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SHEPPARTON NORTH EAST GROWTH CORRIDOR

PRECINCT STRUCTURE PLAN

Traffic Engineering Assessment

Prepared for

GREATER SHEPPARTON CITY COUNCIL

MARCH, 2011

OUR REFERENCE: 12088R6826

SHEPPARTON NORTH EAST GROWTH CORRIDOR

PRECINCT STRUCTURE PLAN

Traffic Engineering Peer Review

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TABLE OF CONTENTS

1 INTRODUCTION

Traffix Group has been engaged by Greater Shepparton City Council to undertake a traffic engineering peer review of the traffic recommendations of the Shepparton North East Growth Corridor Precinct Structure Plan (NEGC), including the following specific tasks:

- Review the recommendations of the AECOM traffic report (dated 17th December, 2009) and Precinct Structure Plan (PSP) (dated 2nd February, 2010) especially in relation to Verney Road;
- Assess the proposed roads against Council's Infrastructure Design Manual (IDM);
- Make recommendations for any amendments to the PSP including modifications to the traffic layout contained on the actual plan; and
- Make additional recommendations as appropriate.

2 EXISTING CONDITIONS

2.1 The Site

The subject site is bounded by Ford Road to the north, Grahamvale Road to the east, Verney Road to the west and existing development to the south, as presented in the locality plan at Figure 1 below.

