# PROPOSED RESIDENTIAL SUBDIVISION MOLLERS LANE, LEOPOLD

Transport Impact Assessment Report

**ESR Transport Planning Pty Ltd** 1/34A Doveton Street North, Ballarat VIC 3350

P: 0427 044 324 | E: drewm@esrtp.com.au | www.esrtp.com.au

## DOCUMENT CONTROL

Date: 23/01/18
Revision: 3
Filename: 180123-R3-TIAR-Mollers Lane
Our Ref: E0160
Author: Drew Matthews

## CONTACT

**ESR Transport Planning Pty Ltd** ABN 86 128 037 429
1/34A Doveton Street North, Ballarat VIC 3350
P: 0427 044 324
E: drewm@esrtp.com.au
www.esrtp.com.au

## PREPARED FOR

TGM Group Pty Ltd

## DISCLAIMER

# Contents

# 1 Introduction

## 1.1 Overview

Planning approval is being sought for the rezoning of land adjacent Mollers Lane in Leopold to enable development of a residential subdivision. To assist in the consideration of the development proposal, ESR Transport Planning has been engaged to assess relevant transport implications.

## 1.2 Scope of This Report

This report documents a transport impact assessment which investigates the following:

- Existing transport conditions in the vicinity of the site.
- Traffic movements generated by the proposed land use.
- Anticipated impacts on the surrounding road network.
- Design of the proposed transport network.

This report was first prepared in November 2016 and has subsequently been updated to reflect latest development plans.

## 1.3 Referenced Information

- Development plans prepared by TGM Group, *Overall Development Plan*, version U dated 14/12/17 and *Typical Road Cross Sections*, dated December 2017.
- Inspections of the site and surrounds during August 2016.
- Austroads 2013, *Guide to Traffic Management Part 3 Traffic Studies & Analysis*.
- Austroads 2010, *Guide to Road Design Part 3 Geometric Design.*
- Austroads 2010, *Guide to Road Design Part 4A Unsignalised and Signalised Intersections.*
- Cardno, 2012, *Ash Road Leopold Development Plan Traffic & Transport Assessment*.
- City of Greater Geelong, 2011 Amended 2013, *Leopold Structure Plan*.
- Geelong Planning Scheme.
- Institute of Transportation Engineers (ITE), 2012, 9th Edition, *Trip Generation Manual*.
- Local Government Infrastructure Design Association, 2016, *Infrastructure Design Manual*.
- Public Transport Victoria, maps and timetables (www.ptv.vic.gov.au).
- Roads and Traffic Authority (RTA), 2002, *Guide to Traffic Generating Developments*.
- Tract Consultants, 2016, *South East Leopold Framework Plan*.
- Transport NSW, 2013, *Guide to Traffic Generating Developments - Updated Traffic Surveys.*
- Trips Database Bureau (TDB), 2016, *Trips Database.*
- Urban Enterprises, 2015, *Ash Road West Draft Shared Infrastructure Funding Plan*.
- VicRoads traffic volume data and Crashstats data (www.data.vic.gov.au).

## 1.4 Terms

- Council City of Greater Geelong
- DOS degree of saturation
- IDM Infrastructure Design Manual
- kph kilometres per hour
- m metres
- $m^2$ square metres
- SIFP Shared Infrastructure Funding Plan
- SISD Safe Intersection Sight Distance
- vph vehicle movements per hour
- vpd vehicle movements per day

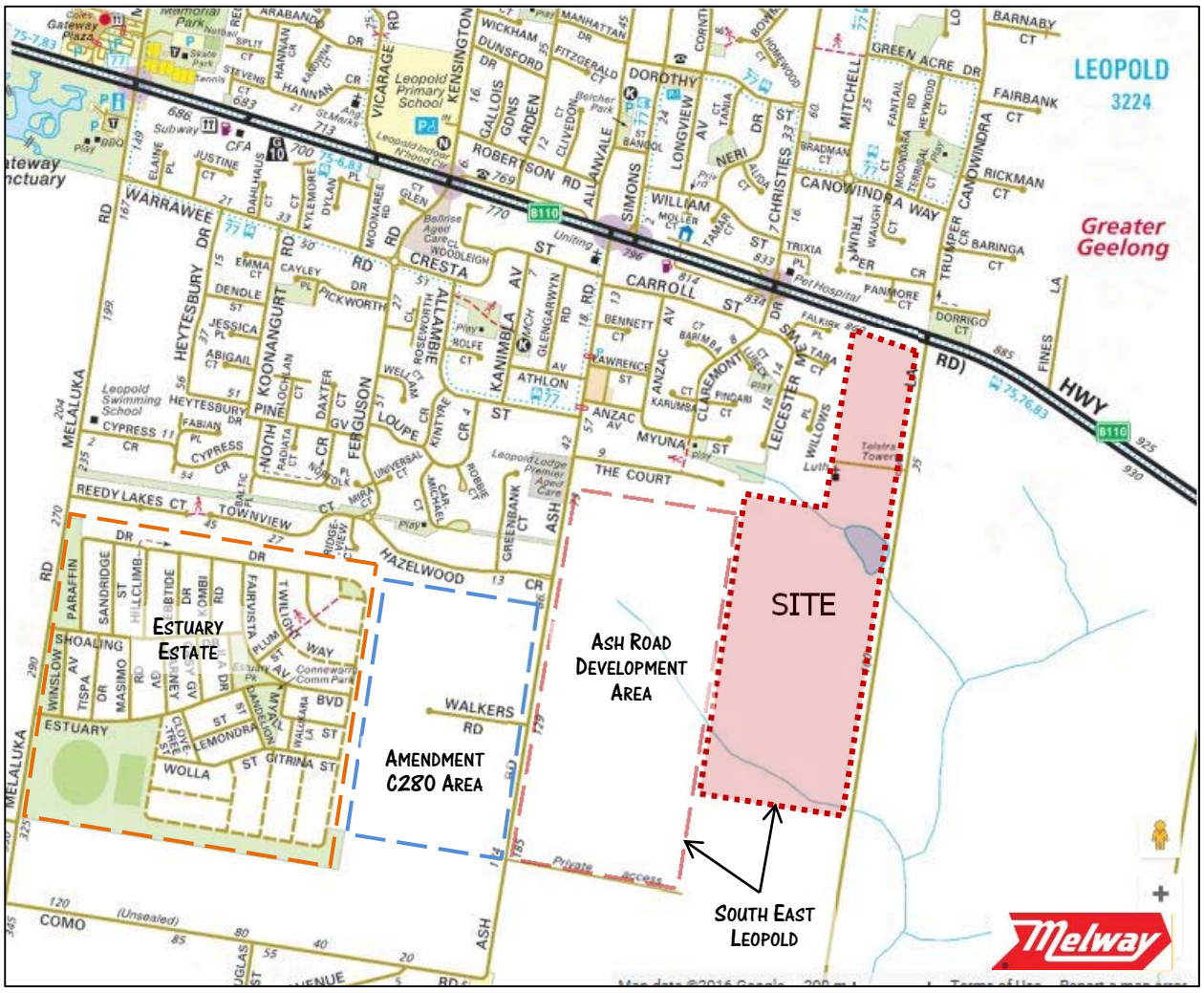
# 2 Contextual Analysis

## 2.1 Site

The site has a northern road frontage to the Bellarine Hwy of approximately 195m and an eastern road frontage to Mollers Lane of approximately 1200m. Currently zoned for farming use, it includes 6 land parcels which are predominately being used for agricultural purposes. Most land parcels include a residential dwelling while 1 of the land parcels is occupied by a church. Numerous access driveways are provided from Mollers Lane. A 10m wide easement for Barwon Water transfer main pipelines is aligned east-west through the centre of the site.

The site and other land to the southwest are identified within the Leopold Structure Plan for rezoning to residential land. This includes an area between the existing Estuary Estate and Ash Road which was recently subject to Planning Scheme Amendment C280. Undeveloped land between the site's western boundary and Ash Road has been titled in this report the 'Ash Road development area' which along with the site forms an area known as South East Leopold.

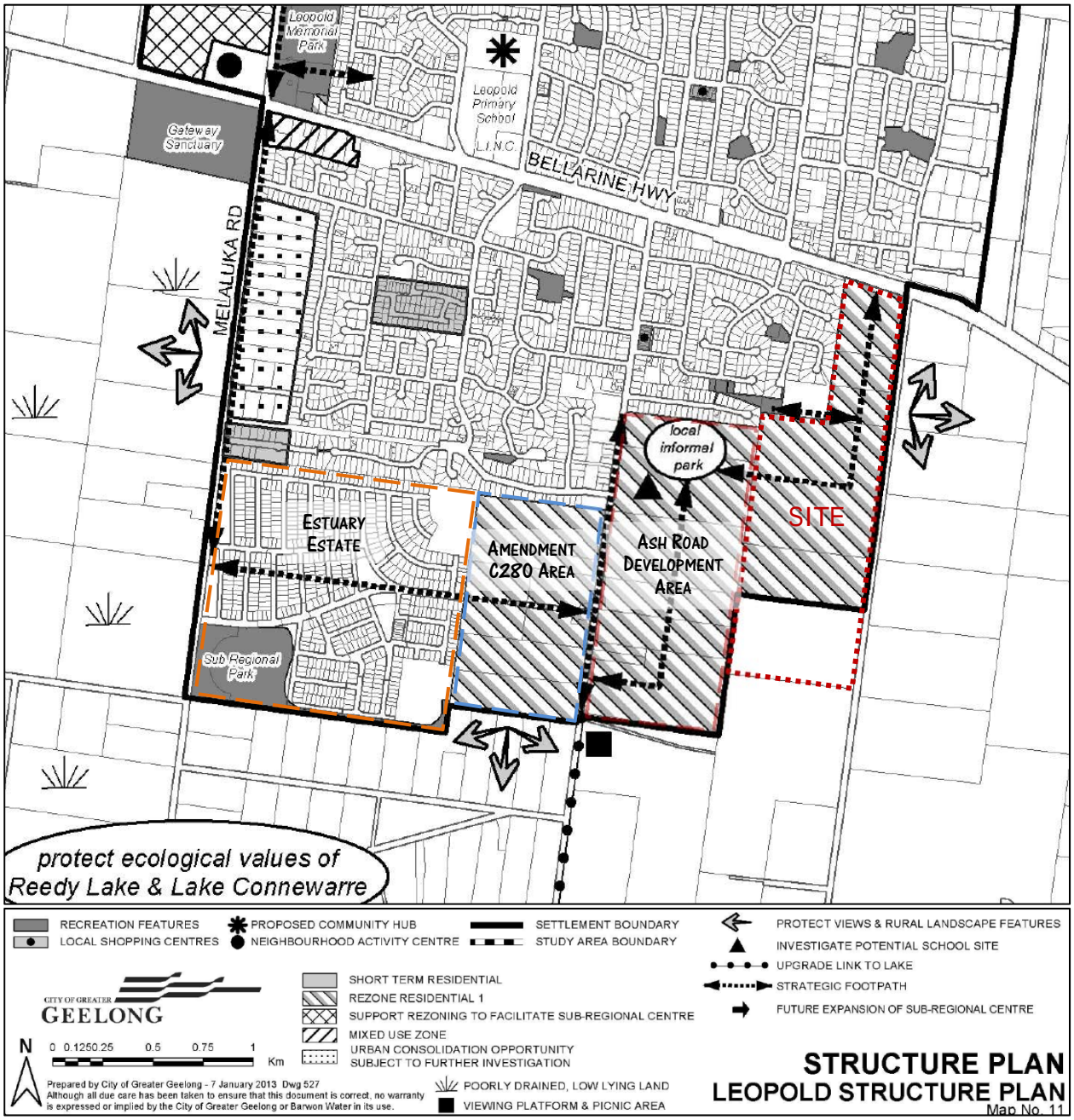
Figure 2.1 Subject Site and Surrounds



## 2.2 Structure Plan and Framework Plan

The Leopold Structure Plan (City of Greater Geelong, 2013) identified the site and other land to the southwest for rezoning to residential land as shown in Figure 2.2.

