ISAAC REGIONAL COUNCIL

BELYANDO RESIDENTIAL ESTATE
MORANBAH

TRAFFIC & TRANSPORT INFRASTRUCTURE ASSESSMENT
PHASE 1 DEVELOPMENT

Report No: TIRC001/R02
REV: B
Date: 12 AUGUST 2013

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REPORT AUTHORISATION					
Revision	**Rev. Date**	**Report Details**			
A	7 December 2012	Issued as Final			
B	12 August 2013	Amended Section 6.4			
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1. INTRODUCTION

UDP Horman Traffic (UDPHT) was engaged by Isaac Regional Council to undertake a Traffic and Transport Infrastructure Assessment for Phase 1 of Belyando Estate. Belyando Estate is a residential development being developed by Isaac Regional Council on behalf of the Urban Land Development Authority (ULDA) as part of the State Governments affordable housing initiative.

This report provides an assessment of the traffic and transport infrastructure required to service Phase 1 of development. This report is the second report prepared for Belyando Estate by UDPHT. The first report (Ref TIRC001 R01 Rev A, Dated 23 November 2012) identifies the traffic infrastructure requirements for the ultimate development of Belyando Estate.

In the course of preparing this assessment, plans of the development were examined, other relevant studies reviewed, and all relevant traffic data analysed. The proceeding assessment was conducted as a desk top assessment based on available data and images including Google Earth and therefore any recommendations made within the report should be verified on site.

2. PROPOSED DEVELOPMENT

Reference to the ultimate development of Belyando Estate is in relation to the context plan produced for the whole of Belyando Estate. Phase 1 road network and allotment layout has since been produced. Reference to these plans by Integran are located in Appendix A are as follows:

- Context Plan – Drg. ContextPlan_001, Rev 1.3, Dated 15/5/2012; and
- Phase 1 – Drg. 121015_PoD_Plan, Rev A, Dated 1/11/2012.

Based on the plans provided, it is proposed to develop Phase 1 in four (4) Stages for the purpose of providing a total of 194 residential allotments and two (2) parks as summarised in Table 2-1.

Table 2-1: Ultimate Housing Provision

Phase 1 Stage No.	Residential Allotment Type			Park	Undefined	Total Allotments
	Traditional	Adaptable / Multi Dwelling	Villa / Court Yard			
Stage 1	32	7	14	1	1	55
Stage 2	32	13	8			53
Stage 3	29	10	8	1	4	52
Stage 4	25	1	7			33
TOTAL	**118 (63%)**	**31 (17%)**	**37 (20%)**	**2**	**5**	**193**

2.1 Location and Land Use

The subject site is situated to the west of Goonyella Road (Moranbah Access Road) and south of Grosvenor Creek, approximately 2.0km southeast of Moranbah town centre.

Moranbah is located approximately 194km southwest of Mackay, Queensland, with a population of around 10,000 permanent and temporary residents.

The ultimate development of Belyando Estate is shown is in Figure 2-1 with reference to Phase 1.

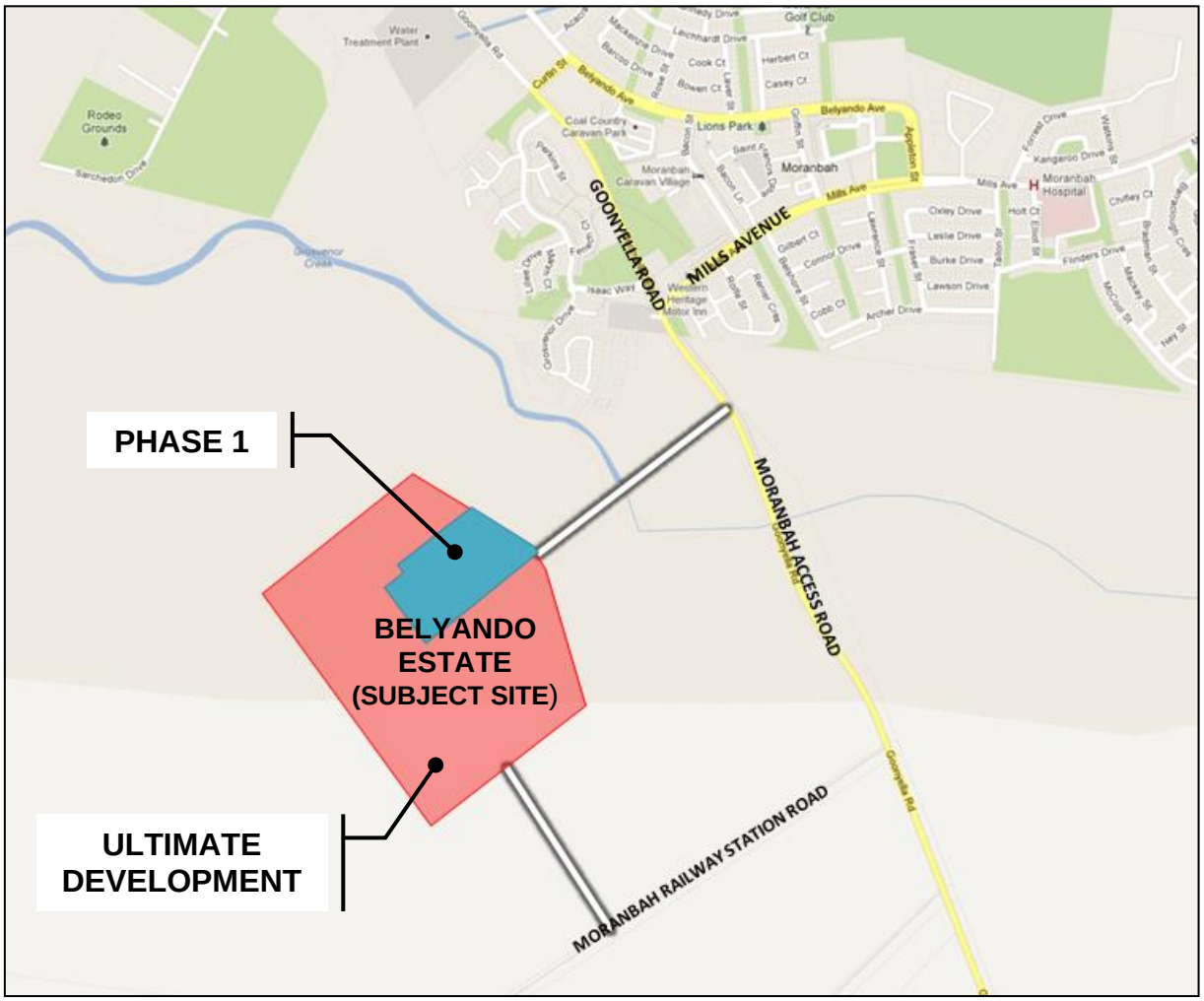

Figure 2-1: Site Location

The subject site is irregular in shape consisting of approximately 100ha. Phase 1 of the subject site consists of 22.31ha. In accordance with the context plan provided, Phase 1 is zoned residential.

The subject site is currently vacant however Google Earth images suggest that the site was previously used for cattle grazing. The land use surrounding the site is zoned as rural and is generally vacant.

Significant land uses of note shown in Figure 4-8 includes the town centre, hospital, and schools within the town centre to the north east of the site, and the mixed use zone on the west side of Goonyella Road south of Mills Avenue. Furthermore, a proposed mining camp catering for approximately 3,500 people is situated to the southeast of the subject site with access provided to Moranbah Access Road from Moranbah Railway Station Road. A proposed residential development is situated to the west of Belyando Estate. Further afield, land surrounding Moranbah contains coal seams and therefore a number of mines are located to the north and south of Moranbah accessed via Goonyella Road and Moranbah Access Road.

2.2 Internal Road Network

Ultimately all vehicle access to / from Belyando Estate is proposed via two (2) connection roads to be constructed as part of the proposed development, one (1) connecting directly to Moranbah Access Road, and the other to Moranbah Railway Station Road which in turn connects with Moranbah Access Road. The alignment of the road connecting directly with Moranbah Access Road intersects the existing commercial centre fronting Moranbah Access Road. Phase 1 is consistent with the context plan where the trunk road network forms a cross through the centre of Belyando Estate by the extension of the access roads from Moranbah Access Road, and Moranbah Railway Station Road as shown in Figure 2-2.

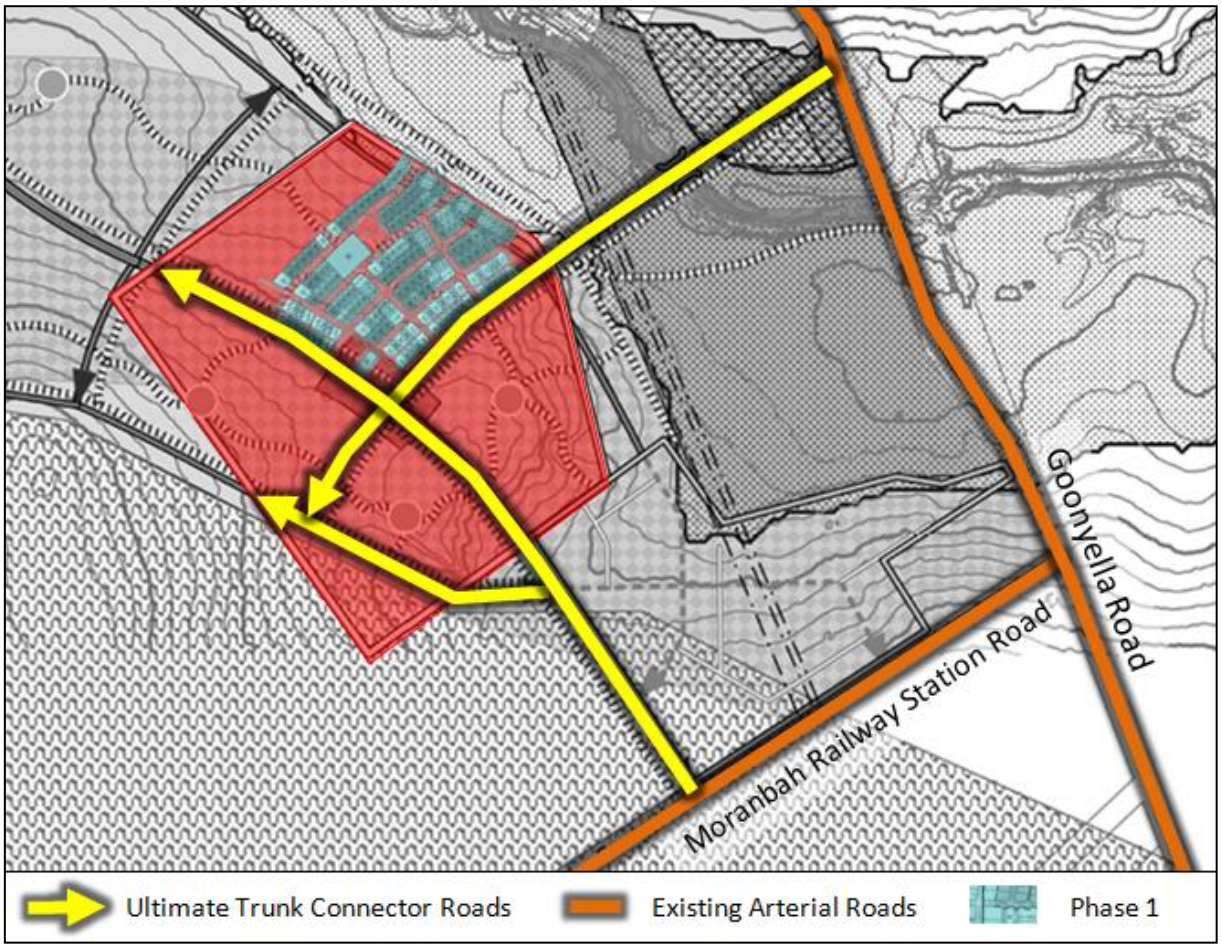

Figure 2-2: Road Network

2.3 Pedestrian and Bicycle Access

As indicated by the context plan, ultimately it is proposed to provide a bicycle path along each of the main access roads connecting to Belyando Estate from Moranbah Access Road and Moranbah Railway Station Road. A third bicycle path is proposed on the south side of Grosvenor Creek through the civic and open space. Although the routes are labelled 'Initial Structure Plan Trunk Bikeway' on the context plan, it is suggested that these paths are intended to be shared paths catering for both pedestrians and cyclists.

Internal to the subject site, the context plan indicatively indicates provision of a bicycle network between proposed park locations. The proposed bicycle network is intended to be extended beyond the subject site to the future residential development to the north-west of the subject site.

The internal road network and allotment layout has since been developed where Phase 1 includes two (2) parks with access provided by the road network. Details of bicycle and pedestrian network facilities within the internal road network are recommended within Sections 7.1.

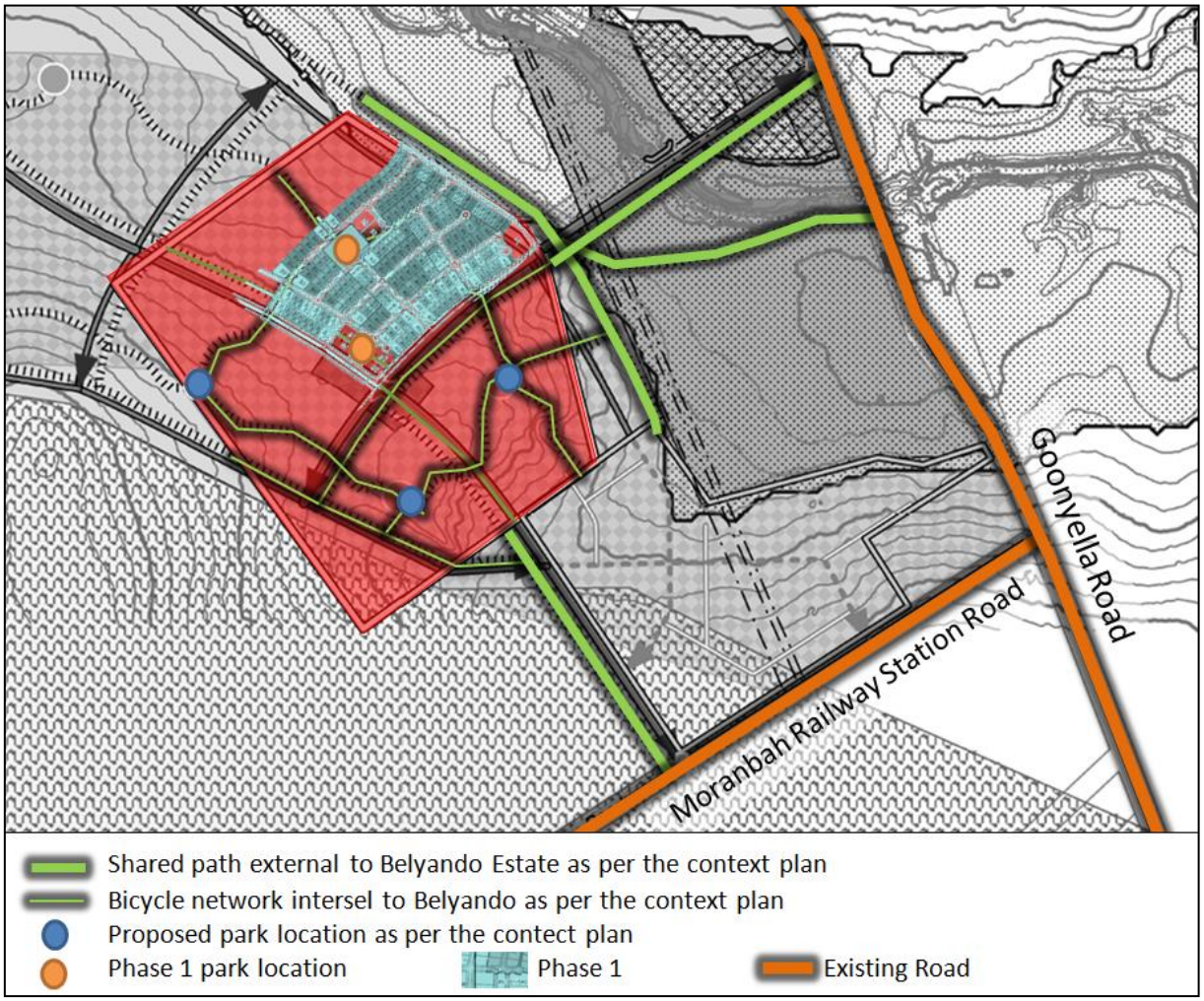

Figure 2-3: Pedestrian and Bicycle Network

2.4 Development Timing

It is proposed to develop Belyando Estate in a number of phases. Phase 1 of development consists of four (4) stages. The first houses in Phase 1 of development are expected to be completed early 2014 with the last scheduled for completion by late 2014. It is anticipated that development will proceed at an approximate rate of 30 allotments per month for the first year taking an average of 1.6 months per stage. A schedule of the development timing for Belyando Estate is attached in Appendix B.

3. EXISTING TRANSPORT INFRASTRUCTURE

3.1 Road Network

The major road network providing access to Moranbah is shown in Figure 3-1.

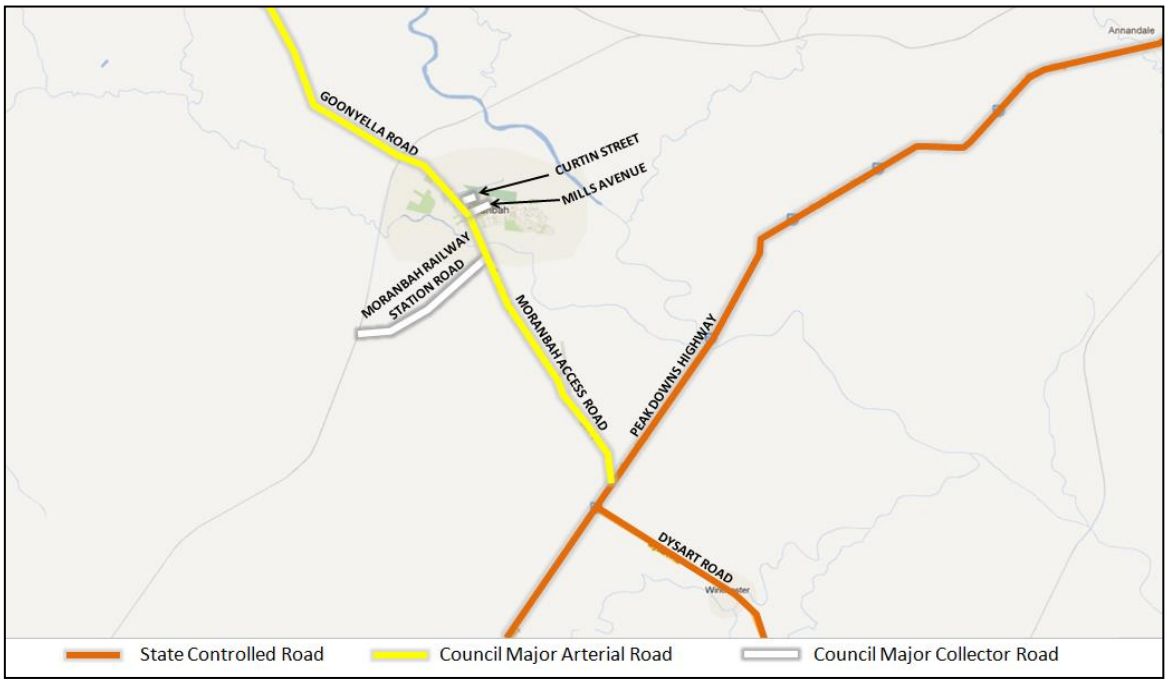

Figure 3-1: Major Road Network

3.1.1 Goonyella Road / Moranbah Access Road

Goonyella Road / Moranbah Access Road is a rural road running north-west to south-east between Peak Downs Highway in the south-west, passing through the township of Moranbah, and terminating at Goonyella Train Station north-west of Moranbah. This road is technically called Moranbah Access Road south-east of Mills Avenue and Goonyella Road north-west of Mills Avenue.

Within the vicinity of the subject site Goonyella Road / Moranbah Access Road is an undivided carriageway providing a single lane in each direction with a sealed shoulder and grass verge on both sides of the road with centre and edge line marking, as shown in Figure 3-2 below.

Figure 3-2: Goonyella Road looking north-west towards Moranbah (Google Street View, April 2008)

Moranbah Access Road provides a priority (give-way) intersection with Moranbah Railway Station Road where Moranbah Access Road is the priority road. On the south-west approach Moranbah Access Road provides a basic left turn treatment (BAL) and an auxiliary right turn treatment (AUR) on the north-east approach to Moranbah Railway Station Road.
At the intersection of Mills Avenue a priority (give-way) intersection is provided where Goonyella Road / Moranbah Access Road is the priority road. On the south-east approach a channelised right turn lane (CHR) is provided where on the north-west approach an auxiliary left turn lane (AUL) is provided.

Similarly, the same intersection treatments are provided at the intersection of Curtin Street as at Mills Avenue.

Generally a speed limit of 100km/hr applies to Goonyella Road / Moranbah Access Road with the exception past Moranbah town centre. On both approaches to Moranbah town centre the posted speed limit drops to 80km/hr then to 60km/hr past the town centre as shown in Figure 3-3 below.

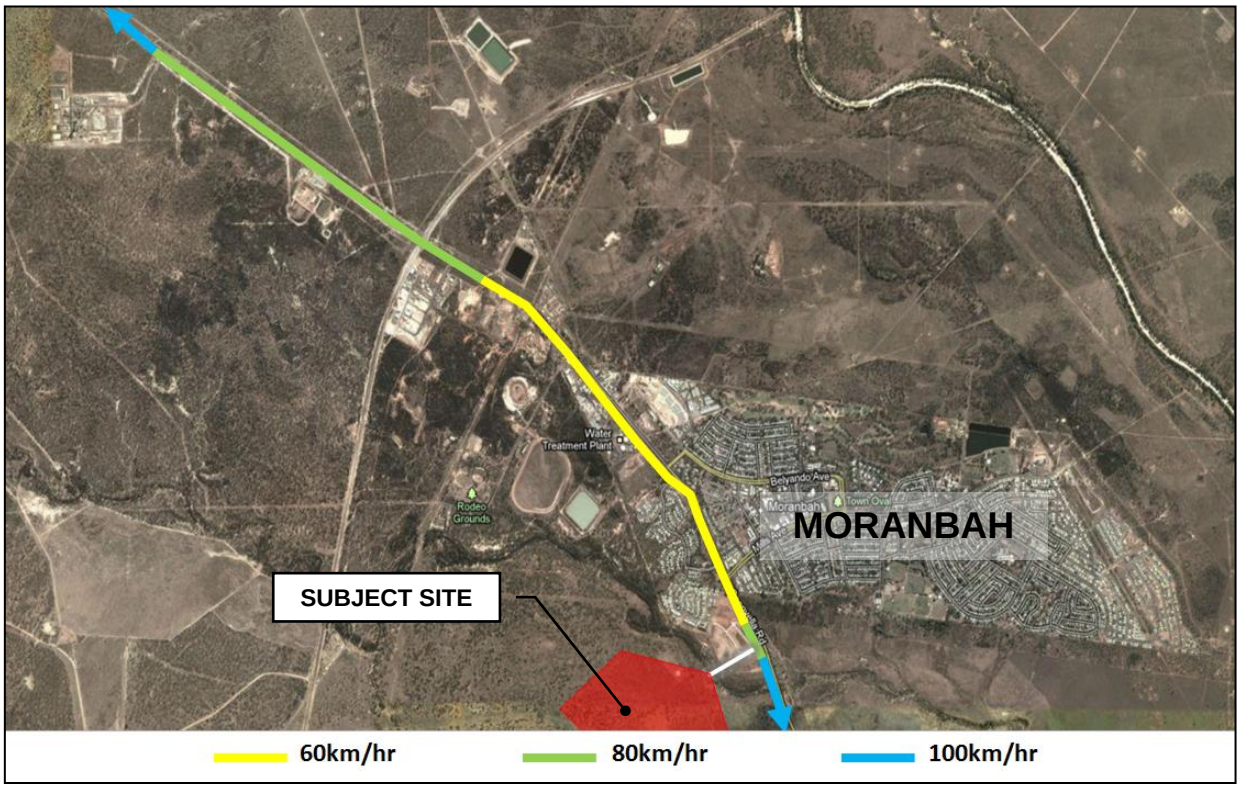

Figure 3-3: Existing Speed Zones

3.1.2 Moranbah Railway Station Road

Moranbah Railway Station Road is a rural road running north-east to south-west between Moranbah Access Road in the north-east and Moranbah Train Station in the south-west providing access to Moranbah Railway Station. Within the vicinity of the subject site Moranbah Railway Station Road is a sealed undivided carriageway providing a single lane in each direction, centre line marking, and grass verge on both sides of the road, as shown in Figure 3-4.

No speed signage is provided on Moranbah Railway Station Road, therefore it is assumed that a speed limit of 100km/hr applies.

Figure 3-4: Moranbah Railway Station Road looking south-west (Google Street View, April 2008)

At the intersection with Moranbah Access Road, Moranbah Railway Station Road provides a priority (give-way) intersection where Moranbah Access Road is the priority road. On the approach to Moranbah Access Road, Moranbah Railway Station Road provides a combined basic left and right turn lane (BAL and BAR).

3.1.3 Mills Avenue

Mills Avenue is the main access road into the town centre of Moranbah from Goonyella Road / Moranbah Access Road. Mills Avenue is a divided carriageway with a wide median providing two (2) lanes in each direction in addition to kerb side parking beyond the intersection of Moranbah Access Road, as shown in Figure 3-5. Breaks in the median are provided to allow for right turning movements from side streets where the width of the median is sufficient to store at least one (1) vehicle.

Figure 3-5: Mills Ave Looking West towards Goonyella Road (Google Street View, April 2008)

A priority (give-way) intersection is provided at the intersection of Goonyella Road / Moranbah Access Road with Mills Avenue where Goonyella Road / Moranbah Access Road is the priority direction. On the approach to Goonyella Road / Moranbah Access Road, Mills Avenue provides separate basic left (BAL) and basic right (BAR) turn lanes.

A posted speed limit of 60km/hr applies to Mills Avenue.

3.1.4 Curtin Street

Curtin Street provides a second access road to the town centre of Moranbah from Goonyella Road connecting Goonyella Road and Belyando Avenue. Curtin Street is a divided

carriageway with a wide median providing two (2) lanes in each direction with no kerb side parking permitted as shown in Figure 3-6.

Figure 3-6: Curtin Street looking south-west towards Goonyella Road (Google Street View, April 2008)

A priority (stop) intersection treatment is provided at the intersection of Goonyella Road where Goonyella Road is the priority road. On the approach to the intersection Curtin Street provides separate basic right (BAR) and basic left (BAL) turn lanes.

Curtin Street is a short street approximately 350m in length and as such a speed limit is not posted. Given the function of the road it is assumed that a speed limit of 60km/hr applies however in reality the length of the road is likely to prevent vehicles from reaching this speed.

3.2 Pedestrian Network

The Federation Walking Track is a 1km scenic trail situated on the north-east side of Moranbah Access Road from Mills Avenue to Grosvenor Park situated on the south side of Grosvenor Creek adjacent to Moranbah Access Road. A footpath is also provided on the south side of Mills Avenue.

3.3 Bicycle Network

The Federation Walking Track as described in Section 3.2 may be classified as a shared path catering for cyclists as well as pedestrians.

3.4 Public Transport Services

Moranbah is serviced by road and air.

Moranbah Airport located approximately 7km south-east of Moranbah on Moranbah Access Road and is a privately owned airport currently accommodating airline carrier Qantas as well as private charters. Qantas offers scheduled domestic flights to / from Brisbane and Townsville daily.

Public transport services by road include regional bus services and local school bus services. Regional busses are operated by Paradise Coaches and Greyhound Australia. Paradise Coaches provide service between Moranbah, Mackay, and Emerald, with one (1) service operating daily. Greyhound also provides service between Moranbah, Mackay, and Emerald with three (3) services operating weekly on Monday, Wednesday, and Friday. Both operators provide connection to further destinations.

