



North Bungendore Planning Proposal - Traffic Impact Assessment

Prepared by Calibre Consulting
Prepared for Queanbeyan-Palerang Regional Council

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1 INTRODUCTION

Calibre Consulting has been commissioned by the Queanbeyan-Palerang Regional Council (QPRC) to undertake a Traffic Impact Assessment (TIA) as part of the North Bungendore Planning Proposal. The North Bungendore Planning Proposal if approved would enable a subdivision application to be submitted for the creation of approximately 309 residential lots. This study has also considered a broader study of approximately 1028 low density residential lots including the currently proposed 309 lots.

1.1 LOCATION OF THE PROJECT

The Planning Proposal Area comprises Part Lot 1 DP 798111. The Study Area comprises the Planning Proposal Area, plus additional land to the north and west (Part Lot 1 DP798111 and Lot 1 DP8800871). Both areas are located approximately 2km northeast of the Bungendore Town Centre. The Study Area is surrounded by the Bungendore Landfill to the west, undeveloped land to the north, Goulburn Bombala Railway to the east and Bungendore to the south.

The Planning Proposal Area is shown in Figure 1-1 as the area bounded by the orange line. The wider Study Area, incorporating the potential future residential development to the north and west is shown in the same figure as the area bounded by the black line.

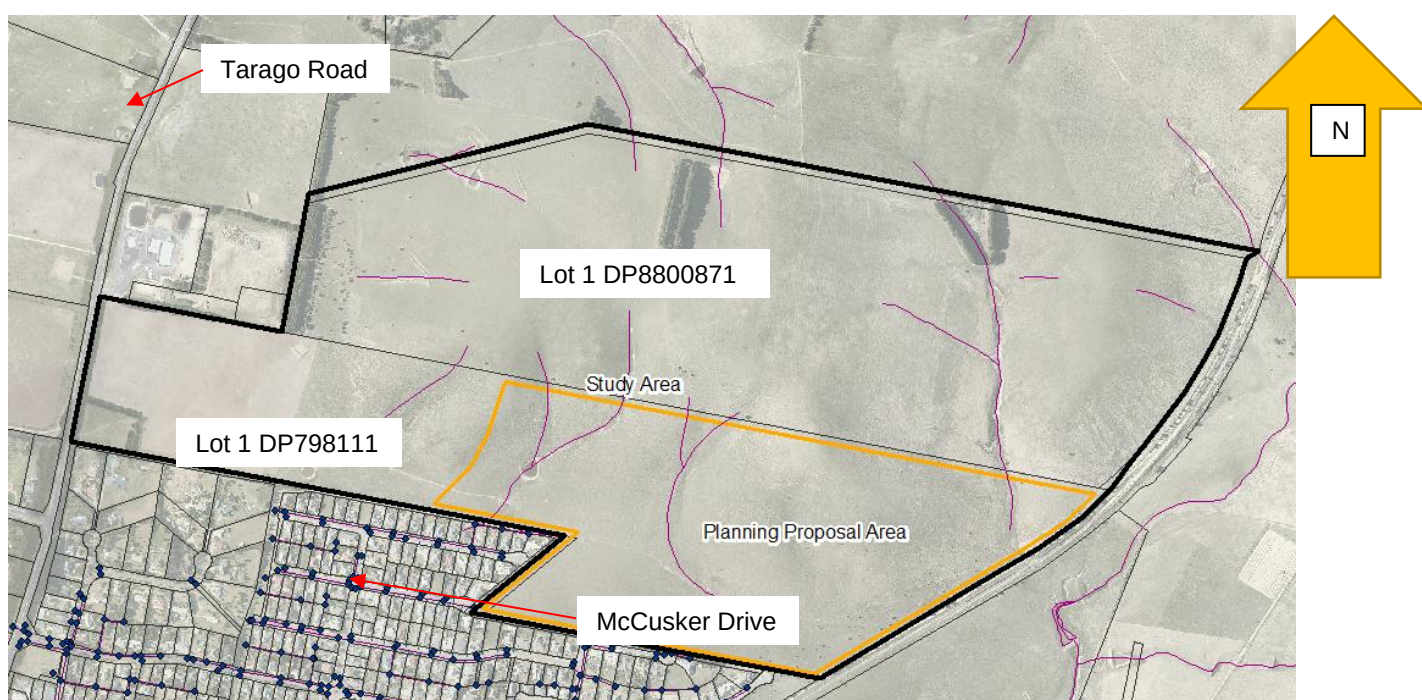


Figure 1-1: Project location

1.2 OBJECTIVES

The objective of this Traffic Impact Assessment is to determine any implications resulting from the proposed development of the Planning Proposal and Study Areas. The report provides a discussion of traffic impacts including:

- Review of potential development yield and determination of vehicle traffic generation.
- Traffic generation and point of access.
- Traffic impacts on nearby existing intersections and proposed intersections
- Potential intersection layout arrangements and adjustments

2 EXISTING CONDITIONS

2.1 STUDY AREA DESCRIPTION

The Study Area has a total area of approximately 186.1Ha and is currently used as grazing land for livestock. There are multiple minor stormwater catchments which are located within the Study Area which stream from the high point located in the centre of Lot 1 DP8800871.

2.2 ADJACENT ROAD NETWORK

The roads surrounding the Study Area and their functions are shown within Table 2-1.

Table 2-1: Surrounding roads and their classification

Road Name	Classification
Tarago Road	Classified Road
Molonglo Street	Classified Road
McCusker Drive	Local Street / Collector Street
Ashby Drive	Local Sub Arterial

Refer to Figure 2-1 for the road network in close proximity to the Study Area.



Figure 2-1: Nearby Roads

2.3 EXISTING TRANSPORT CONDITIONS AND INTERSECTION OPERATION

2.3.1 EXISTING TRAFFIC VOLUMES

Traffic counts were undertaken on Tuesday 1 November 2016 to obtain the existing AM and PM peak hour traffic volumes at the following intersections:

- McCusker Drive – Larmer Street
- McCusker Drive – Eyre Street
- McCusker Drive – Ashby Drive – Keffe PI
- McCusker Drive – McMahon Drive – Donoghoe PI
- Tarago Road – Elmslea Drive
- Tarago Road – Ashby Drive
- Molonglo Street – Turallo Terrace
- Molonglo Street – Gibraltar Street – Bungendore Road
- Simms Drive – Hyland Drive
- Simms Drive – Lithgow Place – Flynn Place

Refer to Figure 2-2 for the location of the intersection counts.

These intersections were surveyed between the hours of 7am-9am during the AM peak hour and 5pm to 7pm during the PM peak hour. From a review of the surveyed traffic volumes it was found that the typical AM peak hour was between the hours of 7am – 8am, and the PM peak hour was between the hours of 5pm-6pm. Refer to Appendix A for diagrams of the existing traffic volumes at each of these intersections during the AM and PM peak hours.



Figure 2-2: Intersection Count Locations

2.3.2 EXISTING INTERSECTION PERFORMANCE

Table 2-2 shows the LOS criteria for SIDRA for uninterrupted flow facilities.

Table 2-2: LOS Criteria for Uninterrupted Flow Facilities

LOS	Average Control Delay, d (s/veh)	Definition
A	$d \leq 10$	A condition of free-flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent
B	$10 < d \leq 20$	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is a little less than with level of service A.
C	$20 < d \leq 35$	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
D	$35 < d \leq 50$	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.
E	$50 < d \leq 70$	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.
F	$70 < d$	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.

SIDRA intersection analysis was undertaken for the pre-development scenario based on the surveyed traffic volume data. The results were based upon the RTA method of analysis in SIDRA and are summarised in Table 2-3.

Table 2-3: Pre-development LOS and Delay

Intersection	Peak Hour	Intersection Type	Maximum Delay (s)	Level of Service	95% Back of Queue (m)
McCusker Drive – Larmer Street	AM	T intersection, Uncontrolled	4.6	A	0.1
McCusker Drive – Eyre Street		Four way, Give Way	4.9	A	0.9
McCusker Drive – Ashby Drive – Keffe PI		Roundabout	7.4	A	2.1
McCusker Drive – McMahon Drive – Donoghoe PI		Roundabout	8.5	A	1.3
Tarago Road – Elmslea Drive		T intersection, Give Way	5.7	A	3.2
Tarago Road – Ashby Drive		T intersection, Give Way	6.1	A	8.0
Molonglo Street – Turallo Terrace		T intersection, Give Way	6.8	A	2.2
Molonglo Street – Gibraltar Street – Bungendore Road		Roundabout	9.6	A	13.9
Simms Drive – Hyland Drive		T intersection, Uncontrolled	4.7	A	0.1
Simms Drive – Lithgow Place – Flynn Place		T intersection, Uncontrolled	4.7	A	0.3
McCusker Drive – Larmer Street	PM	T intersection, Uncontrolled	4.6	A	0.3
McCusker Drive – Eyre Street		Four way, Give Way	5.0	A	1.8
McCusker Drive – Ashby Drive – Keffe PI		Roundabout	7.2	A	2.1
McCusker Drive – McMahon Drive – Donoghoe PI		Roundabout	8.5	A	1.9
Tarago Road – Elmslea Drive		T intersection, Give Way	5.9	A	1.2
Tarago Road – Ashby Drive		T intersection, Give Way	5.8	A	6.2
Molonglo Street – Turallo Terrace		T intersection, Give Way	5.7	A	6.6
Molonglo Street – Gibraltar Street – Bungendore Road		Roundabout	9.7	A	11.6
Simms Drive – Hyland Drive		T intersection, Uncontrolled	4.6	A	0.5
Simms Drive – Lithgow Place – Flynn Place		T intersection, Uncontrolled	4.7	A	0.5

As indicated in Table 2-3, the existing intersections appear to operate well with minimal delays and queues for the existing traffic volumes surveyed during the AM and PM peak hours.

3 PROPOSED DEVELOPMENT AND IMPACTS

3.1 PROPOSED DEVELOPMENT

It is understood that it is currently proposed to only develop approximately 309 lots which falls within the Planning Proposal Area. The pedestrian and road hierarchy analysis has been carried out within the known planning proposal area (Lot 1 DP798111) and does not include analysis within the larger Study Area, as Calibre Consulting has not been provided with any indicative layouts for the planning proposal within this area.

Extrapolation of the current proposed development yield (309 lots across 55 hectares) to full development of the two lots results in a total yield of approximately 1028 lots (approximately 180.5 hectares). However, for the purposes of this traffic assessment, the traffic analysis carried out below allows for the worst case scenario – full development the Study Area.

It is noted that whilst the traffic analysis is being undertaken for the larger Study Area, any future development outside of the current Planning Proposal Area will be required to be the subject of a future planning proposal.

3.2 TRAFFIC MODELLING PROCESS UNDERTAKEN

Calibre Consulting was engaged to produce traffic analysis for the development of the planning proposal area and the study area. Analysis was originally undertaken for the larger study area to determine the maximum impact of traffic generated from the study area on the road network and determine:

- The ultimate geometry of the proposed intersections within the study area; and
- Determine whether or not the existing intersections required upgrading due to additional traffic being generated by the study area.

The analysis undertaken for the larger study area indicated that the existing intersections within Bungendore could generally cater for the traffic generated upon full development of the larger study area. The proposed major intersections within the Study Area were originally analysed with minimal intersection footprints (ie a lane on each approach and exit from the intersection). It was found that these intersections operated well during peak hours, and thus no change to the geometry of the intersections was required.

On the basis of the traffic analysis working well for the larger study area for intersections with minimal footprints, it was considered that undertaking analysis for a lesser development yield (ie the planning proposal area) was not required.

3.3 TRAFFIC ANALYSIS

3.3.1 TRAFFIC GENERATION

The traffic generation for the proposed development was calculated using the Palerang Council Development Control Plan (2015), which specifies a traffic generation rate of 7 trips per day per lot. This equates to a traffic generation rate of approximately 0.7 trips per hour during peak hours. It is expected that approximately 90% of the traffic generated by the proposed development will exit the development in the AM peak hour, with the remaining 10% of the traffic generated expected to enter the development. The reverse will occur during the PM peak hour. Refer to Table 3-1 for the peak hour traffic generation for the proposed development.

Table 3-1: Peak Hour Traffic Generation

Peak Hour	Lots	Generation Rate (veh/hr/lot)	Direction of Travel	Split Ratio	Peak Hour Traffic Generation (veh/hr)
AM	1028	0.7	In	10%	72
			Out	90%	648
PM			In	90%	648
			Out	10%	72

Figure 3-1 indicates the layout of the proposed development and the proposed connection locations with the existing road network from the North Bungendore Planning Proposal. It is noted the QPRC does not support this current layout at this stage, and should the planning proposal proceed, a new subdivision layout may need to be prepared to take into account the various Planning Proposal studies.



Figure 3-1: Proposed Development Layout

From Figure 3-1, it can be seen that the primary means of access to the development is via Tarago Road and McCusker Drive.

A wider review of the road network indicates that the primary destinations for vehicles leaving the proposed development would be as follows:

- Bungendore town centre (accessed via McCusker Drive)
- Bungendore Road (accessed via Tarago Road / Ashby Drive)
- Kings Highway (accessed via Tarago Road / Ashby Drive)

Based on the above, the anticipated traffic volumes which are expected to be generated by the proposed development can be further broken down. It is anticipated that the large majority (approximately 90%) of traffic generated by the proposed development will access the larger road network through the use of Tarago Road. Refer to Table 3-2 for the destinations / origins of traffic to and from the proposed development.