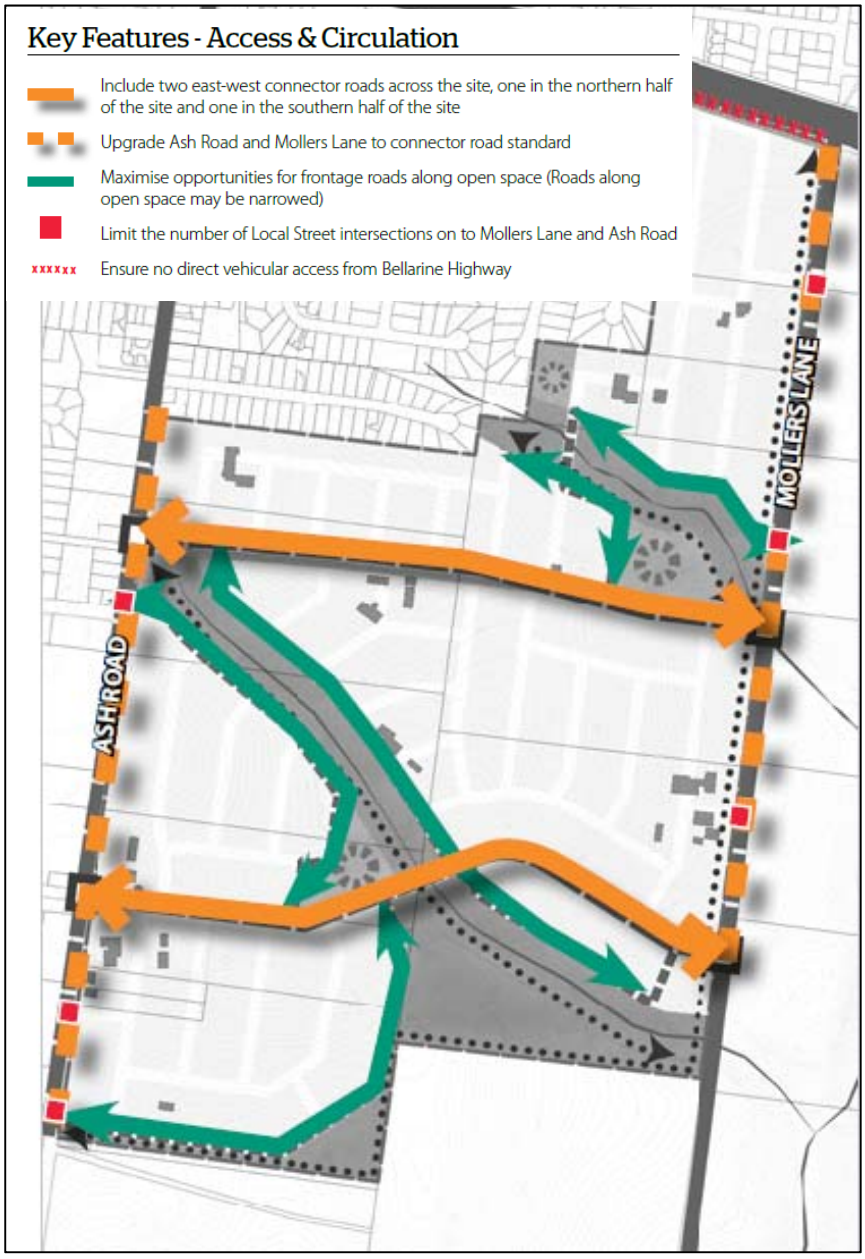
Figure 2.2 Leopold Structure Plan




Source: City of Greater Geelong, 2013.

The South East Leopold Framework Plan (Tract, 2016) was prepared with input from land owners, development representatives, Council officers and service authorities. It outlines a vision for the development of the site and neighbouring Ash Road development area.

Figure 2.3 South East Leopold Framework Plan – Access and Circulation




Source: Tract, 2016.

## 2.3 Amendment C280

An area west of Ash Road has recently been the subject of Planning Scheme Amendment C280 seeking to rezone and secure planning permission for residential development of the land.

This development may yield 328 lots and incorporate 3 road connections to Ash Road, including the extension of Estuary Boulevard from Estuary Estate along the Walkers Road alignment. As part of the Amendment, a Shared Infrastructure Funding Plan (SIFP) and Section 173 Agreement were prepared to allocate funding for mitigating road works, including an extension of the right turn lane into Ash Road at the Bellarine Hwy.

Figure 2.4 Amendment C280 Outline Development Plan


Source: Urban Enterprises, 2015.

## 2.4 Road Network

The Bellarine Hwy is an arterial road (Road Zone Category 1) with a 70kph speed limit through the Leopold urban area and a 100kph speed limit east of the site. It has a divided cross section with 2 traffic lanes in each direction.

Figure 2.5 Bellarine Hwy (facing west from Mollers Lane, site on left)

Mollers Lane operates as an Access Road with an 80kph speed limit sign posted near the Bellarine Hwy. Its 20m road reserve has a rural type cross section incorporating a 6m wide gravel carriageway[1]. For a length of approximately 100m south of Bellarine Hwy, its carriageway is paved. The intersection of Bellarine Hwy / Mollers Lane is give-way sign controlled and includes a right turn lane into Mollers Lane.

Figure 2.6 Mollers Lane (facing south approximately midway along the site frontage)

Figure 2.7 Aerial View of Bellarine Hwy / Mollers Lane Intersection


Ash Road functions as a Connector Street in its northern part and an Access Road in its southern part. It is subject to a 60kph speed limit apart from a 40kph section adjacent a retail precinct between Lawrence Street and Anzac Avenue. Its cross section varies within a 20m road reserve. To the north where residential properties front both sides, it is configured with footpaths on both sides and a 10m carriageway accommodating a traffic lane and kerbside parallel parking in both directions. South of Hazelwood Crescent, it has a rural type cross

[1] Distance measurements in this report are approximate only.

section incorporating a 6m wide carriageway and gravel shoulders. Traffic signals control the Bellarine Hwy / Ash Road / Simons Road intersection.

Figure 2.8 Ash Road (facing north from Lawrence Street)


Figure 2.9 Ash Road (facing north towards Hazelwood Crescent)

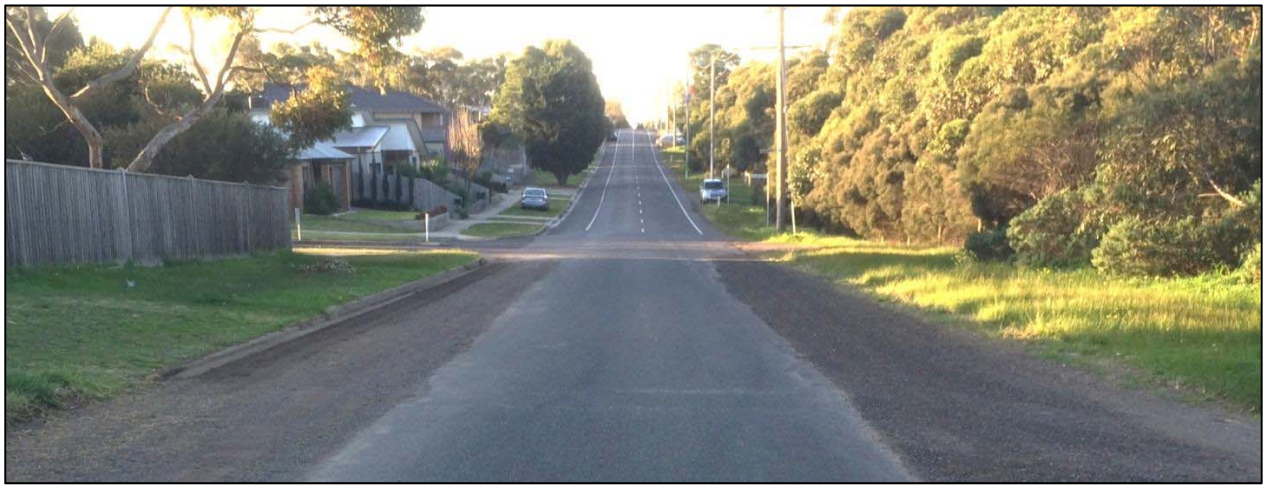


Figure 2.10 Aerial View of Bellarine Hwy / Ash Road / Simons Road Intersection

## 2.5 Traffic Volumes

Traffic volume data has been collated from a variety of sources as follows:

- VicRoads Bellarine Hwy traffic signal detector data (various dates, data for Thr 14/07/16 utilised in this report).
- Council tube counts (Ash Road 2011, Ferguson Road 2013).
- Traffic volume survey at Bellarine Hwy / Mollers Lane intersection Tue 26/07/16, 7:30am-6:30pm.

Figure 2.11 Existing Daily Traffic Volumes (Typical Weekday)

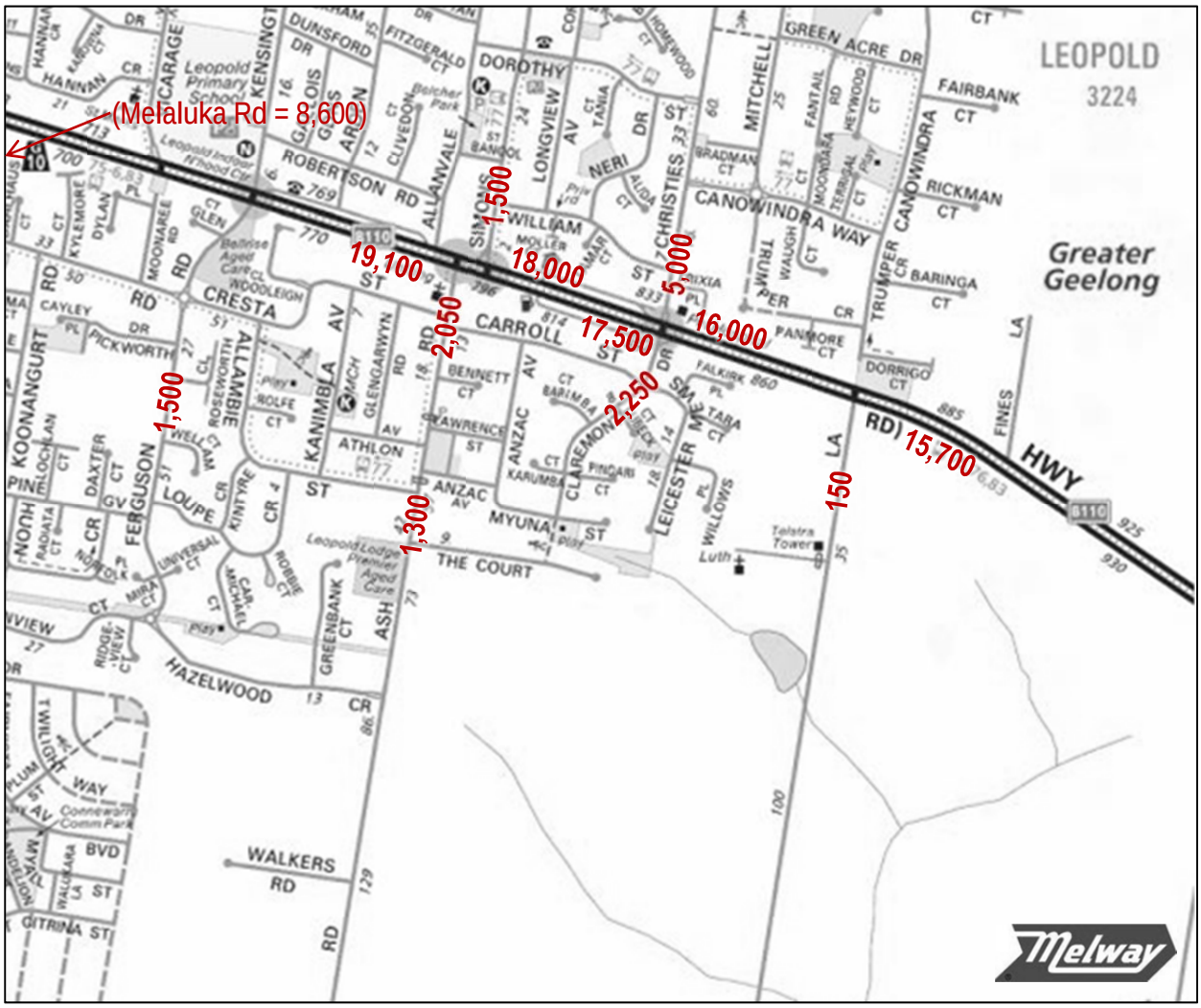
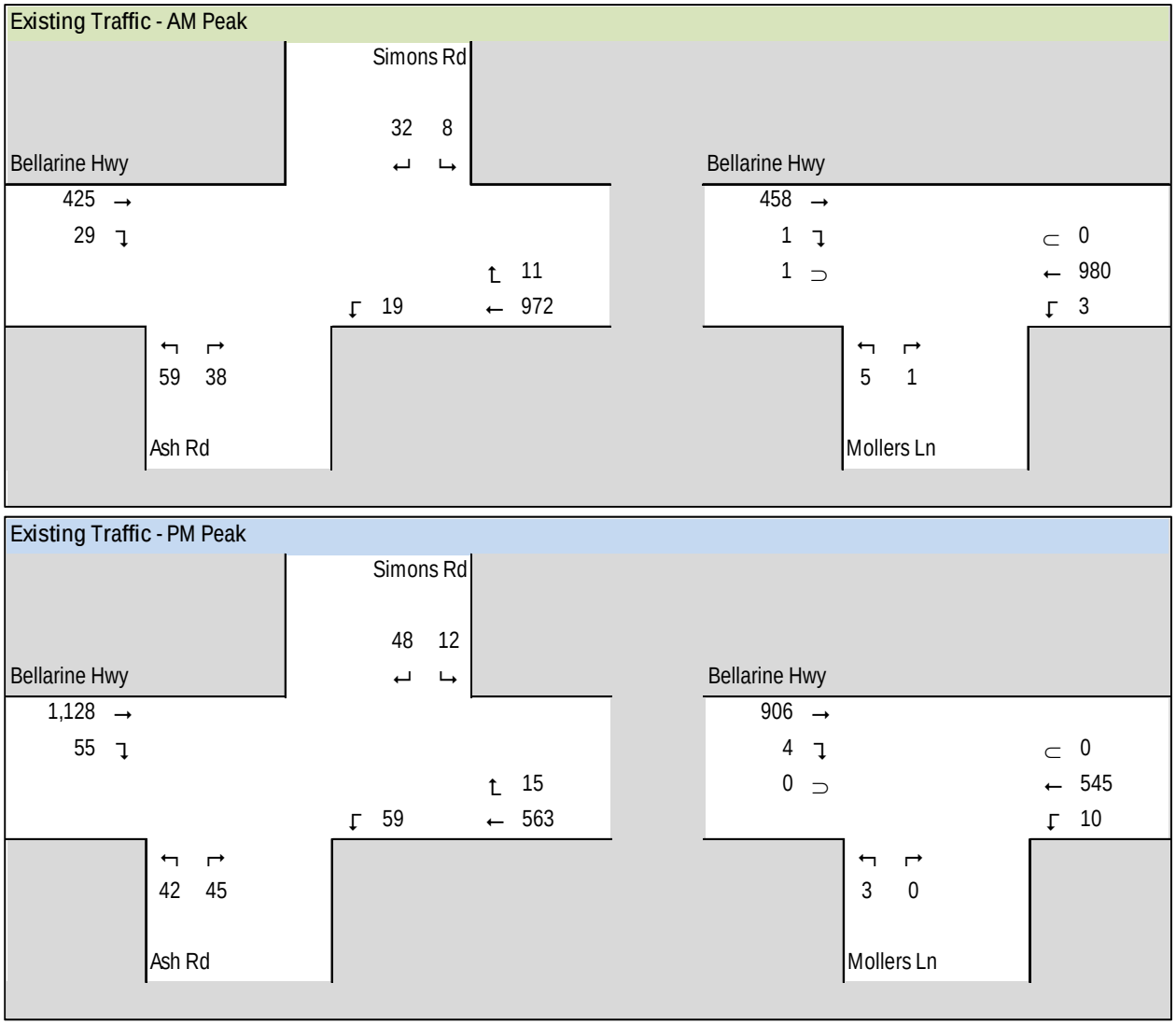