Currently Moranbah does not operate a general public bus network however two (2) public school bus services operate between Moranbah State Schools from the townships of Coppabella and Villafranca on school days by the privately owned company Moranbah Bus Service. A map of the school bus route is shown in Figure 3-7.

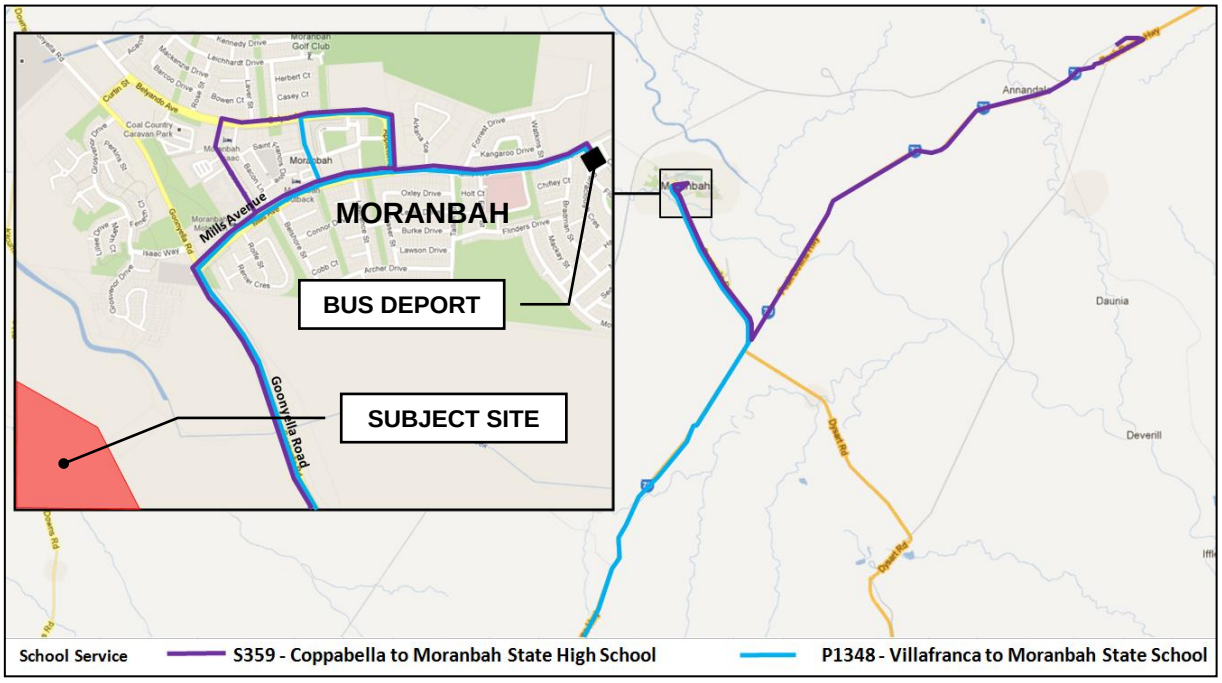

Figure 3-7: School Bus Services

4. BASE TRAFFIC

Base traffic is a prediction of traffic volumes on the road network in the future. Base traffic consists of traffic volumes derived from the following:

- Traffic generation as a result of land use changes;
- Impacts of road network changes; and
- Growth of existing traffic volumes.

As per the traffic operation assessment of the ultimate development of Belyando Estate three (3) existing critical intersections in the Moranbah road network are identified as likely to be impacted by traffic generated by Belyando Estate and therefore base traffic is required at these (3) intersections:

- Curtin Street / Goonyella Road;
- Mills Avenue / Moranbah Access Road / Goonyella Road; and
- Moranbah Railway Station Road / Moranbah Access Road.

The assumptions adopted in the following sections are exactly the same as those adopted in the assessment of the ultimate development of Belyando Estate with the exclusion of future residential development to the west of Belyando Estate and associated road network changes. Future development to the west of Belyando Estate is excluded from the analysis of Phase 1 since the future residential development is scheduled to commence after the completion of the ultimate development of Belyando Estate.

4.1 Existing

The following traffic survey data was supplied by Isaac Regional Council at the locations shown in Figure 4-1.

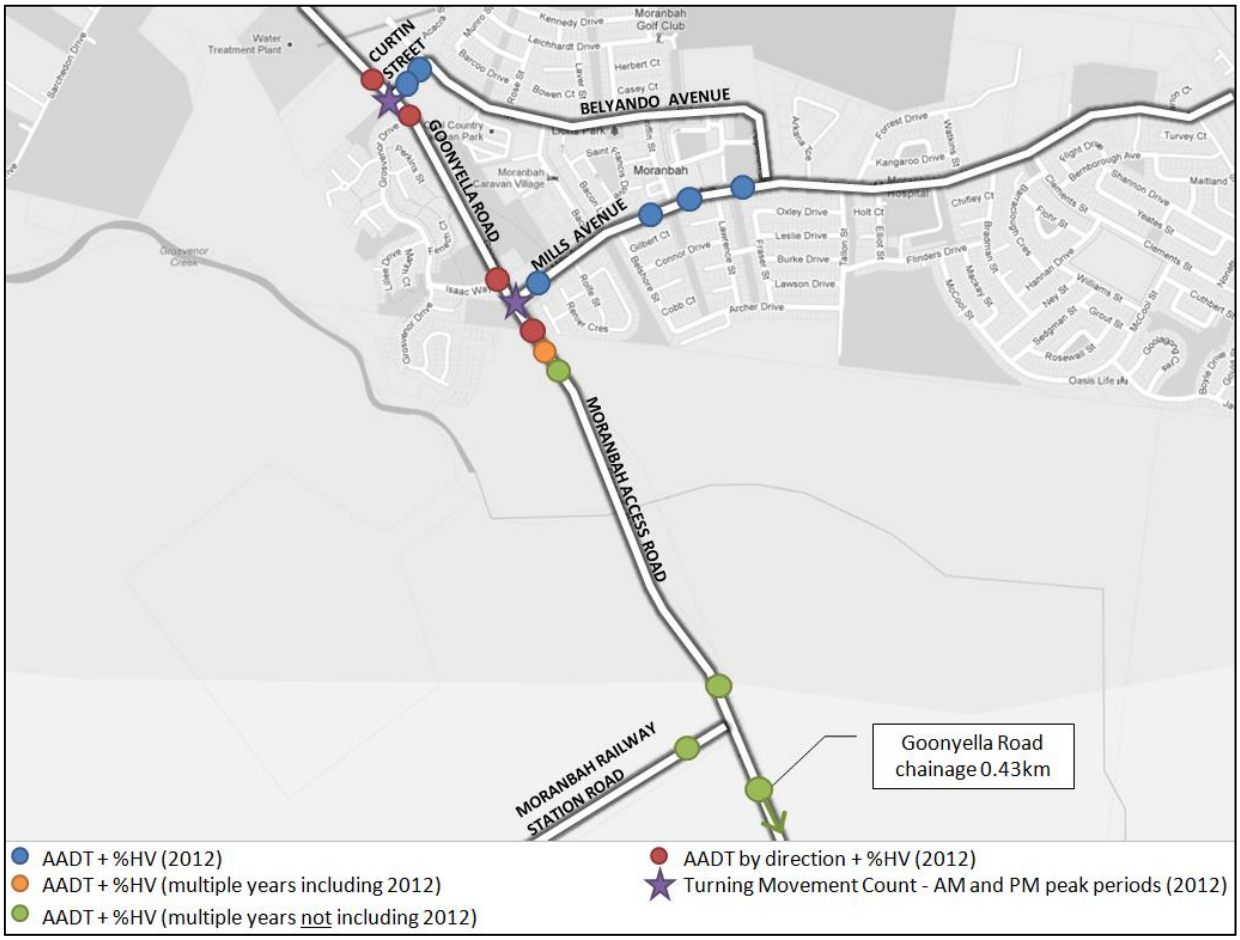

Figure 4-1: Traffic Survey Data (Supplied by Isaac Regional Council)

Adopting the turning movement count data at the intersections of Curtin Street / Goonyella Road and Mills Avenue / Goonyella Road / Moranbah Access Road, the combined peak hours occur at 6:00am - 7:00am during the AM peak period and 5:00pm - 7:00pm during the PM peak period as shown in Figure 4-2.

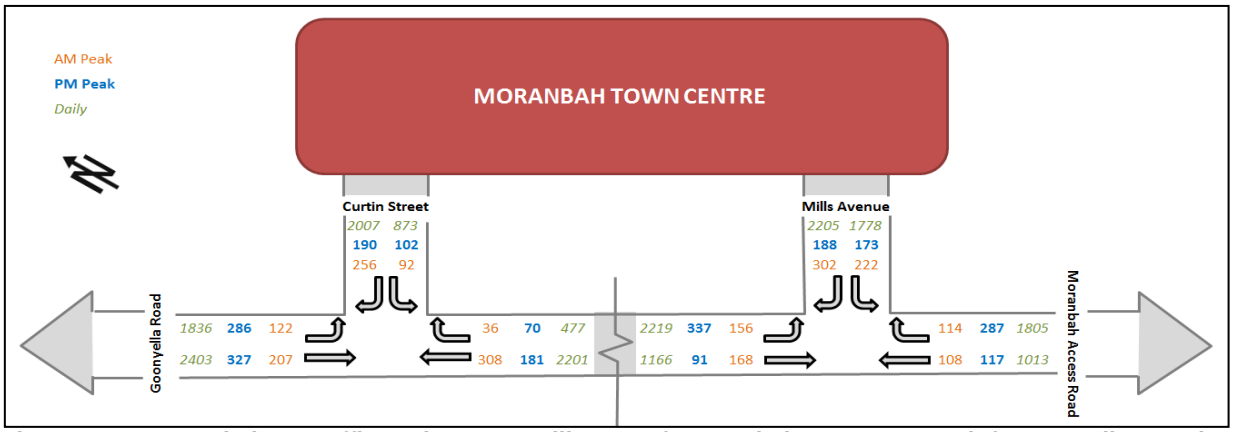

Figure 4-2: Existing Traffic Volumes - Mills Ave / Moranbah Access Road / Goonyella Road, Goonyella Road / Curtin St

Comparing the existing peak hour turning movement data shown in Figure 4-2 to AADT data recorded in 2012 on Goonyella Road, Moranbah Access Road, Curtin Street, and Mills Avenue reveals that on average 11% of the daily traffic volume occurs in the peak periods. It is noted however that the turning movement counts adopted as existing in this report vary somewhat to those adopted in Moranbah Traffic Study dated October 2012 prepared by VDM Consulting on behalf of Isaac Regional Council however it is unclear how these volumes were derived.

At the intersection of Moranbah Access Road / Moranbah Railway Station Road where turning movement counts were not supplied, the AADT data supplied was used to derive peak hour traffic volumes by assuming 11% of the daily traffic occurs in the peak periods as establishd in the above discussion. In the AM peak it is assumed that 80% of traffic is outbound from the town centre of Moranbah with 20% inbound, and during the PM peak 70% is inbound towards the town centre of Moranbah with 30% outbound. Based on the forgoing discussions, traffic volumes adopted as existing at the intersection of Moranbah Access Road / Moranbah Railway Station Road are shown in Figure 4-3.

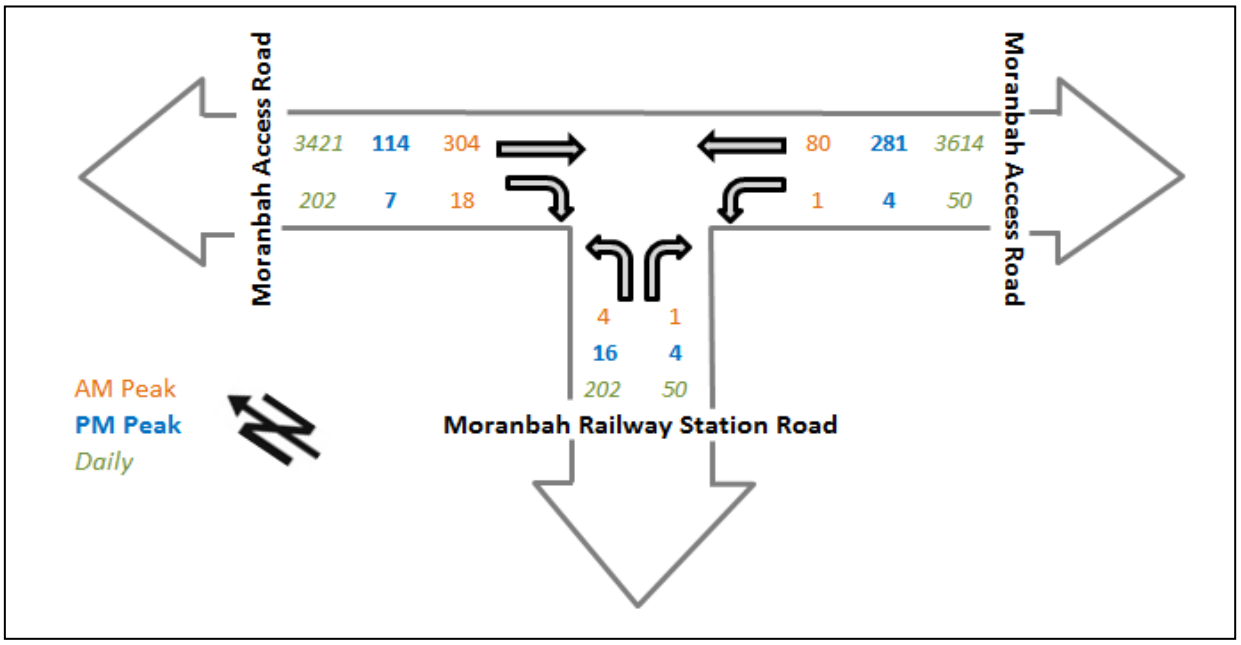

Figure 4-3: Existing Traffic Volumes – Moranbah Access Road / Moranbah Railway Station Road

4.2 Impact of Land Use Changes

Land use changes shown in Figure 4-4 are discussed in sections 4.2.3 and 4.2.4.

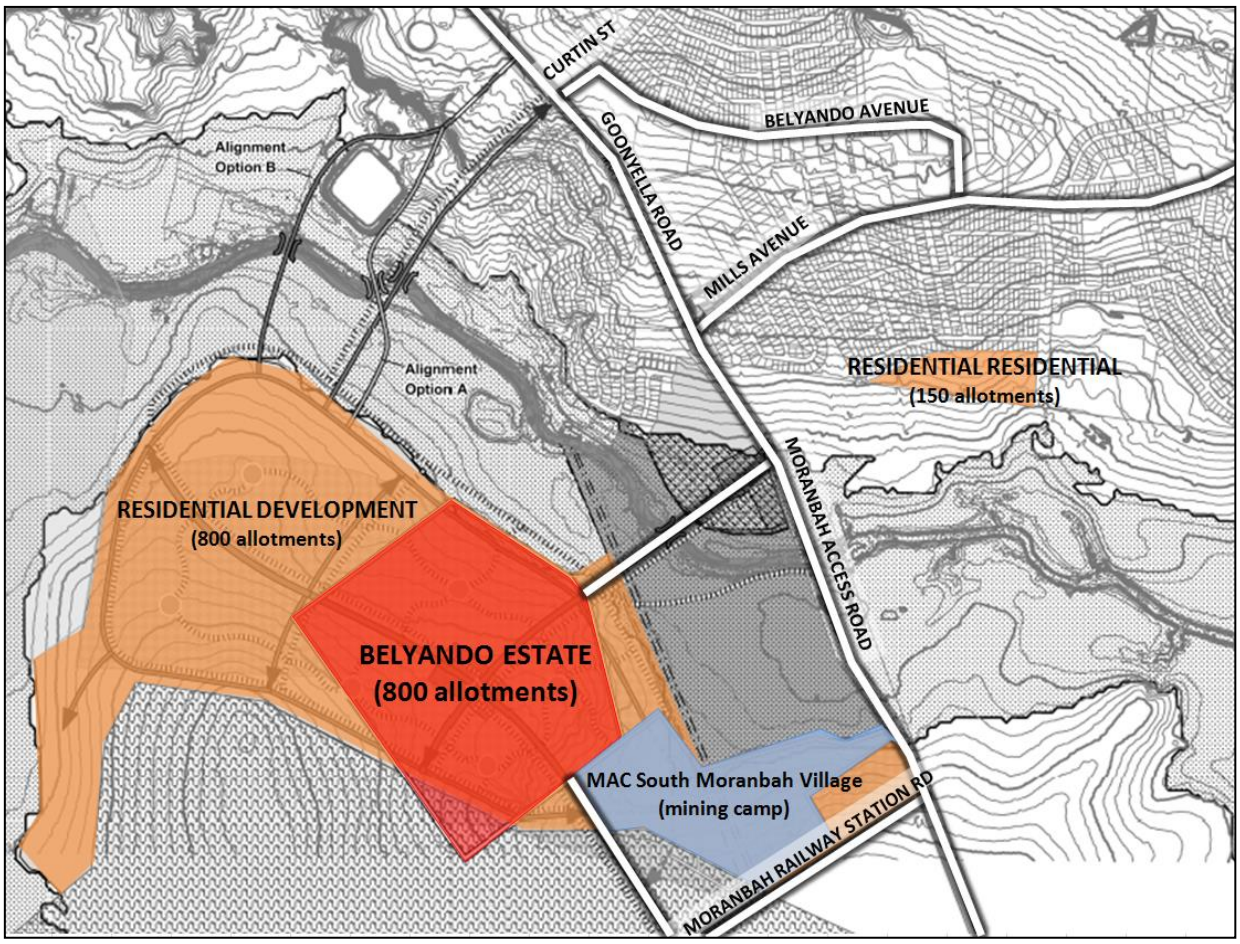

Figure 4-4: Land Use Changes

4.2.1 Impacts of Mining Employment

Traffic patterns in the township of Moranbah are largely characterised by mining activities in the surrounding district. Existing mines and their employment numbers (extracted from the Moranbah Traffic Study by VDM Consulting, October 2012) are shown in Table 4-1 where mines are categorised in accordance with their location either north or south of Moranbah. Table 4-1 reveals the existing mines located south of Moranbah employ approximately 58% of the mining workforce of the mines listed in Table 4-1 compared to the remaining 42% employed by mines located to the north of Moranbah.

Table 4-1: Existing Mine Locations and Operational Employment Numbers

Existing Mining Operations			
Located North of Moranbah		Located South of Moranbah	
Name of Mine	Employment	Name of Mine	Employment
Broadmeadows	475	Daunia	400
Goonyella Riverside	2,360	Peak Downs	1,820
Burton	680	Poitrel	345
North Goonyella	750	Saraji	1,750
Moranbah	36	Moorvale	280
		Millennium	345
		Carbourough Downs	645
		Isaac Plains	345
Total Employment	**4,301**	**Total Employment**	**5,930**

The Queensland Government Department of Employment, Economic Development, and Innovation published a list of mineral and energy projects (February 2012) forecast for development. These projects consist of new mines as well as the expansion of existing mines. Table 4-2 shows the relevant projects to Moranbah extracted from the mineral and energy project list then categorised in accordance with their location either north or south of Moranbah.

Table 4-2: Future Mining Projects and Employment Numbers

Future Mining Operations			
North of Moranbah		South of Moranbah	
Name of Mine	Employment	Name of Mine	Employment
Grosvenor	485	Millennium Expansion	160
Eaglefield	700	Olive Downs North	80
Byerwen	1,000	Eagle Downs	410
Ellensfield	340	Caval Ridge	500
		Peak Downs Expansion	350
Total Employment	**2,525**	**Total Employment**	**1,500**

New mines and the expansion of existing mines shown in Table 4-2 are earmarked for development between 2012 and 2015. These mines are expected to increase employment by 4,025 positions once fully operational. The split of employment by the mining industry north and south of Moranbah is set to become more even with 52% of the mining workforce of the mines listed in Table 4-1 and Table 4-2 employed to the south and 48% to the north.

The location of the future mines is shown in Figure 4-5 below:

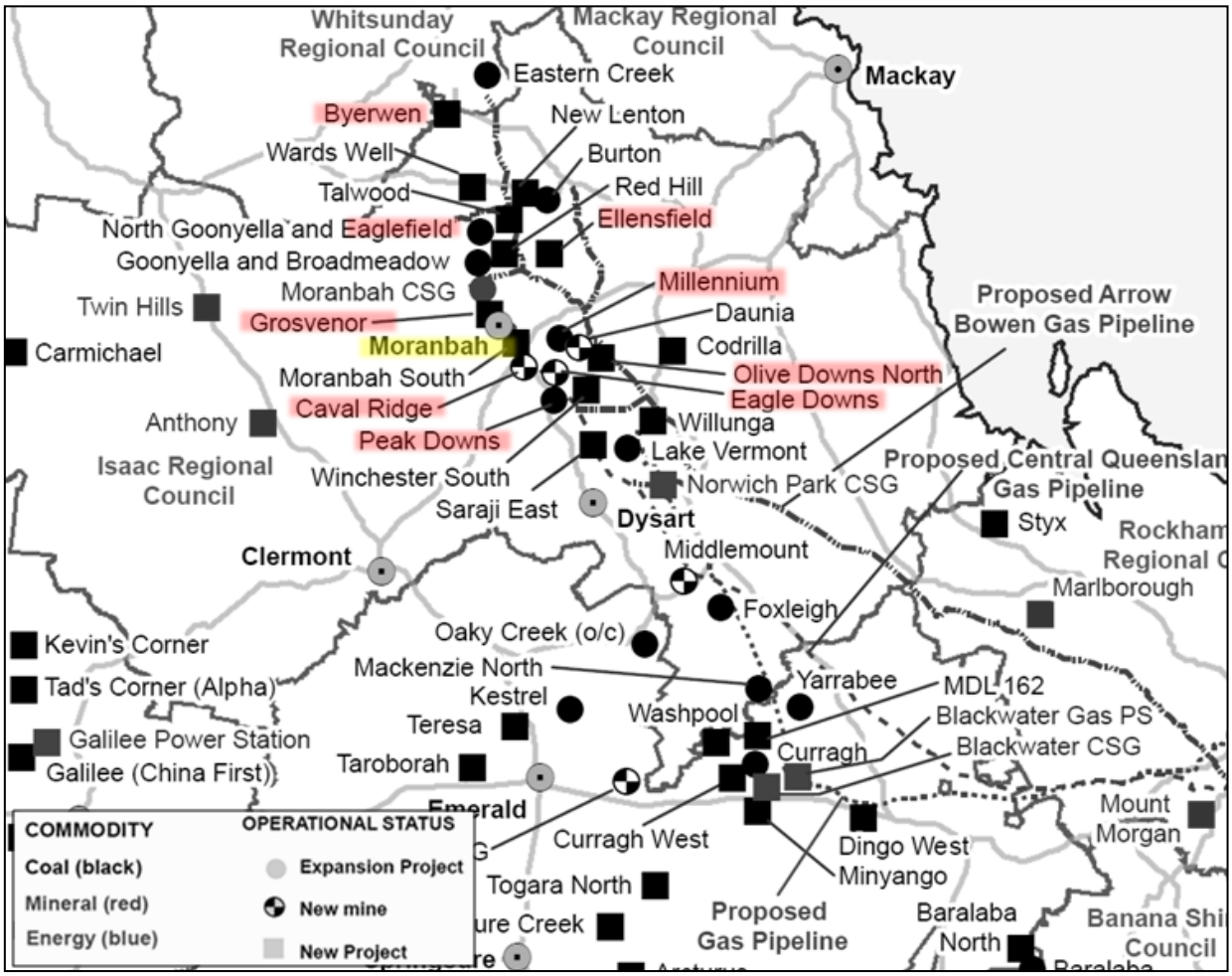

Figure 4-5: Location of Future Mineral and Energy Projects

It should be noted that during the construction phase of future mining projects including new mines and the expansion of existing mines, the construction mining workforce is often up to 20% higher than that during operation. In terms of catering for traffic demand, the peak employment may only last a short period during the construction phase with respect to the operational lifespan of the mine, therefore only the operational phase is considered in traffic operation and impact analysis within this report. Furthermore, it is unlikely that the peak construction period for each mining project coincides.

4.2.2 Fly In Fly Out Mining Operations

Moranbah has an existing airport which makes the fly in fly out mining employment operation commonly known as FIFO feasible in the Moranbah district. FIFO employees are typically housed in mining camps specially designed to accommodate the basic needs of workers between shifts at the mine. At the end of a period at the mine, the employee is flown back to their home city. Between the airport, mining camp, and the mine itself, all transport needs are met by the employer often in the form of mass transit such as busses reducing the impact of traffic on the road network.

The impact assessment of Belyando estate is primarily concerned with the existing road network north of the airport. Traffic generated by FIFO employees is therefore best quantified by the assessment of traffic generation by individual mining camps in Moranbah

discussed in Section 4.2.3. Any subsequent traffic generated is accounted for in the future growth factors applied to the existing traffic volumes discussed in Section 4.4.

4.2.3 MAC South Moranbah Village Mining Camp

A Traffic Engineering Study was prepared by ttm Group, dated October 2012 for the proposed mining camp known as the MAC South Moranbah Village located on the corner of Moranbah Access Road and Moranbah Railway Station Road as shown in Figure 4-4. The following information in relation to the mining camp is provided in accordance with the ttm Group report.

The MAC South Moranbah Village mining camp is to ultimately provide 3,618 cabins in addition to a reception, shop, kitchen and dining facilities, recreational space, as well as laundry facilities and amenities. Access to the site is proposed via two (2) points on Moranbah Railway Station Road ultimately providing access to 2,635 parking spaces on-site in addition to 71 bus parking spaces and interchange facilities.

It is assumed that employees accommodated at the mining camp are transported between the mine and the camp by bus resulting in a low generation rate. Traffic generation rates adopted within this report as per the ttm Group report are 0.1 vehicles / hour / cabin during peak hours equating to 362 vehicles per hour where 10% of the daily total is expected to occur in the peak hours equating to 3,618 vehicles / day.

Due to the 24 hour operation of the mine, mining employees both leave the camp and return from the mine during a shift changeover therefore assuming a relatively balanced split of traffic inbound and outbound during peak hours. It is therefore assumed that during the AM peak 60% of traffic is outbound and 40% inbound where the reverse occurs in the PM peak. It is conservatively assumed that 100% of traffic is distributed to Moranbah Access Road where at the intersection of Moranbah Access Road / Moranbah Railway Station Road 55% of traffic are distributed north-east towards the town centre of Moranbah and 45% south towards Peak Downs Highway as shown in Figure 4-6. It is noted that although these assumptions were adopted as per the report by ttm Group, there appears to be an error in the distribution of traffic volumes presented in Figure 6.1 on page 12 of the report by ttm Group which consequently feeds throughout the proceeding analysis.

It is anticipated that the MAC South Moranbah Village mining camp will be completed in 2014 before the scheduled completion of Belyando Estate in 2022.

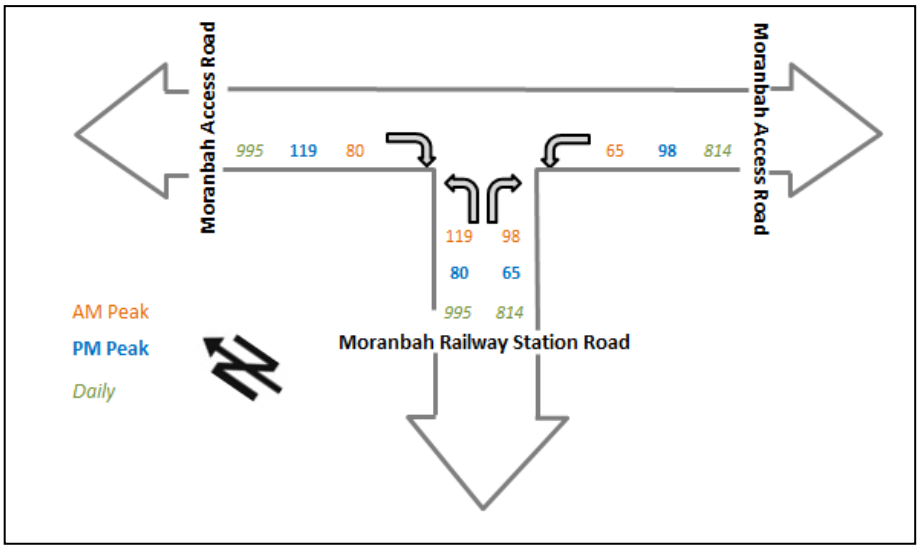

Figure 4-6: MAC South Moranbah Village Traffic Generation

As the scope of analysis within this report includes a wider road network, further distribution of traffic generated by the mining camp is considered. It is assumed that 80% of the traffic generated by the mining camp during peak hours is to and from the mines with staff working at the mining camp itself expected to contribute the remaining 20% of trips. Staffs working at the mining cap are assumed to live locally within Moranbah. The distribution of traffic generated by the mining camp is therefore assumed as shown in Figure 4-7.