Table 3-2: Peak Hour Traffic Generation – Destinations and Origins

Peak Hour	Lots	Peak Hour Traffic Generation	Direction of Travel	Split Ratio	Traffic Volumes (veh/hr)
AM	In	72	Tarago Road	90%	65
			McCusker Drive	10%	8
	Out	648	Tarago Road	90%	583
			McCusker Drive	10%	65
PM	In	648	Tarago Road	90%	583
			McCusker Drive	10%	65
	Out	72	Tarago Road	90%	65
			McCusker Drive	10%	8

3.3.2 TRAFFIC SPLITS

As part of the proposed development it is considered that there will be two primary intersections utilised to access the larger road network – Tarago Road / North Bungendore Road and McCusker Drive / North Bungendore. As no information is available about traffic behaviour for the proposed intersections it is considered that traffic will egress and access the Study Area / Planning Proposal Area at the intersection of Tarago Road / North Bungendore Road in a similar manner to the intersection of Ashby Drive. Refer to Figure 3-2 for the AM peak hour split ratios at the proposed intersection of Tarago Road / North Bungendore Road based upon the surveyed traffic volumes at the intersection of Tarago Road / Ashby Drive. Split ratios for vehicular access colours are shown in yellow, and egress in red.

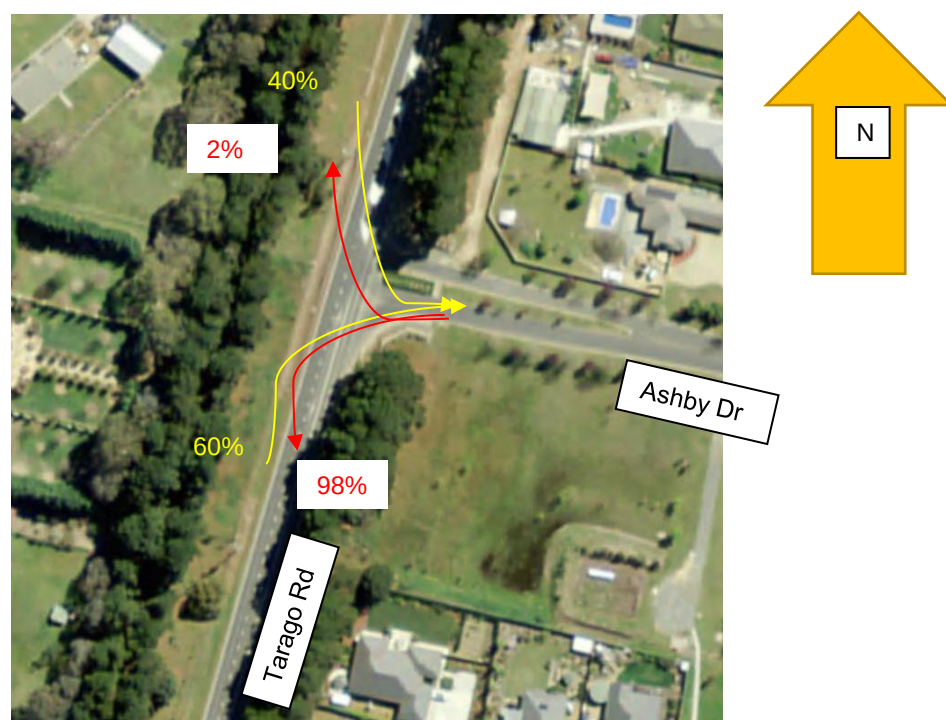


Figure 3-2: AM peak hour intersection splits at Tarago Road / Ashby Drive

Refer to Figure 3-3 for the PM peak hour split ratios at the proposed intersection of Tarago Road / North Bungendore Road based upon the surveyed traffic volumes at the intersection of Tarago Road / Ashby Drive. Split ratios for vehicular access colours are shown in yellow, and egress in red.

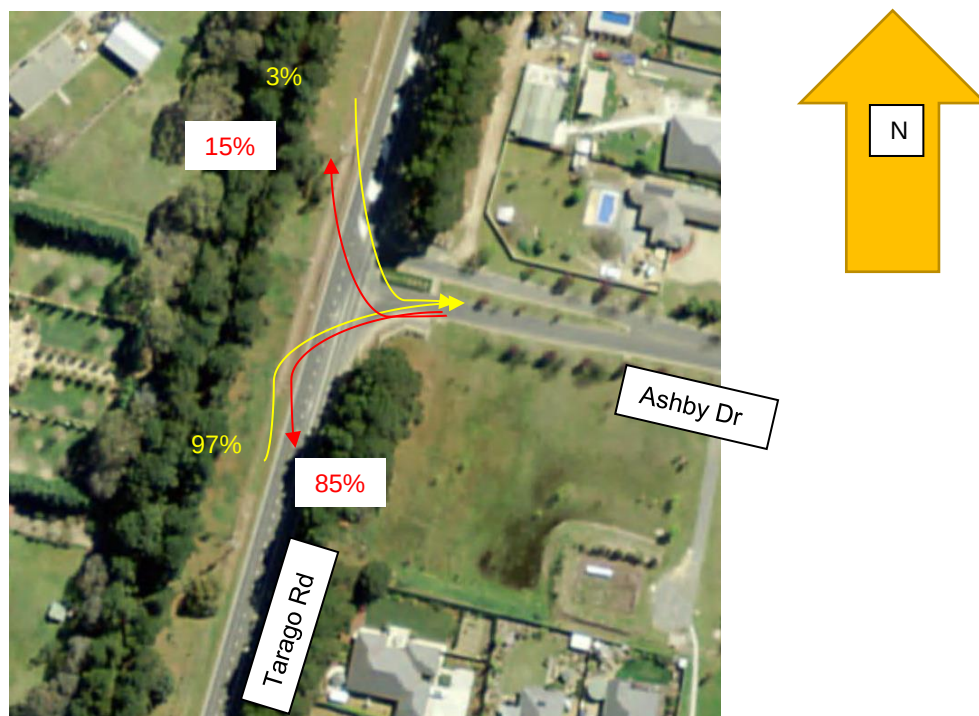


Figure 3-3: PM peak hour intersection splits at Tarago Road / Ashby Drive

A more detailed breakdown of the traffic splits at various intersections is shown in Appendix B.

The traffic generated by the proposed development, shown in Table 3-2, is multiplied by the traffic splits shown in Figure 3-2 and Figure 3-3. This traffic is then added to the existing traffic volumes to determine the post development traffic volumes at the intersections considered. Refer to Appendix C for the post development traffic volumes through the majority of the intersections considered and the proposed intersection of Tarago Road / North Bungendore Road.

It is noted that the intersections of Simms Drive / Hyland Drive and Simms Drive / Lithgow Place has been excluded from further analysis. This is due to the following facts:

- The primary methods of accessing the Study Area / Planning Proposal Area to and from the larger road network is via McCusker Drive and Tarago Road;
- The traffic picked up by Hyland Drive from the Study Area / Planning Proposal Area can only access the larger road network through the intersection of Ashby Drive / McCusker Drive and the intersection of Tarago Road / North Bungendore Road; and
- The traffic volumes for the intersections of Simms Drive / Hyland Drive and Simms Drive / Lithgow Place are relatively low and would operate effectively at a significantly higher volume of traffic than the existing volumes.

3.4 POTENTIAL EXTERNAL INTERSECTION DESIGNS

3.4.1 TARAGO ROAD / NORTH BUNGENDORE ROAD

Calibre Consulting has produced three possible intersection layouts for Tarago Road / North Bungendore Road. A summary of these intersections is as follows:

- Option 1 – Basic Left Turn Treatment (BAL) and Basic Right-Turn Treatment (BAR). This option meets the minimum requirements associated with the development of the North Bungendore Planning Proposal, however, does not make provision for any future development further to the north of the estate.
- Option 2 – BAL and Auxiliary Right-Turn Treatment (AUR). This option meets the minimum requirements associated with the development of the North Bungendore Planning Proposal, however there may be issues associated with northbound vehicles passing queued right turning vehicles
- Option 3 – BAL and Channelised Right-Turn (CHR). This option meets the minimum requirements associated with the development of the North Bungendore Planning Proposal and is the safest option. This, however, is balanced by the amount of land required to be taken up by the intersection and costs associated with the formation of the intersection.

Overall, it is recommended that Option 3 be implemented for the intersection of Tarago Road / North Bungendore Road should costs and land acquisition not be considered to be a constraint.

3.4.2 MCCUSKER DRIVE / LARMER STREET

Calibre Consulting has produced four concept intersection layouts for McCusker Drive / Larmer Street / North Bungendore Road. A summary of these intersections is as follows:

- Option 1 – Staggered T intersection. This option meets the minimum requirements outlined in the Palerang Regional Council Development Control Plan for verges and carriageway widths. This layout, however, is not ideal as northbound lanes and southbound lanes end up directly opposite at the intersection, resulting in confusion and awkward turning movements through the intersection. It is noted that this intersection has also not been modelled as part of the traffic analysis.
- Option 2 – Four-way intersection. This option complies with the traffic analysis within this report and does not have any known safety issues. This intersection, however, is within close proximity to the block boundary of a nearby resident.
- Option 3 – Four-way intersection, Left only on approach. This intersection complies with the traffic analysis within the report and does not have any known safety issues. This intersection would force traffic to utilise the North Bungendore Road to enter Tarago Road and restricted traffic from entering Larmer Street from the north. The intersection, however, is within close proximity to the block boundary of a nearby resident.
- Option 4 – Four-way intersection, Left only on approach with traffic island. This intersection complies with the traffic analysis within the report and does not have any known safety issues. This intersection would force traffic to utilise the North Bungendore Road to enter Tarago Road, however does not restrict traffic entering Larmer Street from the North. The intersection, however, is within close proximity to the block boundary of a nearby resident.

Overall, it is recommended that Option 2 be implemented for the intersection of McCusker Drive / Larmer Street. Alternatively, consideration could be given to not providing a direct connection to North Bungendore via McCusker Drive. Refer to Appendix D for the concept intersection layouts.

3.4.3 POST DEVELOPMENT INTERSECTION PERFORMANCE

A SIDRA 7.0 model was prepared to assess the future traffic conditions. The existing intersections were analysed utilising SIDRA 7.0 software for the future traffic volumes. Table 3-3 shows the SIDRA output results for the post development intersections.

Table 3-3: SIDRA Analysis Post Development Summary

Intersection	Peak Hour	Intersection Type	Maximum Delay (s)	Level of Service	95% Back of Queue (m)
McCusker Drive – Larmer Street	AM	Four way, give way	4.9	A	1.3
McCusker Drive – Eyre Street		Four way, give way	5.2	A	1.9
McCusker Drive – Ashby Drive – Keffe PI		Roundabout	5.2	A	2.8
McCusker Drive – McMahon Drive – Donoghoe PI		Roundabout	8.6	A	1.6
Tarago Road – North Bungendore Road		T intersection	6.4	A	16.8
Tarago Road – Elmslea Drive		T intersection	9.9	A	22.1
Tarago Road – Ashby Drive		T intersection	14.6	B	24.5
Molonglo Street – Turallo Terrace		T intersection	12.6	A	2.8
Molonglo Street – Gibraltar Street – Bungendore Road		Roundabout	16.0	A	63.3
McCusker Drive – Larmer Street	PM	Four way, give way	4.9	A	1.6
McCusker Drive – Eyre Street		Four way, give way	5.3	A	3.2
McCusker Drive – Ashby Drive – Keffe PI		Roundabout	7.3	A	3.3
McCusker Drive – McMahon Drive – Donoghoe PI		Roundabout	8.6	A	2.3
Tarago Road – North Bungendore Road		T intersection	6.4	A	20.2
Tarago Road – Elmslea Drive		T intersection	9.2	A	4.1
Tarago Road – Ashby Drive		T intersection	8.0	A	7.8
Molonglo Street – Turallo Terrace		T intersection	8.9	A	31.9
Molonglo Street – Gibraltar Street – Bungendore Road		Roundabout	17.6	A	43.4

As indicated in Table 3-3, the additional traffic generated from the Study Area will not have a significant impact on the operation of the existing intersections in close proximity to the Study Area.

3.4.4 EXTERNAL INTERSECTION RECOMMENDATIONS

A summary of the positives and negatives associated with Tarago Road / North Bungendore Road is shown in Table 3-4, along with an assessment of whether or not the intersection is suitable for the volume of traffic generated by the Planning Proposal and Study Areas.

Table 3-4: Tarago Road / North Bungendore Road - External Intersection Analysis

Intersection Treatment	Positives	Negatives	Suitable for Planning Proposal Area	Suitable for Study Area
Option 1 - Basic Left Turn (BAL) and Basic Right Turn Treatment (BAR)	• Cheapest option • Least impact on adjoining properties	• Least safe • Most impact on residents to the north • Future development to the north is more likely to require modifications to the intersection than other treatments		
Option 2 - BAL and Auxiliary Right-Turn (AUR)	• Moderately expensive option • Moderate impact on adjoining properties	• Moderately safe • Moderate impact on residents to the north • Future development to the north is moderately likely to require modifications to the intersection		
Option 3 - BAL and Channelised Right-Turn (CHR)	• Safest option • Least impact on residents to the north • Least likely to require modifications for the foreseeable future	• Most expensive option		

As shown in Table 3-4, whilst all options are viable for both the Planning Proposal Area and the Study Area, other factors to consider include safety, expense, impact to adjoining residents and impact on residents to the north of the intersection (i.e. traffic operation of the road network). It is recommended that Option 3 – BAL and CHR be implemented as it is the safest option, minimises potential future reworks associated with any future development, and has the least amount of impact on the road network operation. Additionally, the provision of Option 3 – BAL and CHR will likely reduce any future capital costs associated with mobilisation of work crews for future intersection works.

A summary of the positives and negatives associated with McCusker Drive / Larmer Street is shown in Table 3-5, along with an assessment of whether or not the intersection is suitable for the volume of traffic generated by the Planning Proposal and Study Areas.