Figure 2.12 Existing Weekday AM and PM Peak Hour Intersection Traffic Volumes




Note: Left turn into Ash Road volume not captured by detectors, value estimated by factoring in accordance with known intersection turning movements.

By comparing traffic volume data collected for this report with that presented in the transport assessment report for the C280 Amendment (Cardno, 2012), peak period volumes at the Bellarine Hwy / Ash Road intersection have remained similar between 2011 and 2016, while daily volumes along Ash Road have reduced between 2002 and 2011.

## 2.6 Accident History

A review of road accidents in the site's vicinity has been undertaken using VicRoads Crashstats database[2] which includes accidents reported to police which resulted in personal injury. The review investigated Mollers Lane, Ash Road and their intersections with the Bellarine Hwy for the last available five year. In that time, 2 non-serious injury accidents were recorded at the Bellarine Hwy / Ash Road intersection. Accordingly, this review provides no evidence of a significant road accident pattern in the site's vicinity.

[2] VicRoads databases (www.data.vic.gov.au).

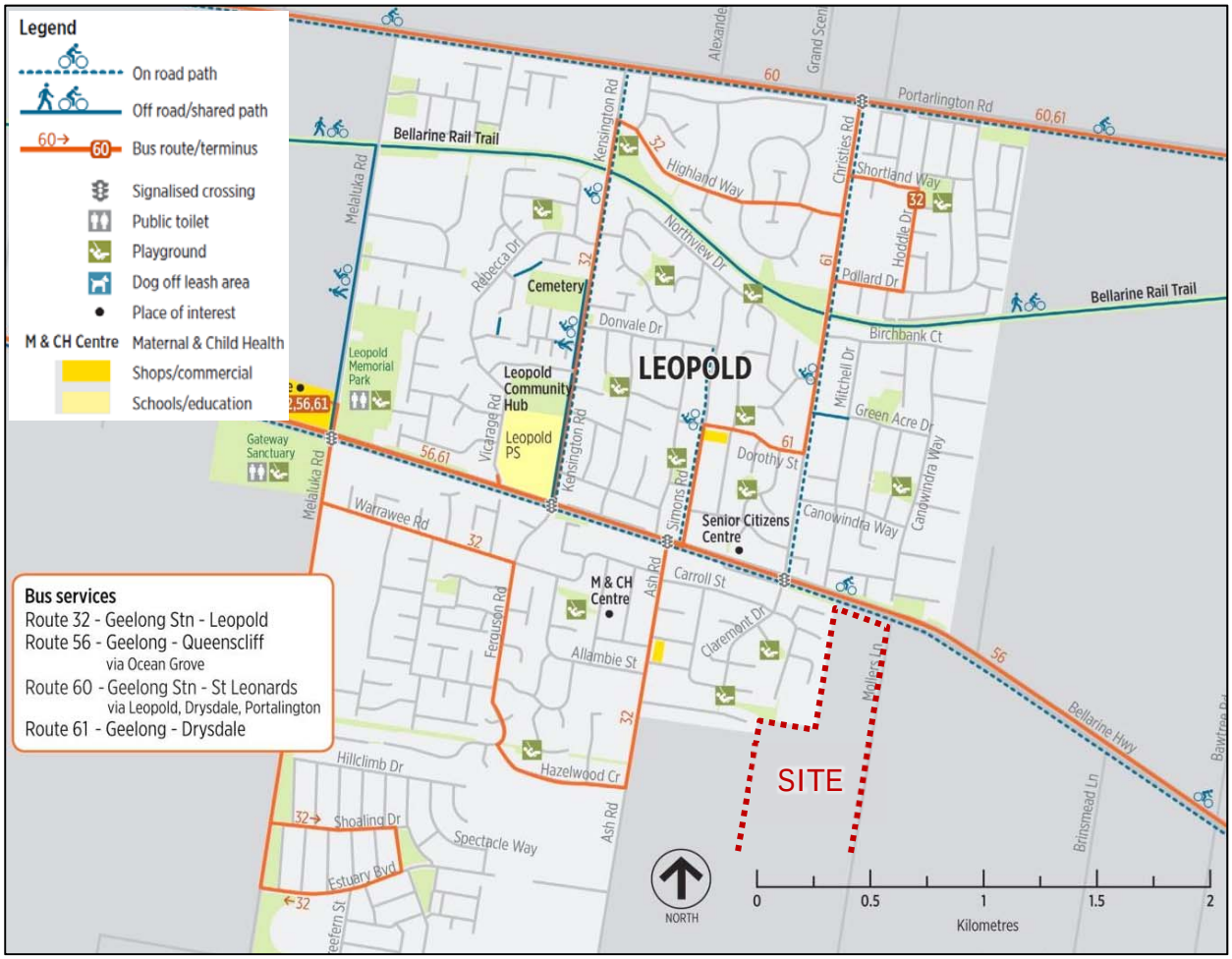
## 2.7 Public Transport, Walking and Cycling

Bus service Leopold to Geelong Station (Route 32) operates along Ash Road and Hazelwood Crescent. Bus services Queenscliff to Geelong Station (Route 56) and Drysdale to Geelong Station (Route 61) operate along the Bellarine Hwy with stops adjacent Ash Road.

Ash Road has footpaths on both sides northwards from Allambie Street. Roads within the residential neighbourhoods northwest of the site have a mix of either no footpaths, one side only or both sides.

The Bellarine Hwy has on-road bicycle lanes within the Leopold urban area.

Figure 2.13 Leopold Active Travel Map




Source: City of Greater Geelong

# 3 Proposed Development

The rezoning being sought is to enable a proposed residential subdivision of the site. Plans for the development (refer copy in Appendix A) indicate a total of approximately 500 lots could be accommodated.

An internal road network is proposed which is generally consistent with the South East Leopold Framework Plan. It includes 2 east-west aligned Connector Streets extending between Mollers Lane and the Ash Road development area.

The site's development is likely to be staged from north to south.

The Ash Road development area is anticipated to have a similar lot yield per hectare equating to 487 lots with both areas combined yielding just less than 1,000 lots.

# 4 Traffic Impact Assessment

## 4.1 Preamble

The traffic assessment in this report analyses traffic impacts due to full development of the South East Leopold area, being the combined areas of the site and Ash Road development area. It focuses on impacts to Mollers Lane, Ash Road and their intersections with the Bellarine Hwy. The impact of traffic to / from the C280 Amendment area is also considered.

It is noted that the traffic generation and distribution assumptions also effectively analyse a scenario of the site being fully developed and no development of the Ash Road development area (ie. all site traffic using the Mollers Lane / Bellarine Hwy intersection).

## 4.2 Traffic Generation

Guidance on the likely traffic generating characteristics of the proposed development has been sought from TDB 2016, Transport NSW 2013, ITE 2012 and RTA 2002. These sources indicate that low density residential land use typically generates traffic movements as follows:

- AM peak hour 0.7-0.8 vph / lot (25% entering, 75% exiting)
- PM peak hour 0.8-1.1 vph / lot (65% entering, 35% exiting)
- Daily 7.5-10 vpd / lot (50% entering, 50% exiting)

As a comparison, the existing traffic generation of the Leopold urban area south of the Bellarine Hwy travelling to / from the highway has been estimated as less than 6 vpd / lot[3].

For the purpose of this report, traffic generation rates of 0.8 vph / lot (AM), 1.0 vph / lot (PM) and 9.0 vpd / lot have been adopted. Accordingly, the following traffic movements could be anticipated upon full development of the South East Leopold area:

- AM peak hour 800 vph (200 vph entering, 600 vph exiting).
- PM peak hour 1,000 vph (650 vph entering, 350 vph exiting).
- Daily 9,000 vpd (4,500 vpd entering, 4,500 vpd exiting).

The C280 Amendment area could be anticipated to generate an additional 2,952 vpd.

## 4.3 Traffic Distribution

The direction in which vehicles travel to and from the site is influenced by a variety of factors including the site's location, configuration of access intersections, characteristics of the surrounding road network and trip purpose.

RTA 2002 sets out that as a guide, approximately 25% of residential trip generation is internal to a residential neighbourhood, involving local shopping, school and social visits.