For the purposes of the analysis contained within this report, it is assumed that a single access point is provided from MAC South Moranbah Village mining camp to Moranbah Railway Station Access Road as shown in Figure 4-7.

A summary of the MAC South Moranbah Village mining camp traffic volumes is shown in Appendix C.

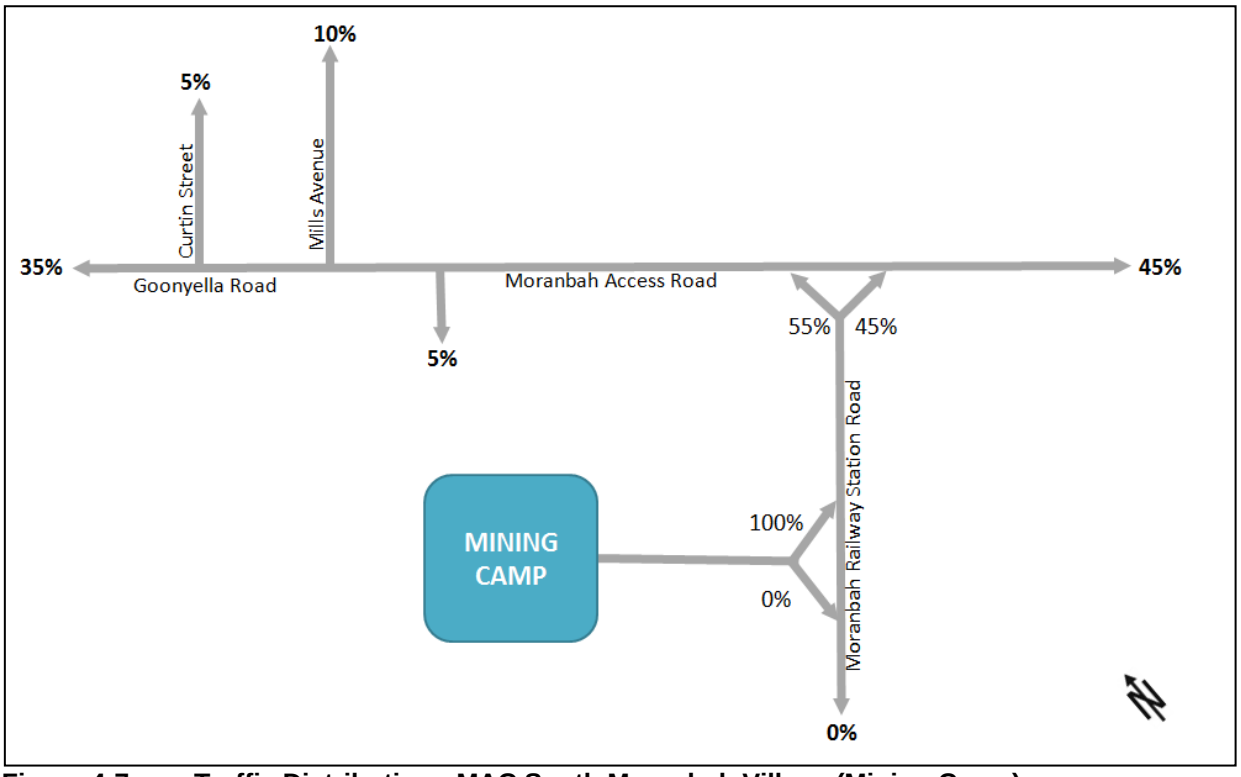

Figure 4-7: Traffic Distribution - MAC South Moranbah Village (Mining Camp)

4.2.4 Future Residential Development

Two (2) significant areas of residential development are proposed in Moranbah in addition to Belyando Estate as shown in Figure 4-4.

The timing of the future residential development located to the west of Belyando Estate is unknown at this stage however construction is assumed to commence not until the ultimate completion of Belyando Estate. The future residential development located south of Mills Avenue however is already under construction and is expected to be completed in 2013 providing in the order of 150 residential allotments.

For the purposes of predicting future traffic generation, it is assumed that each residential allotment will provide a single detached dwelling. Consistent with traffic generation for Phase 1 of Belyando Estate in section 5.1, in accordance with Queensland Street – Design Guidelines for subdivisional Streetworks, May 1993 indicates that:

"The generally accepted design Traffic Generation Rate for catchment sizes applicable to a residential street is 10 trips per dwelling per day."

As determined from analysis of the existing traffic data (refer to Section 4.1), it is assumed that 11% of the daily traffic will occur in the peak hours. It is anticipated that 80% of trips during the AM peak are outbound with 20% of trips inbound and 30% of trips outbound in the PM peak with 70% of trips inbound.

Residential trips are generated for the purpose of retail, shops, school, work, and other requirements which are often made a part of a single outbound trip satisfying more than one (1) need and therefore called a multipurpose trip.

It is noted in Figure 4-8 that the majority of schools, retail, and shops including the supermarkets are located in the town centre representing 50% of all daily trips generated. It is therefore assumed that 20% of all trips will form part of a multipurpose trip via Moranbah Town Centre.

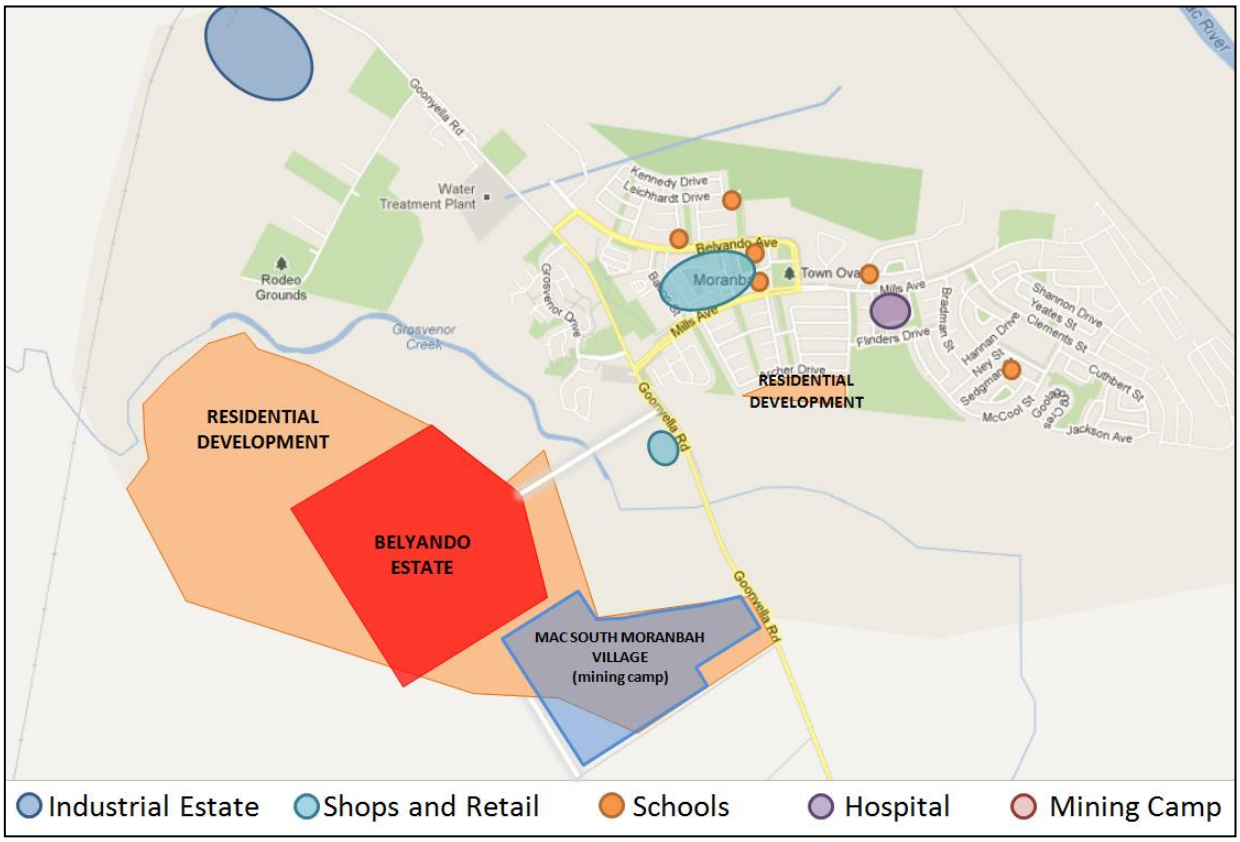

Figure 4-8: Location of Trip Attractors

Given the location of the town centre of Moranbah with respect to the location of the future residential developments, the existing directional split at each intersection, and the future split of mining employment north and south of Moranbah, the distribution of traffic generated by the future residential development on the existing road network is assumed as shown in Figure 4-9.

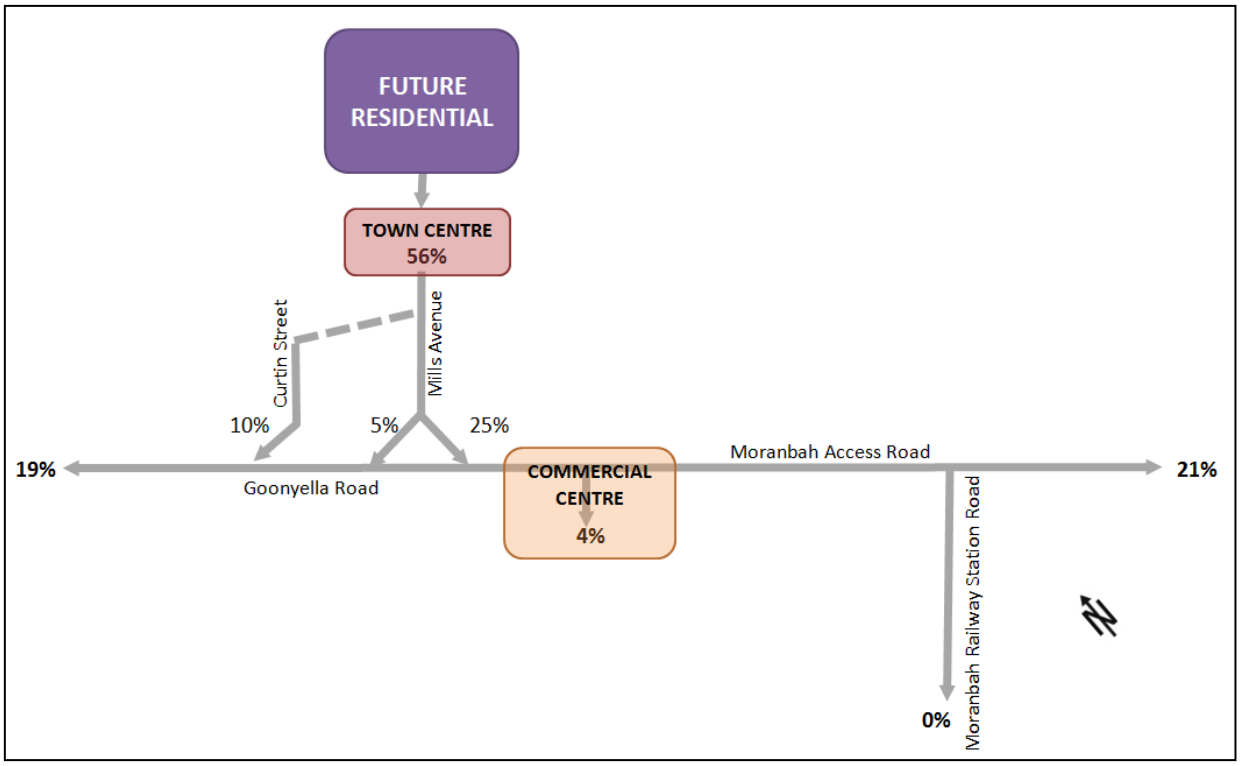

Figure 4-9: Traffic Distribution - Future Residential Development (South of Mills Ave)

Traffic volumes generated by the residential development assigned to the road network as per the distribution adopted in Figure 4-9 are summarised in Appendix C.

4.3 Impact of Road Network Changes

Road network changes may include upgrades to carriageways or intersections often providing additional capacity within the road network or by the addition of new roads connecting with the existing. Changes to the road network relevant to this study are discussed below.

The ultimate development of Belyando Estate includes two (2) connections to the existing arterial road network as shown in Figure 4-10. As part of Phase 1, one (1) or both these connecting road may be constructed as determined by the traffic operation analysis discussed in Section 6.

Based on recommendations made by ttm Group for MAC South Moranbah Village mining camp, it is understood that the intersection at Moranbah Access Road / Moranbah Railway Station Road will require upgrading from a priority (give-way) type intersection as a result of traffic generated by the mining camp. This intersection is within the scope for Phase 1 of Belyando Estate and as such is analysed in Section 6 of this report.

Similarly, in the traffic study analysing the capacity of key intersections in Moranbah undertaken by VDM Consulting on behalf of Isaac Regional Council, it is recommended that the intersections of Mills Avenue / Moranbah Access Road / Goonyella Road and Curtin Street / Goonyella Road be upgraded to dual lane roundabouts as soon as possible. These two (2) intersections also form part of the scope for Phase 1 of Belyando Estate and are analysed in Sections 6.6 and 6.7.

As part of the future residential development to the west of Belyando Estate a new road is proposed to connect between the future residential development and Goonyella Road. Since the development of this area is after the completion of Phase 1 of Belyando Estate, the new

road associated with the future residential development is not considered in this report for analysis of Phase 1 of Belyando Estate.

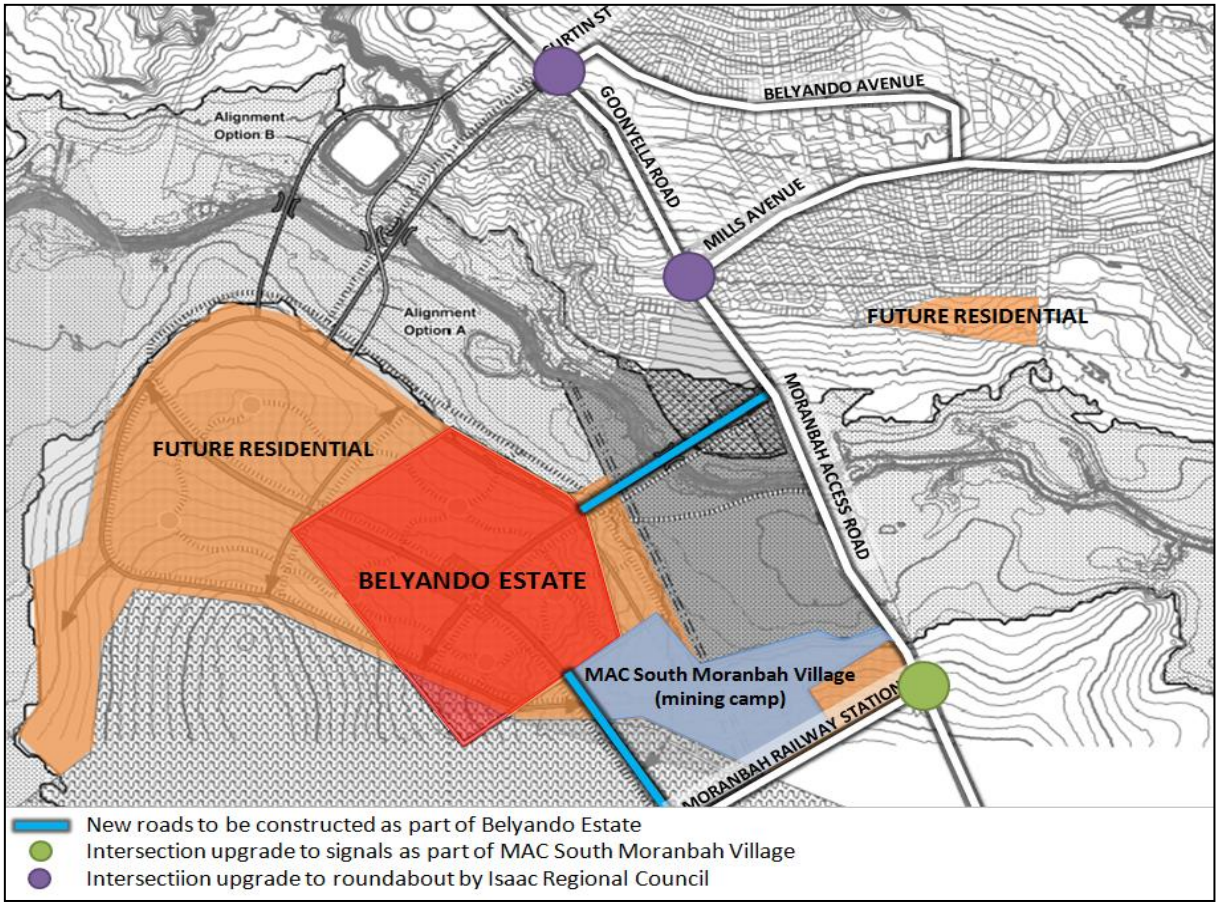

Figure 4-10: Road Network Changes

4.4 Growth

Generally an arterial road growth rate greater than 5% per annum is considered unsustainable where as a growth rate of less than 1% is considered unrealistic.

Historic AADT data recorded at varying times of the year between 2002 and 2012 on Moranbah Access Road between Mills Avenue and Moranbah Railway Station Road indicates an average growth rate of 4.4% between 2004 and 2007. In 2009 a drop in AADT by 7.5% was recorded resulting in an exceptionally large increase of 71% in the following count in 2011, and again a further increase in AADT of 21.6% in 2012. Recent AADT growth is attributed to the mining boom where Moranbah is at its centre. Although the mining boom is set to continue for the next few years before becoming stable, by including traffic generated by land use changes within this analysis it is considered unreasonable to adopt the recent growth rates recorded. It is instead proposed to adopt the upper limit of 5% on Moranbah Access Road and Goonyella Road, 3% on all other roads being Mills Avenue, Curtin Street, and Moranbah Railway Station Road to account for general traffic growth on the road network.

To provide a level of confidence that the growth rates adopted are sufficient in addition to the traffic generated by the individual land use changes given the mining boom, the number of dwellings as a result of land use changes is compared to the number of future mining employment positions, as identified in Section 4.2.1. Belyando Estate, the MAC South Moranbah Village mining camp, and the two (2) future residential developments is estimated to provide 5,368 dwellings where future mining projects are to provide 4,025 new

employment positions. The ratio of dwellings is greater than the number of mining employment position with 67% of dwellings to be provided by the mining camp by 2015 when the future mining projects enter the operational phase.

The growth rates applicable to existing traffic volumes adopted within this section of the report on top of traffic generated by land use change given the preceding discussions are therefore considered appropriate.

5. DEVELOPMENT TRAFFIC

5.1 Traffic Generation

In relation to traffic generation, Queensland Streets – Design Guideline for Subdivisional Streetworks, May 1993, indicates that:

"The generally accepted design Generation Rate for catchments sizes applicable to a residential street is 10 trips per dwelling per day."

"While the predominant land use in average residential streets is single detached dwellings, some catchments may contain other dwelling types or land uses. For traffic generation calculations it is convenient to reduce these uses to "Equivalent Dwellings" using the representative figures given in Table 2.2E."

Of the 186 residential allotments to be provided in Phase 1 of Belyando Estate is proposed to provide 63% traditional type housing or a single dwelling per allotments, 17% adaptable or multi dwelling allotments, and 20% courtyard or villa type dwellings with a single dwelling per allotment.

The applicable equivalent dwelling factors are as follows:

- Traditional housing (single dwelling per allotment) – 1.0 per allotment;
- Adaptable or multi dwelling allotments – 0.6 per dwelling; and
- Courtyard or Villa (single dwelling per allotment) – 1.0 per allotment.

It is assumed that an average of four (4) dwellings are provided for each adaptable or multi dwelling allotment equating to an equivalent dwelling factor of 2.4 per allotment. It is assumed the remainder of residential allotments providing a single dwelling per allotment with an equivalent dwelling factor of 1.0. For the purposes of calculating traffic generation, Phase 1 of Belyando consists of 230 equivalent dwellings.

In accordance with Queensland Streets – Design Guideline for Subdivisional Streetworks, May 1993, daily trips per dwelling are generally made for the following purpose:

- Shops located within the neighbourhood 2 (two);
- School located within the neighbourhood 1 (one);
- Work external to the neighbourhood 4 (four);
- Retail external to the neighbourhood 2 (two); and
- Other external to the neighbourhood 1 (one).

A total of five (5) undefined lots are also to be provided within Phase 1 of Belyando Estate. It is assumed that these lots will be other than residential or parkland. It is speculated that

these lots may be commercial to satisfy the basic shopping needs of local residents within the neighbourhood such as a milk bar or pharmacy, or provide schools, childcare, or the likes. It is therefore conservatively assumed that only one (1) of the three (3) daily trips generated within the neighbourhood in accordance with Queensland Streets are to occur within Phase 1 of Belyando Estate with the remaining two (2) trip external to satisfy the needs of residents.

A discussed in Section 4.1, the existing traffic volume data reveals that 11% of daily traffic occurs during the peak hours. Typically 10% is adopted however given the traffic generation characteristic of mining, 11% is conservatively adopted. During the AM peak hour it is assumed that 80% of trips are outbound and 20% inbound where in the PM peak 30% are outbound with 70% of trips inbound. It is also assumed that a 50% split between inbound and outbound trips occur daily.

The expected traffic volumes generated by Phase 1 of Belyando Estate external to Belyando Estate is shown in Table 5-1 below:

Table 5-1: Belyando Traffic Generation

	AM	PM	Daily
Outbound	46	159	1,035
Inbound	182	68	1,035
Total	**228**	**228**	**2,070**

5.2 Traffic Distribution

The distribution of traffic generated by Belyando Estate is influenced by the arterial road network and the location of trip attractors to satisfy the needs of residents.

Figure 4-8 indicates the majority of shops and retail including a supermarket, schools, and other major trip attractors such as the hospital are located within the town centre of Moranbah and therefore trips made external to Belyando Estate for purposes other than works are assumed to be to the town centre. Often a single round trip combines a number of stops to satisfy trip purposes and is therefore called multipurpose trips. It is assumed that 20% of trips external to Phase 1 of Belyando Estate are multipurpose trips via the town centre of Moranbah.

As discussed in Section 4.2.1 by 2015 mining employment is expected to be split 48% to the north of Moranbah and 52% to the south of Moranbah.

Given the preceding discussions and based on the existing directional spit at existing intersections, the assumed traffic distribution for Phase 1 of Belyando Estate is assumed to be the same as in the ultimate as shown in Figure 5-1.

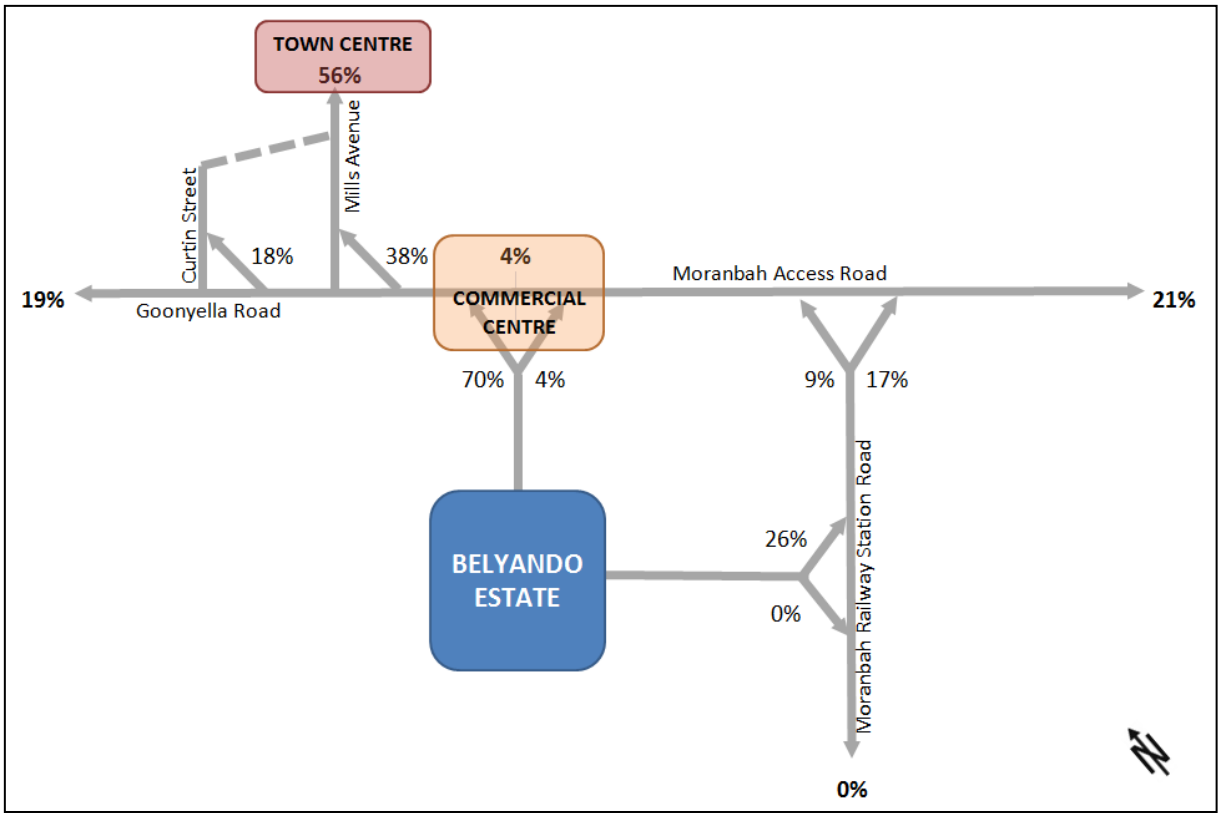

Figure 5-1: Belyando Estate Traffic Distribution

Alternatively if only one (1) or the other connection roads to Moranbah Access Road is constructed during Phase 1 of Belyando Estate, 100% of traffic generated by Phase 1 would travel via this road. At the intersection of Moranbah Access Road the directional split of traffic is the sum of that shown in Figure 5-1.

5.3 Traffic Assignment

Assignment of generated traffic to the road network for volumes in Table 5-1 as per the distribution adopted in Figure 5-1 with consideration to multipurpose trips is shown in Appendix C. Traffic assignment is also considered if only one of the connection roads is constructed as part of Phase 1 of Belyando Estate shown in Appendix C.

6. TRAFFIC OPERATION AND IMPACT ASSESSMENT

As per the ultimate development assessment for Belyando Estate the following intersections are determined as critical to the performance of the major road infrastructure in Moranbah shown in Figure 6-1 which may be impacted by Phase 1 of development.

Figure 6-1: Critical Intersections

It is proposed to analyse the impact of Phase 1 of Belyando Estate at each of the intersections shown in Figure 6-1 with respect to the design year and design horizon for Phase 1. At each of these years it is proposed to analyse base traffic and development traffic to identify the trigger for intersection upgrades, if any are required.

The design year is typically the year in which the ultimate development is scheduled for completion however, in this case, Phase 1 of development is scheduled for completion by late 2014 therefore 2015 is conservatively adopted as the design year. At the design year in 2015 for Phase 1 of Belyando Estate it is assumed that MAC South Moranbah Village mining camp is complete and fully operational and that the residential development to the south of Mills Avenue is also complete. Base traffic volumes in the design year therefore consist of the MAC South Moranbah Village mining camp, the residential development south of Mills Avenue, plus the existing traffic volumes in 2015 including compound growth per annum as per Section 4.4 applied between the years 2012 to 2015.