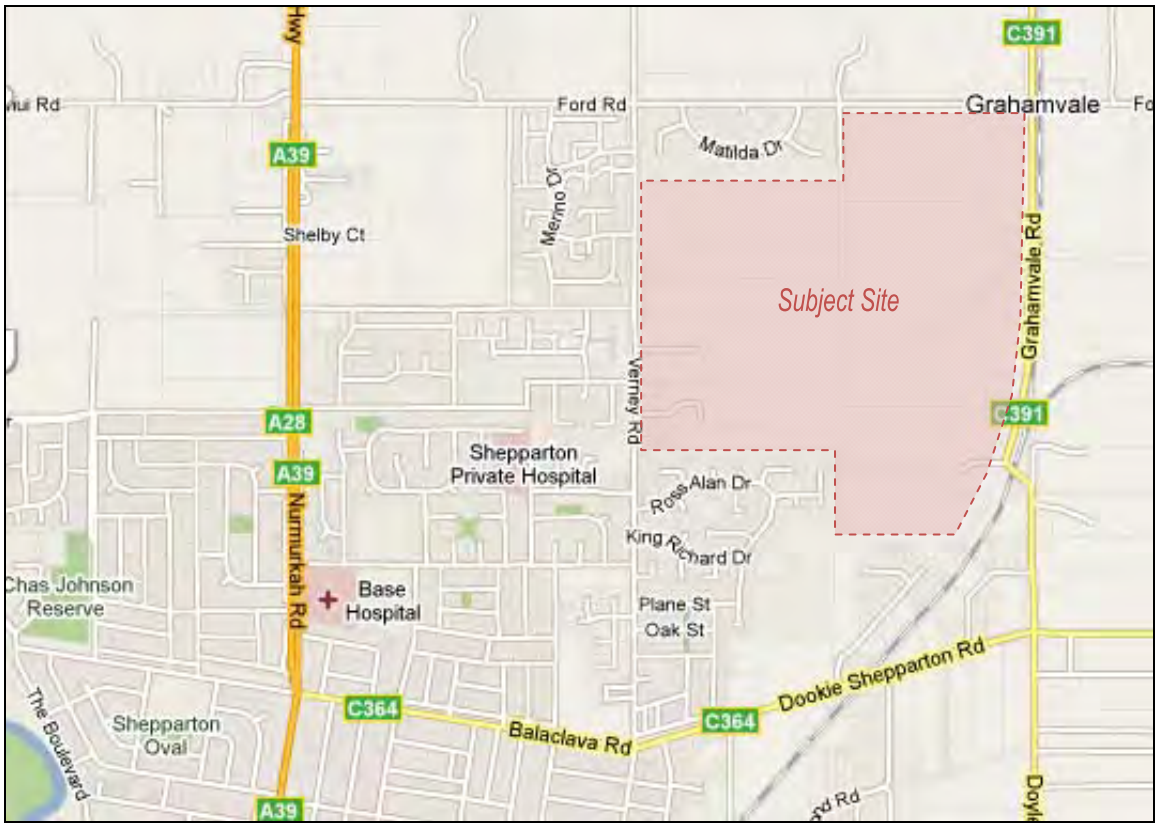

Figure 1: Locality Plan

2.2 Existing Land Use

The majority of the subject site is zoned 'Farming Zone' (FZ), with some parts also zoned 'Public Use Zone – Service & Utility' (PUZ1) under the Greater Shepparton Planning Scheme, as indicated in Figure 2 below.