Table 3-5: McCusker Drive / Larmer Street - External Intersection Analysis

Intersection Treatment	Positives	Negatives	Suitable for Planning Proposal Area	Suitable for Study Area
Option 1 - Staggered T Intersection	Least impact on adjoining land users	- Awkward / unsafe intersection geometry - Major traffic movement (north-south) is required to give way – less efficient road network	X	X
Option 2 - Four-way intersection	- Major traffic movement (north-south) is given priority - Minor impact on adjoining residents	Difficulty in continuation of underground services on same side of road reserve	✓	✓
Option 3 - Four-way intersection, left only on approach	Major traffic movement (north-south) is given priority	- Highest impact on adjoining residents - Difficulty in continuation of underground services on same side of road reserve	✓	✓
Option 4 - Four-way intersection, left only on approach with traffic island	Major traffic movement (north-south) is given priority	- Moderate impact on adjoining residents - Difficulty in continuation of underground services on same side of road reserve	✓	✓

Whilst all intersection treatments are suitable for the intersection of McCusker Drive / Larmer Street (except Option 1) due to the minimal traffic volumes through the intersection, it is recommended that Option 2 – Four-way intersection is implemented. This is due to the fact that it has the smallest impact on adjoining residents, and provides the north-south movement with right of way.

3.5 INTERNAL ROAD HIERARCHY

A review of the North Bungendore Planning Proposal was undertaken to determine the likely road hierarchy within the proposed development. The indicative subdivision layout was utilised from the dfp planning consultant's report (Appendix D). It is noted that the indicative subdivision layout within the North Bungendore Planning Report does not provide any indication of potential road layouts within Lot 1 DP8800871, or a 500m radius from the Bungendore Landfill area. Refer to Figure 3-4 for the indicative subdivision layout produced by dfp planning consultants.



Figure 3-4: Indicative subdivision layout

No additional information has been made available to Calibre Consulting for potential road layouts within the 500m radius from the Bungendore Landfill area or within Lot 1 DP8800871.

Based on the indicative subdivision layout, Calibre Consulting has produced a road hierarchy plan based on the expected number of lots which may utilise the road upon full development of the Study Area and the Palerang Development Control Plan (page 32). Refer to Appendix E for the road hierarchy plan. A summary of the classifications of the roads within the indicative subdivision layout are within Table 3-6.

Table 3-6: Indicative subdivision road classifications

Road Classification	Road Names
Local Sub Arterial	North Bungendore Road
Collector Street	McCusker Drive, and Road 1 (east of McCusker Drive)
Local Street	Road 1 (west of McCusker Drive), Road 2, Road 3, Road 4, Road 5, Road 7, Street 1, Street 2, and Street 3
Access Street	Road 6, Street 4, Street 5, Street 6, Street 7, Street 8, and Street 9,

3.6 MAJOR INTERNAL INTERSECTION FORM

Calibre Consulting has reviewed the road hierarchy plan to determine the likely location of highly trafficked intersections. The intersections which are likely to have large volumes of traffic through them are as follows:

- McCusker Drive / North Bungendore Road; and
- McCusker Drive / Road 1

3.6.1 TRAFFIC VOLUMES

To determine the likely traffic through these intersections, the classification of the roads was utilised – the maximum number of lots for the road classification was multiplied by 7 VPD to determine the maximum vehicles per day on the road. This number was then divided by 10 and split (90% outgoing, 10% incoming during AM peak hour, and the reverse during PM peak hour) to determine peak hour traffic volumes through the intersections. Refer to Figure 3-5 for the AM peak hour traffic volumes through these intersections, and Figure 3-6 for the PM peak hour traffic volumes through these intersections.

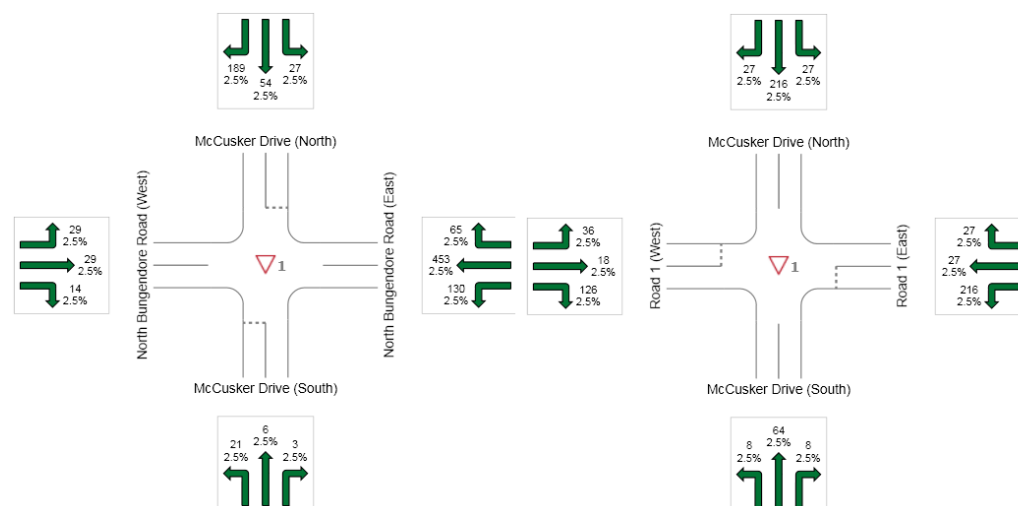


Figure 3-5: Major Internal Intersections - AM Peak Hour Volumes

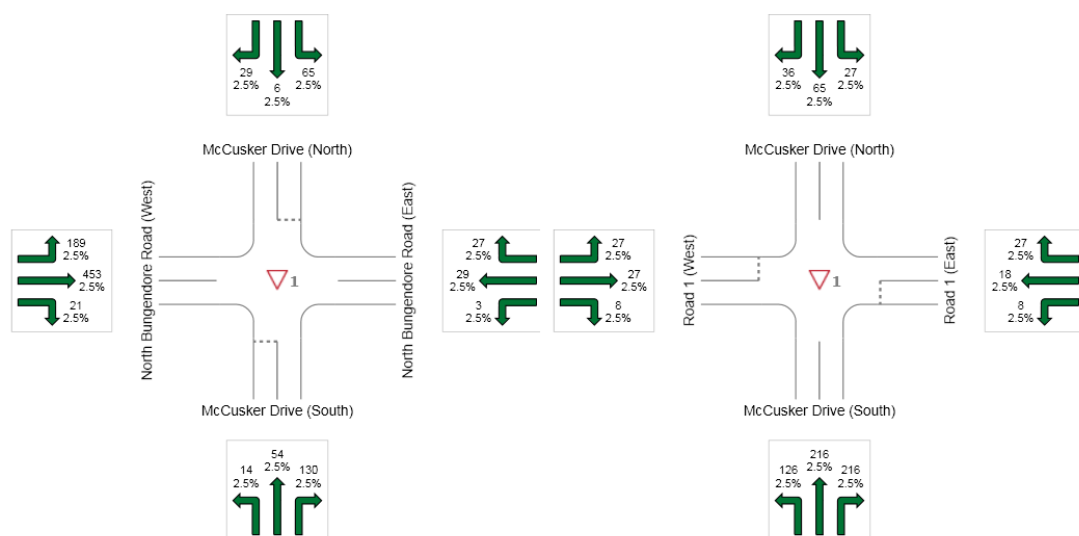


Figure 3-6: Major Internal Intersections - PM Peak Hour Volumes

3.6.2 TRAFFIC ANALYSIS

A SIDRA 7.0 model was prepared to assess the traffic conditions through the major internal intersections. The following intersections types have been analysed as part of this assessments:

- McCusker Drive / North Bungendore Road
 - Four way, give way
 - Roundabout
- McCusker Drive / Road 1
 - Four way, give way
 - Roundabout

Table 3-7 shows the SIDRA output results for the post development intersections. It is noted that the traffic volumes utilised in the assessment is likely to be much higher than the actual volumes through the intersection and should be viewed as a capacity check.

Table 3-7: SIDRA Analysis – Major Internal Intersections

Intersection	Peak Hour	Intersection Type	Maximum Delay (s)	Level of Service	95% Back of Queue (m)
McCusker Drive – North Bungendore Road	AM	Four way, give way	11.2	A	17.7
McCusker Drive – Road 1			7.8	A	7.1
McCusker Drive – North Bungendore Road		Roundabout	11.7	A	35.5
McCusker Drive – Road 1			9.9	A	11.9
McCusker Drive – North Bungendore Road	PM	Four way, give way	10.2	A	18.0
McCusker Drive – Road 1			8.2	A	14.7
McCusker Drive – North Bungendore Road		Roundabout	11.1	A	33.8
McCusker Drive – Road 1			9.9	A	20.8

As indicated in Table 3-7, typically the provision of roundabouts result in longer queues and larger maximum delays during both the AM and PM peak hours. Despite this, the provision of a roundabout also meets and exceeds the minimum LoS criteria and there are no significant delays at the internal intersections, and as such, provision of either a four way, give way intersection or a roundabout would be suitable. Provision of signalised intersections within a small residential subdivision would not be warranted as a priority controlled intersection has been demonstrated to be sufficient.

3.6.3 POSSIBLE LAYOUTS

As noted in Section 3.6.2, the traffic analysis carried out indicates that either a roundabout or a four way, priority controlled intersection would perform well during peak hours, and as such there is no reasoning as to why one intersection form should be provided over another. The SIDRA analysis allowed for a single lane on each approach and exit for the intersection analysis.

Typically, roundabouts have a larger intersection footprint when compared to a priority controlled intersection and will result in additional land being utilised as part of the road reserve, however, have the benefit of being able to be landscaped and typically creates a lower speed environment than a priority controlled intersection. The developer of the Study Area will be required to design a suitable intersection as part of the development application during a later stage of design.

3.7 RECOMMENDATIONS FOR EXTERNAL AND INTERNAL INTERSECTION ARRANGEMENTS

As found in Section 3 and noted in Section 3.2, the internal and external intersections have the minimum intersection footprint (that is a single lane on approach and departure from the intersections). Traffic analysis was carried out for the internal and external intersections. It was found that the minimum intersection footprints operated well for the traffic generated by the Study Area. Traffic generated by the Planning Proposal Area is less than that of the study area due to decreased development yield. On this basis, the traffic generated by the Planning Proposal Area will perform well.

A summary of the recommended internal and external intersection arrangements for both the Planning Proposal area and the Study Area is shown in Table 3-8.

Table 3-8: Planning Proposal and Study Area Intersection Arrangements

Intersection	Planning Proposal Intersection Type	Study Area Intersection Type
McCusker Drive – Larmer Street	Adjust from three way priority to four way priority	Adjust from three way priority to four way priority
McCusker Drive – Eyre Street	No changes to existing intersection	No changes to existing intersection
McCusker Drive – Ashby Drive – Keeffe PI	No changes to existing intersection	No changes to existing intersection
McCusker Drive – McMahon Drive – Donoghoe PI	No changes to existing intersection	No changes to existing intersection
Tarago Road – North Bungendore Road	Adjust existing carriageway to provide for priority controlled T intersection	Adjust existing carriageway to provide for priority controlled T intersection
Tarago Road – Elmslea Drive	No changes to existing intersection	No changes to existing intersection
Tarago Road – Ashby Drive	No changes to existing intersection	No changes to existing intersection
Molonglo Street – Turallo Terrace	No changes to existing intersection	No changes to existing intersection
Molonglo Street – Gibraltar Street – Bungendore Road	No changes to existing intersection	No changes to existing intersection
McCusker Drive – North Bungendore Road	New internal intersection. Either four way priority controlled or roundabout.	New internal intersection. Either four way priority controlled or roundabout.
McCusker Drive – Road 1	New internal intersection. Either four way priority controlled or roundabout.	New internal intersection. Either four way priority controlled or roundabout.

As shown in Table 3-8, there is no difference in the intersections associated with the Planning Proposal Area or the Study Area, that is, the same works should be undertaken if either area is developed.

4 PEDESTRIAN AND CYCLIST MOBILITY

4.1.1 RELEVANT STANDARDS

The following standards are relevant to provision of pedestrian and cyclist methods of travel:

- AS1428.1 – Design for access and mobility – general requirements
- Austroads Guide to Road Design Part 6A: Pedestrian and Cyclist Paths
- Palerang Development Control Plan
- Palerang Bike Plan and Pedestrian Access and Mobility Plan (PAMP)

A summary of the relevant components of the standards is as follows:

AS1428 – Design for Access and Mobility – General Requirements

Compliance with AS1428.1 generally indicates suitable access for mobility impaired users and suitability for areas of high pedestrian traffic.

- Walkway gradients – Not steeper than 1:20
- Maximum camber / cross fall – For walkways of grade of less than 1:33, a camber or crossfall of not steeper than 1:40, or 1:33 where the surface is bitumen. Cross fall is not required for where the gradient is >1:33.

Austroads Guide to Road Design Part 6A: Pedestrian and Cyclist Paths

Austroad Guide to Road Design Part 6A provides the following guidance on the widths of pedestrian paths for low and high demand areas:

- General low demand – 1.0m – 1.2m. This is generally suitable for most streets
- High pedestrian volumes – 2.4m (or wider based on demand). This is Generally suitable for commercial and shopping areas
- For wheelchairs to pass one another – 1.5m to 1.8m

Austroad Guide to Road Design Part 6A also provides the following guidance on bicycle paths:

- Horizontal curvature – varies depending on design speed. Minimum radii is 10m at 20km/hr.
- Bicycle path width – Local access path – 2.5m – 3m
- Bicycle path width – Major path – 2.5m – 4.0m
- Shared path width – local access path – 2.5m – 3m
- Shared path width – Commuter path – 2.5m – 4m
- Shared path width – Recreational path – 3m – 4.0m
- Cross falls of 2-4% acceptable, 2.5% typical.
- Gradients steeper than 5% should be avoided where possible, and where not possible to avoid these grades, no sharp horizontal curves or fixed objects should exist at the bottom of the hill.