The design horizon is typically 10 years post the design year for the ultimate development. The design year of the ultimate development of Belyando Estate is 2022 with the design horizon in 2032 as per report TIRC001 R01 for the purpose of analysis. Since Phase 1 is the

first phase of the ultimate development of Belyando Estate, only the design year for Phase 1 is considered in this report.

Either one or both of the connection roads may be constructed as part of Phase 1 of Belyando Estate. It seems logical that the connection road direct to Moranbah Access Road is to be constructed first however the cost of the bridge over Grosvenor Creek may be significant enough for the connection to Moranbah Railway Station Road to be more economical. Furthermore, the intersection of Moranbah Access Road / Moranbah Railway Station Road is assumed to be upgraded before the completion of Phase 1 by the MAC South Moranbah Village mining camp.

Given the above discussion analyses of the following scenarios are considered:

- Scenario A: Design Year 2015 – Base Traffic;
- Scenario B: Design Year 2015 – Base Traffic + Phase 1 Belyando Estate (both connection roads);
- Scenario C: Design Year 2015 – Base Traffic + Phase 1 Belyando Estate (Moranbah Access Road connection only); and
- Scenario D: Design Year 2015 – Base Traffic + Phase 1 Belyando Estate (Moranbah Railway Station Road connection only).

Traffic volumes for scenarios A to D are located in Appendix C.

6.1 SIDRA Intersection Analysis

It is proposed to measure the intersection operational performance using aaSIDRA Intersection (SIDRA). SIDRA is a computer package used to describe the capacity and operational performance of an intersection in terms of a range of parameters as described below:

Degree of Saturation (DoS) is the ratio of the volume of traffic observed making a particular movement compared to the theoretical capacity for that movement. A DoS of up to 0.6 is rated as excellent where at the other end of the scale a DoS of 1.0 or higher is rated as very poor.

Average Delay is the time measured in seconds for all vehicles making that particular movement during the peak hour.

Level of Service (LoS) is a measure used to describe a drivers perception of the quality of the experience at an intersection where LoS A is the highest and LoS F is the lowest representing virtually grid lock.

95 Percentile Back of Queue represents the maximum queue length measured in metres that can be expected in 95% of queues observed in the peak hour.

SIDRA results are located in Appendix D.

6.2 Safety In Design

Turn treatments on major roads at unsignalised intersection, although not always required by SIDRA to satisfy the intersection operation performance criteria, should be provided for safety in design. Warrants for turn treatments are specified in accordance with Austroads

(2010): 'Guide to Road Design – Part 4A: Unsignalised Intersections and Signalised Intersections', where the following may be specified:

- BAR Basic Right;
- BAL Basic Left;
- AUL Auxiliary Left;
- AUR Auxiliary Right;
- CHR Channelised Right;
- CHL Channelised Left; and
- (S) Short.

Roundabouts should be designed to accommodate the largest vehicle expected to use the intersection. Due to the mining industry surrounding Moranbah, a type 2 road train has been adopted as the design vehicle for roundabouts on Moranbah Access Road and Goonyella Road. In accordance with AustRoads: Guide to Road Design Part 4B (2011), the minimum central radius to accommodate the right turning movement of the design vehicle and car within a dual lane roundabout is 32 metres with a circulation width of 13.9 metres. Mining vehicles, particularly type 2 road trains are not expected to turn right at any of the intersections analysed in the scope of this report however, the dimensions specified in the preceding discussions are adopted for the purpose of SIDRA intersection analysis.

6.3 Belyando Estate / Moranbah Railway Station Road

It is proposed to construct a new road servicing traffic generated by Phase 1 of Belyando Estate connecting with Moranbah Railway Station Road and as such, a new intersection is required at this location. This connection road is considered in scenarios B and D where scenario D is the worst case servicing 100% of traffic generated by Phase 1 of Belyando Estate.

The simplest, most cost effective and low maintenance intersection treatment is a priority (give-way or stop) intersection providing traffic volumes support safe operation of the intersection. In line with the ultimate development it is proposed to provide a priority (give-way) intersection where Moranbah Railway Station Road is the priority road.

To ensure safety in design, warrants for turn lane treatments on the priority road (Moranbah railway Station Road) as discussed in Section 6.2 are considered for traffic volumes generated in scenarios D being the worst case traffic volumes for Phase 1 of development. Traffic volumes suggest only a BAR turn treatment is required which is consistent with that proposed for the ultimate development of Belyando Estate.

The intersection layout adopted for SIDRA analysis is shown in Figure 6-2.

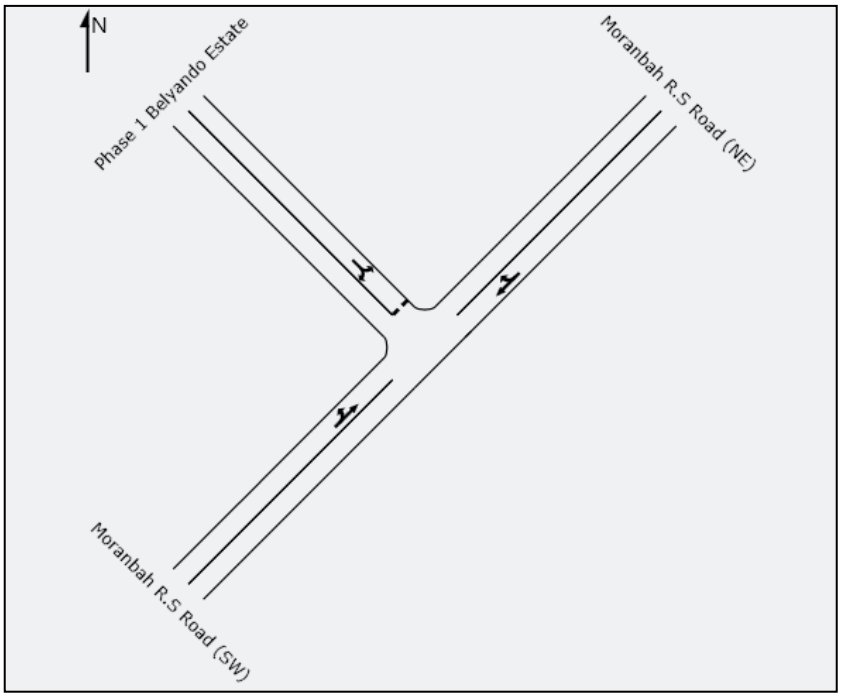

Figure 6-2: Proposed Intersection Layout – Phase 1 Belyando Estate / Moranbah Railway Station Road

A summary of the SIDRA results for scenario D being the worst case scenario is shown in Table 6-1.

Table 6-1: SIDRA Results – Proposed Intersection Layout Phase 1 Belyando Estate / Moranbah Railway Station Road, Scenario D

Approach	Existing AM Peak				Existing PM Peak			
	DoS v/c	Ave Delay	LoS	Q (m)	DoS v/c	Ave Delay	LoS	Q (m)
Moranbah R.S Road (NE)	0.027	3.3 sec	A	1.2	0.058	6.8 sec	A	1.9
Phase 1 Belyando Estate	0.043	8.4 sec	A	1.1	0.018	8.5 sec	A	0.4
Moranbah R.S Road (SW)	0.004	1.2 sec	A	0.0	0.013	0.3 sec	A	0.0

Review of the SIDRA results shown in Table 6-1 indicate that the intersection is expected to operate extremely well with a very low DoS of less than 0.1 on all approaches, negligible queues with a maximum recorded of 1.9 metres (less than 1 vehicle), and a maximum delay of 8.5 seconds. SIDRA results also indicate that the proposed intersection layout which is consistent with that proposed for the ultimate development of Belyando Estate is considered appropriate to service 100% of traffic generated by Phase 1 of development.

If the second connection road was provided, traffic volumes split between the two (2) connection roads would therefore be lower at the proposed intersection of Belyando Estate / Moranbah Railway Station Road and result in improved intersection performance than that shown in Table 6-1.

6.4 Belyando Estate / Moranbah Access Road

It is proposed to construct a new road servicing traffic generated by Belyando Estate connecting with Moranbah Railway Station Road and as such, a new intersection is required at this location. This connection road is considered in scenarios B and C where scenario C is the worst case servicing 100% of traffic generated by Phase 1 development of Belyando Estate.

Again, the simplest, most cost effective and low maintenance intersection treatment is a priority (give-way or stop) intersection providing traffic volumes support safe operation of the intersection.

Ultimately at the design horizon for Belyando Estate in 2032, the intersection of Belyando Estate / Moranbah Access Road will be required to be upgraded to a dual lane roundabout along with duplication of Moranbah Access Road as identified in report TIRC001 R01. An interim priority (give-way) intersection is proposed before the ultimate upgrade where the priority intersection supports ultimate traffic volumes generated by Belyando Estate in 2022. It is proposed to adopt the same intersection layout to assess Phase 1 of development as shown in Figure 6-3.

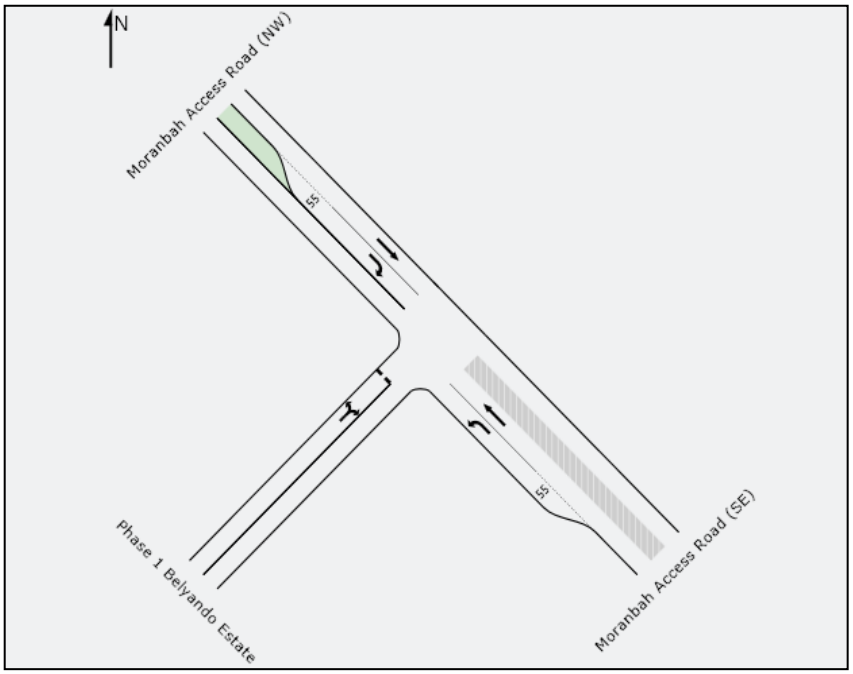

Figure 6-3: Proposed Intersection Layout – Phase 1 Belyando Estate / Moranbah Access Road

A summary of the SIDRA results for scenario C being the worst case scenario is shown in Table 6-2.

Table 6-2: SIDRA Results – Proposed Intersection Layout Phase 1 Belyando Estate / Moranbah Access Road, Scenario C

Approach	Existing AM Peak				Existing PM Peak			
	DoS v/c	Ave Delay	LoS	Q (m)	DoS v/c	Ave Delay	LoS	Q (m)
Moranbah Access Road (SE)	0.132	0.3 sec	A	0.0	0.258	0.5 sec	A	0.0
Phase 1 Belyando Estate	0.287	0.9 sec	B	2.0	0.369	6.1 sec	C	13.0
Moranbah Access Road (NW)	0.324	13.3 sec	B	10.5	0.155	14.5 sec	B	3.9

Review of the SIDRA results shown in Table 6-2 indicate that the intersection is expected to operate very well with a DoS of less than 0.4 on all approaches, minimal queues with a maximum recorded of 13.0 metres (less than 2 vehicles), and a maximum delay of 14.5 seconds. SIDRA results also indicate that the proposed intersection layout which is consistent with that proposed at the design year for the ultimate development of Belyando Estate is considered appropriate to service 100% of traffic generated by Phase 1 of development.

If the second connection road was provided, traffic volumes split between the two (2) connection roads would therefore be lower at the proposed intersection of Belyando Estate / Moranbah Access Road and result in improved intersection performance than that shown in Table 6-2.

6.5 Moranbah Access Road / Moranbah Railway Station Road

The existing priority (give-way) intersection provides the basis to determine if and when the intersection requires upgrading. As per the previous report for the ultimate development of Belyando Estate, it is noted that the existing intersection does not provide an AUL turn treatment on Moranbah Access Road. Traffic volumes without Belyando Estate development traffic warrant an AUL turn lane treatment on Moranbah Access Road in addition to the extension of the CHR(S) on Moranbah Access Road to a full length CHR turn lane treatment. It is assumed that these intersection upgrades will be provided as a requirement of the MAC South Moranbah Village mining camp as a minimum.

Ultimately, at the design horizon in 2032 for Belyando Estate, the intersection of Moranbah Access Road / Moranbah Railway Station Road is recommended to be upgraded to a dual lane roundabout along with duplication of Moranbah Access Road as identified in report TIRC001 R01. An interim priority (give-way) intersection is proposed before the ultimate upgrade where the priority intersection supports ultimate traffic volumes generated by Belyando Estate in 2022.

Given the proceeding discussions, it is proposed to adopt the same intersection layout proposed in the interim for the ultimate development of Belyando Estate to assess Phase 1 of development as shown in Figure 6-4. It is noted that this layout differs from the existing with the inclusion of a full length AUL. Traffic volumes in Phase 1 warrant AUL(S) however it suggested to provide a full length AUL when considering cost effectiveness.

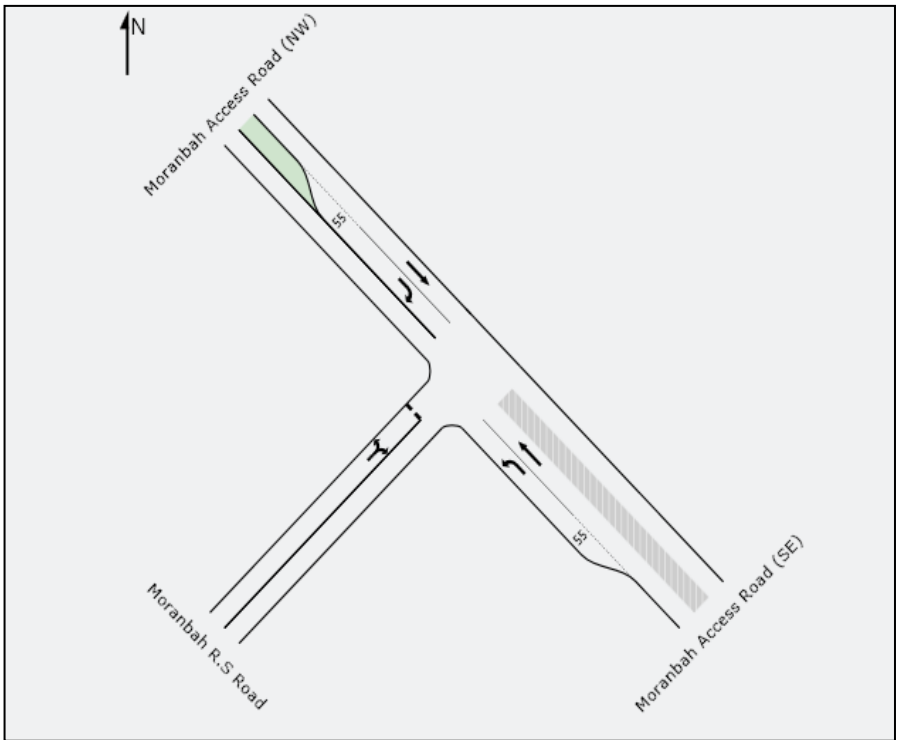

Figure 6-4: Proposed Intersection Layout – Moranbah Access Road / Moranbah Railway Station Road

A summary of the SIDRA results for scenario D being the worst case scenario servicing 100% of traffic generated by Phase 1 development of Belyando Estate is shown in Table 6-3.

Table 6-3: SIDRA Results – Proposed Intersection Layout Moranbah Access Road / Moranbah Railway Station Road, Scenario D

Approach	Existing AM Peak				Existing PM Peak			
	DoS v/c	Ave Delay	LoS	Q (m)	DoS v/c	Ave Delay	LoS	Q (m)
Moranbah Access Road (SE)	0.060	3.5 sec	A	0.0	0.194	2.3 sec	A	0.0
Moranbah Access Road (NW)	0.229	2.6 sec	A	3.8	0.279	7.6 sec	B	10.1
Moranbah R.S Road	0.424	11.3 sec	B	19.1	0.621	24.0 sec	C	31.0

Review of the SIDRA results shown in Table 6-3 indicates that the existing intersection with the introduction of a AUL is expected to operate sufficiently with a maximum DoS of 0.621, LoS C, delay of 24.0 seconds, and queue length of 31.0 metres (4.2 vehicles). It is noted that although the intersection performs sufficiently, Moranbah Railway Station Road is the worst performing leg of the intersection and with any further increase in traffic is expected to reach its practical capacity quite rapidly post 2012.

SIDRA results therefore indicate that the proposed intersection layout shown in Figure 6-4 is considered appropriate to service traffic generated by Phase 1 of Belyando Estate under the worst case scenario in 2015 if only one (1) of the two (2) connection roads are provided. If the second connection was provided traffic volumes split between the two (2) connection

roads and therefore with lower traffic volumes the proposed intersection is expected to perform better and extend the expected lifespan of the intersection.

6.6 Mills Avenue / Moranbah Access Road / Goonyella Road

The existing priority (give-way) intersection provides the basis to determine if and when the intersection requires upgrading as a result of traffic generated by Phase 1 of Belyando Estate. Ultimately the intersection of Mills Avenue / Moranbah Access Road / Goonyella Road is recommended to be upgraded to a dual lane roundabout along with duplication of Moranbah Access Road before the ultimate development of Balyando Estate as identified in report TIRC001 R01. It is therefore proposed to adopt the exiting intersection layout as shown in Figure 6-5 to assess the impact of Phase 1 before the ultimate development of Belyando Estate.

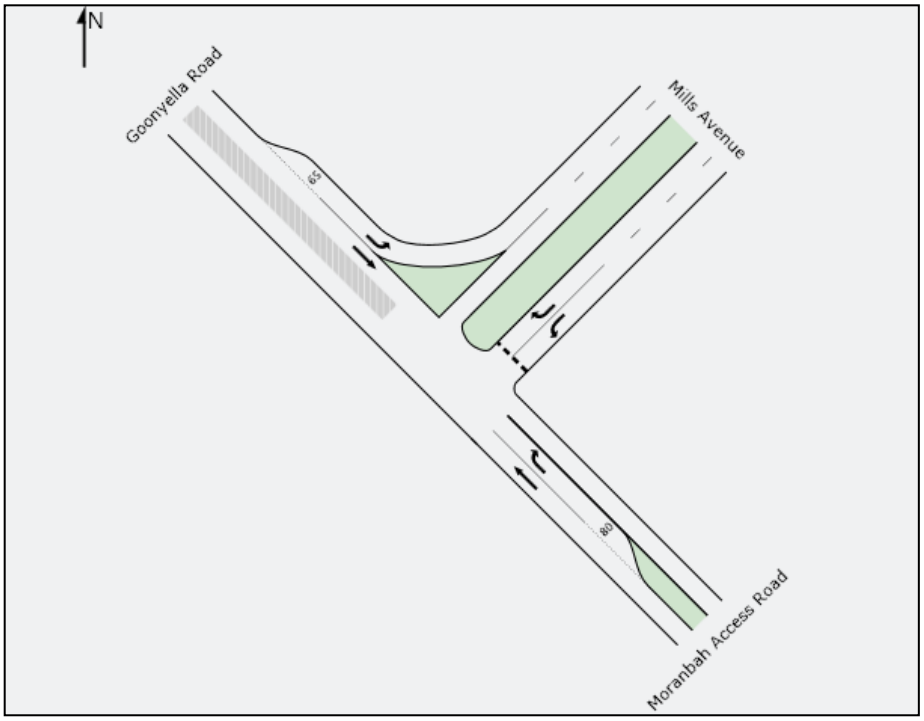

Figure 6-5: Existing Intersection Layout – Mills Ave / Moranbah Access Road / Goonyella Road

Traffic volumes at the intersection of Mills Avenue / Moranbah Access Road / Goonyella Road generated by Phase 1 of Belyando Estate are the same regardless of the number of connection roads servicing Belyando Estate. A summary of the SIDRA results for scenario B, C, and D being the same are shown in Table 6-4.

Table 6-4: SIDRA Results – Proposed Intersection Layout Mills Avenue / Moranbah Access Road / Goonyella Road, Scenario B, C, and D

Approach	Existing AM Peak				Existing PM Peak			
	DoS v/c	Ave Delay	LoS	Q (m)	DoS v/c	Ave Delay	LoS	Q (m)
Moranbah Access Road	0.210	4.6 sec	B	7.2	0.325	5.1 sec	B	12.6
Mills Avenue	0.730	16.4 sec	C	38.3	0.553	14.9 sec	C	20.0
Goonyella Road	0.158	3.0 sec	A	0.0	0.220	4.6 sec	A	0.0

Review of the SIDRA results shown in Table 6-4 indicate that the existing intersection is expected to operate sufficiently with a maximum DoS of 0.730, LoS C, maximum average delay of 16.4 seconds, and a queue length of up to 38.3 metres. It is noted that although the intersection performs sufficiently, Mills Avenue is the worst performing leg of the intersection and with any further increase in traffic on Mills Avenue or Moranbah Access Road / Goonyella Road the existing intersection is expected to reach its operational capacity rapidly within a few years post 2015.

SIDRA results indicate that the existing intersection layout shown in Figure 6-5 is considered appropriate to service traffic generated by Phase 1 of Belyando Estate.

6.7 Curtin Street / Goonyella Road

The existing priority (give-way) intersection provides the basis to determine if and when the intersection requires upgrading as a result of traffic generated by Phase 1 of Belyando Estate. Ultimately the intersection of Curtin Street / Goonyella Road is recommended to be upgraded to a dual lane roundabout along with duplication of Moranbah Access Road before the ultimate development of Balyando Estate as identified in report TIRC001 R01. It is therefore proposed to adopt the exiting intersection layout as shown in Figure 6-6 to assess the impact of Phase 1 before the ultimate development of Belyando Estate.

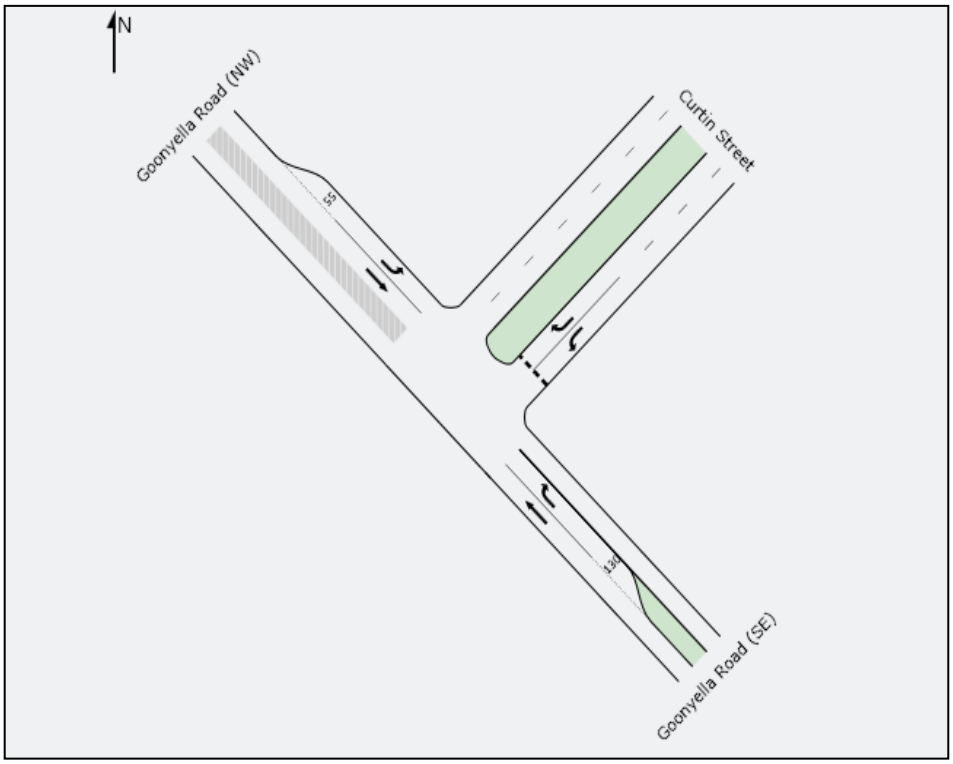

Figure 6-6: Existing Intersection Layout – Curtin Street / Goonyella Road

Traffic volumes at the intersection of Curtin Street / Goonyella Road generated by Phase 1 of Belyando Estate are the same regardless of the number of connection road servicing Belyando Estate. A summary of the SIDRA results for scenario B, C, and D being the same are shown in Table 6-5.

Table 6-5: SIDRA Results – Proposed Intersection Layout Curtin Street / Goonyella Road, Scenario B, C, and D

Approach	Existing AM Peak				Existing PM Peak			
	DoS v/c	Ave Delay	LoS	Q (m)	DoS v/c	Ave Delay	LoS	Q (m)
Goonyella Road (SE)	0.272	1.7 sec	B	2.8	0.169	3.7 sec	B	5.0
Curtin Street	0.725	20.0 sec	C	35.0	0.645	19.8 sec	C	24.7
Goonyella Road (NW)	0.187	2.5 sec	A	0.0	0.328	3.0 sec	A	0.0

Review of the SIDRA results shown in Table 6-5 indicate that the existing intersection is expected to operate sufficiently with a maximum DoS of 0.725, LoS C, maximum average delay of 20.0 seconds, and a queue length of up to 35.0 metres (less than 5 vehicles). It is noted that although the intersection performs sufficiently, Curtin Street is the worst performing leg of the intersection and with any further increase in traffic on Curtin Street or Goonyella Road the existing intersection is expected to reach its operational capacity rapidly post 2015.

SIDRA results indicate that the existing intersection layout shown in Figure 6-5 is considered appropriate to service traffic generated by Phase 1 of Belyando Estate.

7. TRANSPORT NETWORK ASSESSMENT

7.1 Bicycle and Pedestrian Network

As recommended in the assessment of the ultimate development, it is recommended that emphasis is placed on the provision of a bicycle and pedestrian network to encourage walking and cycling as an alternate mode of transport.

Review of the allotment and internal road layout indicates that where a cul-de-sac is located an allotment is left undeveloped which provides connection between the cul-de-sac and the road network. This provides permeability of the road network for pedestrians and cyclist so not to discourage alternate modes of transport by disadvantaging pedestrian and cyclist movements.

In terms of footpath provisions, plans provided do not indicate where it is intended to provide footpaths however as per the assessment for the ultimate development of Belyando Estate, in accordance with ULDA Guideline No.06: Street and Movement Network, April 2002 (UDLA Guideline No.6) with respect to the road hierarchy, the pedestrian requirements are shown in Table 7-1 below:

Table 7-1: Summary of Pedestrian Facilities In accordance with UDLA Guideline No.6

Neighbourhood Road Hierarchy	Function
Truck Connector	Footpath of 1.5 metres minimum on both sides
Connector Street	Footpath of 1.5 metres minimum on both sides
Access Street	Footpath of 1.5 metres minimum on one side or both

In regards to bicycle network facilities in accordance with ULDA Guideline No.06, with respect to the road hierarchy, bicycle requirements are limited to neighbourhood trunk collector roads with respect to the road hierarchy where a 1.5m cycle lane on both sides of the road adjacent to the parking lane is required. All other roads below trunk collector roads in the road hierarchy provide shared space for vehicles and cyclists.

Review of the car parking analysis plan indicates that it is proposed to provide a 7.5 metres wide pavement including on-street kerb side parking on one (1) side with the remaining width as shared space for cyclists and two-way traffic flow.