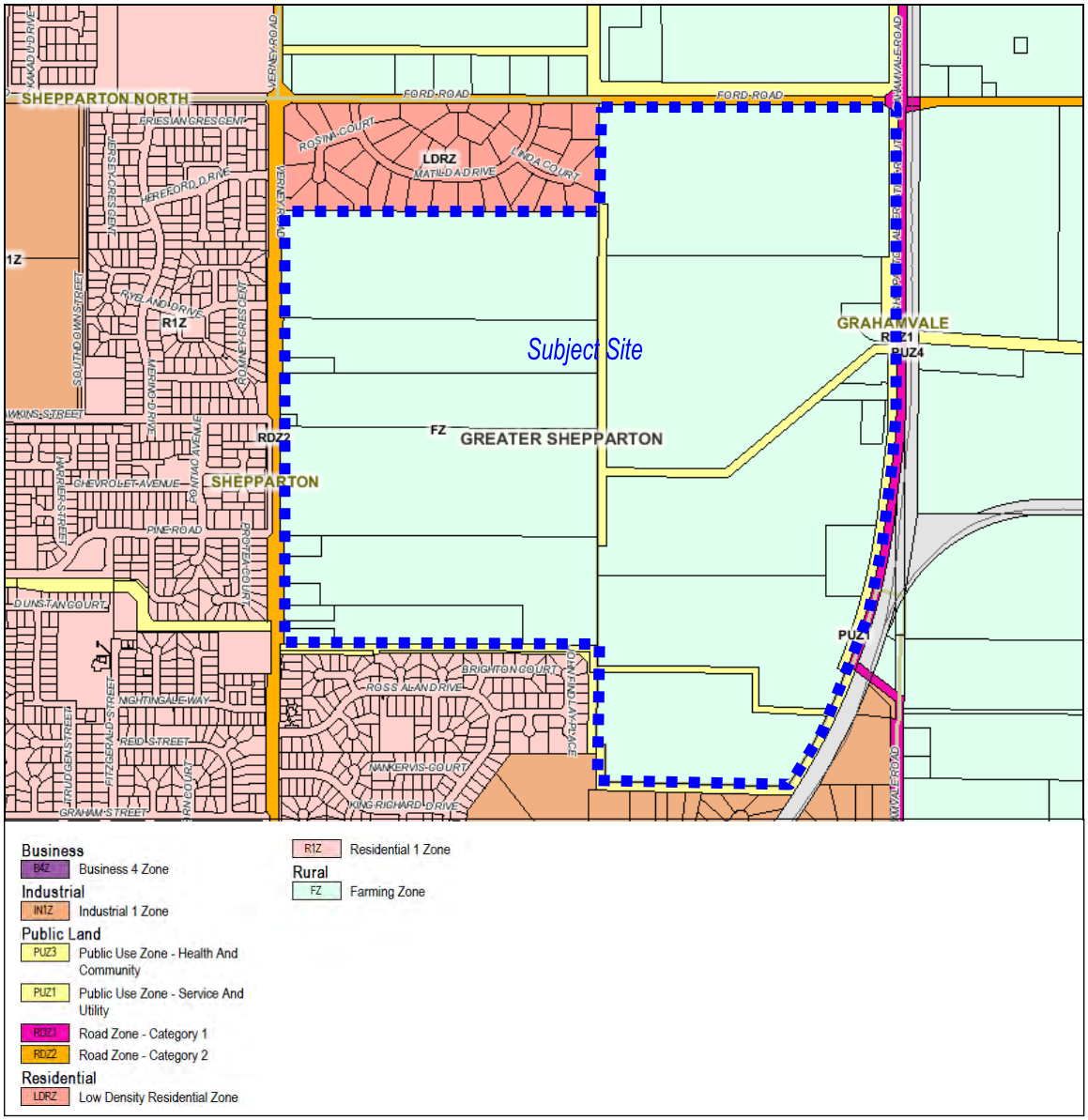

Figure 2: Land Use Zoning (Greater Shepparton Planning Scheme)

2.3 Verney Road

Verney Road is a local main road (Road Zone Category 2) which extends approximately 5.3km in a north-south direction between Goulburn Valley Highway and New Dookie Road.

South of the subject site, Verney Road has a 60km/h posted speed limit and is constructed with one traffic lane and a bike lane in each direction, with a parking lane on the east side, generally within a 30 metre road reservation. Right and left turn lanes are provided at some intersections. There are no left turn lanes provided on the east side of Verney Road.

In the vicinity of the subject site, Verney Road has a 70km/h posted speed limit and no parking lanes or kerb and channel. The narrower section (north of Reylands Drive) has a pavement width of 10.4 metres, with marked bicycle lanes on both sides.

A shared path extends along the western side of Verney Road between Clarke Court and Ford Road.

Figure 3: Verney Road South of Subject Site – Looking South

Figure 4: Verney Road at Subject Site – Looking North

2.4 Crash History

Section 3.4 of the draft traffic impact assessment indicates that in the five year period between 1st January 2004 and 31st December 2008 a total of 46 crashes occurred in the area reviewed, which included the roads bordering the subject site as well as Hawkins Street, Pine Road, Hawdon Street and Goulburn Valley Highway (at the intersections of Balaclava Road, Hawkins Street, Ford Road, Very Road and Pine Road).

The following diagram shows the locations where crashes occurred.