Palerang Development Control Plan

Typically, footpaths within new residential developments follow the same alignment and grade as the nearby road grades. The Palerang Development Control Plan provides the following advice on road and footpath design:

- For access streets, local streets, collector streets and local sub arterial roads, a 1.5m wide carriageway is required to be provided on one side only, however is required to be wider if shown on the Pedestrian and Mobility Plan, with verge widths increased to suit.
- For access streets and local streets, the maximum acceptable grades are 20%.
- For collector streets, the maximum acceptable grade is 15%
- For local sub arterials, the maximum acceptable grade is 10%.

Palerang Bike Plan and Pedestrian Access and Mobility Plan (PAMP)

The PAMP provides guidance on currently utilised pedestrian paths / cycle paths, and planned pedestrian paths / cycle paths. The following items were found during a review of the PAMP which is relevant to the development of the Study Area:

- McCusker Drive did not appear to be heavily trafficked by pedestrians or cyclists
- Tarago Road did not appear to be heavily trafficked by pedestrians or cyclists
- The area to the west appears to be heavily trafficked by pedestrians which travel to the nearby Bungendore Town Centre, adjacent to the existing stormwater swale.
- It is proposed to extend the existing footpath along the stormwater swale to the area north of Larmer Street
- An informal path is aligned to the north of the existing properties on Larmer Street.

4.1.2 PEDESTRIAN AND CYCLIST DEMAND

From a review of the PAMP and the areas surrounding Bungendore, the following areas have been identified as attracting pedestrians and cyclists:

- Bungendore town centre (generally)
- Bungendore Primary School
- Bungendore Pre-school
- Skate Park

Generally, the majority of demand for pedestrians and cyclists would be to the south of the proposed development.

4.1.3 PROPOSED PATHS – INTERNAL

As noted in Section 4.1.1, the Palerang DCP requires that a 1.5m wide path to be provided on one side of the road, and all roads within the proposed development require a footpath. Calibre Consulting has undertaken a review of the existing contours and the indicative subdivision layout to determine areas which would be further investigated or improved during detailed design / development application. Generally, the following roads were identified as having steep grades (>7%) which may be difficult to obtain grades which comply with the relevant standards:

- McCusker Drive (8%)
- Road 2 (11%)
- Road 3 (14%)
- Road 4 (7%)
- Street 2 (8.7%)
- Street 4 (11%)
- Street 5 (11%)

Refer to Appendix F for the pedestrian path grades.

A larger “trunk” path should be provided within the Planning Proposal Area / Study Area in the following locations to promote accessibility to the Bungendore Town Centre:

- Along the McCusker Drive extension into the Planning Proposal Area / Study Area; and
- Along Street 8.

The above are recommended as these paths may be used as a commuter paths to and from the town centre and will tie into the PAMP master plan developed by Palerang Council. The above works are recommended in addition to the external paths works noted in Section 4.1.4 to ensure connectivity between the existing areas and the proposed development.

4.1.4 PROPOSED PATHS – EXTERNAL

As noted in Section 4.1.2, a review of the existing Bungendore infrastructure indicates that the majority of the pedestrian and cyclist demand is typically to the south of the proposed development. As a result of this connections to the existing path network should be considered. These connections include:

- Provision of a path from the end of Street 8 to the existing path to the west of Larmer Street and adjacent to the stormwater swale.
- Provision of a path from the proposed extension McCusker Drive to the intersection of Ashby Drive / McCusker Drive, within the McCusker Drive verge.
- Provision of a cycle path from the end of the cycle path on Tarago Road to North Bungendore Road
- Upgrade of the existing gravel path from the low level crossing on McCusker Drive to the new connection off Lithgow Place

The benefit of providing these paths is to promote a thorough fair to the Bungendore Town Centre and encourage active travel to and from residential areas.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This Traffic Impact Assessment was developed to determine the traffic impact of the residential development associated with the North Bungendore Planning proposal. The proposed development is surrounded the Bungendore Landfill to the west, undeveloped land to the north, Goulburn Bombala Railway to the east and Bungendore to the south.

The primary means of accessing and egressing the Study Area / Planning Proposal Area was found to be via Tarago Road and McCusker Drive.

Ten intersections around the planning proposal area were analysed to determine if there was any significant impact from increased traffic on the existing intersections. As part of the North Bungendore planning proposal, it is anticipated that a new intersection with Tarago Road will be created to facilitate the access and egress of traffic from the planning proposal area.

Analysis of the existing and proposed intersections found that the existing intersections operated satisfactorily based on the expected amount of traffic which may be generated by the proposed development.

Generally, the proposed development has grades which comply with the relevant pedestrian, bicycle and disabled access standards, however careful review of grades for the identified roads and streets will need to be undertaken during the detailed design phase of the project to ensure compliance with the relevant standards.

5.2 RECOMMENDATIONS

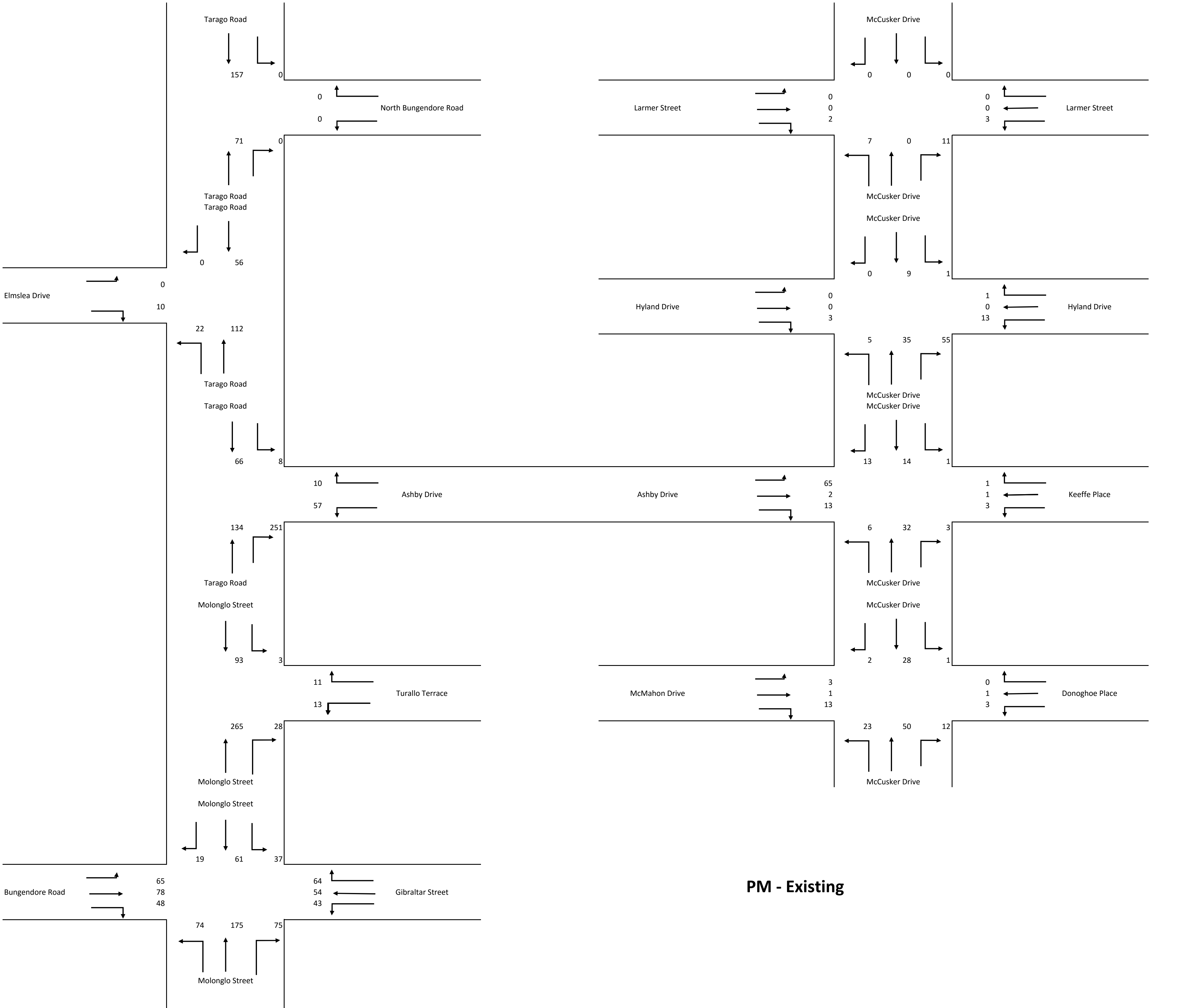
In response to the conclusions made in this Traffic Impact Assessment, the following recommendations are made:

- The existing intersections operated at a satisfactory level of service for both the existing and future scenarios modelled.
- The existing intersection of McCusker Drive / Larmer Street should be modified to become a four-way intersection, providing access to the Study Area / Planning Proposal Area.
- The proposed intersection of Tarago Road / North Bungendore Road should be a BAL and CHR intersection to provide access to the Study Area / Planning Proposal Area.
- The major internal intersections of McCusker Drive / North Bungendore Road and McCusker Drive / Road 1 were found to function well in either a priority controlled intersection or a roundabout. The form of these intersections will be decided by the applicant responsible for developing the North Bungendore Estate.
- Several paths within the proposed development were found to have steep grades. The grades may change during the development application or detailed design phase so that the paths comply with the relevant standards.
- Two major paths should be considered as works external to the proposed development to provide a means of connecting the proposed development pedestrian demand areas, namely west of Larmer Street and within the verge of McCusker Drive.