Existing traffic volume data in Section 2.5 provides relevant background with some key outcomes as follows:

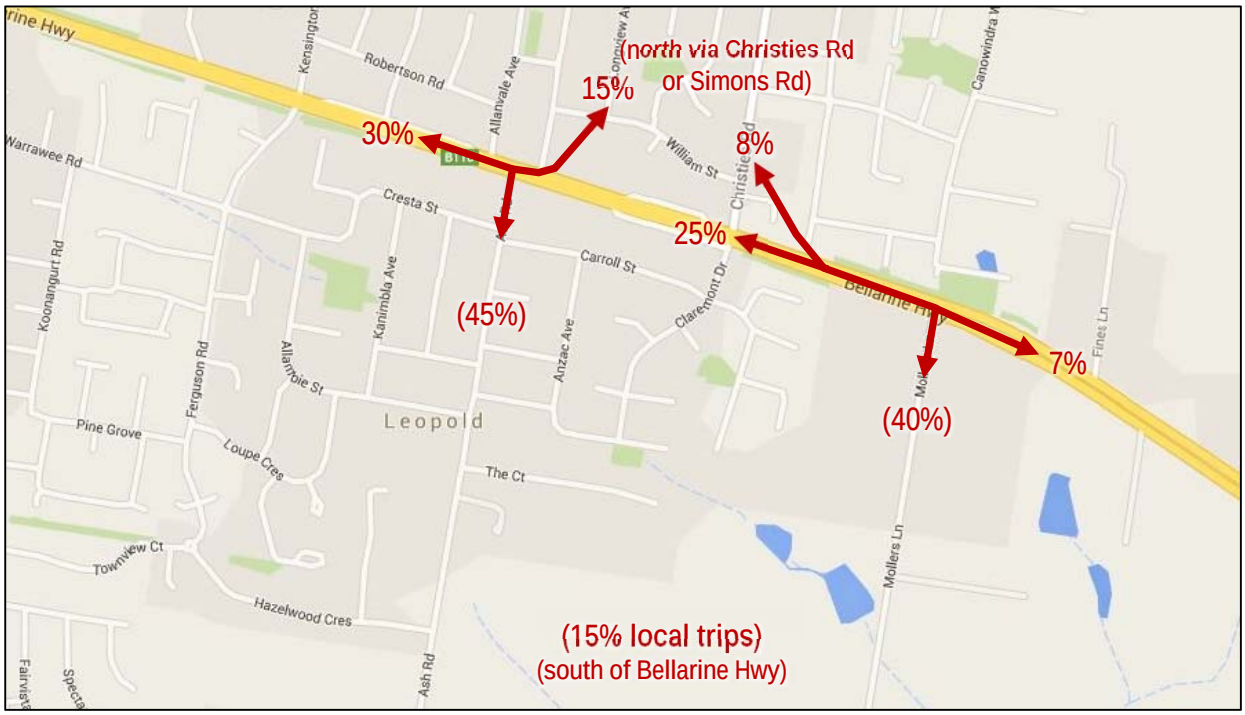
[3] Assumptions: Land area 206Ha, developable area 85% = 175Ha, 15 lots / Ha = 2,625 lots, total traffic volume to / from Bellarine Hwy approx. 15,000 vpd (refer Section 2.5).

- Volumes exiting Ash Road have a distribution towards Geelong of approximately 60% in the AM peak.
- Volumes exiting Simons Road have a distribution towards Geelong of approximately 80% in the AM and PM peaks.
- Volumes entering Claremont Drive have a distribution from Geelong of approximately 63% in the PM peak.
- Volumes along the Bellarine Hwy have a peak period distribution of approximately 70% towards Geelong in the AM peak and 65% away from Geelong in the PM peak.

After reviewing these factors, it is expected that key destinations for site traffic in order from highest to lowest magnitude will be; (i) Bellarine Hwy to/from Geelong, (ii) the Leopold township and Portarlington Road, (iii) adjacent neighbourhoods, and (iv) Bellarine Hwy to/from east.

Given all of the above, the assumed directional distribution of South East Leopold traffic within the nearby road network is shown in Figure 4.1.

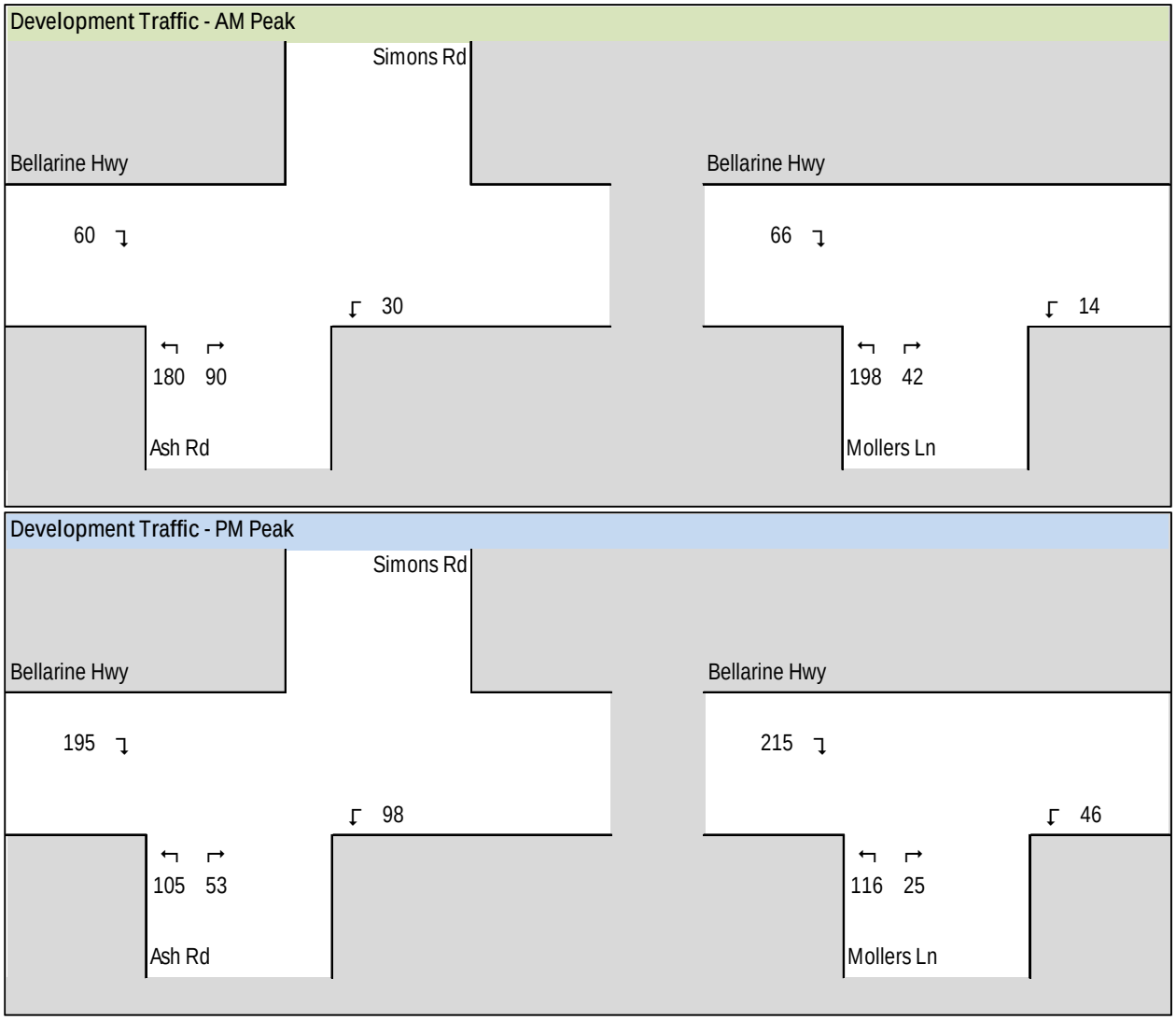
Figure 4.1 Assumed South East Leopold Traffic Directional Distribution




## 4.4 Development Traffic Volumes

Based on the analysis above, development of South East Leopold would generate approximately 4,050 vpd along Ash Road and 3,600 vpd along Mollers Lane. At the Bellarine Hwy intersections, volumes generated in the peak hours turning are shown in Figure 4.2.

Figure 4.2 Peak Period South East Leopold Traffic Turning at the Bellarine Hwy Intersections




## 4.5 C280 Traffic Volumes

A transport assessment report for Amendment C280 (Cardno, 2012) estimated additional traffic volumes along Ash Road of 3,550 vpd. This incorporates C280 site traffic as well as 1,530 vpd from Estuary Estate using the C280 site to access Ash Road (that would currently be using Melaluka Road). The report adopted a traffic generation rate of 10 vpd / lot and distribution of 97% towards the Bellarine Hwy. With reference to Section 4.2, this would seem to be an overestimate of traffic impacting the Bellarine Hwy. The assumption that a significant volume of Estuary Estate traffic will divert to Ash Road may overestimate impacts along Ash Road given Section 4.3 of this report indicates very little demand northeast to southwest. For the purpose of this report, an increase to Ash Road traffic due to the C280 development of 3,000 vpd daily has been adopted and extracted into peak period traffic using the same peak to daily traffic volume ratio as defined in Section 4.2 and a 40 / 60, east / west turning distribution at the Bellarine Hwy / Ash Road intersection.

## 4.6 Future Traffic Volumes

The information above predicts that following full development of South East Leopold and the Amendment C280 area, future daily traffic volumes will be approximately:

- Ash Road (near Bellarine Hwy): 9,100 vpd
- Mollers Lane (near Bellarine Hwy): 3,700 vpd

## 4.7 Roadway Capacities

***Theoretical Capacity***

As a general rule, 2 lane roadways in urban areas experience high delays during commuter peak periods when daily traffic volumes are in the vicinity of 15,000-20,000 vpd[4].

Therefore Mollers Lane, Ash Road and other nearby roadways south of the Bellarine Hwy can be expected to accommodate future traffic volumes well below capacity.

***Amenity Considerations***

The word 'amenity' is often used to describe a pleasing or agreeable environment. Congestion, noise and safety implications of vehicular traffic can be at odds with the amenity of residential neighbourhoods. The Planning Scheme (Clause 56.06) provides some guidance around traffic volume amenity considerations by specifying indicative maximum traffic volumes for roads within residential subdivisions as follows:

- Access Street: 1,000 - 3,000 vpd
- Connector Street: 3,000 - 7,000 vpd

Except for Ash Road, nearby roadways south of the Bellarine Hwy are expected to carry traffic volumes less than their Indicative Maximum Volume. Regarding Ash Road, volumes are likely to vary along its length from very low in the south to an estimated future 9,100 vpd at the Bellarine Hwy. It is also not uncommon for Connector Streets to carry above 7,000 vpd in built up urban areas and / or where they connect to major arterials.

## 4.8 Intersection Analysis

Analysis of the Bellarine Hwy intersections has been undertaken using Sidra Intersection software[5]. Existing conditions and future conditions scenarios have been modelled. The future conditions scenarios increase existing traffic by the amounts indicated above for the South East Leopold and C280 developments, as well as adding 10 years of 1% annual growth to other intersection movements.

[4] Interrupted flow capacity = 900vph lane (Austroads 2013), with 10% peak to daily ratio = 18,000 vpd.

[5] Sidra Intersection is a software tool used widely throughout Australia and all over the world that evaluates the capacity of intersections. It reports results including degree of saturation, level of service, delay and queue lengths. A regularly used performance measure is the degree of saturation (DOS) which is the ratio of arrival traffic volumes to capacity. DOS values above 0.9 are typically considered poor performance while values less than 0.6 are typically considered excellent performance.

At the Mollers Lane intersection, future conditions scenarios are presented for 3 potential intersection configurations as follows; (i) Give-way (as per existing conditions plus the provision of a left turn lane into Mollers Lane), (ii) Traffic signals, and (iii) Roundabout.

At the Ash Road intersection, the future conditions scenario assumes extension of the right turn lane into Ash Road, as identified within C280 Amendment documentation.

Full results are presented in Appendix B while Table's 4.1 and 4.2 provide degree of saturation summaries.

Table 4.1 Sidra Analysis Results - Degree of Saturation - Mollers Lane / Bellarine Hwy Intersection

| Movements | AM Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|
| | Existing | Future GiveWay | Future Signals | Future R/About | Existing | Future GiveWay | Future Signals | Future R/About |
| Bellarine Hwy Through | 0.27 | 0.30 | 0.41 | 0.40 | 0.25 | 0.28 | 0.43 | 0.42 |
| Mollers Lane ingress | 0.27 | 0.54 | 0.79 | 0.40 | 0.15 | 0.70 | 0.91 | 0.42 |
| Mollers Lane egress | 0.01 | 0.65 | 0.85 | 0.37 | 0.00 | 0.19 | 0.30 | 0.18 |

*Key outcomes (Mollers Lane intersection):*

- A give-way controlled intersection can accommodate anticipated future traffic volumes with a degree of saturation of 0.70. However, movements giving way to through traffic experience relatively high delays. For example, the right turn into Mollers Lane experiences an average delay of 45 seconds in the AM peak hour.
- Traffic signals could be expected to operate within typically adopted performance standards and provide high levels of service for Bellarine Hwy through traffic.
- A roundabout has the best intersection performance in terms of both degree of saturation and lowest average delay.

Table 4.2 Sidra Analysis Results - Degree of Saturation – Ash Road / Bellarine Hwy Intersection

| Movements | AM Peak | | PM Peak | |
|---|---|---|---|---|
| | Existing | Future | Existing | Future |
| Bellarine Hwy Through | 0.37 | 0.53 | 0.46 | 0.71 |
| Ash Road ingress | 0.34 | 0.76 | 0.54 | 0.89 |
| Ash Road egress | 0.44 | 0.90 | 0.43 | 0.90 |

*Key outcomes (Ash Road intersection):*

- To accommodate increased traffic associated with development of Leopold South, intersection performance suffers with a significant increase to degree of saturation and delays.
- Notwithstanding, the intersection could be expected to maintain operation within typically adopted performance standards and high levels of service are maintained for Bellarine Hwy through traffic under post development conditions.