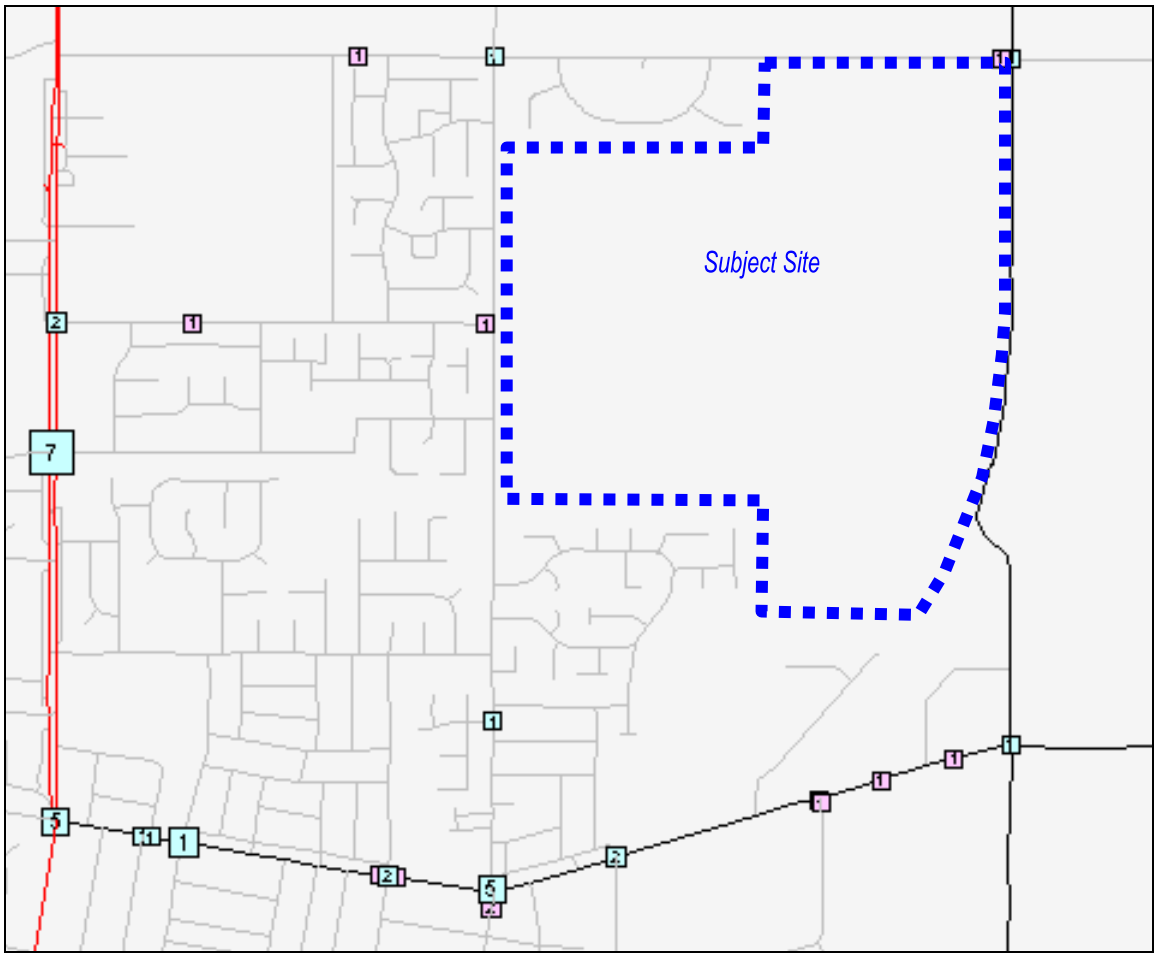

Figure 5: Crash Locations – 1st January 2004 to 31st December, 2008

Review of the crash history revealed that there three locations where more than three crashes occurred during the five year period as follows:

- signalised intersection of Goulburn Valley Highway/Brauman Street (Pine Road extension),
- intersection of Goulburn Valley Highway/Service Road (at Balaclava Road), and
- roundabout-controlled intersection of Balaclava Road/Verney Road.

Of these locations, there was a consistent pattern of crashes at the Goulburn Valley Highway/Brauman Street intersection, where there were six 'right-through' crashes and a rear-end crash. It is recommended that VicRoads ensure that this intersection operates with fully controlled right turns at all times.

3 THE PROPOSAL

The preliminary structure plan is shown in Figure 5 below.