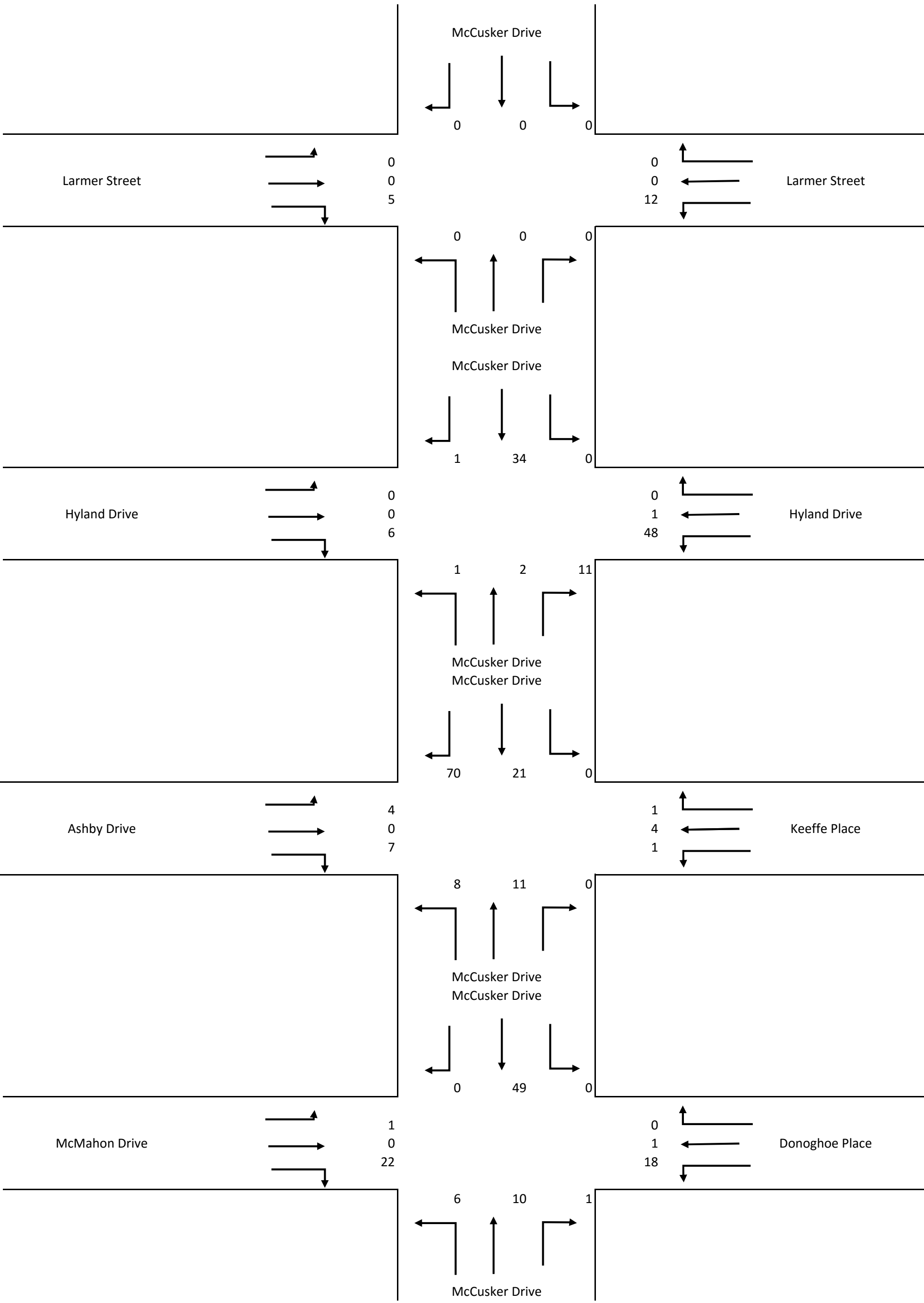
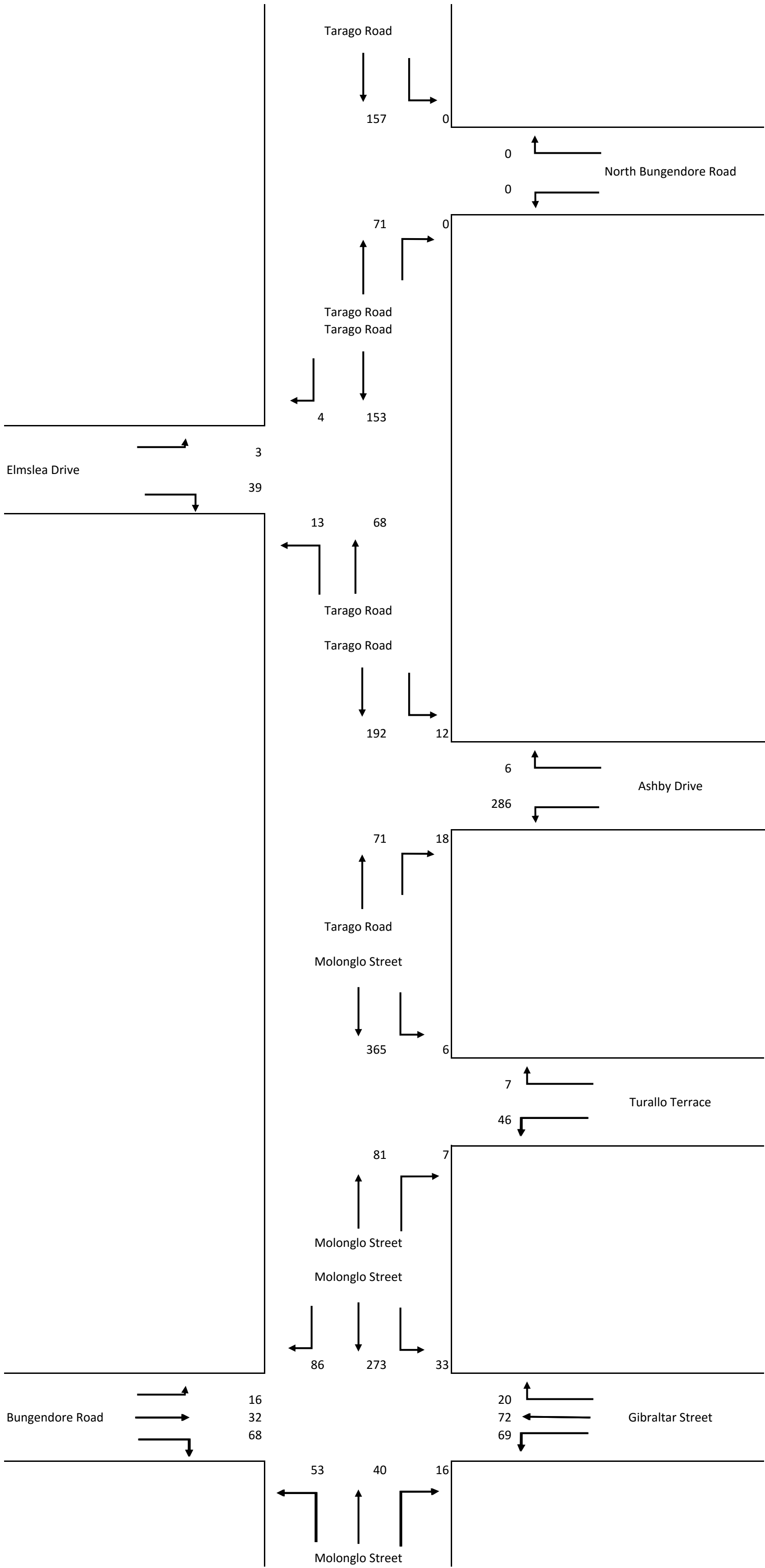
It is noted that there is no difference in the intersection geometry requirements for either the Planning Proposal Area or the Study Area. The above works are likely to be required for the development of either the Planning Proposal Area or the Study Area.

APPENDICES

APPENDIX A EXISTING TRAFFIC VOLUMES

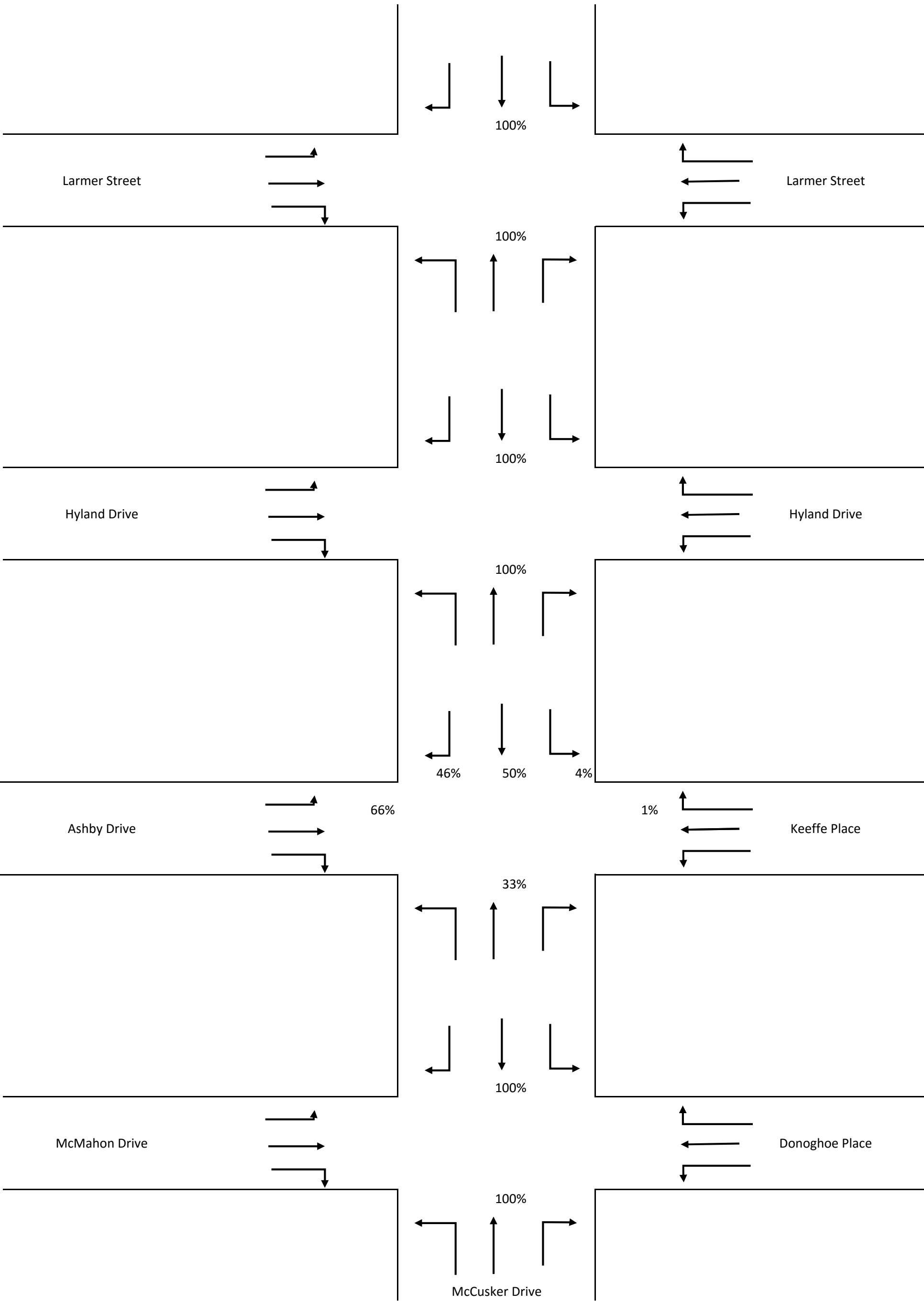
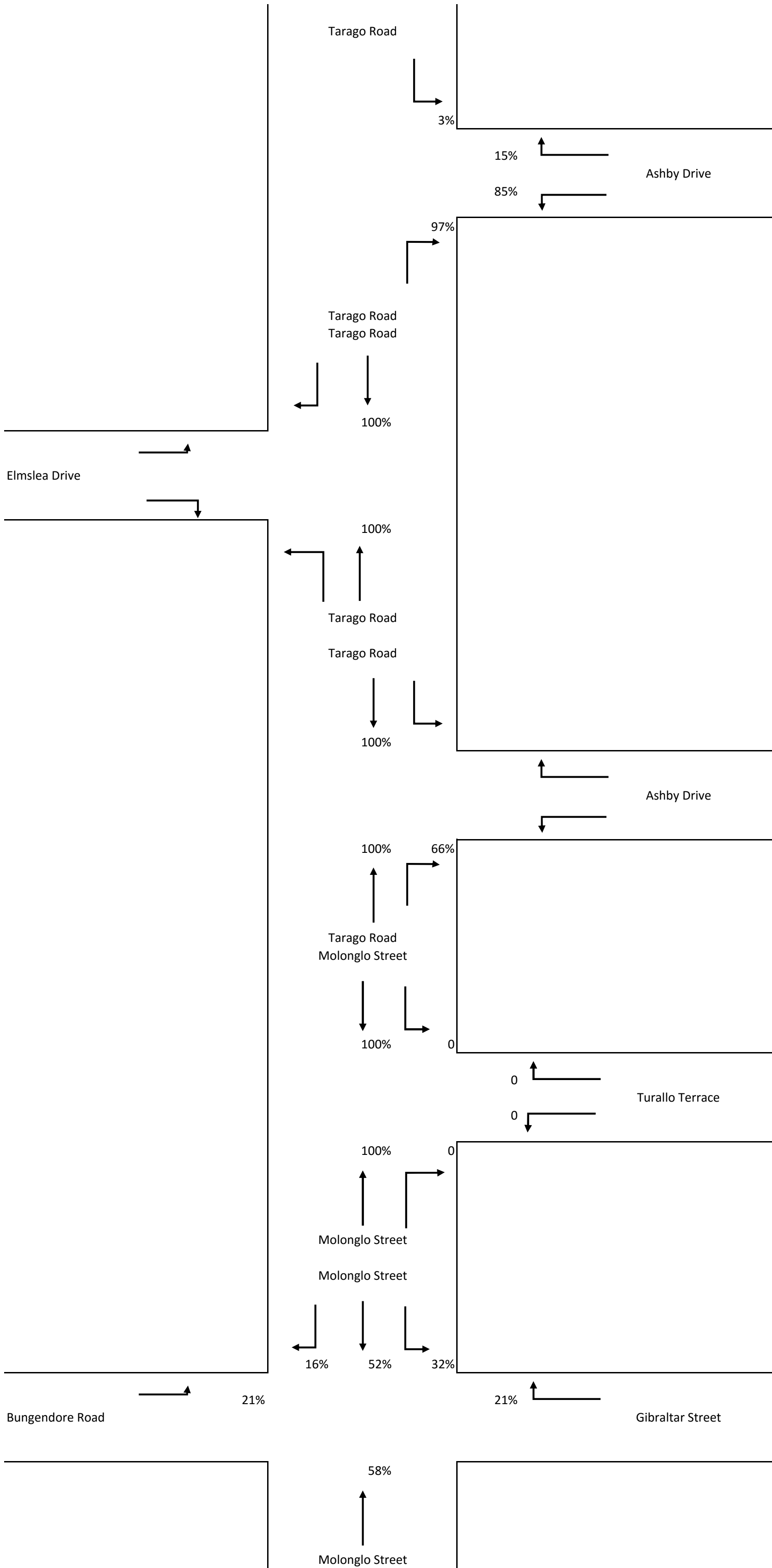


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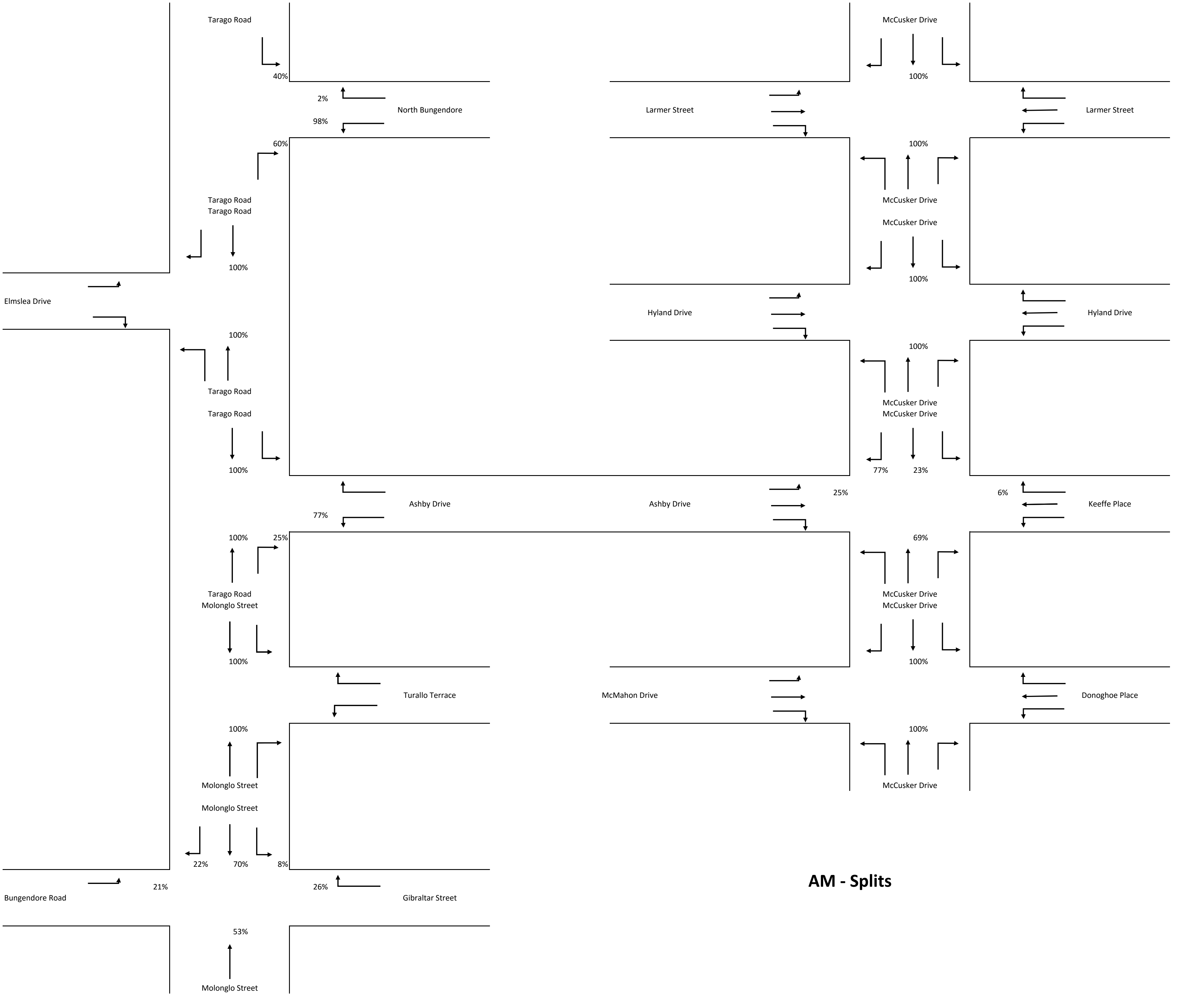