- The right turn into Ash Road experiences long queues of up to 195m (95th percentile during PM peak hour).

Please note that although results above give an expectation of significant queues and delays for the right turn into Ash Road, the reality may differ due to a change in motorists travel behaviour. For example, this report assumes more South East Leopold traffic will utilise Ash Road than Mollers Lane, as it is the most direct route along desire lines. However, given lower delays at the Mollers Lane intersection, Mollers Lane may become the more desirable route. And the analysis above therefore overestimates congestion at the Ash Road intersection and underestimates congestion at the Mollers Lane intersection. Furthermore, traffic distributions may change by time of day as intersection delays change.

## 4.9 Mitigating Works

***Preamble***

Responsible Authorities sometimes require upgrades to the nearby road network as part of conditional approval of development proposals. These are typically works the Responsible Authority considers necessary as a result of the proposed development.

Important considerations are nexus (the correlation between the proposed development and the project need) and equity (fairness, or that a developments share of benefit / use matches its contribution).

The following mitigating works projects have been identified as part of the preparation of this report. They are considered to have a clear nexus to the development proposal.

***Mollers Lane***

An upgrade of Mollers Lane to urban Connector Street standards adjacent the site's boundary as identified by the South East Leopold Framework Plan is expected to fulfil the future requirements of this roadway. A speed zone change to 60kph (or 50kph) is anticipated as part of its change to an urban roadway.

***Ash Road***

Ash Road south of Hazelwood Crescent currently has a rural type cross section and an upgrade adjacent the site's boundary to urban Connector Street standard as identified by the South East Leopold Framework Plan is expected to fulfil the future requirements of this roadway.

***Mollers Lane / Bellarine Hwy Intersection***

***General***

The Mollers Lane / Bellarine Hwy intersection could be expected to accommodate South East Leopold development traffic in either give-way, traffic signals or roundabout configurations.

The give-way configuration assumes the mitigating works of a left turn lane into Mollers Lane. These are relatively minor works and are considered suitable to be implemented during early stages of development to safely and efficiently cater for traffic as development occurs.

Under the future conditions circumstances analysed above (ie. Leopold South fully developed and 10 years growth applied to other traffic), turning movements at the intersection experience relatively high delays in peak periods. Typically when a busy duplicated arterial has a side road give-way intersection experiencing moderate to high traffic volumes, road authorities have a desire to implement traffic signal or roundabout control to increase safety and the convenience of side road traffic movements. Therefore it may be appropriate that the developers of Leopold South contribute to what may be a necessary future intersection upgrade. It is considered that a timeframe coinciding with latter stages of development would be reasonable for such an upgrade. Such as completion of approximately 275 lots.

It is noted that traffic signal control of the Mollers Lane / Bellarine Hwy intersection would significantly increase pedestrian and cyclist amenity along with connectivity for north-south movements. While a busy 2-lane roundabout can create poor pedestrian and cyclist amenity outcomes.

### *Bellarine Hwy Speed Limit*

The Bellarine Hwy speed limit currently changes from 70kph to 100kph between Mollers Lane and Christies Road. As Mollers Lane becomes an urban road with increased traffic, it is recommended that the transition to 70kph is relocated east of Mollers Lane.

### *Sight Distances*

Austroads 2010 (Part 4A) specifies that provision of a minimum Safe Intersection Sight Distance (SISD) of approximately 150m is desirable for a 70kph speed environment. Measurements indicate a SISD in excess of this is currently available at the intersection. However, it is noted that roadside vegetation east of Mollers Lane restricts sight lines and it is recommended that it is trimmed to improve intersection safety as shown in Figure 4.3.

Figure 4.3 Sight Line from Mollers Lane to Bellarine Hwy East


### *Ash Road / Bellarine Hwy Intersection*

The Ash Road / Bellarine Hwy intersection could be expected to accommodate Leopold South development traffic volumes provided the right turn lane into Ash Road is extended to accommodate longer queue lengths.

Its existing lane length is approximately 45m.

As part of the C280 Amendment process, VicRoads nominated that the right turn lane should be extended to provide a minimum of 100m storage. The Amendment incorporates a mechanism for development of the C280 area to fund such works.

The future conditions analysis above anticipates queue lengths of up to 195m may be possible upon full development of Leopold South. Therefore, it may be appropriate that the developers of South East Leopold make additional contribution to the intersection upgrade.

***Equity of Infrastructure Funding***

It is not within the scope of this report to resolve issues around equity or matching developer contribution with share of benefit. However the following information is provided to inform such decisions:

- Development of each land holding within Leopold South will generate traffic movements that travel in all directions, but predominantly to/from the northwest.
- Land holdings in the eastern part of South East Leopold are likely to be the major contributors of traffic using Mollers Lane. And land holdings in the western part of South East Leopold (together with the C280 area) are likely to be the major contributors of traffic using Ash Road.
- Ash Road already provides an established urban roadway and signalised intersection with the Bellarine Hwy. Its road upgrade funding requirements are therefore likely to be significantly less than those for Mollers Lane and its intersection with Bellarine Hwy. Therefore, proportion of usage may not be a balanced funding contribution model.

## 4.10 Summary

Key points that can be taken from the analysis and discussion above are listed as follows:

1. Development of South East Leopold will generate significant traffic activity with a generation of approximately 9,000 vehicle movements per day.
2. In the future upon full development of Leopold South, daily traffic volumes near the Bellarine Hwy may be 3,700 vpd along Mollers Lane and 9,100 vpd along Ash Road. These are significant increases from existing traffic volumes.
3. Significant traffic volume increases along Mollers Lane and Ash Road should not be a surprise to Planning Authorities given the amount of land earmarked for development and its reliance on the Bellarine Hwy to provide access to the wider road network. Future Ash Road volumes are still well less than roadway capacity and of a magnitude that is not uncommon for Connector Streets in built up urban areas.
4. The Mollers Lane / Bellarine Hwy intersection has the capacity to accommodate South East Leopold development traffic as a give-way priority intersection. However, for road safety considerations and to manage side road traffic delays, an upgrade to traffic signal or roundabout control may be warranted. With such works having a timeframe requirement coinciding with latter stages of development (eg. 275 lots).
5. The Ash Road / Bellarine Hwy intersection will require works to extend the queue storage capacity of the right turn lane into Ash Road. As part of Amendment C280, funding has been allocated for this upgrade but given further traffic demands from South East Leopold, it

may be appropriate that further funding is made available to further increase its storage capacity.

6. High levels of service are maintained for Bellarine Hwy through traffic at the critical access intersections under post development conditions.

# 5 Subdivision Design Assessment

## 5.1 Preamble

The proposed subdivision transport network has been reviewed to assess its ability to accommodate the safe and efficient movement for all road users. Design guidance for new residential subdivisions is contained within Clause 56.06 of the Geelong Planning Scheme and Infrastructure Design Manual (IDM).

## 5.2 Overview

In general, the proposed road network is considered consistent with the objectives of the Planning Scheme. Roads are predominately aligned in a grid pattern that is permeable and easily navigated. Good connectivity is provided through various linkages to surrounding neighbourhoods. Road alignments are also generally consistent with the South East Leopold Framework Plan.

## 5.3 Road Hierarchy

As per the South East Leopold Framework Plan, the proposed subdivision road network includes two east-west aligned roadways to function as Connector Streets.

Most other internal roads can be classified as Access Streets. While cul-de-sac roadways can be classified as Access Lanes or Access Places.

## 5.4 Intersections

At cross intersections with Connector Streets, roundabouts are recommended to manage vehicle speeds and to safely control turning movements. There are no such intersections proposed within the site however the Ash Road development area is envisaged to include Connector cross intersections at Ash Road / Hazelwood Crescent, Ash Road / Walkers Road, and midway along the proposed northern Connector Street.

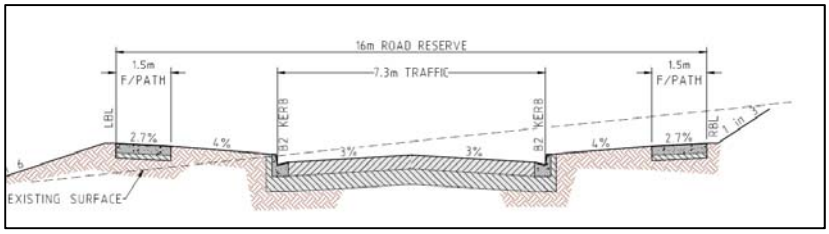
Other proposed intersections are predominately T intersections, and give-way control will be appropriate.

## 5.5 Road Cross Sections

***Access Streets***

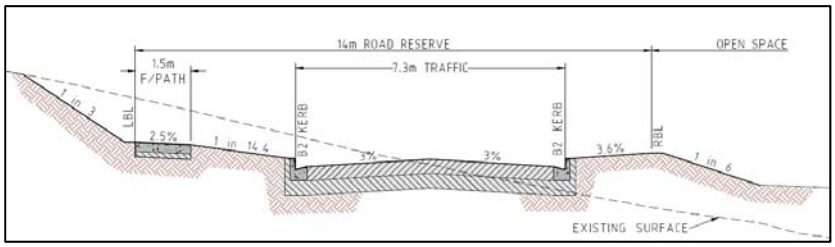
Roads within neighbouring areas of Leopold that could be classified as Access Streets typically have cross sections consistent with those specified in the Planning Scheme and IDM. That is, road reserves and carriageways of approximately 16m and 7.5m, respectively. The same type of cross section for the site is proposed as shown in Figure 5.1 and is considered suitable.

Figure 5.1 Proposed Access Street Cross Section (Source: TGM Group)




It is noted that some Access Streets have alignments abutting open space reserves and accordingly verges may not be necessary on that side. In these instances, a 14m road reserve is proposed with cross section as shown in Figure 5.2.

Figure 5.2 Proposed Access Street Adjacent Open Space Cross Section (Source: TGM Group)




***Connector Streets***

Roads within neighbouring areas of Leopold that could be classified as Connector Streets typically have 20m road reserves and carriageways of approximately 10m, as does Ash Road. Mollers Lane has a 20m road reserve.

The Planning Scheme specifies a minimum 20.6m road reserve for Connector Streets comprising the critical components of a 4.5m verge, 2.3m parking lanes and 3.5 traffic lanes. Both the Planning Scheme and IDM provide a range of cyclist provisions that range from no facilities, widening of the traffic lane and dedicated on-road cycle lanes.

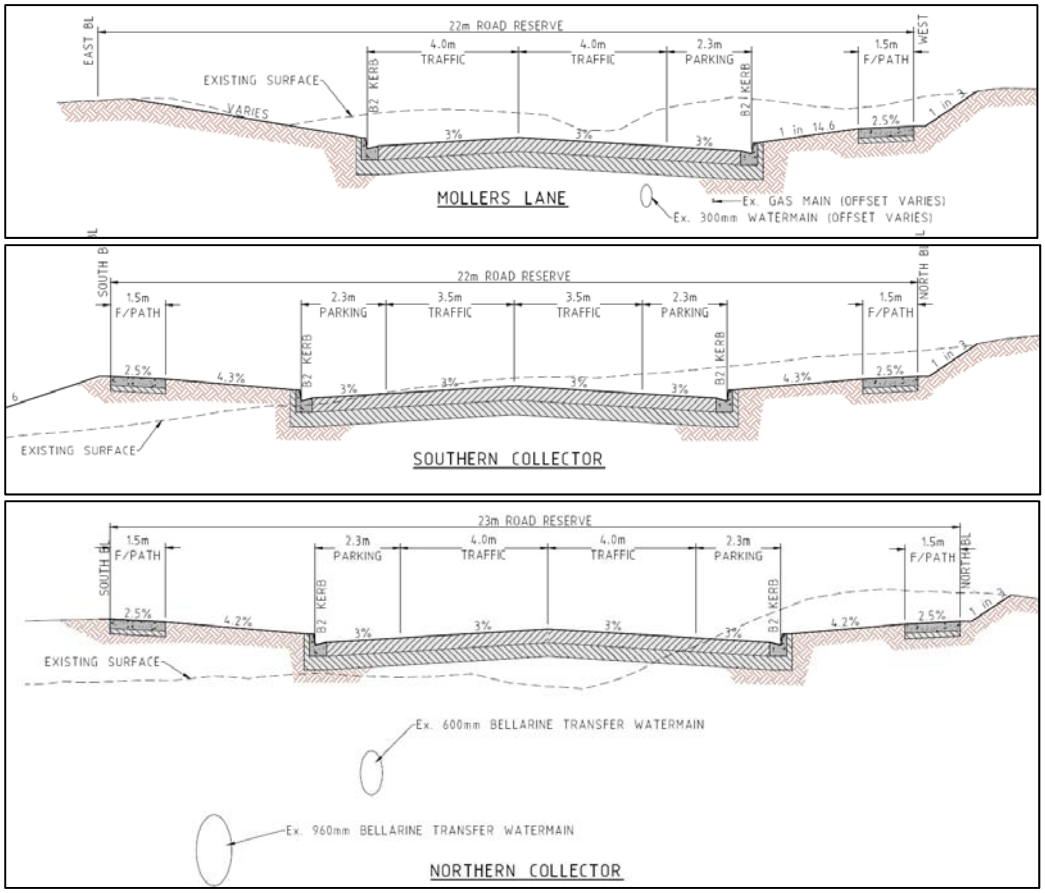
The South East Leopold Framework Plan identifies 22m road reserves for the Connector Streets, although verge and carriageway dimensions are not specified. It also identifies upgrades of Mollers Lane and Ash Road along the site frontage to Connector Street standard.