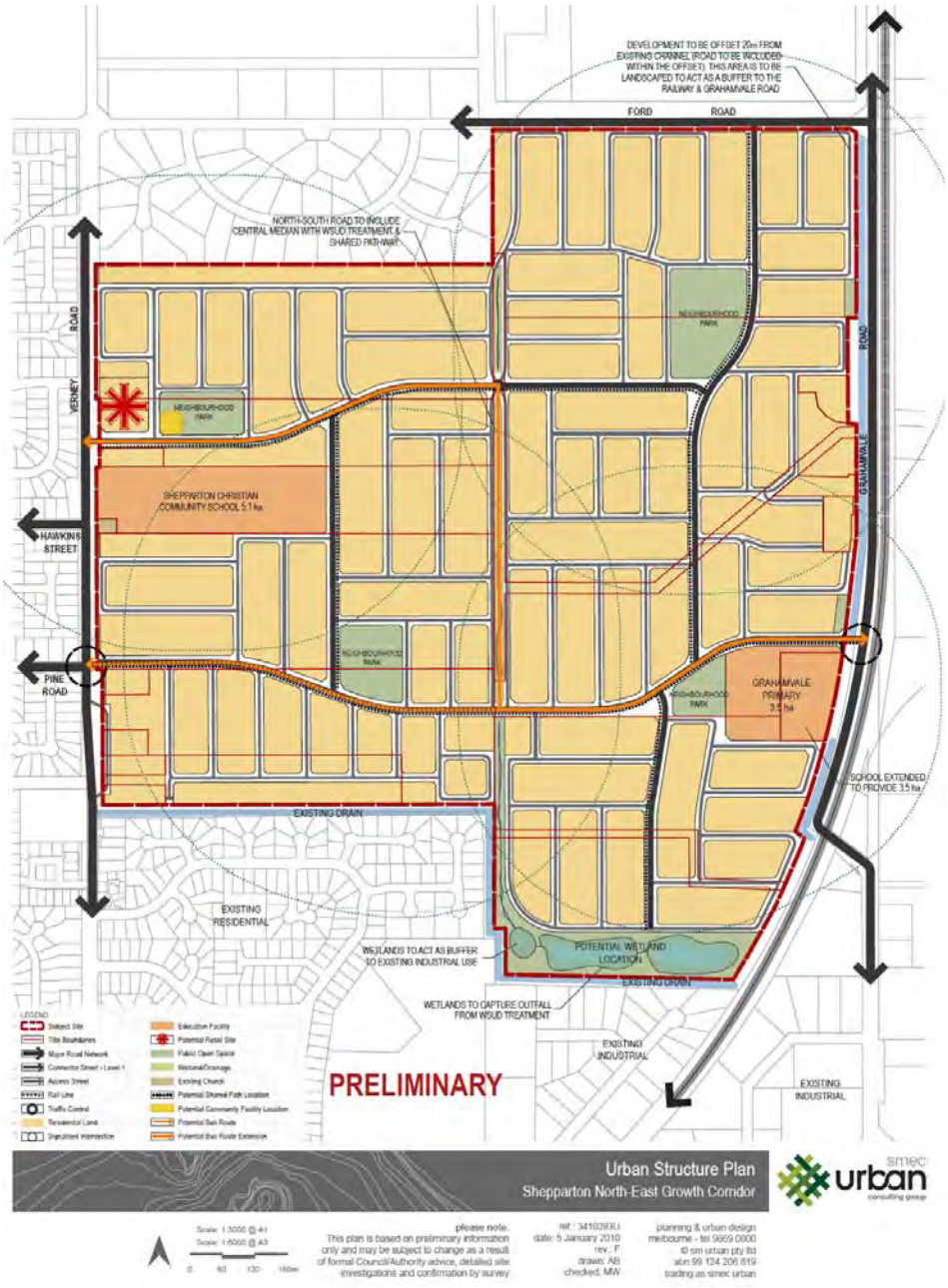

Figure 6: Preliminary Urban Structure Plan (Source: Draft PSP – page 10)

The preliminary PSP shows Verney Road, Ford Road and Grahamvale Road forming the major road network surrounding the site. Four connector road intersections are proposed, including two to Verney Road (of which one is opposite Pine Road), one to Ford Road and one to Grahamvale Road.

We understand that the future development of the area will include in the order of 1,677 residential dwellings, as well as a retail and community hub including 1,350 m^2 gross floor area (including 900 m^2 convenience supermarket). It is also proposed to expand the Grahamvale Primary School.

4 CONSIDERATION OF PSP

The draft PSP addresses transport and movement at Section 4.6. The following table provides an assessment of the proposed planning and design guidelines (as set out in Section 4.6.3 of the draft PSP).

Table 1: Consideration of Planning & Design Guidelines (Transport & Movement)

Guideline	Comment
ROAD NETWORK	
The local road network must provide permeable and safe routes for walking and cycling to activity centres, schools, community facilities and public open spaces.	The Urban Structure Plan is very prescriptive (all roads shown) and doesn't appear to really allow for developers to modify the network. If a prescriptive road network is to be shown on the Urban Structure Plan, it should already ensure that this guideline is met, without the need to repeat it here.
Dwellings should front roads, including arterial roads.	Perhaps need to be clearer, i.e. "direct property access to arterial roads is not permitted, however long sections of rear fencing will not be supported, and accordingly frontage roads will be required to ensure active frontages are provided to all streets including arterial roads".
Cul-de-sacs should be avoided and if required, must not detract from the convenient and safe pedestrian movement.	Okay, but again only necessary if the Urban Structure Plan is less prescriptive and doesn't show all of the roads.
Collector roads are to be constructed by development proponents as part of the subdivision works prior to the issue of a state of compliance for the relevant stage.	The part of the collector road (pavement and land requirement) that is over and above a local road requirement should be reimbursed by the DCP.
Staging of subdivisions is to provide for the timely connection of road links between properties and to the collector and arterial road network and the off-road pedestrian and bicycle network to the satisfaction of the responsible authority.	Staging is likely to be driven by other factors such as when individual land owners are ready to sell/develop. It is noted that land is currently zoned Farming Zone (FZ). Based on the proposed Urban Structure Plan, some properties will be land locked and may require temporary intersections until such time that adjacent land is developed. The PSP should make a comment in this regard, i.e. any temporary road connections must be removed as soon as alternative access is provided at the preferred locations shown in the structure plan. Also, it is not clear whether any consideration has been given to the existing irrigation channels (PUZ1). These appear not to be part of larger faming titles, and are separate entities (most likely owned by the water authority). There does not appear to be any incentive for

