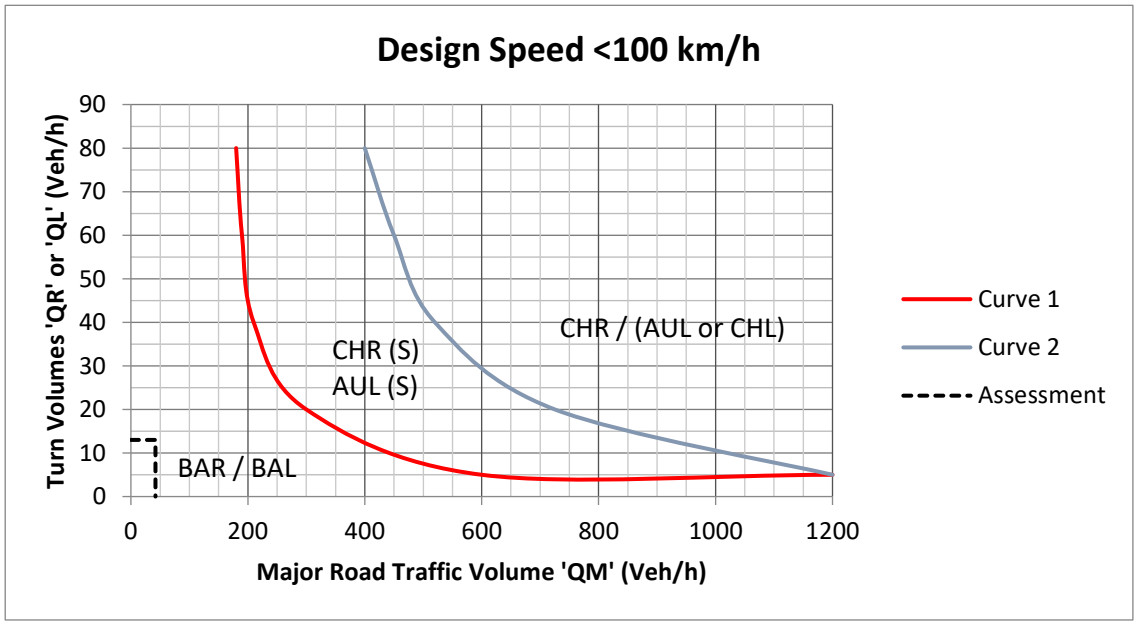
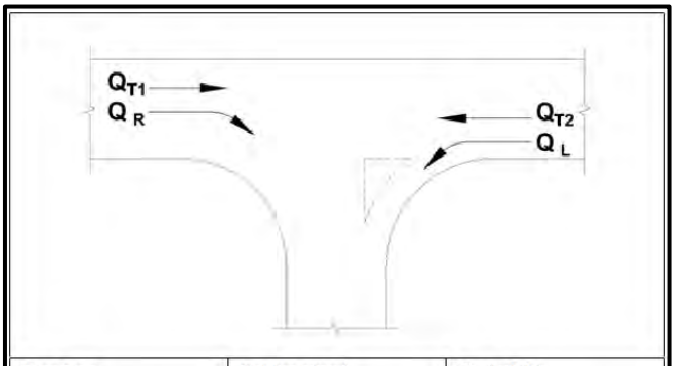


Figure 10: Warrants for Turn Treatments on Major Roads at Unsignalised Intersections - Design Speed <100km/h (Austroads)



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}

Figure 11: Calculation of the Major Traffic Volume Parameter Q_M (Austroads)

8. Impact on Surrounding Roads

8.1. Main Roads WA RAV Network Guidelines

The largest vehicle used for the proposed haulage is RAV 4 trucks (Pocket Road Trains). The Main Roads WA *Standard Restrict Access Vehicles (RAV) Route Assessment Guidelines* (RAV guidelines) has been referred to for advice on typical rural road widths with heavy vehicle traffic. For roads with a design speed between 80 and 100 km/hr and an AADT more than 1,000 vpd, the RAV guidelines recommends a 9.9 m carriageway with a 7.1m wide seal. The current cross section of Walyunga Road (approximately 7.7m seal with varying unsealed shoulders) meets this requirement.