7.2 Bus Network

As recommended in the assessment of the ultimate development, although there is currently no local bus service operating in Moranbah, it is recommended that the road network of Belyando Estate does not prevent or limit the future provision of a bus network including conventional on-route local bus services or school bus routes. It is recommended that a holistic approach be taken to future provision of a bus route taking into account not only Phase 1 of Belyando Estate but the ultimate development of Belyando Estate as well as the ultimate development to the north-west and future road network connections.

Phase 1 alone is perhaps considered insufficient to justify operation of a bus route however review of the road network to ensure Phase 1 supports the ultimate bus route for Belyando Estate reveals that Road 1, 2, and 10 form part of the future provision as shown in Figure 7-1.

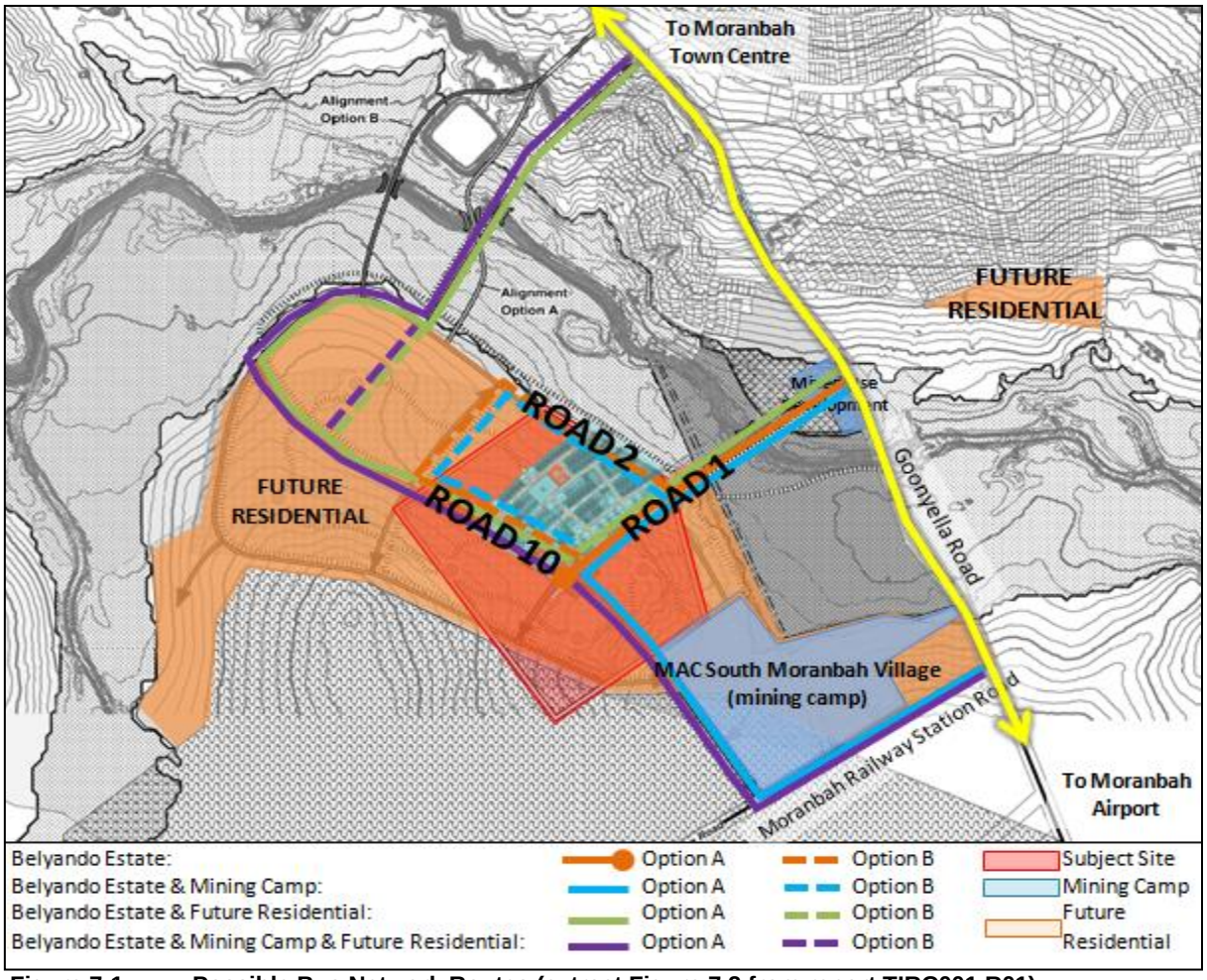

Figure 7-1: Possible Bus Network Routes (extract Figure 7.2 from report TIRC001 R01)

Review of Roads 1, 2, and 10 with respect to road hierarchy in accordance with ULDA Guideline No.06 indicates that Roads 1 and 10 identified as trunk connector roads in Section 8.1 provide for a bus route with bus stops facilitated by the removal of parking. Road 2 identified as a neighbourhood connector street in the road hierarchy in accordance with ULDA Guideline No.06 may provide for a bus route as part of the overall network however additional lane width is required.

8. INTERNAL ROAD NETWORK ASSESSMENT

In accordance with Queensland Streets – Design Guidelines for Subdivisional Streetworks, May 1993, a desirable maximum catchment of 200 dwellings for streets with direct frontage access is recommended with an absolute maximum catchment of 300 equivalent dwellings where an equivalent dwelling for separate dwellings is 1.0. This equates to a traffic generation in the order of 2,000 to 3,000 vehicles per day which is the most commonly recommended range of maximum acceptable traffic volumes along a residential street with direct frontage access to allotments. It is acknowledged however that various standards suggest limits anywhere between 1,200 and 5,000 vehicles per day. In actual fact ULDA Guideline No.06 allows direct property access for neighbourhood connector streets carrying up to 7,500 vehicles daily.

Given that the Phase 1 of development consists of 230 equivalent dwellings estimated to generate in the order of 2,300 vehicle movements per day, traffic generated falls between within the acceptable range to allow direct street frontage. However the ultimate

development should also be considered. With reference to the Phase 1 plan showing the road layout, Roads 1, 2, 9, 10, and 19 all provide connectivity with the adjacent area within Belyando Estate as shown in Figure 8-1.

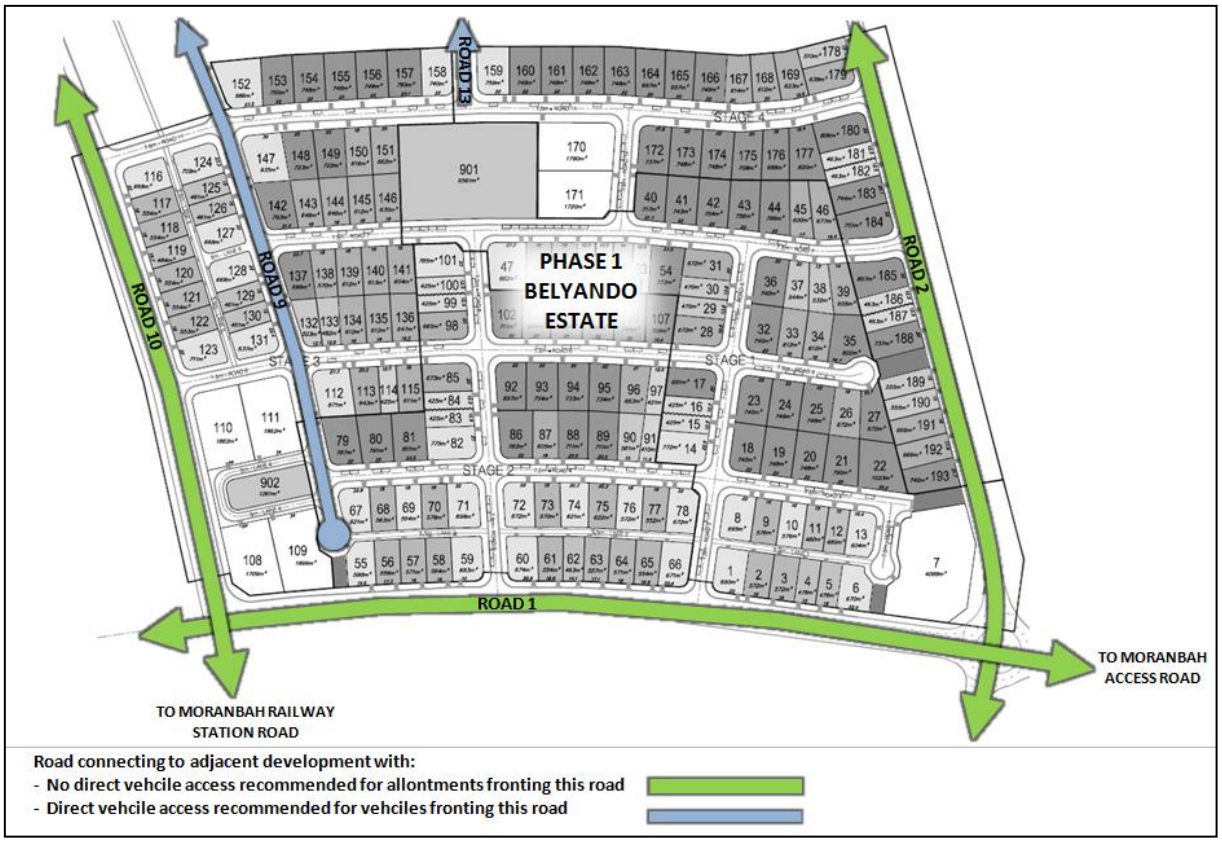

Figure 8-1: Phase 1 Internal Road Network – Connecting Roads without Direct Vehicle Access Permitted

Roads 1 and 10 provide direct connection to the arterial road network. Road 10 services the remainder of the western portion of Belyando Estate and potentially traffic generated by future residential traffic to the west of Belyando Estate equating to a catchment in excess of 300 dwellings. Similarly Road 1 is expected to service Belyando Estate to the south and east of Phase 1 also estimated to service a catchment of over 300 dwellings. These roads are expected the threshold of traffic volumes to allow front loaded allotments and therefore it is recommended that vehicle access to allotments fronting these roads are provided via the rear in accordance. In saying this it is noted that Lanes 1 to 5 are located at the rear of properties fronting Roads 1 and 10 suggesting it is proposed that these properties are rear loaded. This is consistent with the road hierarchy nominated in Figure 8-2.

Road 9 running parallel to Road 10 is located one (1) block north ending in a cul-de-sac and therefore is not expected to service more than 200 dwellings. Road 13, although connecting to the adjacent development with Belyando Estate, is located in the centre of development in the north-west corner of Belyando Estate and is therefore not likely to service more than 200 dwellings.

Road 2 on the other hand is likely to connect with the adjacent development of Belyando Estate and also the future residential development to the west of Belyando Estate as shown by the context plan. If this was to occur it is recommended that design of the street network ensures the ultimate catchment maintains traffic volumes below the threshold allowing allotments with direct frontage access on Road 2.

8.1 Road Hierarchy

In accordance with ULDA Guideline No.06 given the expected traffic volumes and road function the following road hierarchy is shown in Figure 8-2.

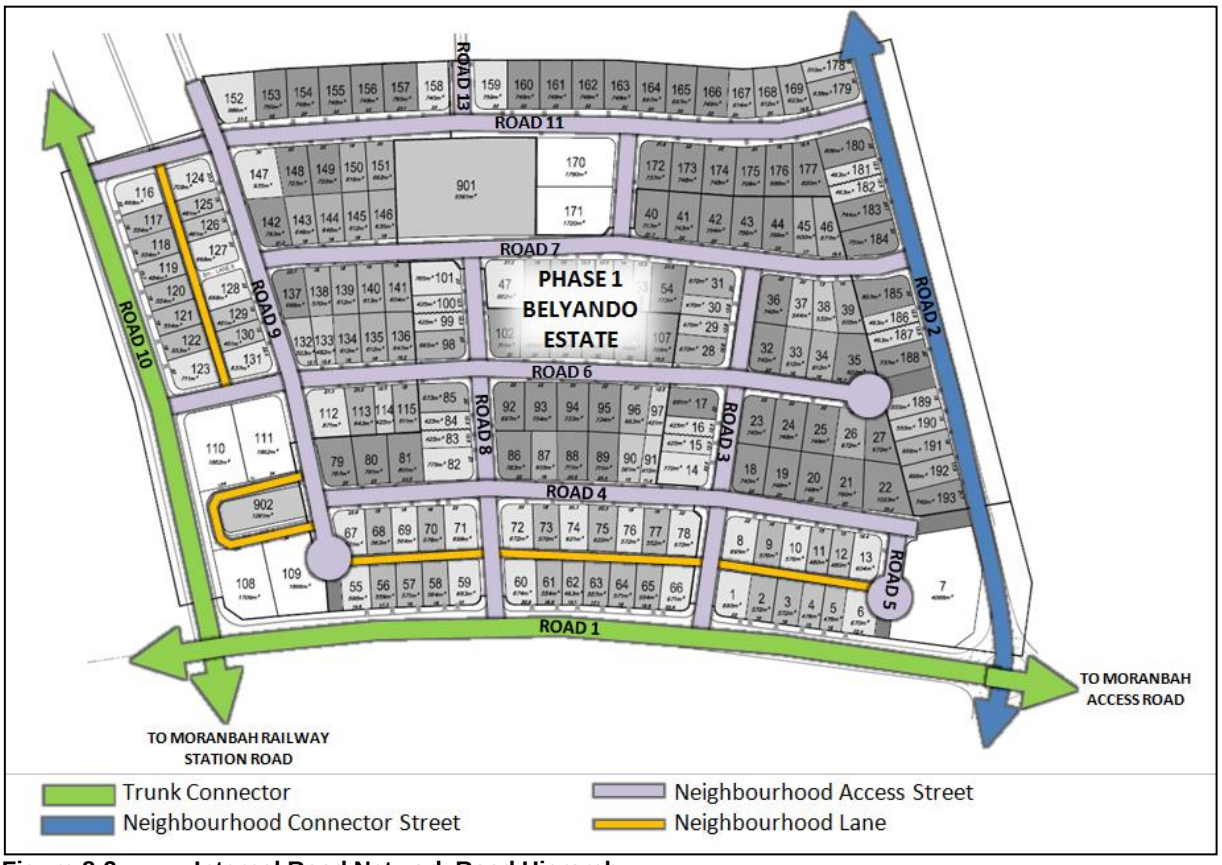

Figure 8-2: Internal Road Network Road Hierarchy

8.2 Intersections

Wherever possible the priority direction of travel at intersections should be given to the higher order road in the hierarchy of roads in order to meet driver expectations. For example where Lane 2 intersects with Road 8 the priority direction of travel is assumed on Road 8. It is for this reason cross roads of the same road hierarchy should be avoided unless an appropriate intersection treatment is provided.

The order of the most cost effective intersection treatments are:

- Priority (give-way or stop);
- Roundabout; and
- Signals.

If a cross roads intersection of the same road hierarchy is treated with a priority (give-way) intersection treatment, it is recommended that the minor road is narrowed at the approach through the removal of parking and provision of kerb outstands. Alternatively, it is recommended that a roundabout treatment be provided at the locations shown in Figure 8-3.

Intersections 1 and 2 as shown in Figure 8-3 were analysed as part of the ultimate traffic operation assessment. It was recommended that a roundabout is provided at these intersections.

At each of the five (5) intersections where Phase 1 of Belyando Estate (Road 2, 3, 6, 8, and 11) connects with the neighbourhood connector roads, any one of the minor roads is estimated to service in a maximum 100 of the 230 vehicle movements generated during peak hours based on the equivalent dwelling factor of 230 dwellings in Phase 1 established in Section 5.1. Adopting the ultimate traffic volumes presented in Appendix D consistent with that presented in report TIRC001 R01, and distribution as per Section 5.2 of this report, SIDRA intersection analysis was performed to assess the intersection capacity if a priority (give-way) intersection is provided with the exclusion of Road 2 as it is already established a roundabout is recommended at Intersection 1. SIDRA results for the intersection of Road 3 / Road 1 where traffic volumes are highest on Road 1 being the worst case scenario are shown in Table 8-1 with the SIDRA movement summary located in Appendix D.

Table 8-1: SIDRA Results – Proposed Priority (give-way) Intersection Layout – Road 3 / Road 1

Approach	Existing AM Peak				Existing PM Peak			
	DoS v/c	Ave Delay	LoS	Q (m)	DoS v/c	Ave Delay	LoS	Q (m)
Road 1 (NE)	0.78	3.1 sec	A	3.8	0.255	2.0 sec	A	12.3
Road 3	0.81	9.0 sec	A	2.2	0.024	7.8 sec	A	0.7
Road 1 (SW)	0.238	0.0 sec	A	0.0	0.089	0.0 sec	A	0.0

Review of the SIDRA results shown in Table 8-1 indicate that each of the intersections in Phase 1 connecting with the trunk connector roads are expected to operate very well with a DoS less than 0.3, a maximum delay of 9.0 seconds on Road 3, and a queue length of 12.3 meters (1.7 vehicles) on Road 1 due to right turning vehicles. Phase 1 plan indicates that Road 1 is to be dual lane road and in this case no delay or queues are expected on Road 1.

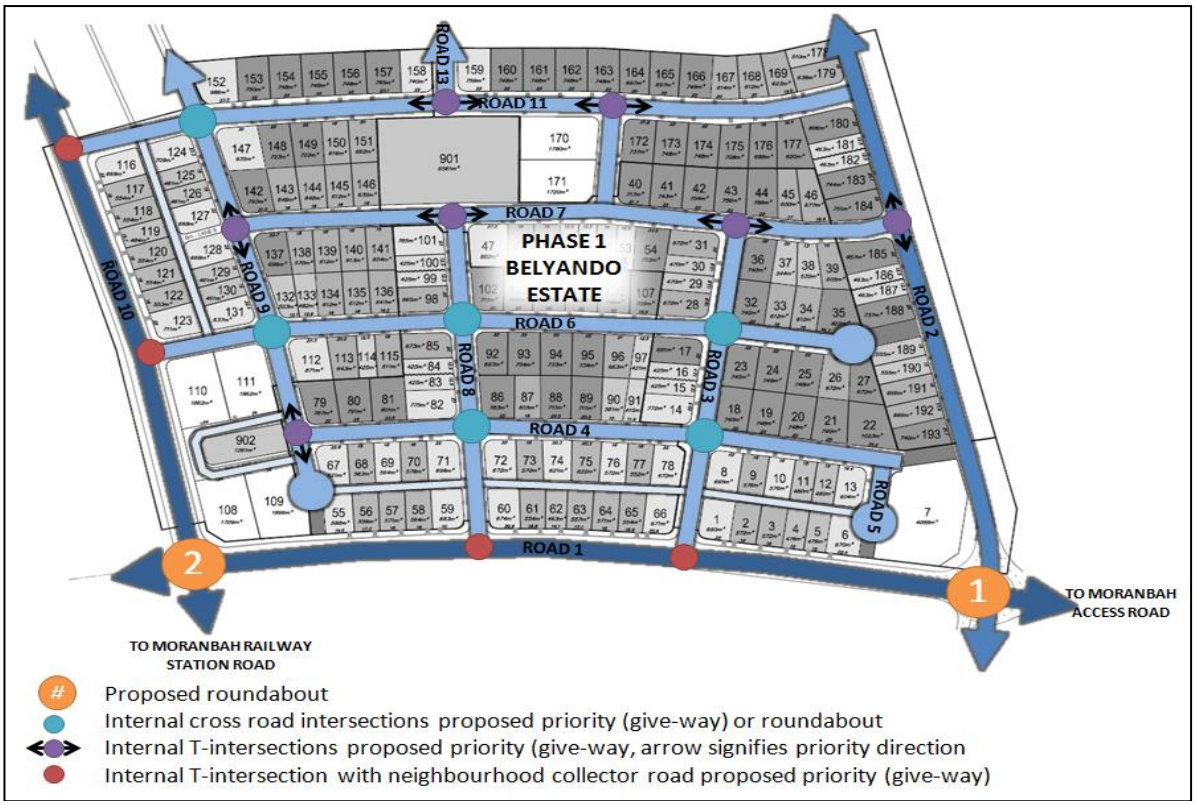

Figure 8-3: Internal Intersections

8.3 Traffic Calming

Traffic calming is provided by physically limiting the speed of vehicles through the road network. Traffic calming is achieved by the spacing between traffic calming measures which depends on the maximum design speed to be achieved. In accordance with Queensland Streets: Design Guideline for Subdivisional Streetworks, May 1993, for a maximum design speed of 50km/hr it is recommended that the spacing between traffic calming devices is 155 metres.

Traffic calming may be achieved through good design of the road network incorporating but not limited to the following traffic calming measures at the above mentioned spacing as appropriate:

- Roundabouts;
- Curves in the road alignment;
- Street length;
- Restriction of the carriageway width;
- Speed humps; and
- Pedestrian crossings.

Figure 8-4 identifies the locations proposed to provide traffic calming where street lengths exceed 155 meters on the neighbourhood access street where a 50km/hr speed limit applies. It is assumed roundabouts are adopted at the cross road internal intersections. It is noted that trunk connectors and neighbourhood connector streets provide long straights without traffic calming however Roads 1, 2, and 10 are identified to provide future provision of bus routes and therefore are the exception.

Figure 8-4: Traffic Calming

It is recommended that the traffic calming be provided in the form of a modified T-intersection by modifying the kerb alignment opposite the intercepting road providing a minor chicane for traffic travelling straight through the intersection on the priority road as shown in Figure 8-5. The benefit of this treatment is it prevents parking opposite a T-intersection and also provides opportunity for vegetation at this location which reduces the impact of vehicle headlights on the dwelling located opposite the T-intersection.

Figure 8-5: Modified T-intersection with normal priority (Google Image from Mainroads WA)

9. CONCLUSIONS AND RECOMMENDATIONS

- A total of five (5) undefined lots are also to be provided within Phase 1 of Belyando Estate other than residential or parkland. It is likely that these lots will provide commercial development to satisfy the basic shopping needs of local residents within the neighbourhood such as a milk bar or pharmacy, or provide schools, childcare, or the likes. Of the ten (10) trips typically generated per dwelling daily in accordance with Complete Streets, three (3) are within the local neighbourhood. It is therefore conservatively assumed that only one (1) of the three (3) daily trips generated within the neighbourhood in accordance with Complete Streets are to occur within Phase 1 of Belyando Estate with the remaining two (2) trip external to satisfy the needs of residents.

- It is recommended to provide a priority (give-way) intersection to service traffic generated by Phase 1 of Belyando Estate on Moranbah Railway Station Road with basic right (BAR) and left (BAL) turn facilities on Moranbah Railway Station Road. SIDRA results indicate that the proposed intersection layout which is consistent with that proposed for the ultimate development of Belyando Estate is considered appropriate to service 100% of traffic generated by Phase 1 of development or alternatively both connection roads may be provided.

- It is recommended to provide a priority (give-way) intersection to service traffic generated by Phase 1 of Belyando Estate on Moranbah Access Road. For safety in design it is proposed to include an auxiliary left (AUL) and channelised (CHR) turn facilities on Moranbah Access Road consistent with that proposed in the interim for the ultimate development of Belyando Estate. SIDRA results indicate that the proposed intersection layout is considered appropriate to service 100% of traffic generated by Phase 1 of development or alternatively both connection roads may be provided. Ultimately the intersection of Belyando Estate / Moranbah Access Road will require upgrading to a dual lane roundabout when duplication of Moranbah Access Road occurs.

- It is recommended the existing priority (give-way) intersection at Moranbah Access Road / Moranbah Railway Station Road is upgraded to provide an auxiliary left (AUL) turn treatment and a channelised right (CHR) turn treatment. It is noted at the completion of Phase 1 a full length CHR is not yet required based on traffic volumes but is recommended for improved safety and life of the intersection. It is assumed that these intersection upgrades will be provided as a requirement of the MAC South Moranbah Village mining camp at a minimum. SIDRA results indicate that the proposed intersection layout which is consistent with that proposed for the ultimate development of Belyando Estate is considered appropriate to service 100% of traffic generated by Phase 1 of development or alternatively both connection roads may be provided. Ultimately the intersection of Belyando Estate / Moranbah Access Road will require upgrading to a dual lane roundabout when duplication of Moranbah Access Road occurs.

- The existing priority (give-way) intersection at Mills Avenue / Moranbah Access Road / Goonyella Road and Curtin Road / Goonyella Road provided the basis to determine if and when the intersection requires upgrading as a result of traffic generated by Phase 1 of Belyando Estate. SIDRA results indicate that the existing intersection layout is considered appropriate to service traffic generated by Phase 1 of Belyando Estate however is expected to rapidly reach capacity post 2015. Ultimately these intersections will require upgrading to a dual lane roundabout when duplication of Moranbah Access Road occurs.

- As recommended in the assessment of the ultimate development, it is recommended that emphasis is placed on the provision of bicycle and pedestrian network to encourage walking and cycling as an alternate mode of transport. In regards to the internal road network of Phase 1 of Belyando Estate, it is recommended to provide pedestrian facilities in the form of a 1.5 metre wide footpath on one (1) side or both of each road in accordance with UDLA Guideline No.6. Bicycle facilities are provide via shared road space on neighbourhood access streets in accordance with UDLA Guideline No.6 road hierarchy. Designated bicycle lanes are recommended on trunk connector roads forming the south and west boundaries of Phase 1.

- Wherever possible the priority direction of travel at intersections should be given to the higher order road in the hierarchy of roads in order to meet driver expectations. The order of the most cost effective intersection treatments is priority (give-way or stop), roundabout or signals. If a cross roads intersection of the same road hierarchy is treated with a priority (give-way) intersection treatment, it is recommended that the minor road is narrowed at the approach through the removal of parking and kerb outstands. Alternatively, it is recommended that a roundabout treatment be provided at the six (6) locations this occurs within Phase 1 of Belyando Estate.

- It is recommended to provide priority (give-way) intersections where neighbourhood access streets intersect trunk connector roads as defined by the road hierarchy. SIDRA results indicate that the proposed intersection will operate sufficiently under ultimate traffic loading on the trunk collector roads and is therefore considered appropriate.

- Traffic calming is recommended to physical restrict vehicles to the design speed by providing traffic calming measures at 155 metres spacing on neighbourhood access streets designated at 50km/hr. Four (4) locations are identified where traffic calming is recommended. At these locations it is recommended that traffic calming be provided at in the form of a modified T-intersection by modifying the kerb alignment on the priority road opposite the intercepting road to provide a minor chicane.

APPENDIX A
DEVELOPMENT PLANS

STAGE 1

STAGE 2

STAGE 3

STAGE 4

6m x 2.4m Carpark - 149 Total

Built to Boundary

	Stage 1	Stage 2	Stage 3	Stage 4	Total Lots	Allotment %	Total Dwellings
Traditional Large	19	16	9	19	63	34%	63
Traditional Long	10	4	15	6	20	11%	20
Traditional Laneway	3	12	5	0	35	19%	53
Adaptable	5	11	6	0	22	12%	66
Courtyard Lane	4	1	5	0	11	6%	11
Courtyard	5	1	2	3	10	5%	10
Villa	5	6	1	4	16	9%	16
Multi-family dwellings	2	2	4	1	9	5%	18
Total Lots	53	53	47	33			
Total					186	100%	257

0 20 40 60m

1 : 1000 (Before Reduction)

Rev.	Description	Date	By	Checked
A	Issue for Review	1/11/12	GW	JMN

Drawn	GW
Checked	SD
Approved	JMN
Date	1/11/2012
Rev.	A
Scale	1:1,000 @ A1

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ISAAC REGIONAL COUNCIL

BELYANDO ESTATE

Carparking Analysis Plan

PROJECT NUMBER: 1124-2

DRAWING NO.: 2

DRAWING: 121015_PoD_Plan

LEGEND

GENERAL

- Property Boundary
- Belyando Estate Site
- M.A.C. Site
- 1m Contour

ROAD NETWORK INFRASTRUCTURE

- Existing Trunk Road

INITIAL STRUCTURE PLAN ROADS

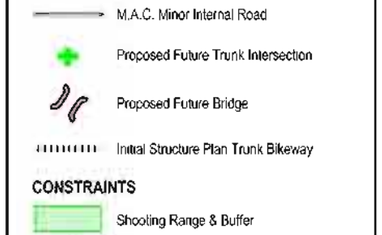
- Trunk Road
- Major Internal Road
- Option A Alignment
- Option B Alignment
- M.A.C. Major Internal Road
- M.A.C. Minor Internal Road
- Proposed Future Trunk Intersection
- Proposed Future Bridge
- Initial Structure Plan Trunk Bikeway

CONSTRAINTS

- Shooting Range & Buffer
- Dust Exclusion Area
- Q100 Inundation Line
- Q100 Approved Filling Area

DEVELOPMENT SCHEME LAND USES

- Civic & Open Space
- Mixed Use
- Residential
- High Density Residential
- Rural
- Activity Node
- Proposed Future Park
- UDA Residential



Alignment Option B

Alignment Option A

Moorlaben Access Road

Moorlaben Railway Station Road

NOTE: Road corridors and alignments outside Belyando Estate subject to land owner agreement and planning approval.