AM - Existing

APPENDIX B TRAFFIC SPLITS

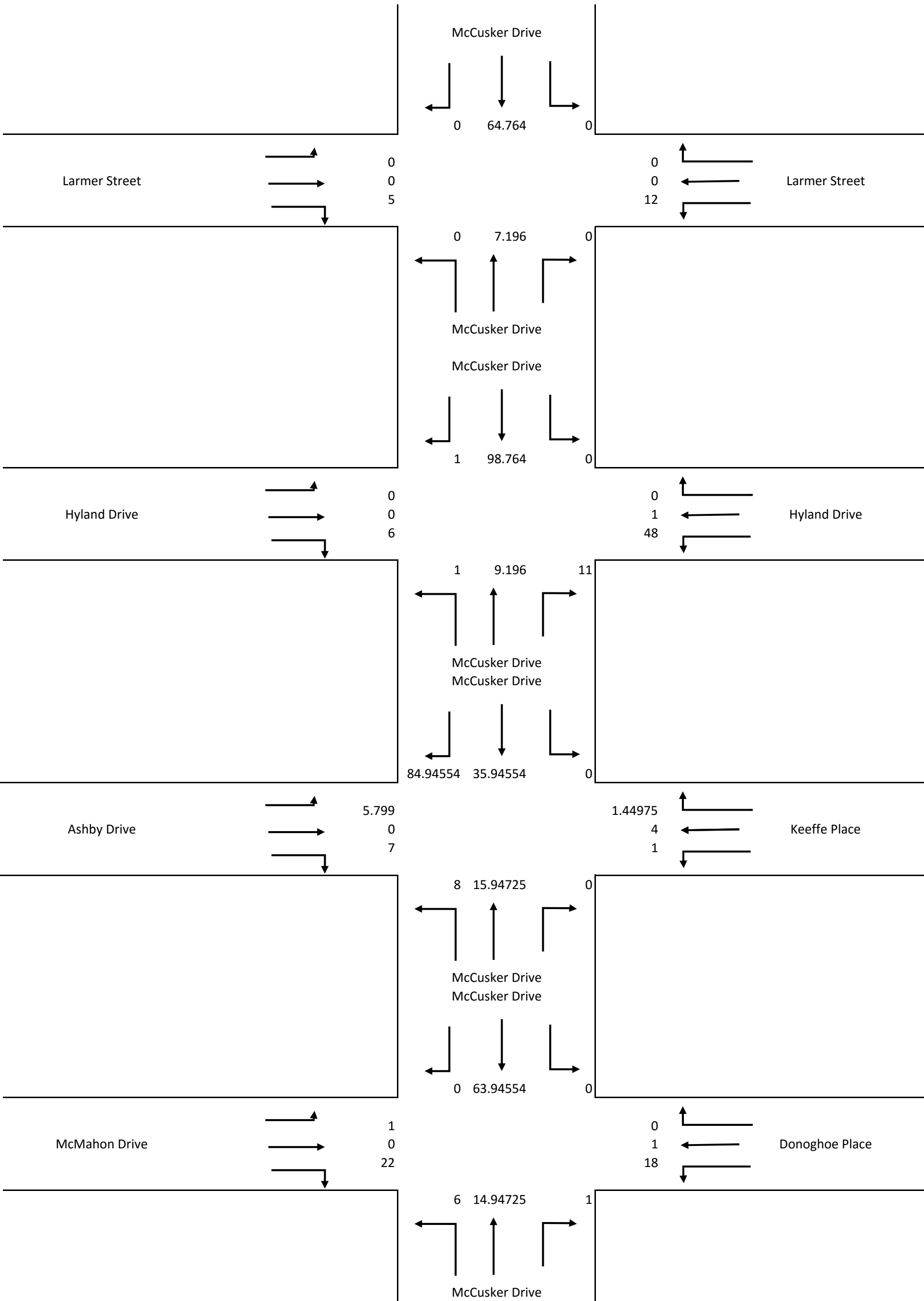
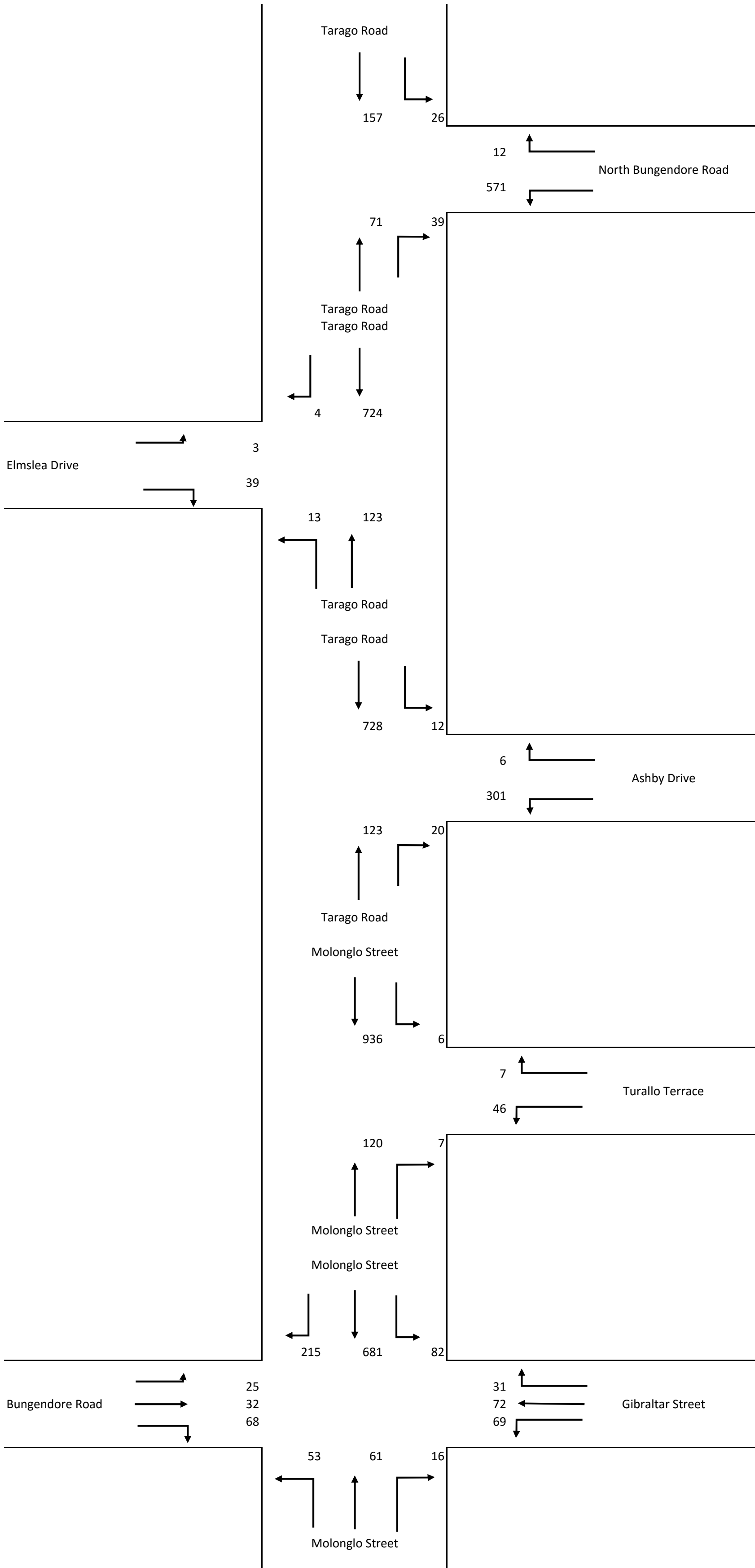


PM - Splits

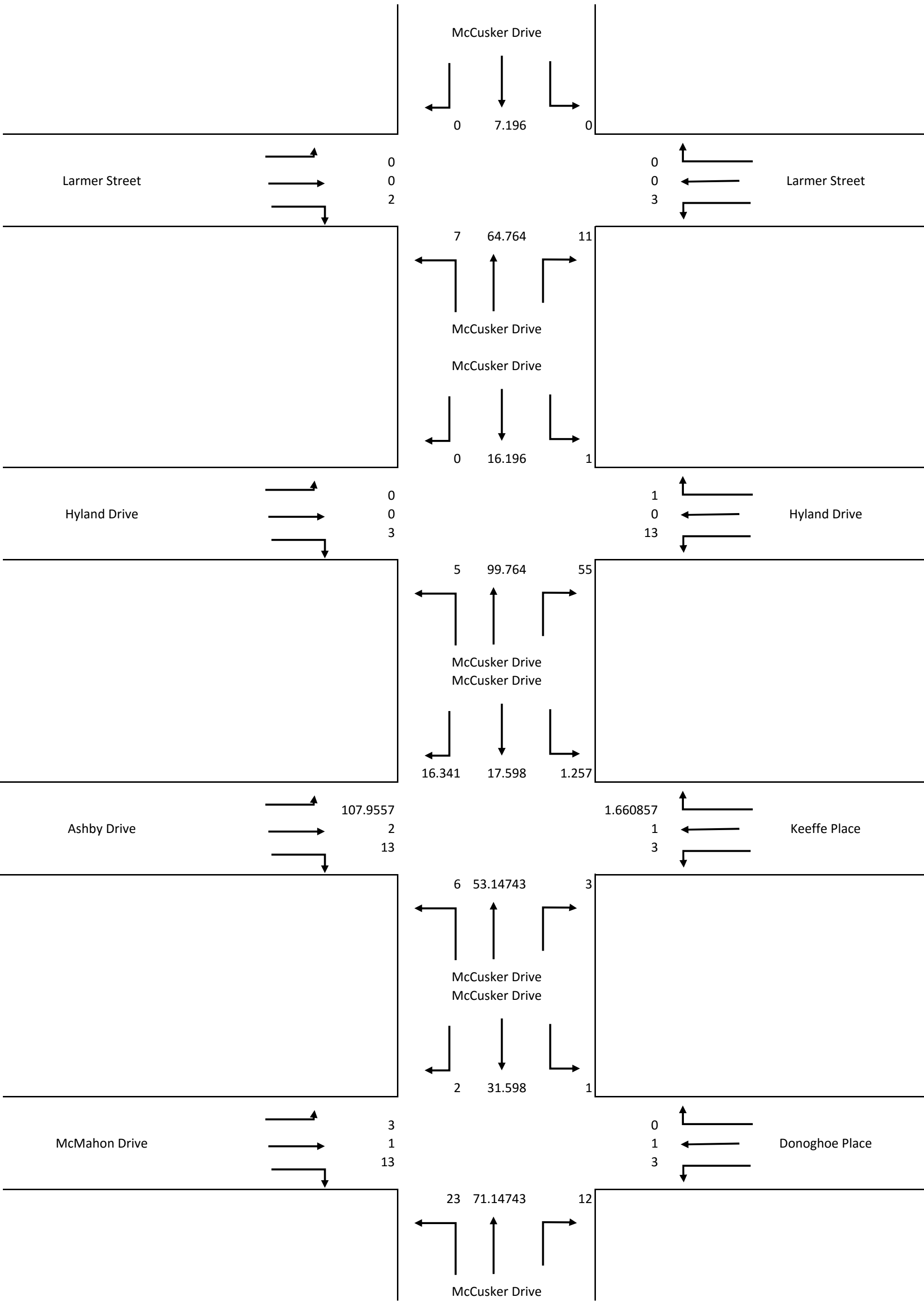
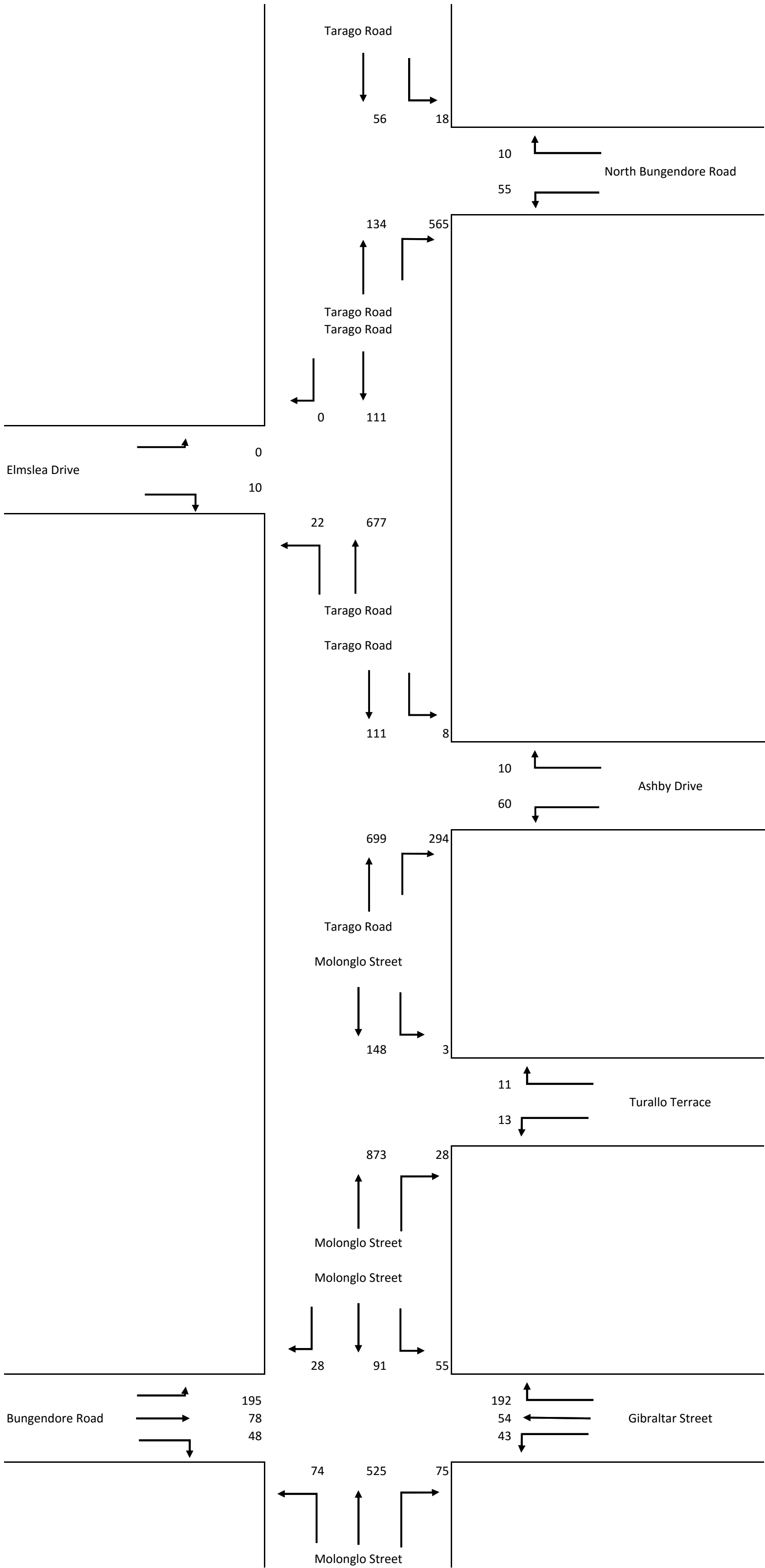