8.2. Austroads Guidelines

Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis* (AGTM06) provides the following advice on the typical lane capacity of different road types:

- Two-lane two-way rural roads and highways — 1,700 passenger cars / hour
- Urban roads with interrupted flow — 900 - 1,000 passenger cars / hour

The resulting traffic volumes on the road network as shown in Table 3 are shown to be well within the practical capacity of the existing roads and the proposed development is considered to have minimal impact on the capacity of the road network at mid-block locations.

The existing geometry of Walyunga Road has been assessed according to Austroads *Guide to Road Design Part 3: Geometric Design* (AGRD03). Table 4.5 of AGRD03, shown below in Figure 12, outlines the design road cross sections for single carriageway rural roads.

Table 4.5: Single carriageway rural road widths (m)

Element	Design AADT				
	1–150	150–500	500–1000	1000–3000	> 3000
Traffic lanes[1]	3.7 (1 x 3.7)	6.2 (2 x 3.1)	6.2–7.0 (2 x 3.1/3.5)	7.0 (2 x 3.5)	7.0 (2 x 3.5)
Total shoulder	2.5	1.5	1.5	2.0	2.5
Minimum shoulder seal [2],[3],[4],[5],[6]	0	0.5	0.5	1.0	1.5
Total carriageway	8.7	9.2	9.2–10.0	11.0	12.0

1 *Traffic lane widths include centrelines but are exclusive of edge-lines.*
2 *Where significant numbers of cyclists use the roadway, consideration should be given to fully sealing the shoulders. Suggest use of a maximum size 10 mm seal within a 20 km radius of towns.*
3 *Wider shoulder seals may be appropriate depending on requirements for maintenance costs, soil and climatic conditions or to accommodate the tracked width requirements for Large Combination Vehicles.*
4 *Short lengths of wider shoulder seal or lay-bys to be provided at suitable locations to provide for discretionary stops.*
5 *Full width shoulder seals may be appropriate adjacent to safety barriers and on the high side of superelevation.*
6 *A minimum 7.0 m seal should be provided on designated heavy vehicle routes (or where the AADT contains more than 15% heavy vehicles).*

Figure 12: Single Carriageway Rural Road Widths (Austroads)

Based on the predicted daily traffic volume of 1,145 vpd along Walyunga Road during carting, the design road cross section should be an 11.0m carriageway with an 8m sealed width (7m traffic width and 1m sealed shoulder) and 1m unsealed shoulder.

The existing sealed width of Walyunga Road in the vicinity of the site access is measured to be approximately 7.7m and there are unsealed shoulders of varying width (approximately 0.5m to 2m).

The Extended Design Domain (EDD) of AGRD03 notes that there are many existing two-lane rural roads that do not meet the Normal Design Domain criteria and that it is often preferred to retain the existing carriageway with only minor upgrade work (e.g. sealing shoulders, overlays).

Considering that the current road geometry meets the Main Roads WA RAV guidelines, further widening and upgrade of Walyunga Road is not considered necessary. It is noted that intersection of Walyunga Road with GNH was upgraded in late 2014 for the purpose of transporting material and that the current geometry of Walyunga Road has accommodated the truck movements of the existing quarry to the north without issue.

9. Impact on Intersections

All traffic generated to and from the site are proposed to access via the GNH / Walyunga Road intersection. The peak hour operation of this intersection has been modelled using SIDRA Intersection 7.0 under the pre-development and post development traffic volumes to quantify the impact of the proposed development.

SIDRA is a commonly used intersection modelling tool used by traffic engineers for all types of intersections. Outputs for four standard measures of operational performance can be obtained, being Degree of Saturation (DoS), Average Delay, Queue Length, and Level of Service (LoS).