Road alignment Options A & B subject to geotech and alighment.

0 250 500
metres

N W E S

GDA

Drawn:	SN
Checked:	SD
Approved:	JMN
Date:	15/05/2012
Rev:	1.3
Scale:	1:12,500

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ISAAC REGIONAL COUNCIL

BELYANDO ESTATE

DRAFT CONTEXT PLAN

PROJECT NUMBER: 1124-2

GRID: 1

DRAWING: ContextPlan_001

M:\1124-2 Isaac - Belyando Estate\Work\Mapinfo\Workspaces\Planning\120515_ContextPlan

APPENDIX B
DEVELOPMENT TIMING

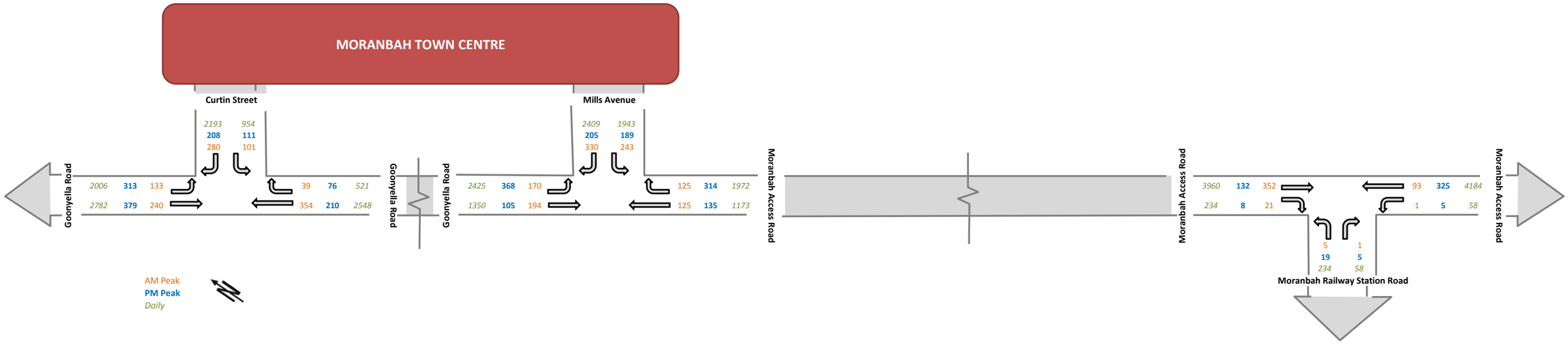
Development Timing
Belyando Estate

Dwelling Type	Housing Completion																																	
	2014			2015				2016				2017				2018				2019				2020				2021				2022			
	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	4 Qtr	1 Qtr	2 Qtr	3 Qtr	
Detached	25	25	25	25	30	30	30	25	25	25	25	25	25	25	20	20	20	20	20	20	20	20	20	20	20	20	20	15	15	15	15	15	15	735
Duplex (Multi-Family)	2	4	4	6	6	6	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2	1	0	1	0	1	0	1	0	1	0	1	0	90
Triplex (Adaptable Lot)	6	24	24	24	30	30	30	24	24	12	12	12	8	8	8	8	4	4	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	302
Attached Units - 1 bedroom	4	4	4	8	8	8	8	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
Attached Units - 2 bedroom	10	10	20	20	20	20	20	10	10	10	10	10	10	10	10	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	250
Attached Units - 3 bedroom	0	0	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Total	**47**	**67**	**82**	**88**	**99**	**99**	**97**	**67**	**65**	**51**	**51**	**51**	**47**	**47**	**42**	**32**	**28**	**38**	**26**	**24**	**24**	**34**	**21**	**20**	**21**	**30**	**21**	**20**	**16**	**25**	**16**	**15**	**16**	**25**	**1452**
Accumulative Total	**47**	**114**	**196**	**284**	**383**	**482**	**579**	**646**	**711**	**762**	**813**	**864**	**911**	**958**	**1000**	**1032**	**1060**	**1098**	**1124**	**1148**	**1172**	**1206**	**1227**	**1247**	**1268**	**1298**	**1319**	**1339**	**1355**	**1380**	**1396**	**1411**	**1427**	**1452**	

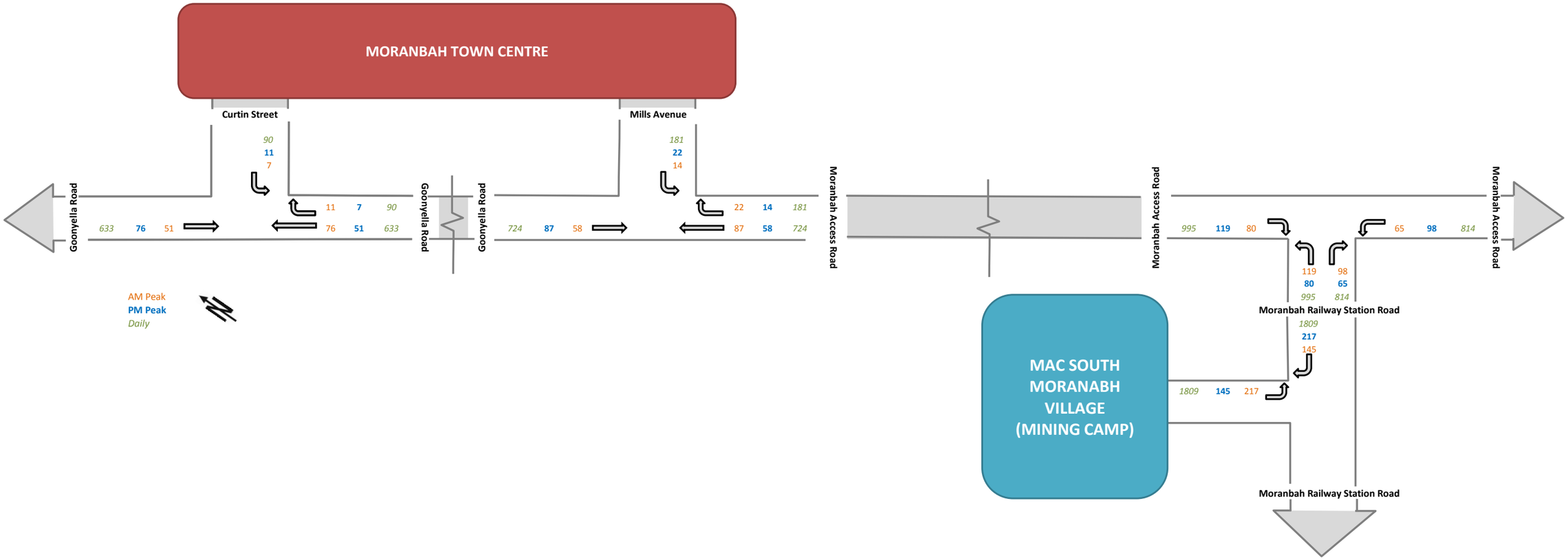
1 Qtr	Jan	-	Mar
2 Qtr	Apr	-	Jun
3 Qtr	Jul	-	Sep
4 Qtr	Oct	-	Dec

APPENDIX C
TRAFFIC VOLUMES

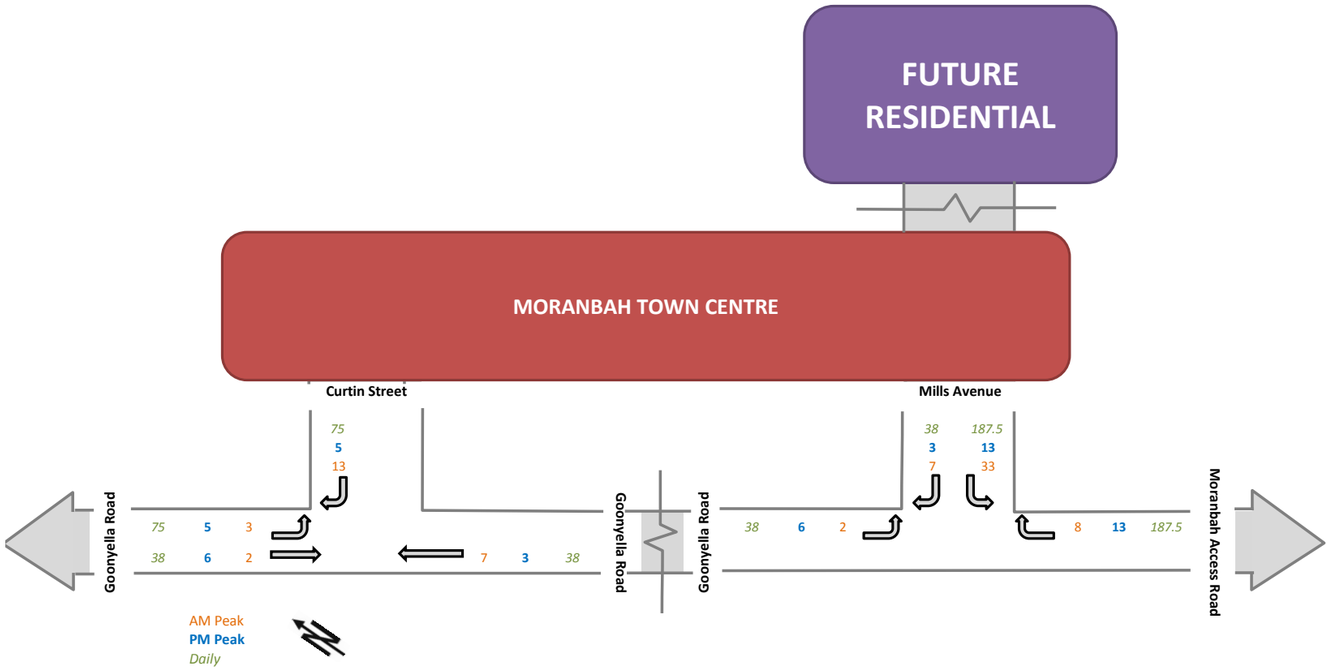
Existing Traffic Volumes + Growth (2015)



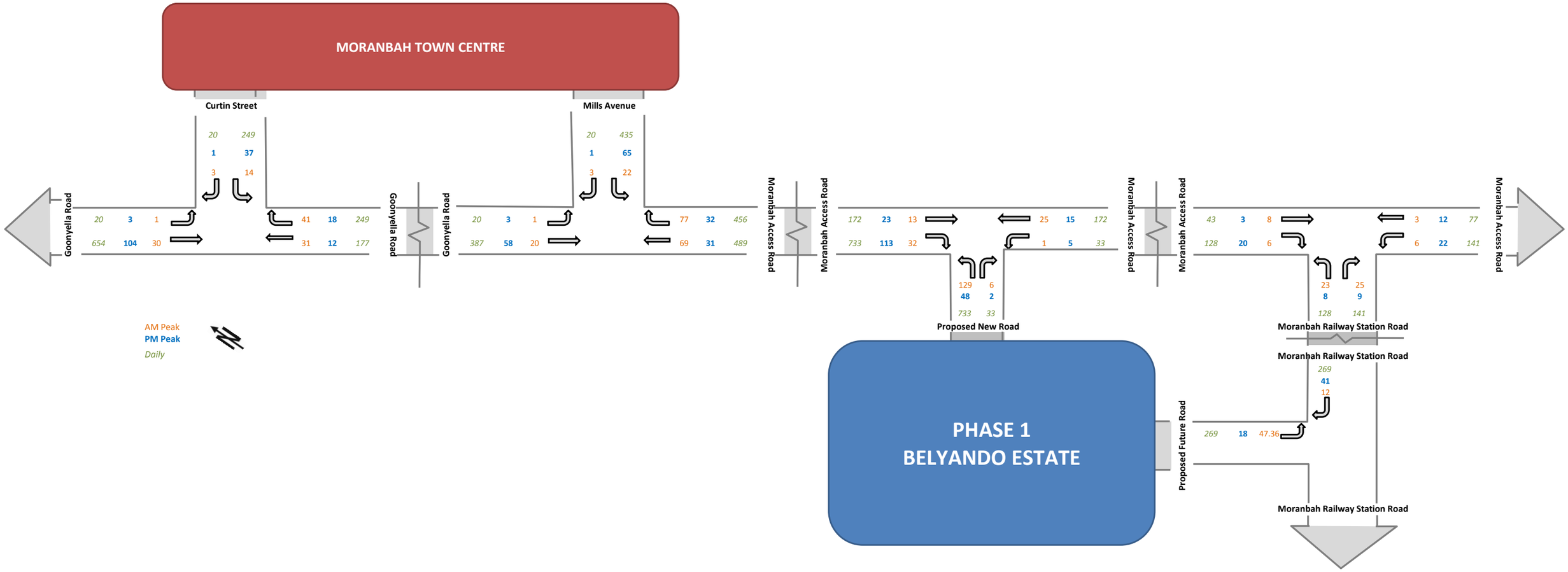
MAC South Moranbah Village (mining camp)



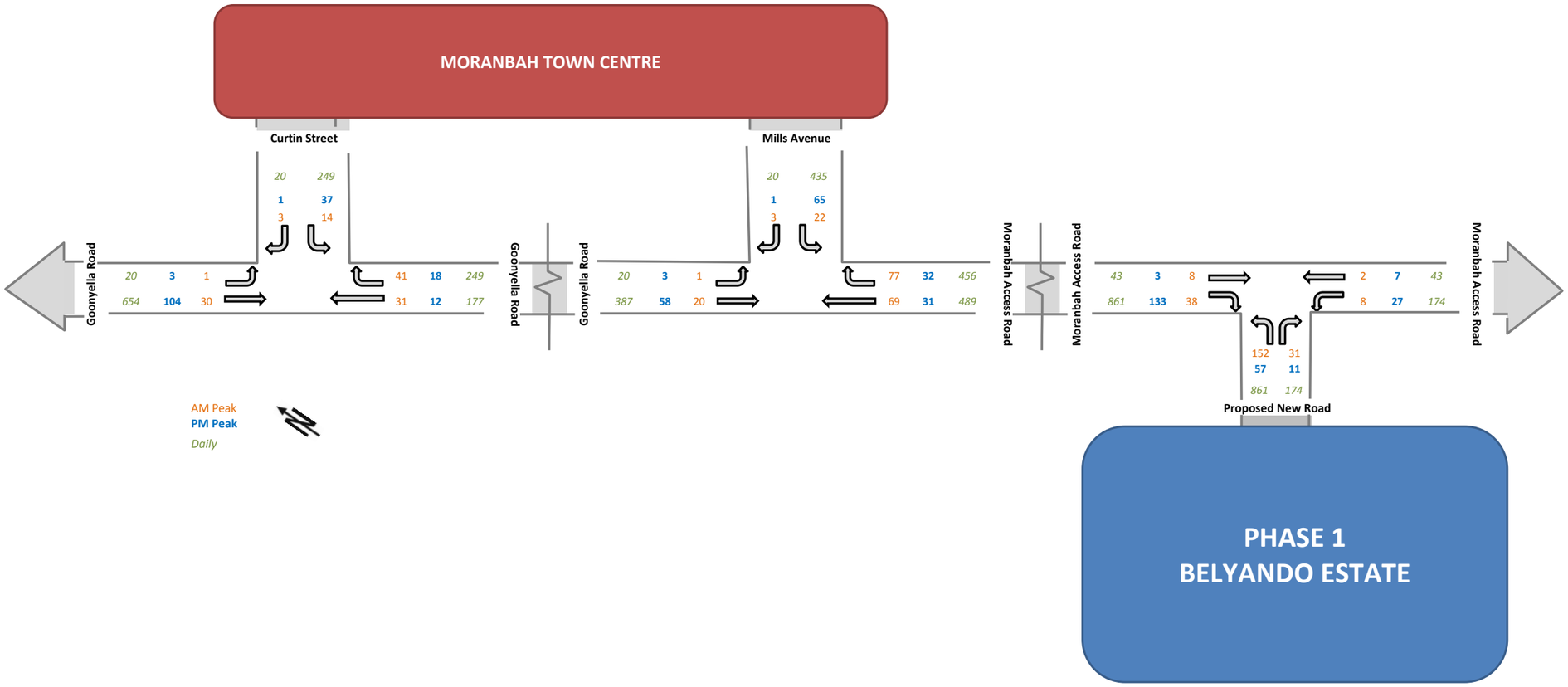
Future Residential Development (south of Mills Avenue)



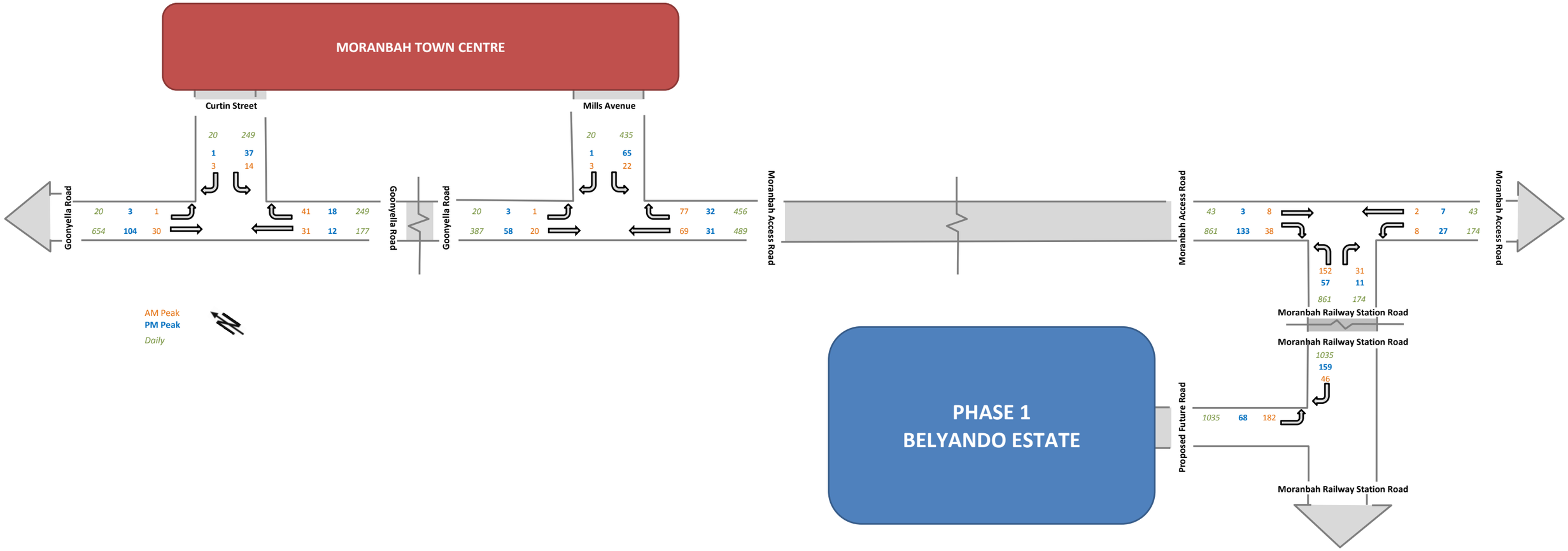
Phase 1 Belyando Estate (both connection roads)



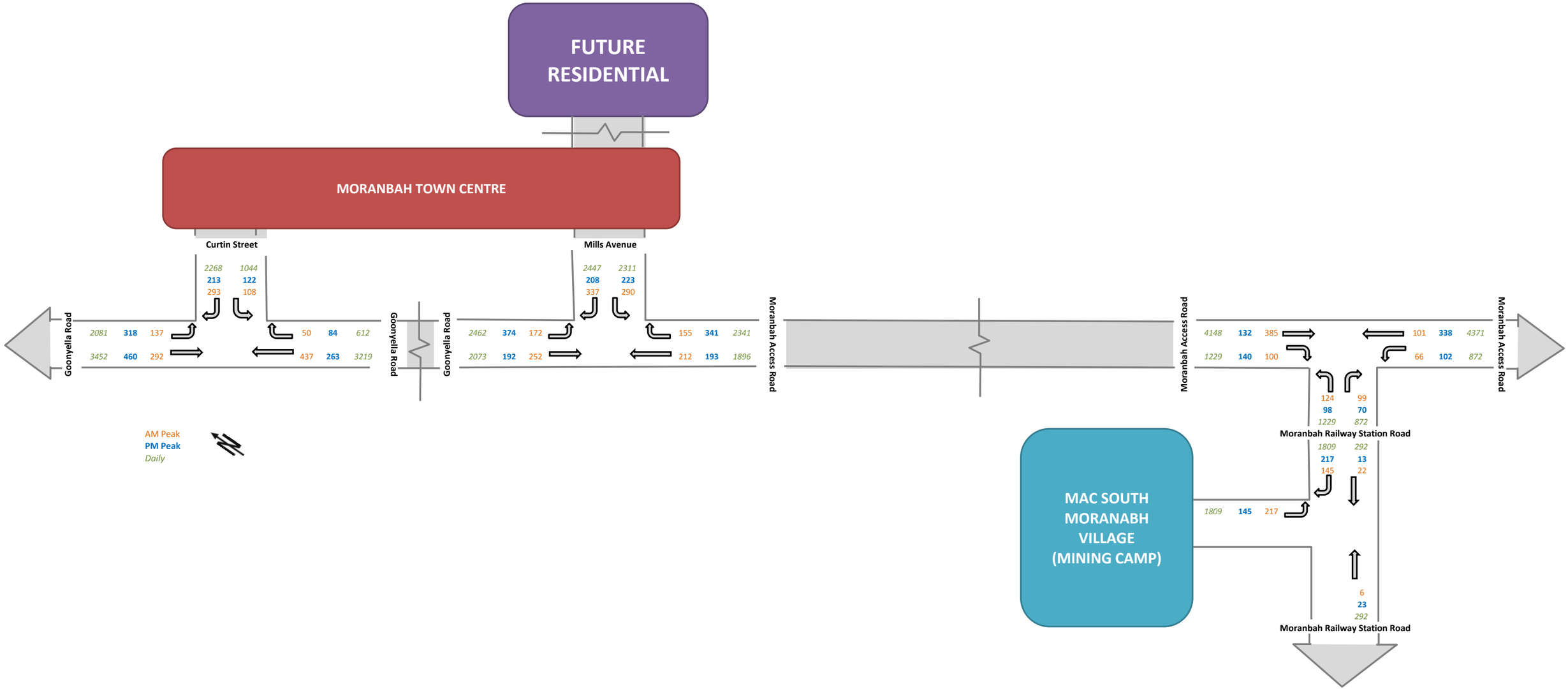
Phase 1 Belyando Estate (Moranbah Access Road connection only)



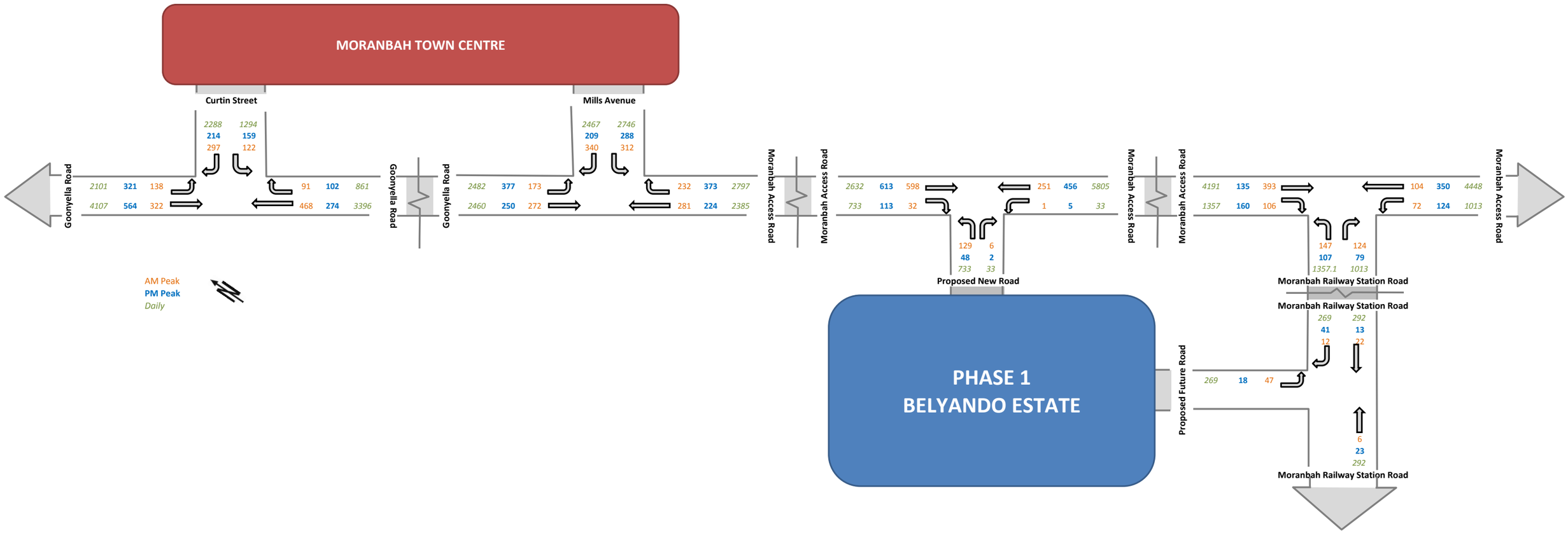
Phase 1 Belyando Estate (Moranbah Railway Station Access Road connection only)



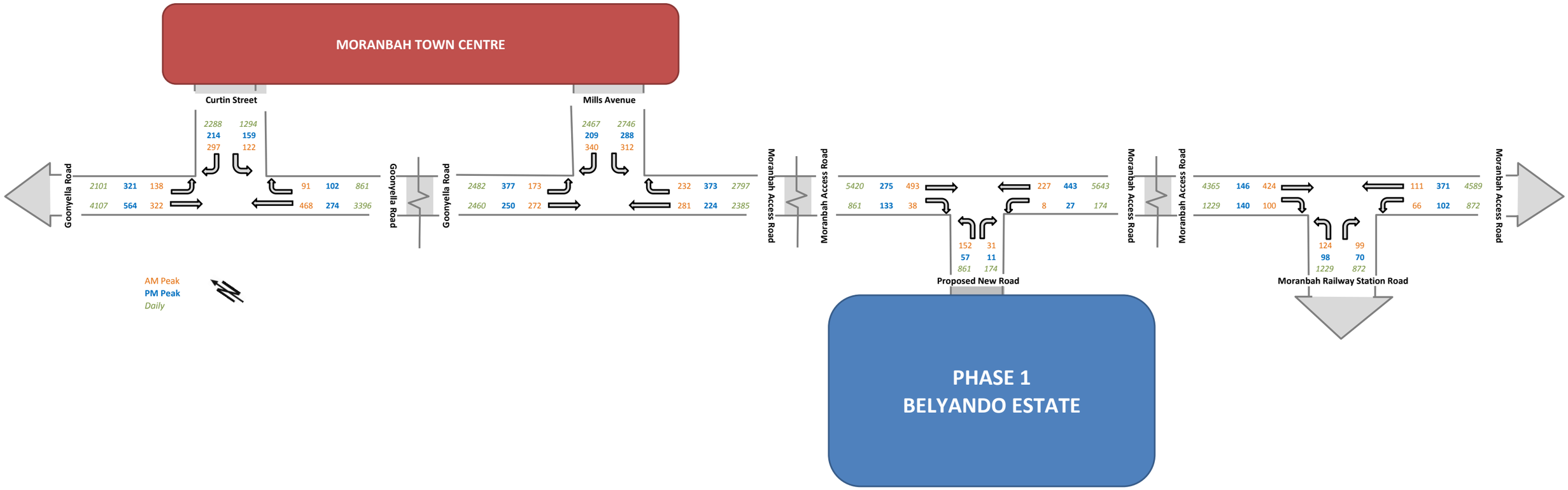
Scenario A: Design Year 2015 - Base Traffic