Based on all of the above, it is recommended that Connector Streets within the proposed subdivision incorporate the minimum dimensions of 4.5m verges, 2.3m parking lanes and 3.5 traffic lanes. Parking lanes should be indented to provide kerb outstands at intersections for improved pedestrian amenity and safety. Each Connector Street proposed has unique characteristics and further discussion specific to each is set out as follows:

- *Northern Connector* - Ideally, the traffic lane would incorporate some additional width (eg. 0.3-0.7m) for what is likely to be low cyclist volumes.
- *Southern Connector* - Cyclist volumes are likely to be low given the roads alignment and location near the outer edge of urban Leopold. No further cyclist provision is considered necessary.
- *Mollers Lane* - Ideally, the traffic lane would incorporate some additional width (eg. 0.3-0.7m) for what is likely to be low cyclist volumes. It is noted that a parking lane may only be necessary along the developed western side.

Figure 5.3 shows the proposed cross sections for these Connector Streets which are consistent with the above commentary.

Figure 5.3 Proposed Connector Street Cross Sections (Source: TGM Group)




## 5.6 Road Gradients

The site has naturally sloping terrain with gradients of up to 10% in the steepest areas.

The proposed subdivision road network is expected to provide appropriate longitudinal grades given Austroads 2010 (Part 3) specifies longitudinal grades of 6-9% will have minimal effect on light vehicles and the IDM specifies desirable and absolute maximum grades of 10% and 20%, respectively.

It is noted that detailed design of the proposed road network should carefully consider the impact of road crests to sight distances and adverse cross gradients at intersections.

## 5.7 Access to Public Transport

As Leopold South is developed and new road connections made, there is a potential for route bus service plans to be modified to align services more proximate to a greater number of households.

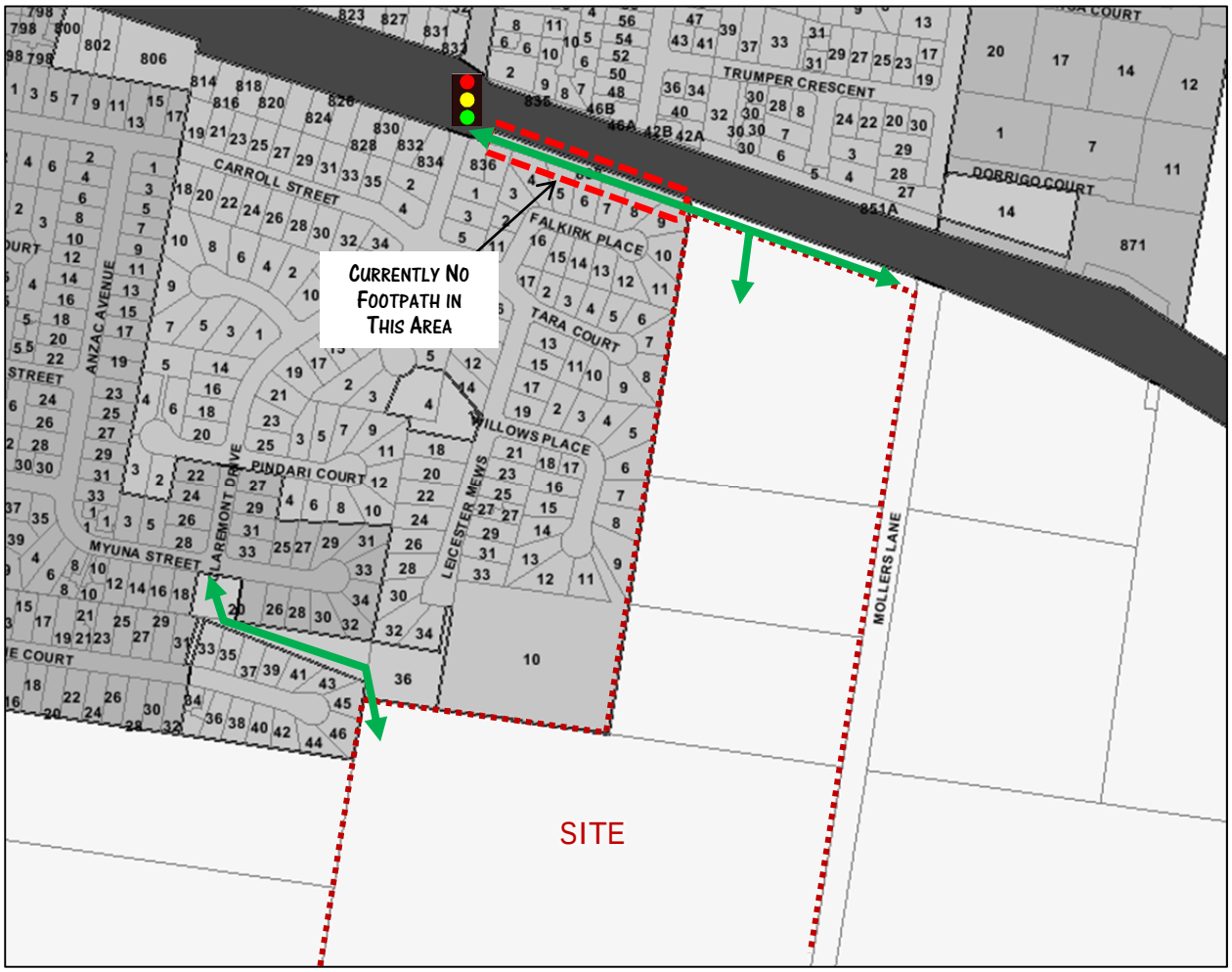
Given the proposed road network is permeable and well connected to surrounding neighbourhoods, it should provide a range of potential route options for future bus services.

Typically bus services in residential neighbourhood travel along Connector Streets and this should be noted during detailed design of Connector Street intersections and roundabouts.

## 5.8 Walking and Cycling

The proposed subdivision road network and open space pathways are expected to provide easily navigated, safe and efficient walking and cycling routes. Connections to the existing neighbouring path network should be made where possible, refer Figure 5.4.

Figure 5.4 Opportunities for Footpath Connections to Neighbouring Network

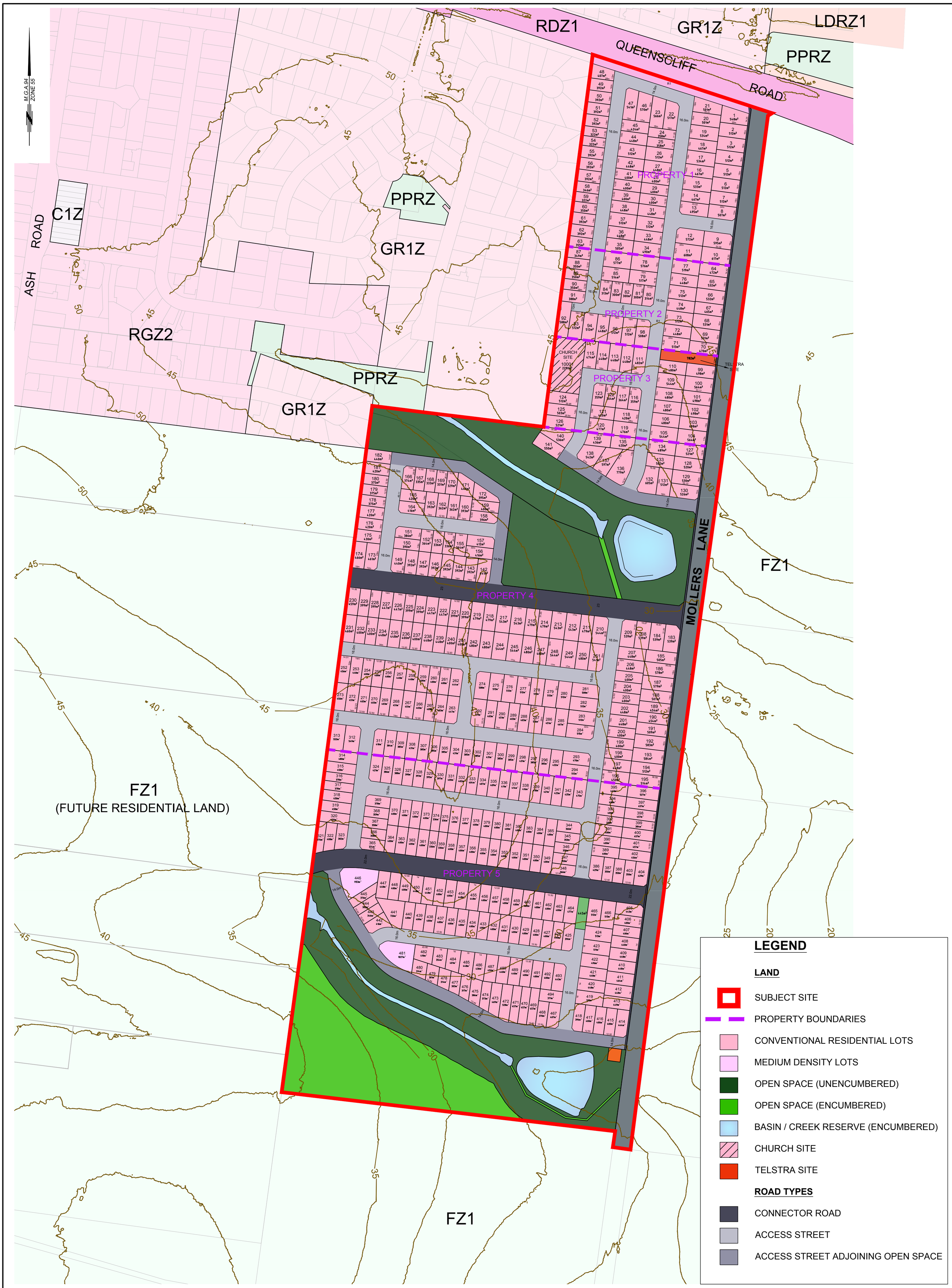



## 5.9 Summary

Key points that can be taken from the analysis and discussion above are listed as follows:

1. The proposed road network is considered consistent with the objectives of the Planning Scheme and South East Leopold Framework Plan.
2. The proposed road and footpath networks are expected to provide easily navigated, safe and efficient walking and cycling routes.
3. The proposed road network is expected to facilitate a range of future bus service options.
4. Specific design recommendations have been made with respect to road cross sections, intersection control and connections to surrounding neighbourhoods.