- Degree of Saturation is a measure of how much physical capacity is being used with reference to the full capability of the particular movement, approach, or overall intersection. A DoS of 1.0 equates to full theoretical capacity although in some instances this level is exceeded in practice. SIDRA uses maximum acceptable DoS of 0.90 for signalised intersections for its Design Life analysis. Design engineers typically set a maximum DoS threshold of 0.95 for new intersection layouts or modifications.
- Average Delay reports the average delay per vehicle in seconds experienced by all vehicles in a particular lane, approach, or for the intersection as a whole. For severely congested intersections the average delay begins to climb exponentially.
- Queue Length measures the length of approach queues. In this document we have reported queue length in terms of the length of queue at the 95th percentile (the maximum queue length that will not be exceeded for 95 percent of the time). Queue lengths provide a useful indication of the impact of signals on network performance. It also enables the traffic engineer to consider the likely impact of queues blocking back and impacting on upstream intersections and accesses.
- Level of Service is a combined appreciation of queuing incidence and delay time incurred, producing an alphanumeric ranking of A through F. A LoS of A indicates an excellent level of service whereby drivers delay is at a minimum and they clear the intersection at each change of signals or soon after arrival with little if any queuing. Values of B through D are acceptable in normal traffic conditions. Whilst values of E and F are typically considered undesirable, within central business district areas with significant vehicular and pedestrian numbers, corresponding delays/queues are unavoidable and hence, are generally accepted by road users.

The peak hour traffic flows and heavy vehicle percentages were derived from the traffic data. Based on the previous consultation with MRWA, the gap acceptance parameters used were the SIDRA default values and heavy vehicle parameters were set as shown in Table 4 below:

Table 4: Vehicle Parameter Settings

Vehicle Type	Vehicle Length (m)	PCE / PCU	Mass (kg)	Maximum Power (kW)
Light Vehicle (Austroads Class 1-2) - Default Values	4.5m	1	1600	120
Austroads Class 3-5	12.5m	2	15000	170
Austroads Class 6-9 (including Semi and Pig)	19.0m	3	64000	300
Austroads Class 10-11 (including Truck and Dog and Pocket Road Trains)	27.5m	5	79000	400

In addition, of the vehicles traveling westbound along Walyunga Road, approximately 3 light vehicles are assumed to turn right at GNH intersection during both AM and PM peak period. The results of the assessment are detailed in Appendix A and summarised in Table 5.

Table 5: SIDRA Results Summary

Intersection / Access	Peak Period	Scenario	Average DoS	Average Delay (s)	Worst Delay (s)	Maximum Queue (m)	Average LoS	Worst LoS
GNH / Walyunga Road intersection	AM Peak	Existing	0.601	0.7	39.5	4.1	A-B	E
		Future	0.601	1.4	42.1	19.1	A-C	E
	PM Peak	Existing	0.610	0.6	35.5	2.4	A-B	E
		Future	0.610	1.1	37.8	9.1	A-C	E

The results of the analysis indicate that with the traffic generated from the proposed site and Walyunga Quarry the intersection will perform at a similar level of service with minimal increase in average delays and other measures of performance.

It is noted that the worst delay and LoS for all scenarios are dictated by the right turn movement from Walyunga Road onto GNH. The vehicles that are predicted to make this movement are the assumed 3 light vehicle movements of the existing Walyunga Road traffic and this is considered acceptable as the model does not take into account the staged turning of vehicles even though there is sufficient width in the median to allow light vehicles to do so.

The maximum queue distance for all scenarios are dictated by the right-turn movement from GNH to Walyunga Road. This is the effect of the increase in heavy vehicles to the proposed site and the Walyunga Quarry. This is also considered acceptable as the queue capacity for trucks waiting for a gap to turn-right into Walyunga Road is measured to be approximately 190m which is well above the modelled maximum queue length. The predicted LoS, DoS and average delay for this movement are also within acceptable levels during both peak periods of traffic on the road network.