Guideline	Comment
	the water authority to construct the sections of local and connector road which pass across their land. If the PUZ1 land is required to be retained in the ultimate development scenario, it may be necessary to review the road network to minimise the number of road crossing points, and then include any crossings in the DCP.
Road reserves shall be finished (including street lighting, signs and line markings) to suit the character of the surrounding residential areas, the City of Greater Shepparton Urban Design Manual (2000) and any additional requirements imposed by City of Greater Shepparton.	Okay.
Trees planted within the road reserve shall be in accordance with the City of Greater Shepparton Street Tree Masterplan.	Okay.
Roadways should be designed to allow for cycle and pedestrian use and ensure connectivity to major destinations (e.g. educational facilities and public open spaces). Roadways should also allow for on-street parking. Where possible, cycle areas and vehicle parking should be separated.	In our experience, PSP's usually include pedestrian and cycle plans showing exactly where these facilities are required, to ensure that it is clear to developers exactly what is required. PSP's also typically show the various road cross-sections that are required, depending on traffic volumes and function of each street. In this case, only a collector road cross-section has been included (Figure 11) and it is recommended that additional diagrams generally consistent with the Infrastructure Design Manual be included.
All roads should be designed in accordance with City of Greater Shepparton requirements, VicRoads design standards and all relevant Australian Standards and laws.	This 'guideline' should be removed, or modified as follows: *"All roads should comply with City of Greater Shepparton requirements, VicRoads design standards and all relevant Australian Standards and laws unless an alternative is specified".* The 'collector road cross section shown in Figure 11 of the draft PSP is not consistent with the Infrastructure Design Manual (IDM). That's not to say that the proposed cross-section would not be appropriate, but it is not possible to meet this 'guideline' AND construct the road in accordance with Figure 11 (conflicting information).

Guideline	Comment
BUS NETWORK	
Where a bus route or bus stop has been nominated by the Director of Public Transport: - Bus stop facilities should be constructed by development proponents as part of the subdivision works (prior to the issue of a statement of compliance for the relevant stage) to a design standard approved by the Director of Public Transport, - Bus stops should be provided with DDA compliant direct and safe pedestrian access connected to an existing pedestrian/shared path, and - Be designed as an integral part of activity centres and activity centres and activity generating land uses, such as schools, sports fields and employment areas	Typically bus routes do not get approved until after the road network is complete and there is a reasonable demand for services, i.e. most dwellings are completed. Accordingly, it may be better for Council to collect an amount via a DCP for the bus stops, so that they can be installed at a later date when and where required. Otherwise, at the time of the subdivision works, there is unlikely to be any requirement for developers to pay for bus stop facilities. It is unlikely that a future public bus route would go directly past all activity centres, schools, sports fields and employment areas so it may not be appropriate to construct bus stops at these locations straight up.
Adequate clearance should be provided for potential future bus routes through the north-south and east-west major roads within the development.	Okay.
The Public Transport Guidelines for Land Use and Development (released in September 2008) should be used to guide the design of any roads that may need to provide for buses.	The requirements set out in the guidelines conflict with the 'collector road' cross-section in Figure 11. The Public Transport Guidelines should prevail.
Route and service details for buses relevant to the development should be developed with the Department of Transport to assist planning.	It is not clear who is required to do this, i.e. the developers or Council. Land ownership is fragmented. It is recommended that a 'public transport plan' be shown in the PSP to give developers a clear indication of which roads will require the appropriate design having regard to the existing route location and the requirement for 95% of dwellings to be within 800m street walking distance of a bus route, and/or require all collector roads to comply with DOT requirements, i.e. modify Figure 11. The bus route layouts for the subdivision stages should be designed early with road infrastructure and cross-sections designed to suit.