# Appendix A Development Plan




| Rev. | Revision | Date |
|---|---|---|
| - | - | - |
| | | |
| | | |


TGM Group
1/27-31 Myers Street (PO Box 1137)
Geelong Vic 3220
T 03 5202 4600
03 5202 4691
ABN 11 125 568 461
www.tgmgroup.com
Geelong I Melbourne I Ballarat
JAS-ANZ Accredited: Quality ISO 9001 - OH&S AS/NZS 4801 - Environment ISO 14001


**DEVELOPMENT ANALYSIS**

| | | |
|---|---|---|
| **TOTAL SITE AREA** | | **39.53 ha** |
| ENCUMBERED RESERVES | | 1.262 ha |
| ENCUMBERED OPEN SPACE | | 2.425 ha |
| ROAD RESERVE | | 0.414 ha |
| TELSRA SITE | 0.078 ha | |
| PUMP STATION | | 0.023 ha |
| TOTAL | | **4.202 ha** |
| **TOTAL DEVEOPLABLE AREA** | | **35.33 ha** |
| PUBLIC OPEN SPACE | | 5.926 ha (16.77%) |

| | |
|---|---|
| TOTAL LOTS | 494 |
| LOTS PER DEVELOPABLE HA | 14 |

# OVERALL DEVELOPMENT PLAN

MOLLERS LANE, LEOPOLD

MOLLERS LANE DEVELOPMENTS PTY. LTD.
PAMAS PROPERTY PTY. LTD

**Job Number:** 15196-100
**Sheet:** 1 of 1
**Date of Survey:**

**Date of Issue** 14/12/2017

SCALE 1:2000
20 0 20 40 60 80 100
LENGTHS ARE IN METRES

**At Size** A1

**Survey:** -- **Drawn:** J.S. **Checked:** P.P.

**DWG:** 15196-100 OPT U **VERSION:** U

# Appendix B Sidra Analysis Results

## Site: 101 [Bell-Mollers_AM_exg]

Giveway / Yield (Two-Way)

**Lane Use and Performance**

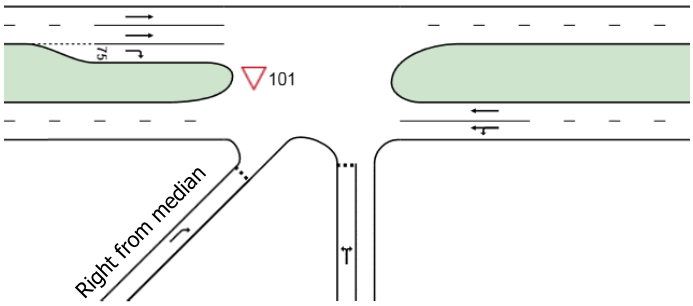
| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 | 6 | 5.0 | 506 | 0.012 | 100 | 14.7 | LOS B | 0.1 | 0.4 | Full | 500 | 0.0 | 0.0 |
| Approach | 6 | 5.0 | | 0.012 | | 14.7 | LOS B | 0.1 | 0.4 | | | | |
| East: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 517 | 5.0 | 1888 | 0.274 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 517 | 5.0 | 1889 | 0.274 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 1035 | 5.0 | | 0.274 | | 3.0 | NA | 0.0 | 0.0 | | | | |
| West: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 241 | 5.0 | 1889 | 0.128 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 241 | 5.0 | 1889 | 0.128 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 1 | 5.0 | 279 | 0.004 | 100 | 18.5 | LOS C | 0.0 | 0.1 | Short | 75 | 0.0 | NA |
| Approach | 483 | 5.0 | | 0.128 | | 0.1 | NA | 0.0 | 0.1 | | | | |
| SouthWest: Staged Right S-E | | | | | | | | | | | | | |
| Lane 1 | 1 | 5.0 | 632 | 0.002 | 100 | 9.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 1 | 5.0 | | 0.002 | | 9.0 | LOS A | 0.0 | 0.0 | | | | |
| Intersection | 1525 | 5.0 | | 0.274 | | 2.1 | NA | 0.1 | 0.4 | | | | |

## Site: 101 [Bell-Mollers_PM_exg]

Giveway / Yield (Two-Way)

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 | 4 | 5.0 | 990 | 0.004 | 100 | 9.7 | LOS A | 0.0 | 0.2 | Full | 500 | 0.0 | 0.0 |
| Approach | 4 | 5.0 | | 0.004 | | 9.7 | LOS A | 0.0 | 0.2 | | | | |
| East: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 292 | 5.0 | 1885 | 0.155 | 100 | 3.1 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 292 | 5.0 | 1889 | 0.155 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 584 | 5.0 | | 0.155 | | 3.0 | NA | 0.0 | 0.0 | | | | |
| West: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 477 | 5.0 | 1889 | 0.252 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 477 | 5.0 | 1889 | 0.252 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 4 | 5.0 | 578 | 0.007 | 100 | 11.6 | LOS B | 0.0 | 0.2 | Short | 75 | 0.0 | NA |
| Approach | 958 | 5.0 | | 0.252 | | 0.1 | NA | 0.0 | 0.2 | | | | |
| SouthWest: Staged Right S-E | | | | | | | | | | | | | |
| Lane 1 | 1 | 5.0 | 310 | 0.003 | 100 | 15.1 | LOS C | 0.0 | 0.1 | Full | 500 | 0.0 | 0.0 |
| Approach | 1 | 5.0 | | 0.003 | | 15.1 | LOS C | 0.0 | 0.1 | | | | |
| Intersection | 1547 | 5.0 | | 0.252 | | 1.2 | NA | 0.0 | 0.2 | | | | |



## Site: 101 [Bell-Mollers_AM_ftr giveway]

Giveway / Yield (Two-Way)

**Lane Use and Performance**

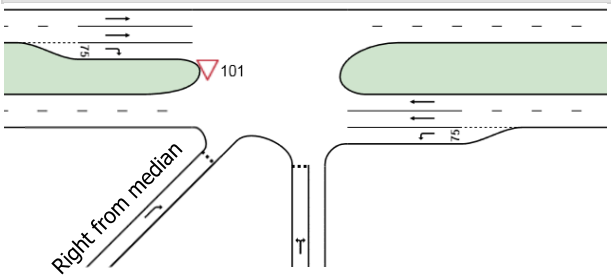
| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 | 259 | 5.0 | 397 | 0.653 | 100 | 29.0 | LOS D | 4.7 | 34.6 | Full | 500 | 0.0 | 0.0 |
| Approach | 259 | 5.0 | | 0.653 | | 29.0 | LOS D | 4.7 | 34.6 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 18 | 5.0 | 1793 | 0.010 | 100 | 8.0 | LOS A | 0.0 | 0.0 | Short | 75 | 0.0 | NA |
| Lane 2 | 570 | 5.0 | 1889 | 0.302 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 570 | 5.0 | 1889 | 0.302 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 1158 | 5.0 | | 0.302 | | 3.0 | NA | 0.0 | 0.0 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 266 | 5.0 | 1889 | 0.141 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 266 | 5.0 | 1889 | 0.141 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 71 | 5.0 | 131 | 0.540 | 100 | 44.8 | LOS E | 1.9 | 14.1 | Short | 75 | 0.0 | NA |
| Approach | 603 | 5.0 | | 0.540 | | 5.3 | NA | 1.9 | 14.1 | | | | |
| SouthWest: Staged Right S-E | | | | | | | | | | | | | |
| Lane 1 | 45 | 5.0 | 484 | 0.094 | 100 | 10.8 | LOS B | 0.3 | 2.1 | Full | 500 | 0.0 | 0.0 |
| Approach | 45 | 5.0 | | 0.094 | | 10.8 | LOS B | 0.3 | 2.1 | | | | |
| Intersection | 2065 | 5.0 | | 0.653 | | 7.1 | NA | 4.7 | 34.6 | | | | |

## Site: 101 [Bell-Mollers_PM_ftr giveway]

Giveway / Yield (Two-Way)

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 | 152 | 5.0 | 798 | 0.190 | 100 | 11.5 | LOS B | 1.0 | 7.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 152 | 5.0 | | 0.190 | | 11.5 | LOS B | 1.0 | 7.0 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 59 | 5.0 | 1793 | 0.033 | 100 | 8.0 | LOS A | 0.0 | 0.0 | Short | 75 | 0.0 | NA |
| Lane 2 | 317 | 5.0 | 1889 | 0.168 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 317 | 5.0 | 1889 | 0.168 | 100 | 3.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 693 | 5.0 | | 0.168 | | 3.4 | NA | 0.0 | 0.0 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 527 | 5.0 | 1889 | 0.279 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 527 | 5.0 | 1889 | 0.279 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 231 | 5.0 | 328 | 0.702 | 100 | 25.8 | LOS D | 4.3 | 31.5 | Short | 75 | 0.0 | NA |
| Approach | 1284 | 5.0 | | 0.702 | | 4.7 | NA | 4.3 | 31.5 | | | | |
| SouthWest: Staged Right S-E | | | | | | | | | | | | | |
| Lane 1 | 26 | 5.0 | 195 | 0.135 | 100 | 22.4 | LOS C | 0.4 | 2.8 | Full | 500 | 0.0 | 0.0 |
| Approach | 26 | 5.0 | | 0.135 | | 22.4 | LOS C | 0.4 | 2.8 | | | | |
| Intersection | 2155 | 5.0 | | 0.702 | | 4.9 | NA | 4.3 | 31.5 | | | | |



## Site: 101 [Bell-Mollers_AM_ftr signals]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

**Lane Use and Performance**

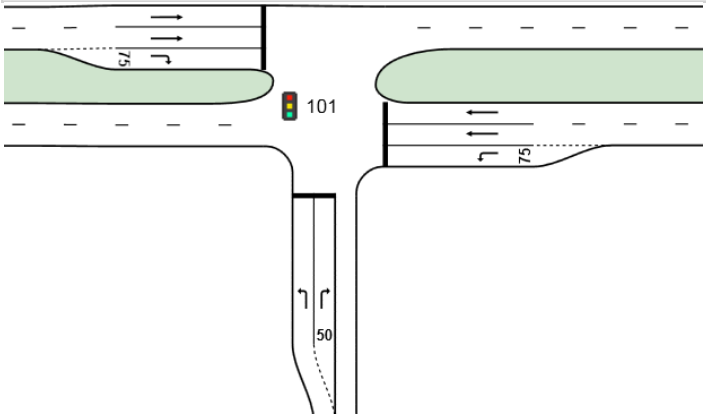
| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 | 214 | 5.0 | 252 [1] | 0.849 | 100 | 68.3 | LOS E | 13.7 | 99.7 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 45 | 5.0 | 90 | 0.505 | 100 | 70.1 | LOS E | 2.8 | 20.3 | Short | 50 | 0.0 | NA |
| Approach | 259 | 5.0 | | 0.849 | | 68.6 | LOS E | 13.7 | 99.7 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 18 | 5.0 | 1554 | 0.012 | 100 | 6.7 | LOS A | 0.1 | 1.0 | Short | 75 | 0.0 | NA |
| Lane 2 | 570 | 5.0 | 1385 | 0.412 | 100 | 0.6 | LOS A | 1.2 | 9.0 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 570 | 5.0 | 1385 | 0.412 | 100 | 0.6 | LOS A | 1.2 | 9.0 | Full | 500 | 0.0 | 0.0 |
| Approach | 1158 | 5.0 | | 0.412 | | 0.7 | LOS A | 1.2 | 9.0 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 266 | 5.0 | 1385 | 0.192 | 100 | 0.5 | LOS A | 0.4 | 3.1 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 266 | 5.0 | 1385 | 0.192 | 100 | 0.5 | LOS A | 0.4 | 3.1 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 71 | 5.0 | 90 | 0.787 | 100 | 74.0 | LOS E | 4.6 | 33.3 | Short | 75 | 0.0 | NA |
| Approach | 603 | 5.0 | | 0.787 | | 9.1 | LOS A | 4.6 | 33.3 | | | | |
| Intersection | 2020 | 5.0 | | 0.849 | | 11.9 | LOS B | 13.7 | 99.7 | | | | |

## Site: 101 [Bell-Mollers_PM_ftr signals]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 | 125 | 5.0 | 418 | 0.299 | 100 | 46.6 | LOS D | 6.1 | 44.4 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 26 | 5.0 | 90 | 0.294 | 100 | 68.9 | LOS E | 1.6 | 11.6 | Short | 50 | 0.0 | NA |
| Approach | 152 | 5.0 | | 0.299 | | 50.5 | LOS D | 6.1 | 44.4 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 59 | 5.0 | 1390 | 0.042 | 100 | 8.9 | LOS A | 0.8 | 5.7 | Short | 75 | 0.0 | NA |
| Lane 2 | 317 | 5.0 | 1212 | 0.261 | 100 | 4.5 | LOS A | 3.4 | 24.7 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 317 | 5.0 | 1212 | 0.261 | 100 | 4.5 | LOS A | 3.4 | 24.7 | Full | 500 | 0.0 | 0.0 |
| Approach | 693 | 5.0 | | 0.261 | | 4.9 | LOS A | 3.4 | 24.7 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 527 | 5.0 | 1212 | 0.435 | 100 | 5.2 | LOS A | 7.0 | 50.8 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 527 | 5.0 | 1212 | 0.435 | 100 | 5.2 | LOS A | 7.0 | 50.8 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 231 | 5.0 | 254 | 0.907 | 100 | 75.6 | LOS E | 15.8 | 115.3 | Short | 75 | 0.0 | NA |
| Approach | 1284 | 5.0 | | 0.907 | | 17.9 | LOS B | 15.8 | 115.3 | | | | |
| Intersection | 2128 | 5.0 | | 0.907 | | 16.0 | LOS B | 15.8 | 115.3 | | | | |