It is reminded that the existing traffic generated from Walyunga Quarry (Lot 5 Walyunga Road) and the proposed clay extraction and transportation will generate traffic on a campaign basis, varying from two to three days per month (per site), and at all other times, only sand carting will occur (approximately one third of the peak site traffic generation).

10. Road Safety

The crash history along the whole length of Walyunga Road and the intersection of GNH / Walyunga Road for the five-year period ending December 2016 was accessed via the MRWA Crash Analysis Reporting System (CARS). The report indicated that there were no recorded crashes.

The crash records indicate no particular safety issues for the existing road and intersection.

As discussed in Section 7.2.1, clearing of roadside vegetation will be required to achieve SISD and to maximise safety, 'Truck Entering' signs or other similar warning signage is recommended to be placed on approach to the development access.

11. Public Transport Access

There are no public transport services currently available within reasonable walking distance from the site. Based on the proposed land use for clay extraction, there is not likely to be any demand for public transport access.

12. Pedestrian / Cyclist Access and Amenity

The site is unlikely to generate any demand for pedestrian or cyclist access.

13. Conclusions

A Transport Impact Assessment for the proposed clay and sand extraction on Lot 5 and Lot 6 GNH, Bullsbrook concluded the following:

- The estimated site traffic generation of 350 daily vehicle movements and 26 peak hour truck movements can be accommodated within the capacity of the existing road network at mid-block and intersection locations;
- The proposed site crossover will need to be designed to accommodate the swept path of 27.5m RAV 4 trucks;
- The proposed site access is located on the inside curve of Walyunga Road horizontal curve. The available sight distance from the proposed access towards the east fails to meet the minimum requirements of Austroads guidelines. Clearing of roadside vegetation will be required to achieve the minimum required SISD of 142m;
- Based on the peak hour traffic movements at the access and the warrants outlined in Austroads, a basic right (BAR) turn treatment may be warranted at the access intersection. For this development, a BAR is not recommended due to the relatively low, evenly distributed turning volumes, the low volume of through traffic and the preference for through vehicles to wait behind turning vehicles instead of overtaking turning trucks;
- The existing width of Walyunga Road meets the minimum requirements of Main Roads WA RAV guidelines for RAV 4 category roads carrying more than 1,000 vpd. When assessed against the Austroads AGRD03 for rural roads, the average sealed width is slightly narrower (approximately 300mm) than the recommended cross section. The Extended Design Domain (EDD) of AGRD03 notes that there are many existing two-lane rural roads that do not meet the Normal Design Domain criteria and that it is often preferred to retain the existing carriageway with only minor upgrade work (e.g. sealing shoulders, overlays). In this instance, as the existing road meets Main Roads WA standards and currently accommodates the same type of transport vehicles, any widening or upgrade of Walyunga Road is not considered necessary.
- An assessment of the peak hour operation of GNH / Walyunga Road intersection using SIDRA confirmed that there is sufficient capacity to accommodate the traffic generated by the site and Walyunga Quarry;
- The additional traffic generated by the site is not considered to increase the likelihood of crashes to unacceptable levels. It is recommended that 'Trucks Entering' or similar warning signage is placed on approach to the development access to maximise safety.

Appendix A: Traffic Count Data

SITE 5877

Volume by Hour

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
North of Apple St (SLK 15.39)

Count: Classification Counts

Average Vehicle Volume

Both Directions

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000		48	61					55	
0100		32	34					33	
0200		36	34					35	
0300		62	61					62	
0400		205	209					207	
0500		662	659					661	
0600		1121	1112					1117	
0700		1256	1272					1264	
0800		1089	1104					1097	
0900		984	913					949	
1000		859	872					866	
1100		917	854					886	
1200		871	853					862	
1300		954	826					890	
1400		1151	1069					1110	
1500		1244	1142					1193	
1600		1222	1311					1267	
1700		1185	1144					1165	
1800		721	788					755	
1900		431	435					433	
2000		299	325					312	
2100		251	242					247	
2200		159	137					148	
2300		74	110					92	
Total		15833	15567					15706	