AM - Splits

APPENDIX C POST DEVELOPMENT TRAFFIC VOLUMES

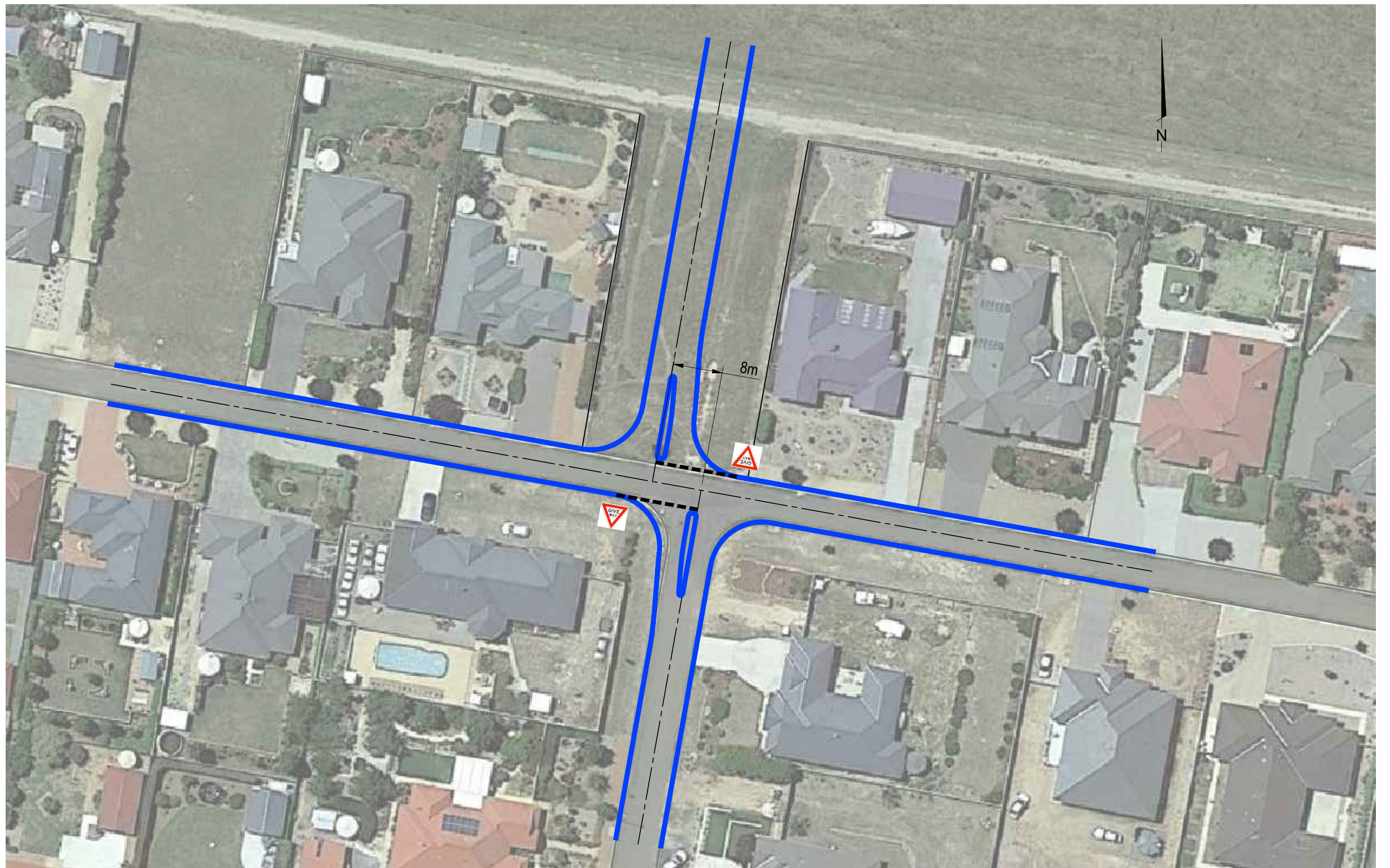


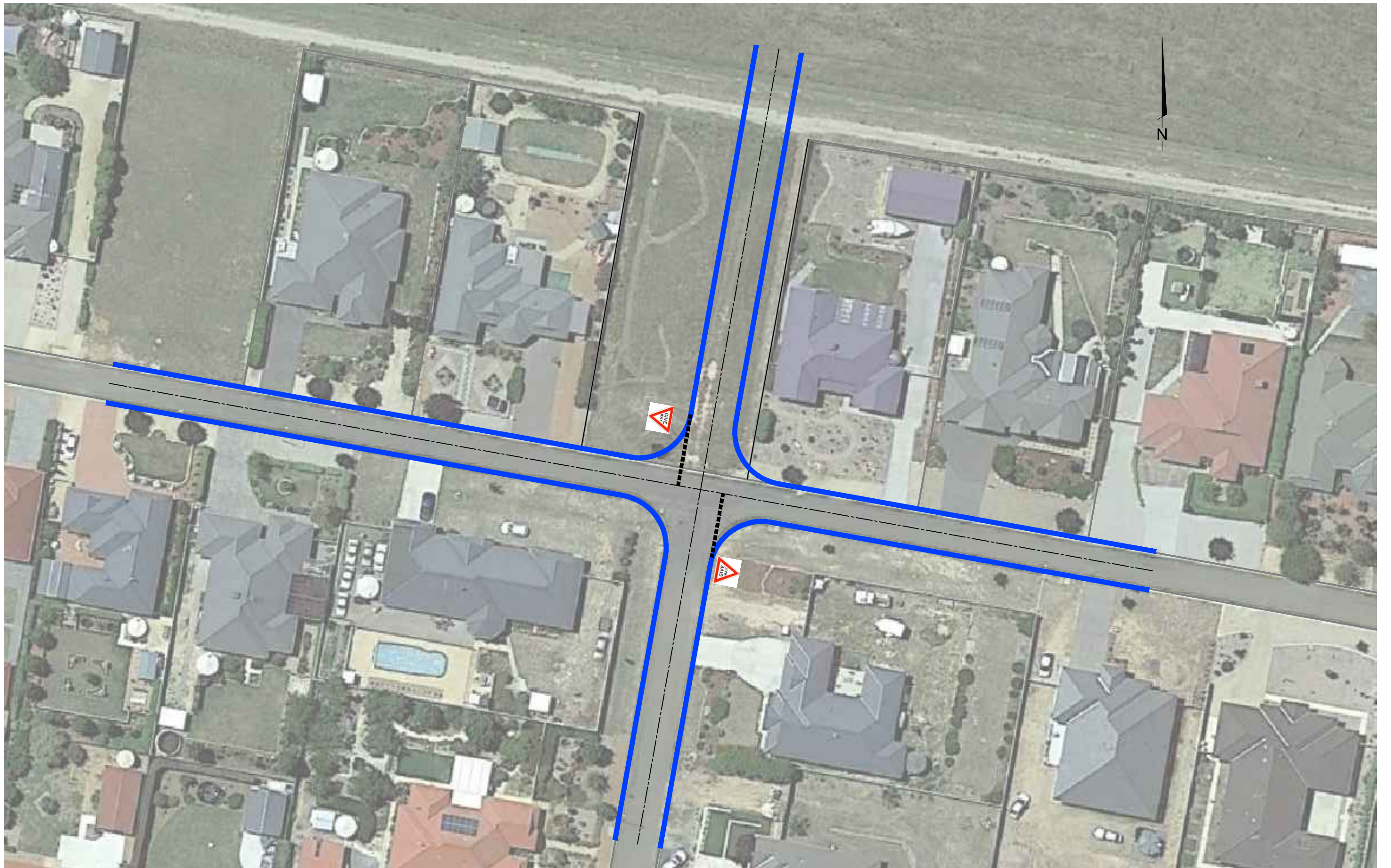
AM - Post Development



PM - Post Development

APPENDIX D POSSIBLE EXTERNAL INTERSECTION LAYOUTS





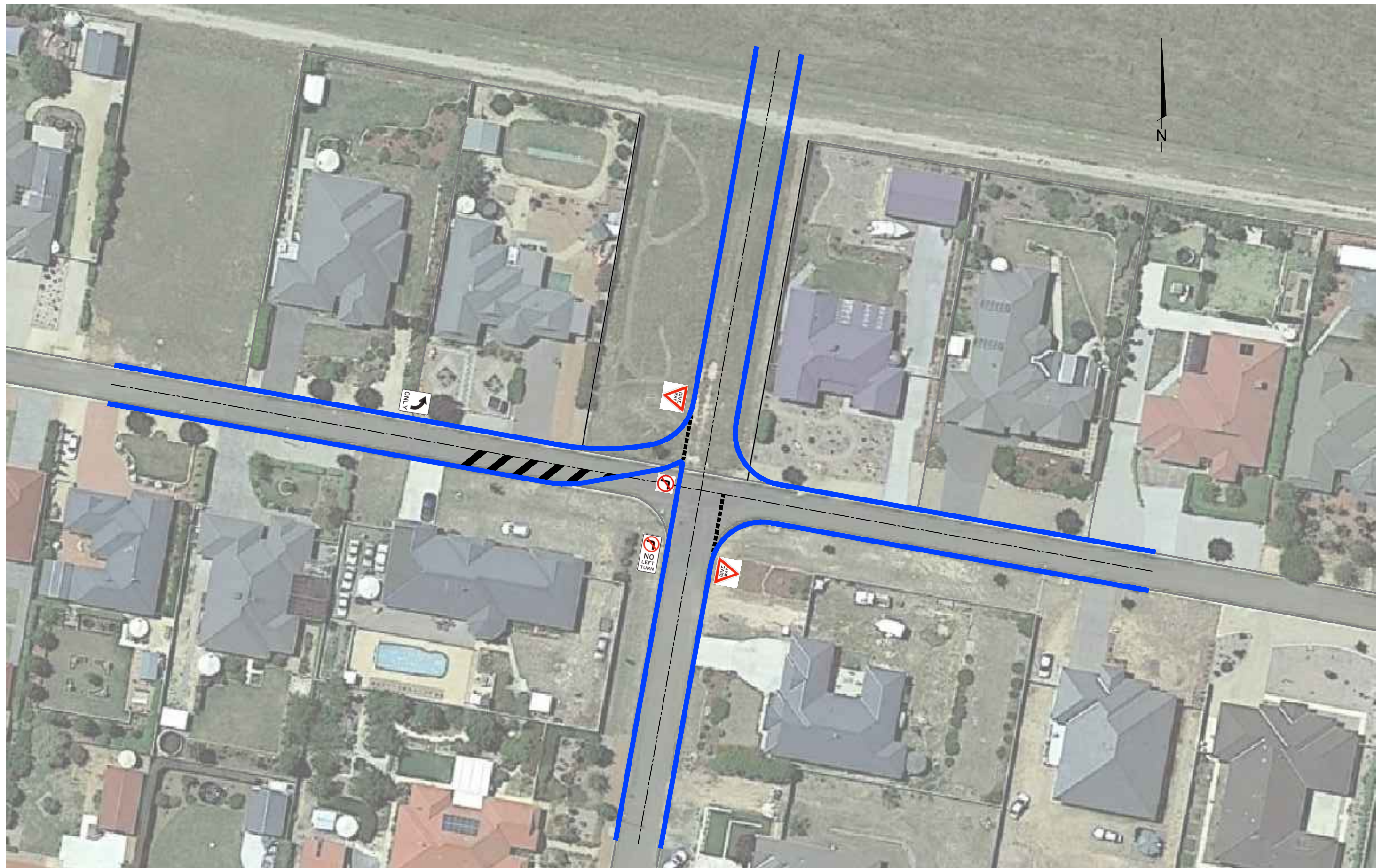
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McCusker St - Option 2