## Site: 101 [Bell-Mollers-AM-ftr rabout]

Roundabout

**Lane Use and Performance**

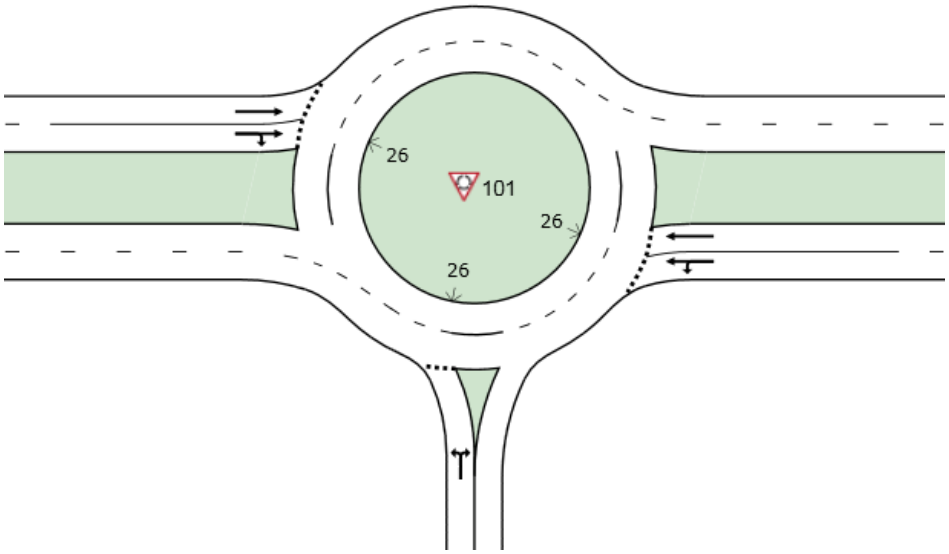
| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 d | 259 | 5.0 | 696 | 0.372 | 100 | 9.1 | LOS A | 1.7 | 12.5 | Full | 500 | 0.0 | 0.0 |
| Approach | 259 | 5.0 | | 0.372 | | 9.1 | LOS A | 1.7 | 12.5 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 d | 610 | 5.0 | 1508 | 0.405 | 100 | 4.1 | LOS A | 2.4 | 17.4 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 547 | 5.0 | 1353 | 0.405 | 100 | 4.2 | LOS A | 2.4 | 17.3 | Full | 500 | 0.0 | 0.0 |
| Approach | 1158 | 5.0 | | 0.405 | | 4.2 | LOS A | 2.4 | 17.4 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 d | 317 | 5.0 | 1509 | 0.210 | 100 | 4.0 | LOS A | 1.2 | 8.7 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 286 | 5.0 | 1365 | 0.210 | 100 | 5.3 | LOS A | 1.2 | 8.5 | Full | 500 | 0.0 | 0.0 |
| Approach | 603 | 5.0 | | 0.210 | | 4.6 | LOS A | 1.2 | 8.7 | | | | |
| Intersection | 2020 | 5.0 | | 0.405 | | 4.9 | LOS A | 2.4 | 17.4 | | | | |

## Site: 101 [Bell-Mollers-PM-ftr rabout]

Roundabout

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Mollers Ln | | | | | | | | | | | | | |
| Lane 1 d | 152 | 5.0 | 833 | 0.182 | 100 | 6.8 | LOS A | 0.7 | 5.4 | Full | 500 | 0.0 | 0.0 |
| Approach | 152 | 5.0 | | 0.182 | | 6.8 | LOS A | 0.7 | 5.4 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 d | 362 | 5.0 | 1265 | 0.286 | 100 | 4.8 | LOS A | 1.5 | 10.7 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 331 | 5.0 | 1156 | 0.286 | 100 | 4.9 | LOS A | 1.4 | 10.5 | Full | 500 | 0.0 | 0.0 |
| Approach | 693 | 5.0 | | 0.286 | | 4.8 | LOS A | 1.5 | 10.7 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 d | 683 | 5.0 | 1624 | 0.421 | 100 | 3.9 | LOS A | 3.0 | 21.7 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 601 | 5.0 | 1429 | 0.421 | 100 | 6.0 | LOS A | 2.9 | 21.4 | Full | 500 | 0.0 | 0.0 |
| Approach | 1284 | 5.0 | | 0.421 | | 4.9 | LOS A | 3.0 | 21.7 | | | | |
| Intersection | 2128 | 5.0 | | 0.421 | | 5.0 | LOS A | 3.0 | 21.7 | | | | |



## Site: 101 [Bell-Ash_AM_exg]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

**Lane Use and Performance**

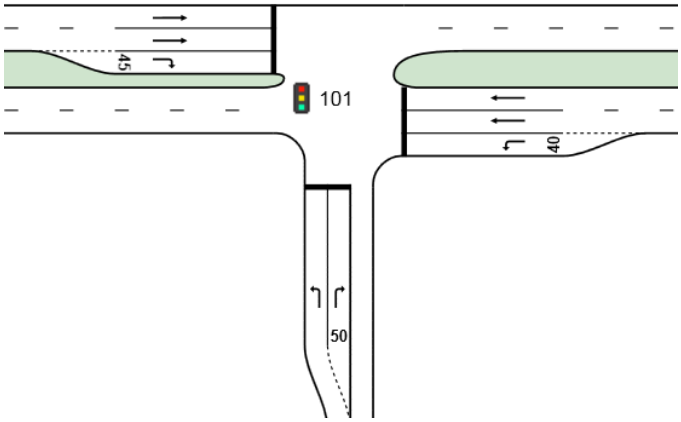
| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Ash Rd | | | | | | | | | | | | | |
| Lane 1 | 62 | 5.0 | 254 | 0.244 | 100 | 55.9 | LOS E | 3.3 | 24.1 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 40 | 2.0 | 92 | 0.437 | 100 | 69.6 | LOS E | 2.4 | 17.4 | Short | 50 | 0.0 | NA |
| Approach | 102 | 3.8 | | 0.437 | | 61.3 | LOS E | 3.3 | 24.1 | | | | |
| East: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 20 | 2.0 | 1587 | 0.013 | 100 | 6.7 | LOS A | 0.2 | 1.1 | Short | 40 | 0.0 | NA |
| Lane 2 | 512 | 5.0 | 1385 | 0.369 | 100 | 0.6 | LOS A | 1.0 | 7.5 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 512 | 5.0 | 1385 | 0.369 | 100 | 0.6 | LOS A | 1.0 | 7.5 | Full | 500 | 0.0 | 0.0 |
| Approach | 1043 | 4.9 | | 0.369 | | 0.7 | LOS A | 1.0 | 7.5 | | | | |
| West: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 224 | 5.0 | 1385 | 0.162 | 100 | 0.5 | LOS A | 0.3 | 2.5 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 224 | 5.0 | 1385 | 0.162 | 100 | 0.5 | LOS A | 0.3 | 2.5 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 31 | 5.0 | 90 | 0.340 | 100 | 69.2 | LOS E | 1.9 | 13.5 | Short | 45 | 0.0 | NA |
| Approach | 478 | 5.0 | | 0.340 | | 4.9 | LOS A | 1.9 | 13.5 | | | | |
| Intersection | 1623 | 4.9 | | 0.437 | | 5.7 | LOS A | 3.3 | 24.1 | | | | |

## Site: 101 [Bell-Ash_PM_exg]

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Ash Rd | | | | | | | | | | | | | |
| Lane 1 | 44 | 5.0 | 305 | 0.145 | 100 | 44.3 | LOS D | 1.9 | 13.6 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 47 | 2.0 | 110 | 0.431 | 100 | 58.1 | LOS E | 2.4 | 17.1 | Short | 50 | 0.0 | NA |
| Approach | 92 | 3.4 | | 0.431 | | 51.4 | LOS D | 2.4 | 17.1 | | | | |
| East: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 62 | 2.0 | 1538 | 0.040 | 100 | 6.9 | LOS A | 0.5 | 3.5 | Short | 40 | 0.0 | NA |
| Lane 2 | 296 | 5.0 | 1284 | 0.231 | 100 | 2.2 | LOS A | 1.7 | 12.2 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 296 | 5.0 | 1284 | 0.231 | 100 | 2.2 | LOS A | 1.7 | 12.2 | Full | 500 | 0.0 | 0.0 |
| Approach | 655 | 4.7 | | 0.231 | | 2.6 | LOS A | 1.7 | 12.2 | | | | |
| West: Bellarine Hwy | | | | | | | | | | | | | |
| Lane 1 | 594 | 5.0 | 1284 | 0.462 | 100 | 2.7 | LOS A | 4.6 | 33.5 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 594 | 5.0 | 1284 | 0.462 | 100 | 2.7 | LOS A | 4.6 | 33.5 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 58 | 5.0 | 108 | 0.538 | 100 | 58.9 | LOS E | 3.0 | 21.7 | Short | 45 | 0.0 | NA |
| Approach | 1245 | 5.0 | | 0.538 | | 5.3 | LOS A | 4.6 | 33.5 | | | | |
| Intersection | 1992 | 4.8 | | 0.538 | | 6.5 | LOS A | 4.6 | 33.5 | | | | |



## Site: 101 [Bell-Ash_AM_ftr]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Ash Rd | | | | | | | | | | | | | |
| Lane 1 | 378 | 5.0 | 418 [1] | 0.905 | 100 | 64.2 | LOS E | 24.5 | 179.0 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 219 | 2.0 | 290 | 0.755 | 100 | 61.1 | LOS E | 13.0 | 92.5 | Short | 50 | 0.0 | NA |
| Approach | 597 | 3.9 | | 0.905 | | 63.1 | LOS E | 24.5 | 179.0 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 79 | 2.0 | 1495 | 0.053 | 100 | 7.8 | LOS A | 0.9 | 6.1 | Short | 40 | 0.0 | NA |
| Lane 2 | 555 | 5.0 | 1048 [1] | 0.530 | 100 | 10.3 | LOS B | 12.3 | 89.6 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 575 | 5.0 | 1086 | 0.530 | 100 | 10.4 | LOS B | 13.0 | 95.2 | Full | 500 | 0.0 | 0.0 |
| Approach | 1209 | 4.8 | | 0.530 | | 10.2 | LOS B | 13.0 | 95.2 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 247 | 5.0 | 1086 | 0.227 | 100 | 8.3 | LOS A | 4.0 | 29.2 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 247 | 5.0 | 1086 | 0.227 | 100 | 8.3 | LOS A | 4.0 | 29.2 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 136 | 5.0 | 179 | 0.757 | 100 | 67.2 | LOS E | 8.4 | 61.0 | Short | 150 | 0.0 | NA |
| Approach | 629 | 5.0 | | 0.757 | | 21.0 | LOS C | 8.4 | 61.0 | | | | |
| Intersection | 2436 | 4.6 | | 0.905 | | 25.9 | LOS C | 24.5 | 179.0 | | | | |

## Site: 101 [Bell-Ash_PM_ftr]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

**Lane Use and Performance**

| | Demand Flows Total veh/h | HV % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Average Delay sec | Level of Service | 95% Back of Queue Veh | Dist m | Lane Config | Lane Length m | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Ash Rd | | | | | | | | | | | | | |
| Lane 1 | 228 | 5.0 | 687 | 0.332 | 100 | 33.5 | LOS C | 9.4 | 68.5 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 152 | 2.0 | 168 | 0.903 | 100 | 77.7 | LOS E | 10.3 | 73.3 | Short | 50 | 0.0 | NA |
| Approach | 380 | 3.8 | | 0.903 | | 51.1 | LOS D | 10.3 | 73.3 | | | | |
| East: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 256 | 2.0 | 1221 | 0.210 | 100 | 13.7 | LOS B | 5.7 | 40.4 | Short | 40 | 0.0 | NA |
| Lane 2 | 327 | 5.0 | 929 | 0.353 | 100 | 15.5 | LOS B | 8.5 | 61.8 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 327 | 5.0 | 929 | 0.353 | 100 | 15.5 | LOS B | 8.5 | 61.8 | Full | 500 | 0.0 | 0.0 |
| Approach | 911 | 4.2 | | 0.353 | | 15.0 | LOS B | 8.5 | 61.8 | | | | |
| West: Bellerine Hwy | | | | | | | | | | | | | |
| Lane 1 | 656 | 5.0 | 929 | 0.706 | 100 | 19.7 | LOS B | 24.4 | 177.9 | Full | 500 | 0.0 | 0.0 |
| Lane 2 | 656 | 5.0 | 929 | 0.706 | 100 | 19.7 | LOS B | 24.4 | 177.9 | Full | 500 | 0.0 | 0.0 |
| Lane 3 | 400 | 5.0 | 448 | 0.892 | 100 | 65.5 | LOS E | 26.5 | 193.8 | Short | 150 | 0.0 | NA |
| Approach | 1712 | 5.0 | | 0.892 | | 30.4 | LOS C | 26.5 | 193.8 | | | | |
| Intersection | 3002 | 4.6 | | 0.903 | | 28.4 | LOS C | 26.5 | 193.8 | | | | |