Peak Statistics

		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour		0715	0745					0715	
	1/4 Hr Vol		341	340					337	
	1 Hour		0700	0715					0700	
	1 Hr Vol		1256	1282					1264	
	1 Hr Fact		.9208	.9426					.9391	
PM	1/4 Hour		1530	1615					1615	
	1/4 Hr Vol		358	344					338	
	1 Hour		1530	1600					1530	
	1 Hr Vol		1299	1311					1285	
	1 Hr Fact		.9071	.9528					.9504	

✈ = Public Holiday
✍ = School Holiday

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SITE 5877

Class By Day

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
N of Apple St (SLK 15.39)

Vehicle Classification Austroads 1994 — **Both Directions**

Class	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
Monday														
%														
Tuesday	10763	361	2247	227	61	56	137	93	635	356	895	2	**4709**	**15833**
%	68.0	2.3	14.2	1.4	0.4	0.4	0.9	0.6	4.0	2.2	5.7	0.0	**29.7**	
Wednesday	10591	361	2392	210	54	67	148	102	545	238	859	0	**4615**	**15567**
%	68.0	2.3	15.4	1.3	0.3	0.4	1.0	0.7	3.5	1.5	5.5	0.0	**29.6**	
Thursday														
%														
Friday														
%														
Saturday														
%														
Sunday														
%														

Class	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
ADT (M-S)														
%														
AWT (M-F)	10677	361	2320	219	58	62	143	98	590	297	877	1	**4665**	**15700**
%	68.0	2.3	14.8	1.4	0.4	0.4	0.9	0.6	3.8	1.9	5.6	0.0	**29.7**	
Weekend														
%														

Heavy = Classes 3 - 12
✈ = Public Holiday
✍ = School Holiday

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SITE 6847

Volume by Hour

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
South of Bullsbrook Rd (SLK 25.05)

Count: Classification Counts

Average Vehicle Volume

Both Directions

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000		49	88					69	
0100		34	39					37	
0200		44	41					43	
0300		61	55					58	
0400		197	212					205	
0500		644	684					664	
0600		1045	1030					1038	
0700		1194	1253					1224	
0800		959	976					968	
0900		864	846					855	
1000		783	816					800	
1100		736	759					748	
1200		723	738					731	
1300		781	734					758	
1400		936	925					931	
1500		1051	1003					1027	
1600		1059	1155					1107	
1700		1070	1035					1053	
1800		715	806					761	
1900		447	440					444	
2000		313	357					335	
2100		242	239					241	
2200		193	130					162	
2300		88	134					111	
Total		14228	14495					14370	

Peak Statistics

		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour		0745	0730					0730	
	1/4 Hr Vol		312	330					311	
	1 Hour		0700	0700					0700	
	1 Hr Vol		1194	1253					1224	
	1 Hr Fact		.9567	.9492					.9839	
PM	1/4 Hour		1715	1600					1530	
	1/4 Hr Vol		294	298					287	
	1 Hour		1530	1600					1600	
	1 Hr Vol		1089	1155					1107	
	1 Hr Fact		.9654	.969					.9814	

✈ = Public Holiday
🎒 = School Holiday

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SITE 6847

Class By Day

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
S of Bullsbrook Rd (SLK 25.05)

Vehicle Classification Austroads 1994 — **Both Directions**

Class	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
Monday														
%														
Tuesday	10551	326	1696	207	41	36	88	45	261	218	757	2	**3351**	**14228**
%	74.2	2.3	11.9	1.5	0.3	0.3	0.6	0.3	1.8	1.5	5.3	0.0	**23.6**	
Wednesday	10929	325	1601	198	40	59	103	63	241	198	737	1	**3241**	**14495**
%	75.4	2.2	11.0	1.4	0.3	0.4	0.7	0.4	1.7	1.4	5.1	0.0	**22.4**	
Thursday														
%														
Friday														
%														
Saturday														
%														
Sunday														
%														