For Discussion Purposes Only
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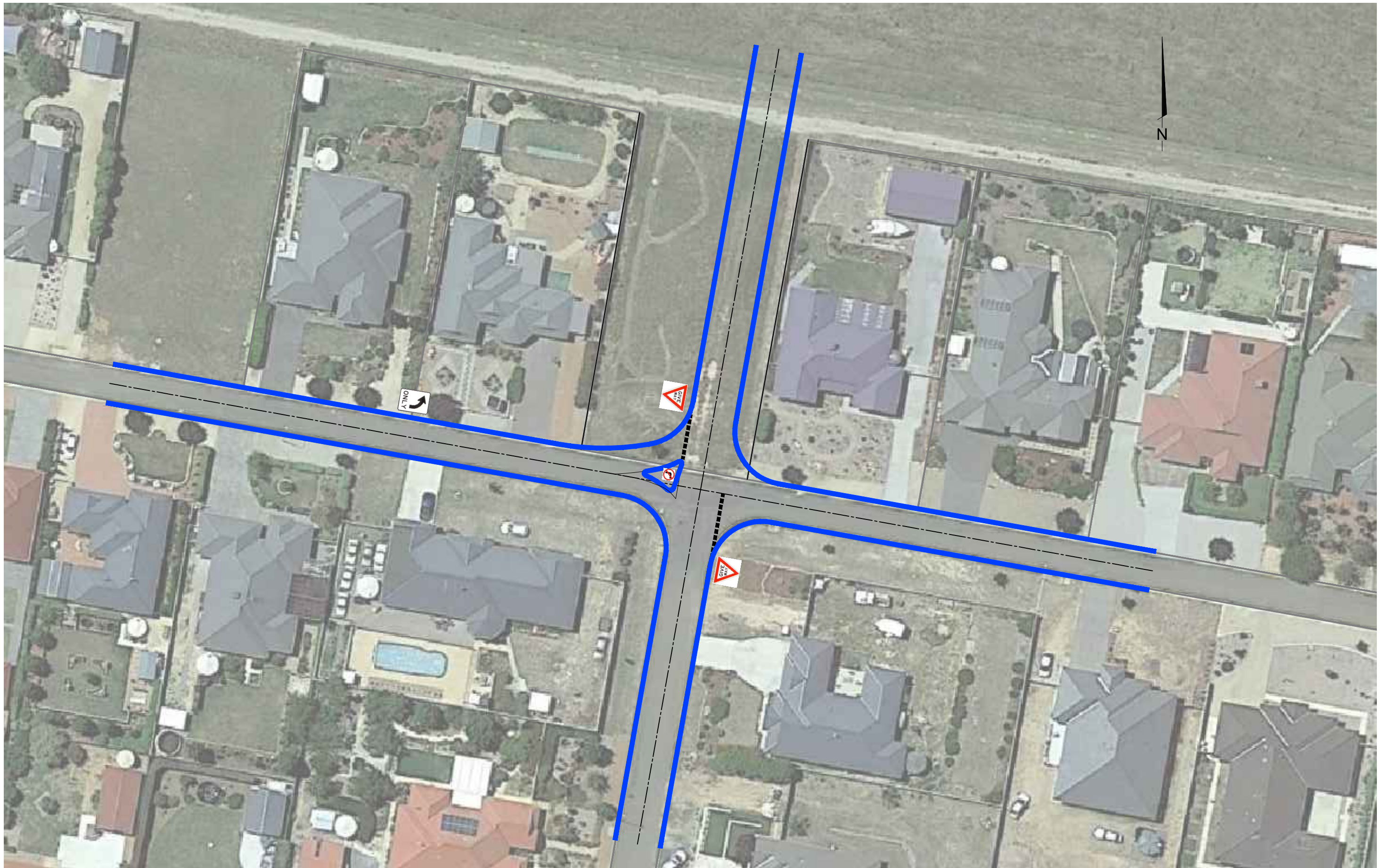
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16-000809 - North Bungendore TIA
McCusker St - Option 3
For Discussion Purposes Only

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16-000809 - North Bungendore TIA
McCusker St - Option 4
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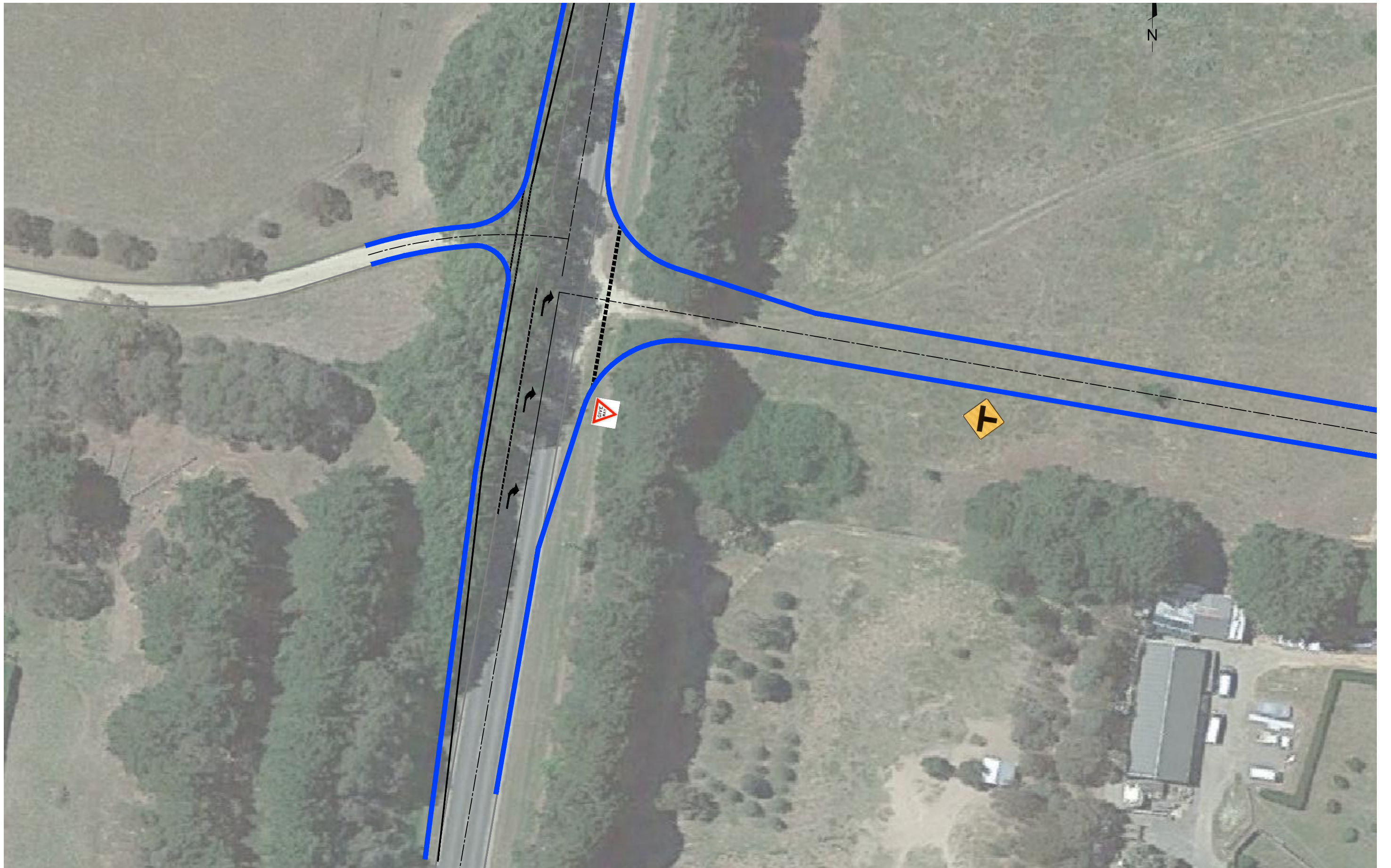


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16-000809 - North Bungendore TIA
 Tarago Rdt - Option 1 - BAL and BAR
 For Discussion Purposes Only
 Drawn: PTL - Scale: 1:250 @ A1

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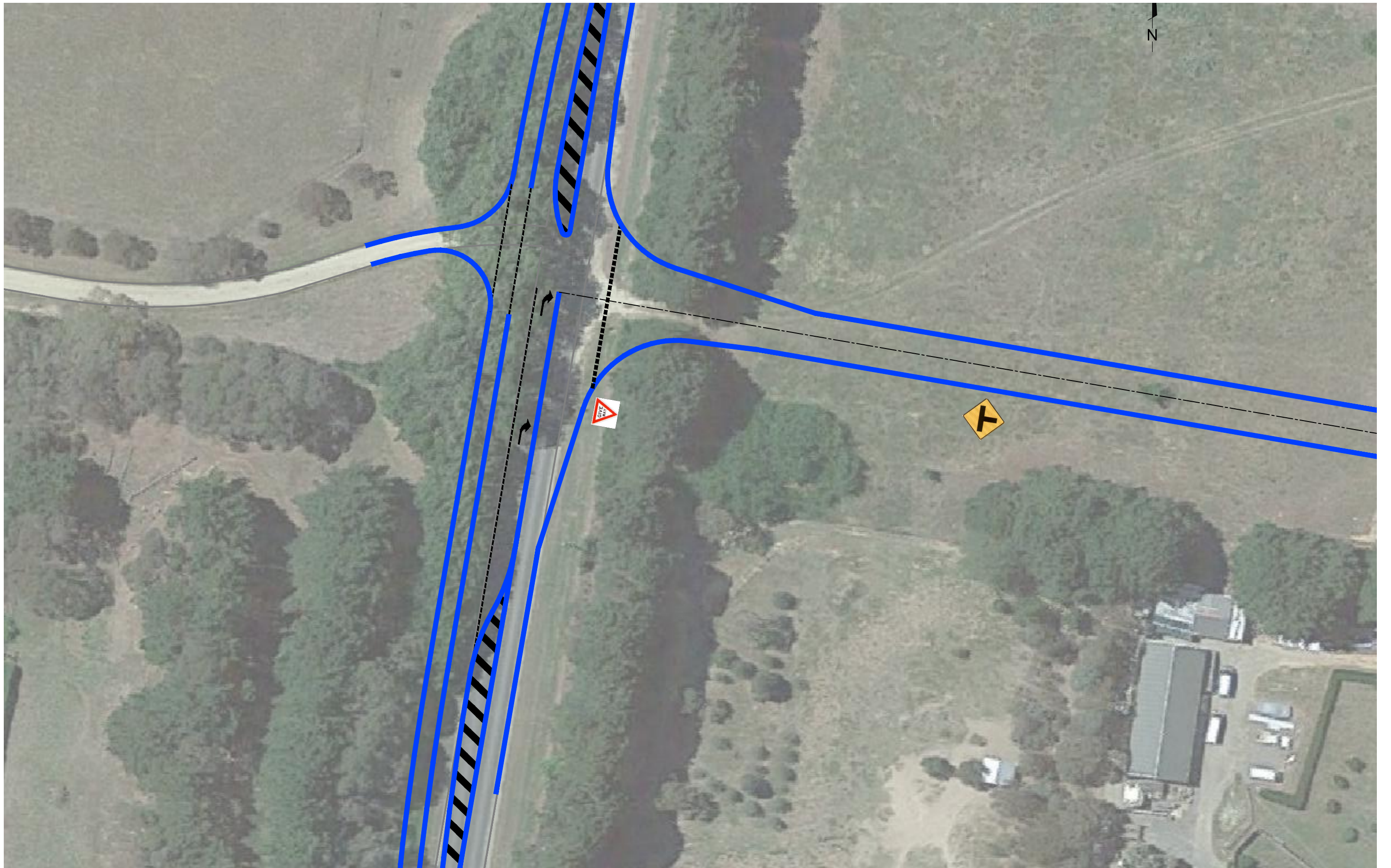


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16-000809 - North Bungendore TIA
Tarago Rdt - Option 2 - BAL and AUR
For Discussion Purposes Only
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16-000809 - North Bungendore TIA
 Tarago Rdt - Option 3 - BAL and CHR
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APPENDIX E INTERNAL ROAD HIERARCHY PLANS AND EXTERNAL CONNECTIONS TO EXISTING PATH NETWORKS

APPENDIX F PEDESTRIAN PATH GRADES