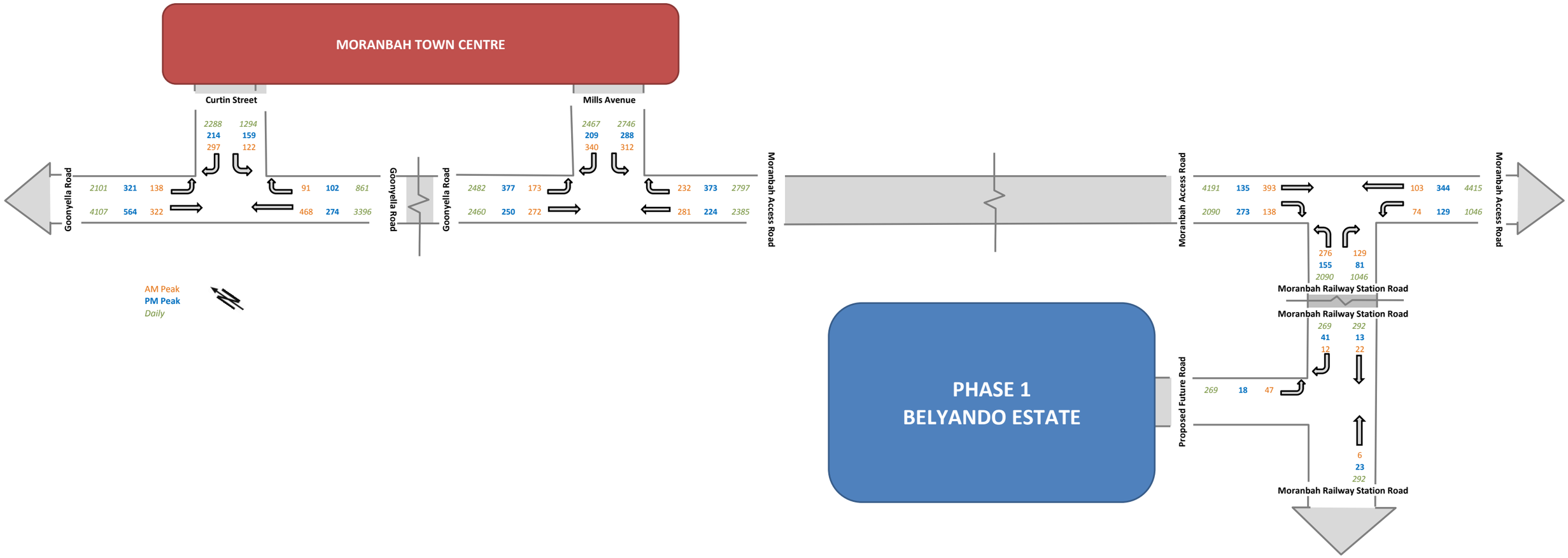
Scenario B: Design Year 2015 - Base Traffic + Phase 1 Belyando (both connection roads)



Scenario C: Design Year 2015 - Base + Phase 1 Belyando (Moranbah Access Road connection only)



Scenario D: Design Year 2015 - Base + Phase 1 Belyando (Moranbah Railway Station Road connection only)

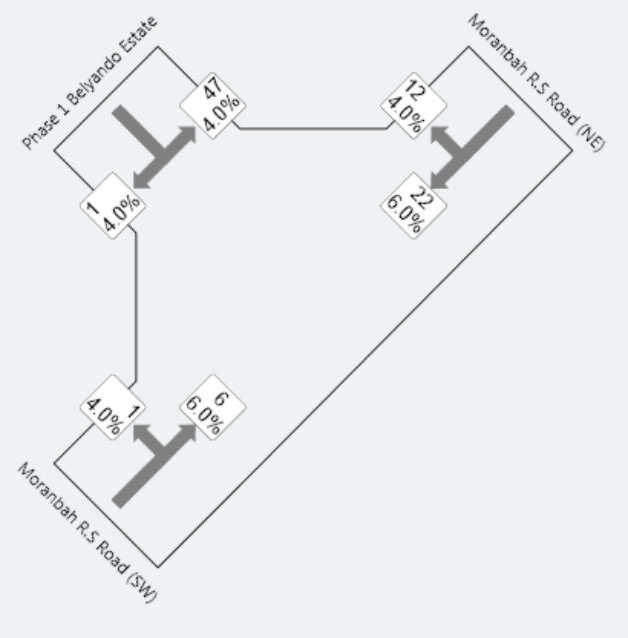


APPENDIX D
SIDRA RESULTS

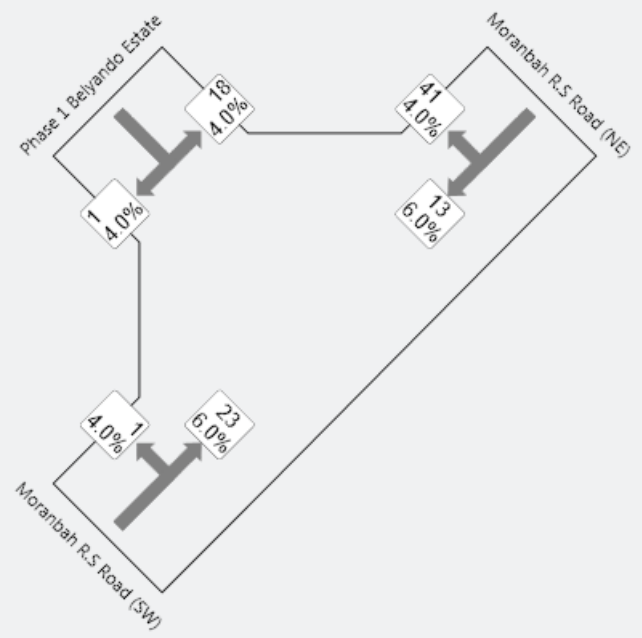
Belyando Estate / Moranbah Railway Station Road

Volumes – Scenario D

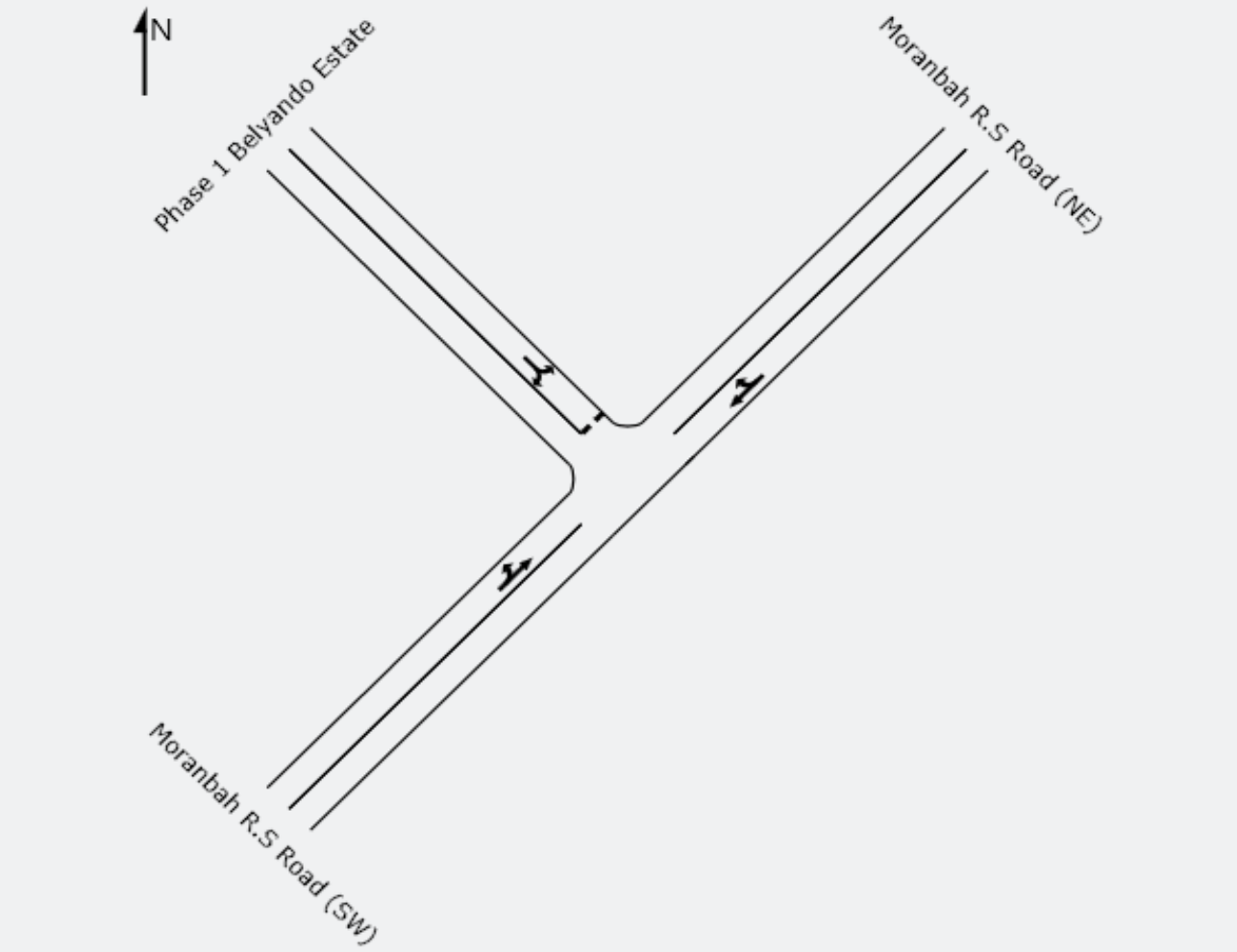
AM



PM



Proposed Layout



MOVEMENT SUMMARY

Site: D_2015_AM

Phase 1 Belyando Estate / Moranbah Railway Station Road
Design Year 2015 - Scenario D (worst case)
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Moranbah R.S Road (NE)											
25	T	23	6.0	0.027	0.3	LOS A	0.2	1.2	0.14	0.00	56.9
26	R	13	4.0	0.027	8.9	LOS A	0.2	1.2	0.14	0.86	48.5
Approach		36	5.3	0.027	3.3	NA	0.2	1.2	0.14	0.30	53.6
North West: Phase 1 Belyando Estate											
27	L	49	4.0	0.043	8.4	LOS A	0.2	1.1	0.04	0.65	48.8
29	R	1	4.0	0.043	8.5	LOS A	0.2	1.1	0.04	0.72	48.5
Approach		51	4.0	0.043	8.4	LOS A	0.2	1.1	0.04	0.65	48.8
South West: Moranbah R.S Road (SW)											
30	L	1	4.0	0.004	8.2	LOS A	0.0	0.0	0.00	0.99	49.0
31	T	6	6.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		7	5.7	0.004	1.2	NA	0.0	0.0	0.00	0.14	58.1
All Vehicles		94	4.6	0.043	5.9	NA	0.2	1.2	0.08	0.48	51.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: D_2015_PM

Phase 1 Belyando Estate / Moranbah Railway Station Road
Design Year 2015 - Scenario D (worst case)
PM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

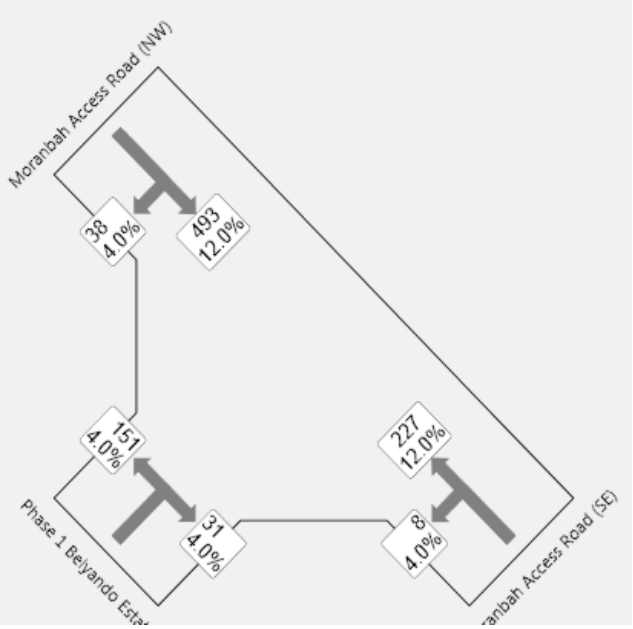
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Moranbah R.S Road (NE)											
25	T	14	6.0	0.058	0.3	LOS A	0.3	1.9	0.14	0.00	56.5
26	R	43	4.0	0.058	8.9	LOS A	0.3	1.9	0.14	0.71	48.2
Approach		57	4.5	0.058	6.8	NA	0.3	1.9	0.14	0.54	50.0
North West: Phase 1 Belyando Estate											
27	L	19	4.0	0.018	8.5	LOS A	0.1	0.4	0.09	0.63	48.6
29	R	1	4.0	0.018	8.6	LOS A	0.1	0.4	0.09	0.70	48.3
Approach		20	4.0	0.018	8.5	LOS A	0.1	0.4	0.09	0.63	48.5
South West: Moranbah R.S Road (SW)											
30	L	1	4.0	0.013	8.2	LOS A	0.0	0.0	0.00	1.06	49.0
31	T	24	6.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		25	5.9	0.013	0.3	NA	0.0	0.0	0.00	0.04	59.4
All Vehicles		102	4.7	0.058	5.6	NA	0.3	1.9	0.10	0.44	51.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

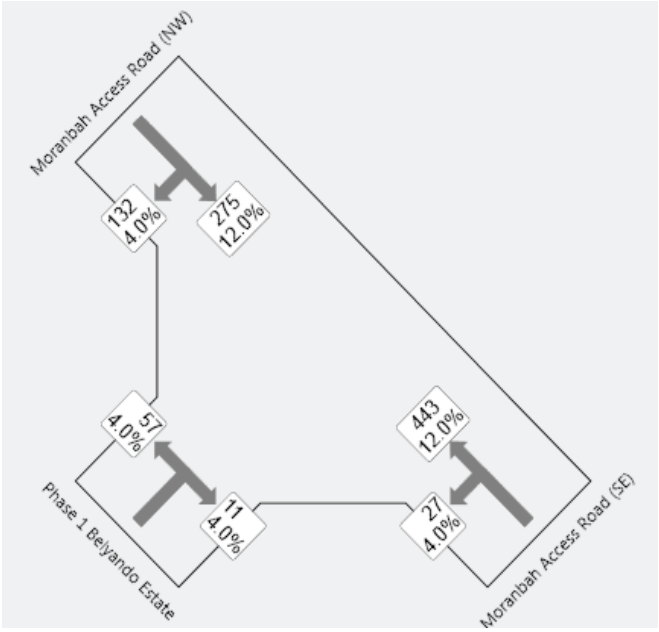
Belyando Estate / Moranbah Access Road

Volumes – Scenario C

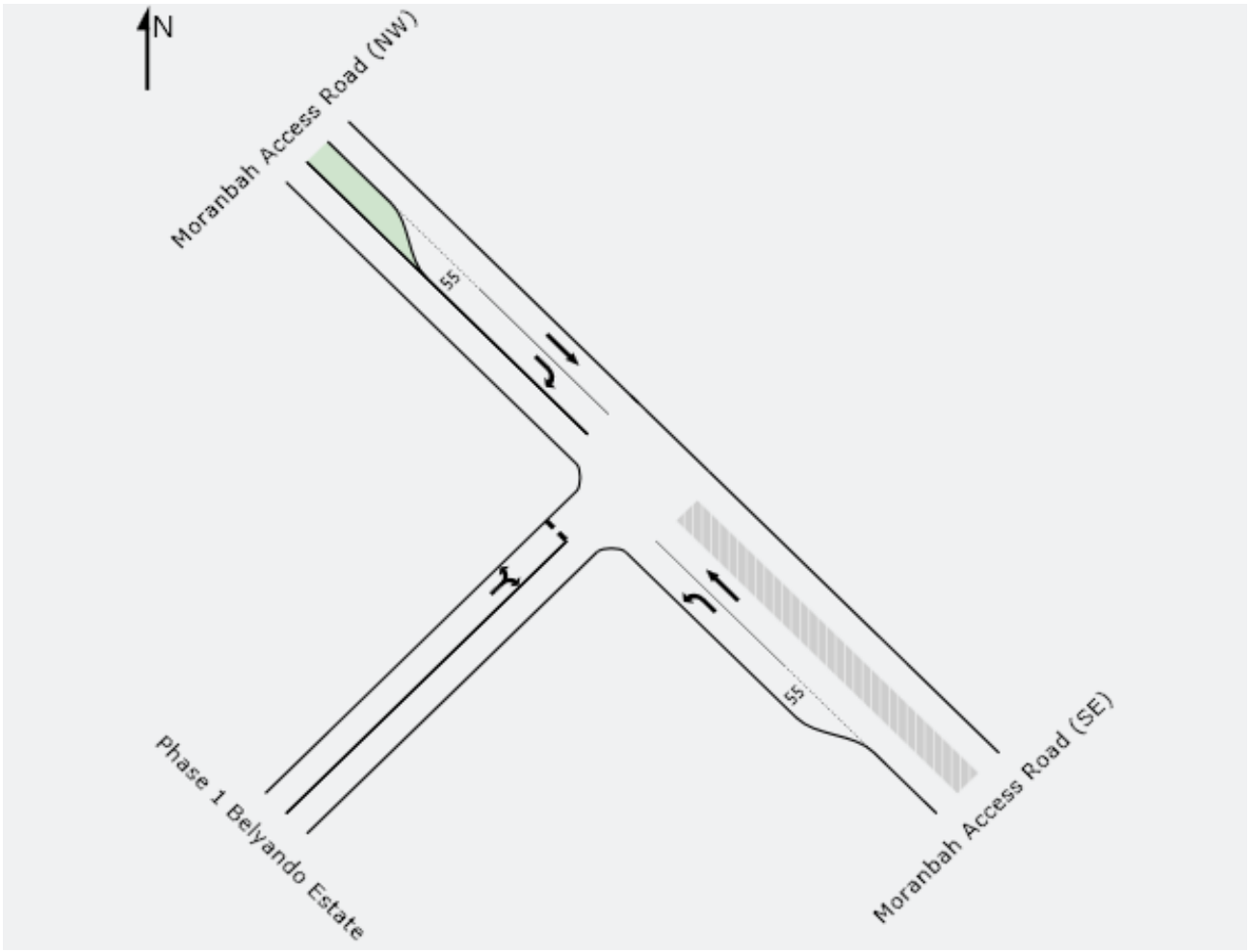
AM



PM



Proposed Layout



MOVEMENT SUMMARY

Site: C_2015_AM

Phase 1 Belyando Estate / Moranbah Access Road
Design Year 2015 - Scenario C
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Moranbah Access Road (SE)											
21	L	8	4.0	0.005	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
22	T	239	12.0	0.132	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		247	11.7	0.132	0.3	NA	0.0	0.0	0.00	0.02	59.5
North West: Moranbah Access Road (NW)											
28	T	519	12.0	0.287	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
29	R	40	4.0	0.074	12.4	LOS B	0.3	2.0	0.49	0.76	44.8
Approach		559	11.4	0.287	0.9	NA	0.3	2.0	0.03	0.05	58.6
South West: Phase 1 Belyando Estate											
30	L	159	4.0	0.324	13.3	LOS B	1.5	10.5	0.50	0.75	44.0
32	R	33	4.0	0.324	13.4	LOS B	1.5	10.5	0.50	0.86	43.9
Approach		192	4.0	0.324	13.3	LOS B	1.5	10.5	0.50	0.77	44.0
All Vehicles		998	10.1	0.324	3.1	NA	1.5	10.5	0.12	0.18	55.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: C_2015_PM

Phase 1 Belyando Estate / Moranbah Access Road
Design Year 2015 - Scenario C
PM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

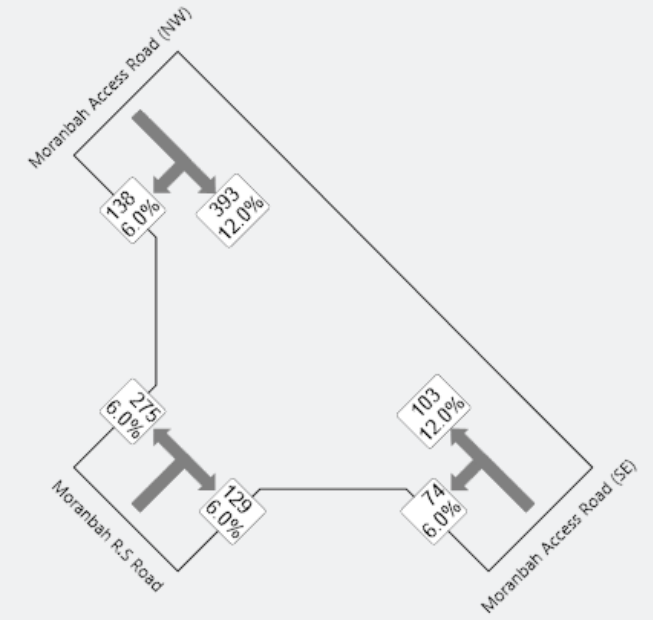
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Moranbah Access Road (SE)											
21	L	28	4.0	0.016	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
22	T	466	12.0	0.258	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		495	11.5	0.258	0.5	NA	0.0	0.0	0.00	0.04	59.2
North West: Moranbah Access Road (NW)											
28	T	289	12.0	0.160	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
29	R	139	4.0	0.369	19.0	LOS C	1.8	13.0	0.69	0.97	39.4
Approach		428	9.4	0.369	6.1	NA	1.8	13.0	0.22	0.32	51.4
South West: Phase 1 Belyando Estate											
30	L	60	4.0	0.155	14.5	LOS B	0.5	3.9	0.59	0.82	43.0
32	R	12	4.0	0.155	14.6	LOS B	0.5	3.9	0.59	0.87	43.0
Approach		72	4.0	0.155	14.5	LOS B	0.5	3.9	0.59	0.83	43.0
All Vehicles		995	10.1	0.369	3.9	NA	1.8	13.0	0.14	0.21	54.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

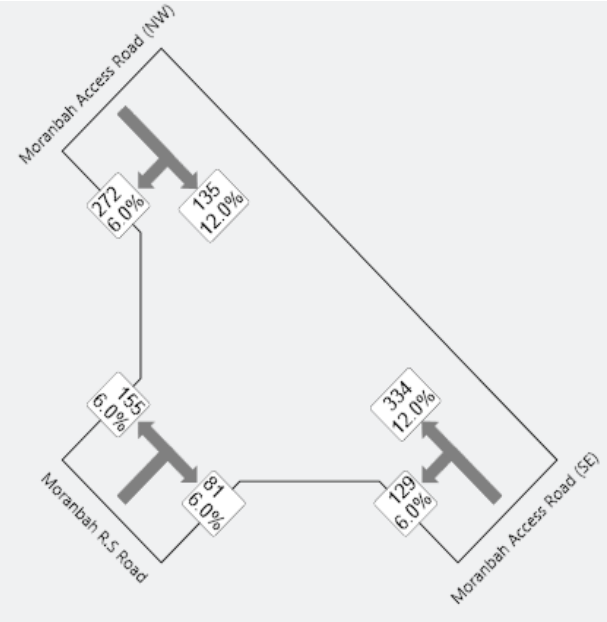
Moranbah Access Road / Moranbah Railway Station Road

Volumes – Scenario D

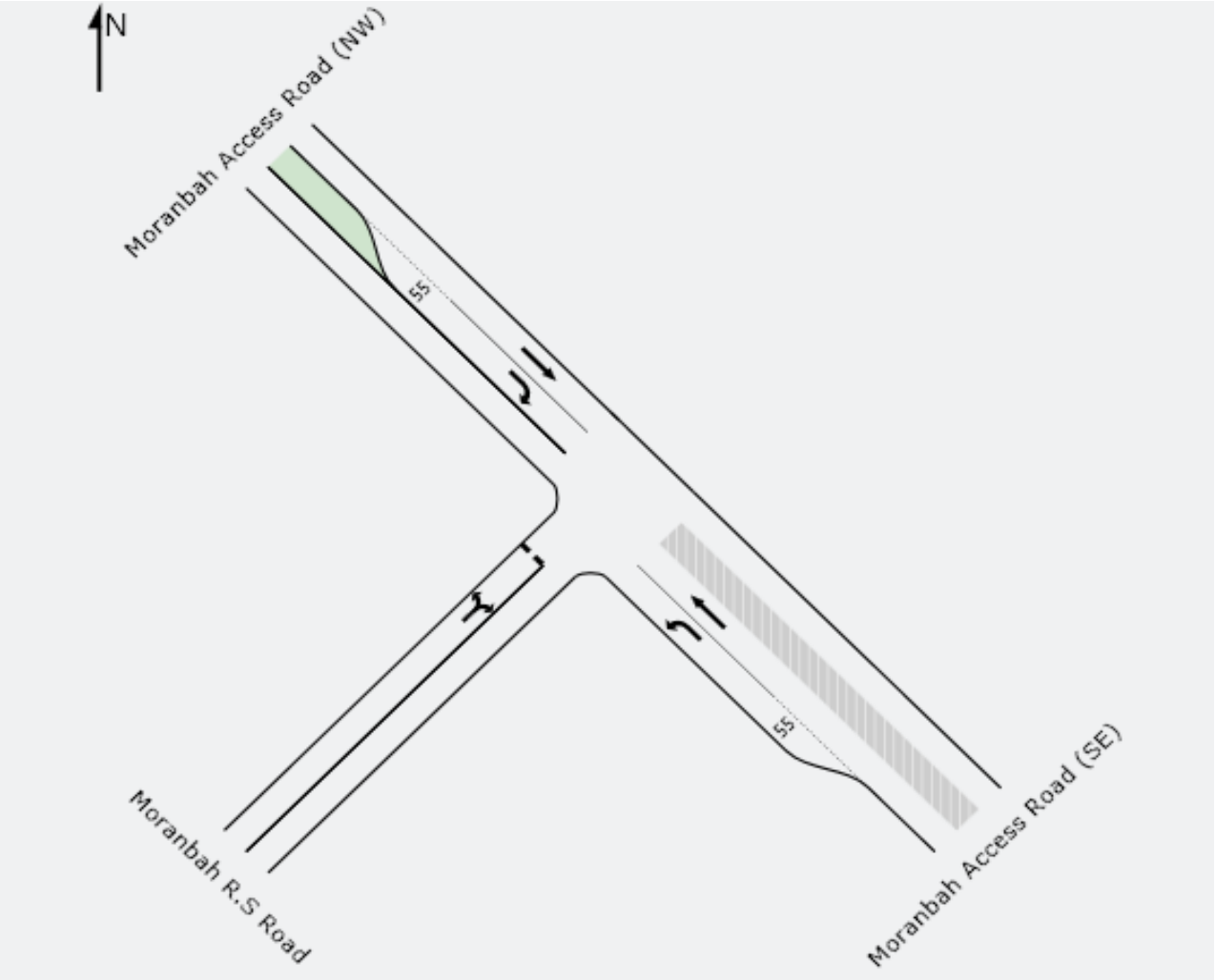
AM



PM



Proposed Layout



MOVEMENT SUMMARY

Site: D_2015_AM

Moranbah Access Road / Moranbah Railway Station Road
Design Year 2015 - Scenario D
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Moranbah Access Road (SE)											
21	L	78	6.0	0.044	8.4	LOS A	0.0	0.0	0.00	0.67	49.0
22	T	108	12.0	0.060	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		186	9.5	0.060	3.5	NA	0.0	0.0	0.00	0.28	54.8
North West: Moranbah Access Road (NW)											
28	T	414	12.0	0.229	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
29	R	145	6.0	0.111	9.9	LOS A	0.5	3.8	0.42	0.69	47.0
Approach		559	10.4	0.229	2.6	NA	0.5	3.8	0.11	0.18	56.0
South West: Moranbah R.S Road											
30	L	289	6.0	0.424	11.2	LOS B	2.6	19.1	0.36	0.67	46.0
32	R	136	6.0	0.424	11.4	LOS B	2.6	19.1	0.36	0.83	45.9
Approach		425	6.0	0.424	11.3	LOS B	2.6	19.1	0.36	0.72	46.0
All Vehicles		1171	8.7	0.424	5.9	NA	2.6	19.1	0.18	0.39	51.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: D_2015_PM