Class	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
ADT (M-S)														
%														
AWT (M-F)	10740	326	1649	203	41	48	96	54	251	208	747	2	**3299**	**14362**
%	74.8	2.3	11.5	1.4	0.3	0.3	0.7	0.4	1.7	1.4	5.2	0.0	**23.0**	
Weekend														
%														

Heavy = Classes 3 - 12
✈ = Public Holiday
✍ = School Holiday

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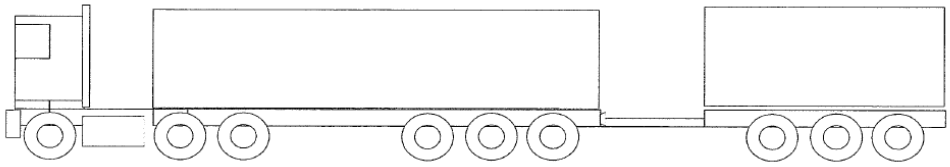
Appendix B: Typical Truck Configurations

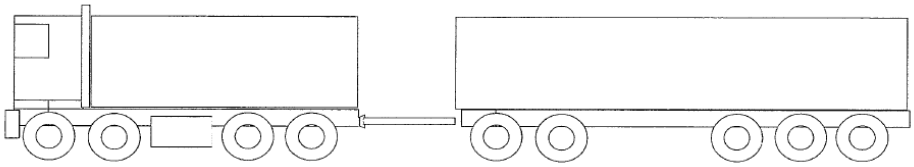
AXLE GROUP LOADING

Both the semi and pig and the road train may be able to get the .5 tonne allowance for the steer tyre



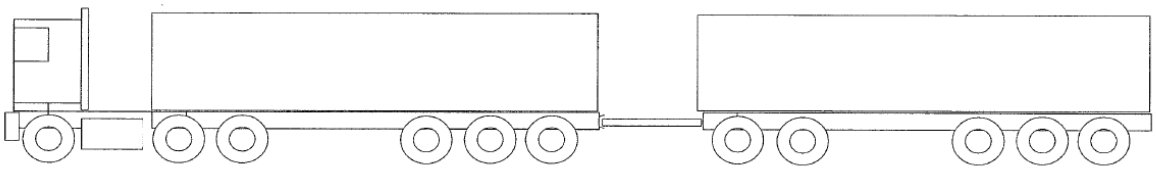
6 tonne 16.5 tonne 20 tonne 18 tonne

SEMI & PIG TOTALLING 60.5 TONNE



11 tonne 16.5 tonne 16.5 tonne 20 tonne

TRUCK & DOG TOTALLING 64 TONNE



6 tonne 16.5 tonne 20 tonne 16.5 tonne 20 tonne

POCKET ROAD TRAIN TOTALLING 79 TONNE

Appendix C: SIDRA Outputs

MOVEMENT SUMMARY

▽ Site: 101 [Walyunga / GNH AM Peak Pre-Dev]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: GNH S											
2	T1	508	28.6	0.410	0.1	LOS A	0.0	0.0	0.00	0.00	99.5
3	R2	21	55.0	0.069	21.6	LOS C	0.2	4.1	0.80	0.93	47.2
Approach		529	29.6	0.410	0.9	NA	0.2	4.1	0.03	0.04	95.3
East: Walyunga Road											
4	L2	22	57.1	0.026	5.1	LOS A	0.0	0.0	0.00	0.44	46.2
6	R2	3	0.0	0.032	39.5	LOS E	0.1	0.7	0.92	0.96	37.0
Approach		25	50.0	0.032	9.4	LOS A	0.1	0.7	0.12	0.50	44.8
North: GNH N											
7	L2	3	0.0	0.601	8.0	LOS A	0.0	0.0	0.00	0.00	88.3
8	T1	823	22.6	0.601	0.2	LOS A	0.0	0.0	0.00	0.00	99.0
Approach		826	22.5	0.601	0.2	NA	0.0	0.0	0.00	0.00	98.9
All Vehicles		1381	25.8	0.601	0.7	NA	0.2	4.1	0.01	0.02	95.4

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.