Moranbah Access Road / Moranbah Railway Station Road
Design Year 2015 - Scenario D
PM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

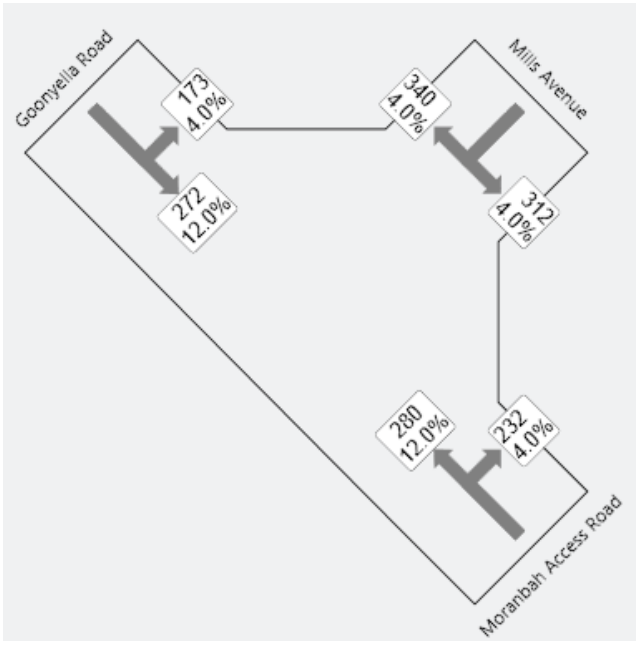
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Moranbah Access Road (SE)											
21	L	136	6.0	0.076	8.4	LOS A	0.0	0.0	0.00	0.67	49.0
22	T	352	12.0	0.194	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		487	10.3	0.194	2.3	NA	0.0	0.0	0.00	0.19	56.5
North West: Moranbah Access Road (NW)											
28	T	142	12.0	0.079	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
29	R	286	6.0	0.279	11.4	LOS B	1.4	10.1	0.59	0.83	45.8
Approach		428	8.0	0.279	7.6	NA	1.4	10.1	0.39	0.55	49.7
South West: Moranbah R.S Road											
30	L	163	6.0	0.621	24.0	LOS C	4.2	31.0	0.73	1.17	36.2
32	R	85	6.0	0.621	24.1	LOS C	4.2	31.0	0.73	1.10	36.2
Approach		248	6.0	0.621	24.0	LOS C	4.2	31.0	0.73	1.15	36.2
All Vehicles		1164	8.5	0.621	8.9	NA	4.2	31.0	0.30	0.53	48.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Mills Avenue / Moranbah Access Road / Goonyella Road

Volumes – Scenario D

AM



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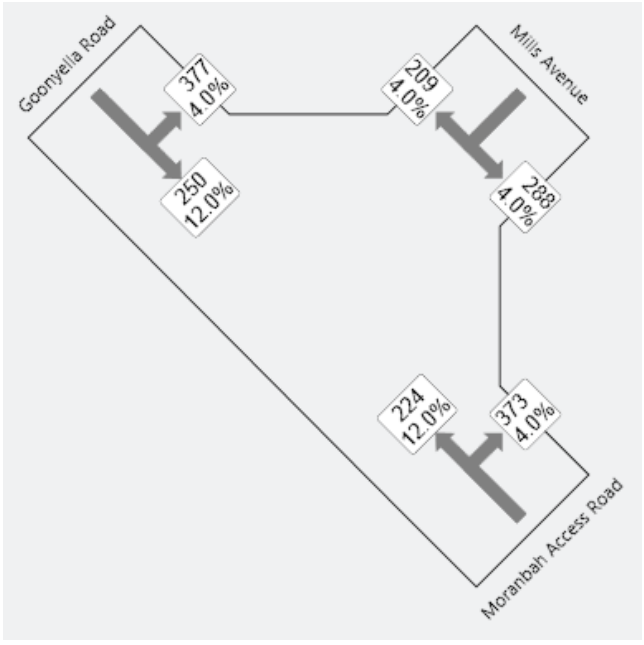
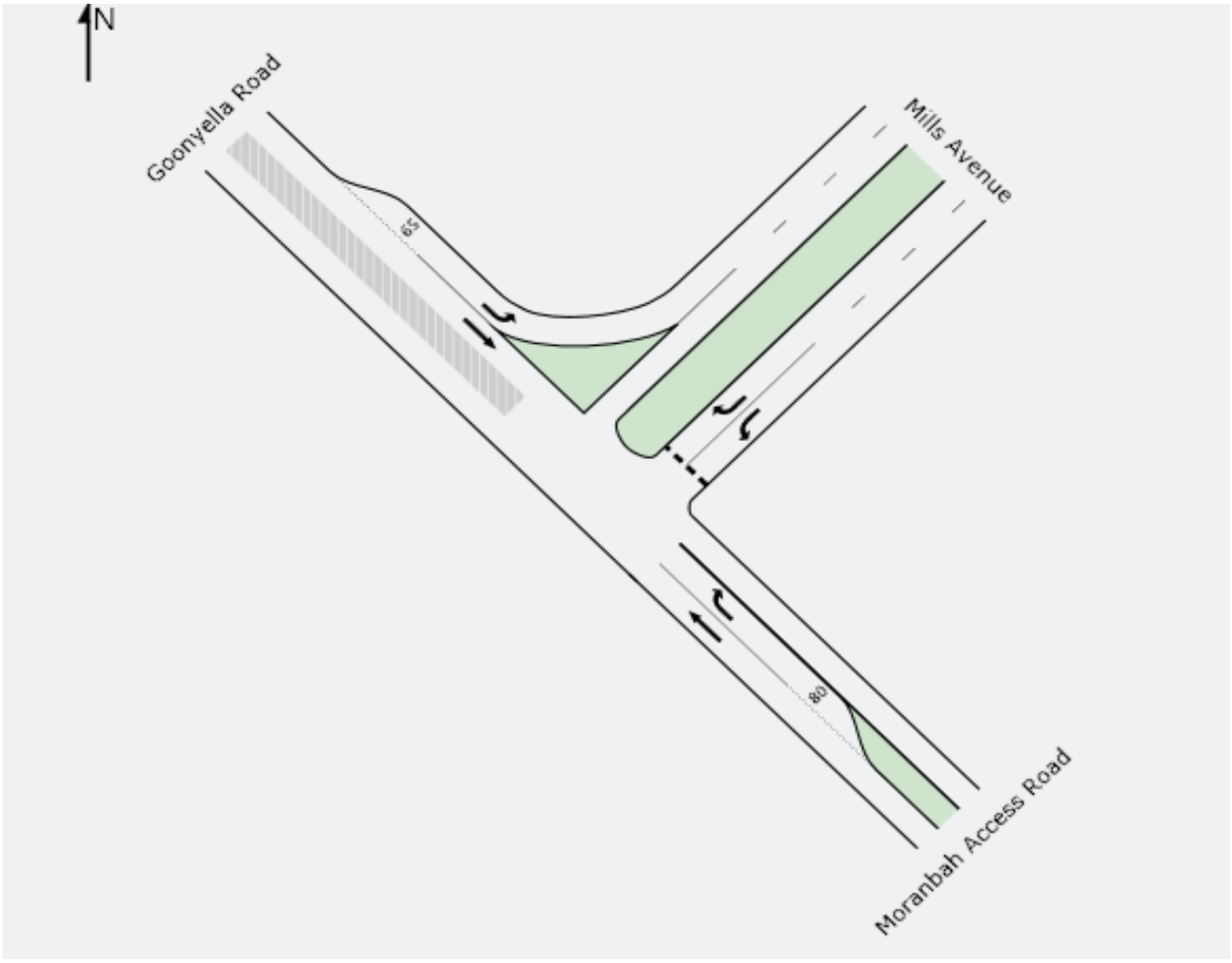


Proposed Layout



MOVEMENT SUMMARY

Site: BCD_2015_AM

Mills Avenue / Moranbah Access Road
Design Year 2015 - Scenario B, C, and D
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Moranbah Access Road											
22	T	295	12.0	0.163	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	244	4.0	0.210	10.1	LOS B	1.0	7.2	0.52	0.73	46.8
Approach		539	8.4	0.210	4.6	NA	1.0	7.2	0.24	0.33	53.2
North East: Mills Avenue											
24	L	328	4.0	0.286	10.0	LOS B	1.3	9.5	0.48	0.74	46.9
26	R	358	4.0	0.730	22.2	LOS C	5.3	38.3	0.86	1.25	37.4
Approach		686	4.0	0.730	16.4	LOS C	5.3	38.3	0.68	1.01	41.4
North West: Goonyella Road											
27	L	182	4.0	0.101	7.7	X	X	X	X	0.60	49.8
28	T	286	12.0	0.158	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		468	8.9	0.158	3.0	NA	0.0	0.0	0.00	0.23	55.5
All Vehicles		1694	6.7	0.730	8.9	NA	5.3	38.3	0.35	0.58	48.2

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: BCD_2015_PM

Mills Avenue / Moranbah Access Road
Design Year 2015 - Scenario B, C, and D
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Moranbah Access Road											
22	T	236	12.0	0.130	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	393	4.0	0.325	10.2	LOS B	1.7	12.6	0.54	0.75	46.7
Approach		628	7.0	0.325	6.4	NA	1.7	12.6	0.34	0.47	50.9
North East: Mills Avenue											
24	L	303	4.0	0.286	10.5	LOS B	1.3	9.4	0.52	0.78	46.7
26	R	220	4.0	0.553	21.1	LOS C	2.8	20.0	0.84	1.08	38.1
Approach		523	4.0	0.553	14.9	LOS B	2.8	20.0	0.66	0.90	42.6
North West: Goonyella Road											
27	L	397	4.0	0.220	7.7	X	X	X	X	0.60	49.8
28	T	263	12.0	0.145	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		660	7.2	0.220	4.6	NA	0.0	0.0	0.00	0.36	53.4
All Vehicles		1812	6.2	0.553	8.2	NA	2.8	20.0	0.31	0.56	49.0

X: Not applicable for Continuous movement.

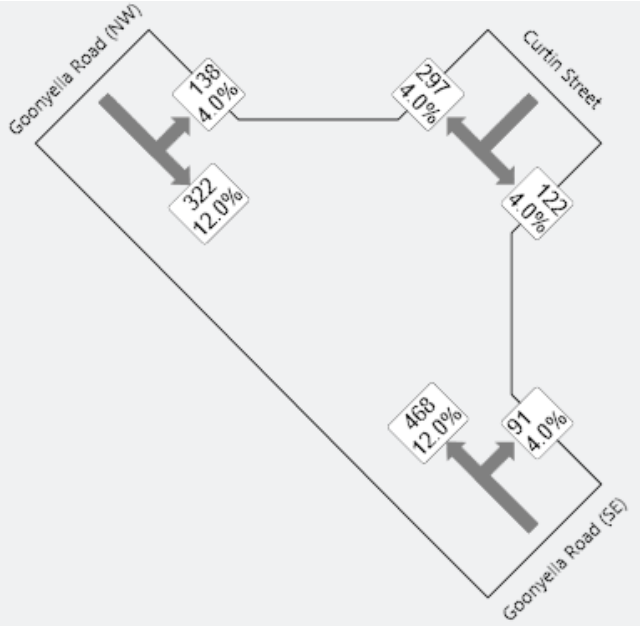
Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

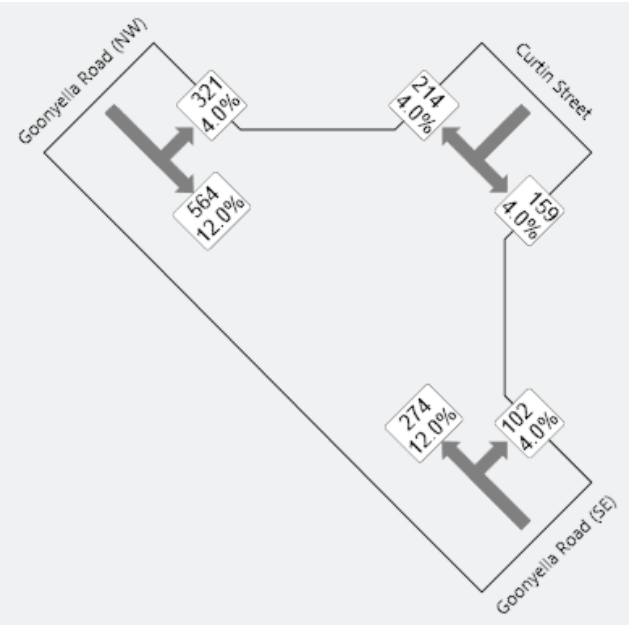
Mills Avenue / Moranbah Access Road / Goonyella Road

Volumes – Scenario D

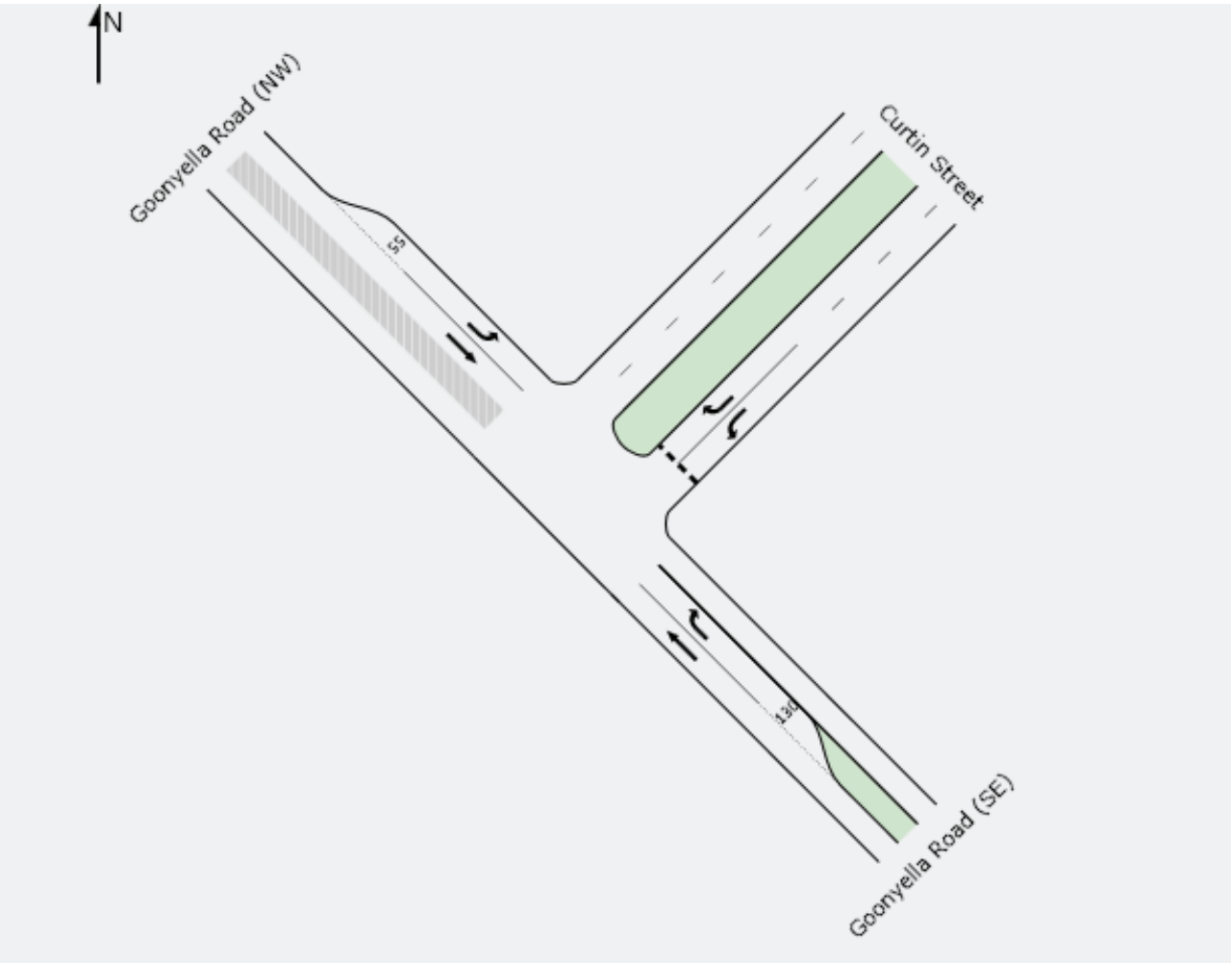
AM



PM



Proposed Layout



MOVEMENT SUMMARY

Site: BCD_2015_AM

Curtin Street / Goonyella Road
Design Year 2015 - Scenario B, C, and D
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Goonyella Road (SE)											
22	T	493	12.0	0.272	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	96	4.0	0.090	10.3	LOS B	0.4	2.8	0.52	0.72	46.8
Approach		588	10.7	0.272	1.7	NA	0.4	2.8	0.08	0.12	57.4
North East: Curtin Street											
24	L	128	4.0	0.116	9.9	LOS A	0.5	3.4	0.45	0.71	47.0
26	R	313	4.0	0.725	24.1	LOS C	4.8	35.0	0.88	1.24	36.2
Approach		441	4.0	0.725	20.0	LOS C	4.8	35.0	0.76	1.09	38.8
North West: Goonyella Road (NW)											
27	L	145	4.0	0.080	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
28	T	339	12.0	0.187	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		484	9.6	0.187	2.5	NA	0.0	0.0	0.00	0.20	56.2
All Vehicles		1514	8.4	0.725	7.3	NA	4.8	35.0	0.25	0.43	50.1

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: BCD_2015_PM

Curtin Street / Goonyella Road
Design Year 2015 - Scenario B, C, and D
PM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

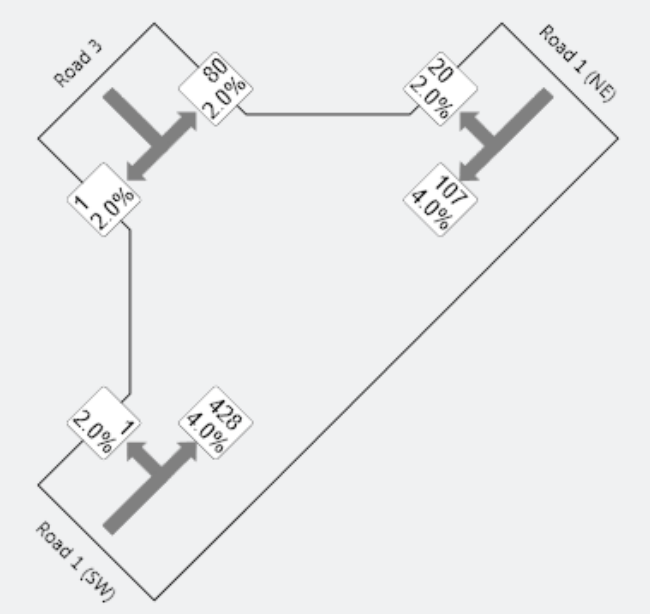
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Goonyella Road (SE)											
22	T	288	12.0	0.159	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	107	4.0	0.169	13.6	LOS B	0.7	5.0	0.69	0.89	43.8
Approach		396	9.8	0.169	3.7	NA	0.7	5.0	0.19	0.24	54.5
North East: Curtin Street											
24	L	167	4.0	0.226	12.4	LOS B	0.9	6.6	0.62	0.88	44.9
26	R	225	4.0	0.645	25.3	LOS D	3.4	24.7	0.89	1.15	35.5
Approach		393	4.0	0.645	19.8	LOS C	3.4	24.7	0.77	1.03	39.0
North West: Goonyella Road (NW)											
27	L	338	4.0	0.187	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
28	T	594	12.0	0.328	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		932	9.1	0.328	3.0	NA	0.0	0.0	0.00	0.24	55.5
All Vehicles		1720	8.1	0.645	7.0	NA	3.4	24.7	0.22	0.42	50.4

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

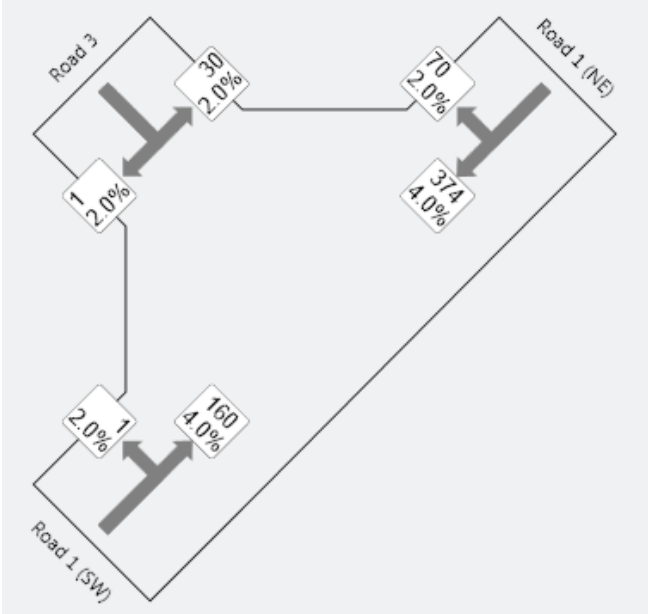
Internal Intersection – Road 3 / Road 1

Volumes – Worst Case

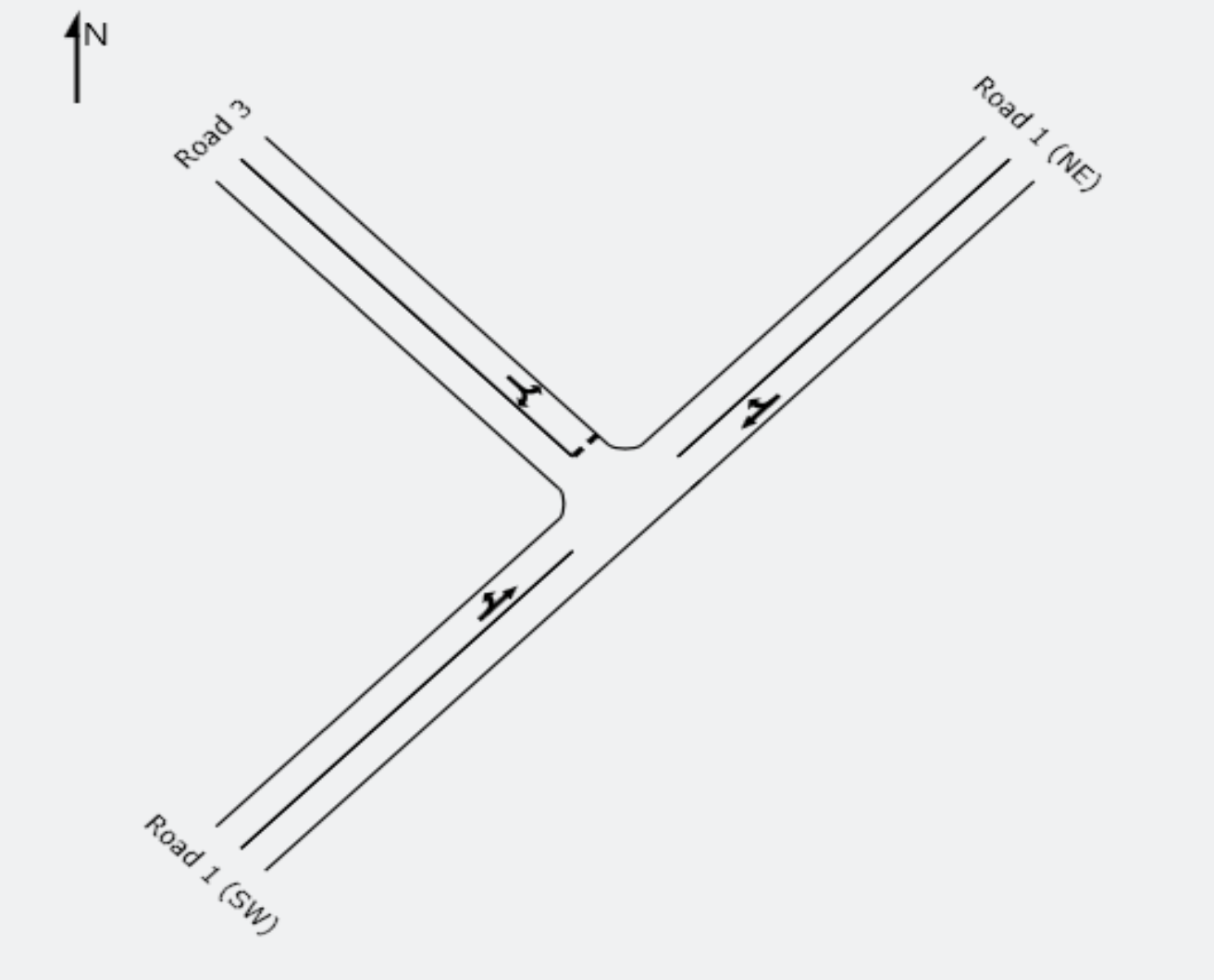
AM



PM



Adopted Layout



MOVEMENT SUMMARY

Site: Raod 3 / Road 1 AM

Road 3 / Road 1
Road 3 - Phase 1 Belyando Estate, Road 1 - Ultimate Belyando Estate
AM peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Road 1 (NE)											
25	T	113	4.0	0.078	1.9	LOS A	0.5	3.8	0.50	0.00	51.0
26	R	21	2.0	0.078	9.7	LOS A	0.5	3.8	0.50	0.95	48.6
Approach		134	3.7	0.078	3.1	NA	0.5	3.8	0.50	0.15	50.6
North West: Road 3											
27	L	84	2.0	0.081	9.0	LOS A	0.3	2.2	0.46	0.70	42.2
29	R	1	2.0	0.081	9.2	LOS A	0.3	2.2	0.46	0.79	42.2
Approach		85	2.0	0.081	9.0	LOS A	0.3	2.2	0.46	0.70	42.2
South West: Road 1 (SW)											
30	L	1	2.0	0.238	7.4	LOS A	0.0	0.0	0.00	1.19	48.6
31	T	451	4.0	0.238	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		452	4.0	0.238	0.0	NA	0.0	0.0	0.00	0.00	60.0
All Vehicles		671	3.7	0.238	1.8	NA	0.5	3.8	0.16	0.12	55.0

Level of Service (LOS) Method: Delay (HCM 2000).
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SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Raod 3 / Road 1 PM

Road 3 / Road 1
Road 3 - Phase 1 Belyando Estate, Road 1 - Ultimate Belyando Estate
AM peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Road 1 (NE)											
25	T	394	4.0	0.255	0.8	LOS A	1.7	12.3	0.36	0.00	53.3
26	R	74	2.0	0.255	8.6	LOS A	1.7	12.3	0.36	0.95	48.6
Approach		467	3.7	0.255	2.0	NA	1.7	12.3	0.36	0.15	52.5
North West: Road 3											
27	L	32	2.0	0.024	7.8	LOS A	0.1	0.7	0.25	0.59	42.9
29	R	1	2.0	0.024	8.1	LOS A	0.1	0.7	0.25	0.73	42.8
Approach		33	2.0	0.024	7.8	LOS A	0.1	0.7	0.25	0.60	42.9
South West: Road 1 (SW)											
30	L	1	2.0	0.089	7.4	LOS A	0.0	0.0	0.00	1.18	48.6
31	T	168	4.0	0.089	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		169	4.0	0.089	0.0	NA	0.0	0.0	0.00	0.01	59.9
All Vehicles		669	3.7	0.255	1.8	NA	1.7	12.3	0.26	0.14	53.6

Level of Service (LOS) Method: Delay (HCM 2000).
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