MOVEMENT SUMMARY

▽ Site: 101 [Walyunga / GNH AM Peak Post-Dev]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: GNH S											
2	T1	508	28.6	0.410	0.1	LOS A	0.0	0.0	0.00	0.00	99.5
3	R2	51	81.3	0.218	28.6	LOS D	0.8	19.1	0.85	0.97	43.1
Approach		559	33.3	0.410	2.7	NA	0.8	19.1	0.08	0.09	89.0
East: Walyunga Road											
4	L2	52	81.6	0.096	5.5	LOS A	0.0	0.0	0.00	0.43	45.5
6	R2	3	0.0	0.035	42.1	LOS E	0.1	0.7	0.93	0.97	36.1
Approach		55	76.9	0.096	7.6	LOS A	0.1	0.7	0.05	0.46	44.9
North: GNH N											
7	L2	3	0.0	0.601	8.0	LOS A	0.0	0.0	0.00	0.00	88.3
8	T1	823	22.6	0.601	0.2	LOS A	0.0	0.0	0.00	0.00	99.0
Approach		826	22.5	0.601	0.2	NA	0.0	0.0	0.00	0.00	98.9
All Vehicles		1440	28.8	0.601	1.4	NA	0.8	19.1	0.03	0.05	90.8

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.

MOVEMENT SUMMARY

▽ Site: 101 [Walyunga / GNH PM Peak Pre-Dev]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total 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: GNH S											
2	T1	777	27.6	0.610	0.2	LOS A	0.0	0.0	0.00	0.00	98.9
3	R2	23	54.5	0.035	14.1	LOS B	0.1	2.4	0.58	0.75	52.2
Approach		800	28.4	0.610	0.6	NA	0.1	2.4	0.02	0.02	96.4
East: Walyunga Road											
4	L2	26	56.0	0.029	5.0	LOS A	0.0	0.0	0.00	0.44	46.3
6	R2	3	0.0	0.029	35.5	LOS E	0.1	0.6	0.91	0.96	38.6
Approach		29	50.0	0.029	8.3	LOS A	0.1	0.6	0.10	0.49	45.3
North: GNH N											
7	L2	3	0.0	0.369	7.9	LOS A	0.0	0.0	0.00	0.00	88.4
8	T1	505	22.7	0.369	0.1	LOS A	0.0	0.0	0.00	0.00	99.5
Approach		508	22.6	0.369	0.1	NA	0.0	0.0	0.00	0.00	99.4
All Vehicles		1338	26.7	0.610	0.6	NA	0.1	2.4	0.01	0.03	95.1

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.

MOVEMENT SUMMARY

▽ Site: 101 [Walyunga / GNH PM Peak Post-Dev]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total 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: GNH S											
2	T1	777	27.6	0.610	0.2	LOS A	0.0	0.0	0.00	0.00	98.9
3	R2	53	80.0	0.096	16.6	LOS C	0.4	9.1	0.62	0.83	50.1
Approach		829	31.0	0.610	1.2	NA	0.4	9.1	0.04	0.05	93.2
East: Walyunga Road											
4	L2	54	78.4	0.093	5.4	LOS A	0.0	0.0	0.00	0.43	45.6
6	R2	3	0.0	0.031	37.8	LOS E	0.1	0.6	0.92	0.96	37.7
Approach		57	74.1	0.093	7.2	LOS A	0.1	0.6	0.05	0.46	45.1
North: GNH N											
7	L2	3	0.0	0.369	7.9	LOS A	0.0	0.0	0.00	0.00	88.4
8	T1	505	22.7	0.369	0.1	LOS A	0.0	0.0	0.00	0.00	99.5
Approach		508	22.6	0.369	0.1	NA	0.0	0.0	0.00	0.00	99.4
All Vehicles		1395	29.7	0.610	1.1	NA	0.4	9.1	0.03	0.05	91.2

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.

Appendix D: Transport Statement – Lot 5 Walyunga Road, Bullsbrook