Guideline	Comment
SHARED PATHWAYS	
Continuous footpaths are to be provided for all property frontages and sidages in urban residential and commercial developments in accordance with Table 2 Urban Road/Street Characteristics, GSC Infrastructure Design Manual at Section 12.3.2.	Table 2 of the IDM indicates that for low volume access places (up to 300vpd), a footpath on one side only is appropriate, which means that there may be some frontages/sideages that don't need to have a footpath (because there will be one on the other side of the road). However, we understand that Council's Access and Inclusion requirements now require footpaths on both sides of the road in new subdivisions. It is recommended that the guideline be shortened to simply indicate that footpath provision should be in accordance with the IDM and Council's Access and Inclusion requirements.
Connective links are to be established with existing footpaths where demand is directly related to the development.	Okay.
The minimum width for shared paths is to be 2.5m and designed and constructed in accordance with the Austroads publication 'Guide to Traffic Engineering Part 14 – Bicycle Facilities.	This publication has been superseded. The relevant version is now called 'Austroads Guide to Road Design Part 6A – pedestrian and cyclist paths'.
Footpaths and cycle paths are to be provided with increased width in areas expecting high foot traffic such as in front of schools and in activity centres.	Okay.
Cycle parking facilities are to be provided by development proponents in convenient and prominent locations at key destinations such as schools, sporting facilities and activity centres.	Okay. Perhaps mention that facilities should be provided in accordance with Clause 52.34 of the Greater Shepparton Planning Scheme.
Pedestrian and cycle crossing are provided on key desire lines and in particular at the interface between residential areas and in the vicinity of bus stops.	Pedestrian crossings are major traffic control items and have to be approved by VicRoads, with warrants based on the number of pedestrians crossing and the volume of traffic that will be crossed. It is recommended that this guideline be reworded to ensure that developers construct pedestrian refuges with DDA compliant pram crossings at key desire lines, rather than formal pedestrian crossings.

5 TRAFFIC IMPACT ASSESSMENT REVIEW

5.1 Review of Assumptions

Growth Factor

Section 6.1.1 of the AECOM report states that a background traffic growth rate of 1.5% per annum has been applied to surveyed traffic movements as agreed with City of Greater Shepparton (CGS) Projects Department, and based on historical growth rate of the Verney Road area.

We note that VicRoads typically adopt a growth rate of 2 – 3% on arterial routes in urban areas. The adopted growth rate is lower than this, however it is slightly higher than the population growth rate (regional areas typically experience less growth than metropolitan suburban areas) and is considered to be appropriate in this case.

Notably, Section 2.0 of the AECOM report indicates that the population growth is approximately 800 persons per year, and the population at 2008 was 60,528 persons, which corresponds to a growth rate of approximately 1.3% per year.

Residential Traffic Generation Rate

Section 6.1.2 of the report indicates that Council's Infrastructure Design Manual (IDM) requires a traffic generation of 10 vehicle trips per lot per day, with a weekday peak hour vehicle trip generation rate of 0.9 movements per dwelling.

The AECOM assessment has further reduced this peak-hour rate to approximately 0.8 movements per dwelling (11% reduction) on the basis that all 4 to 11 year olds (comprising approximately 11% of the Shepparton population) will attend Grahamvale Primary School and will not generate external trips during the peak hours.

We note that the age range includes 8 years, whereas children only spend 7 years at primary school (most don't start till 5 years old). Also, it is likely that some would attend private/specialist schools located outside the study area and accordingly would generate a trip. Furthermore, the afternoon pick-up period for primary schools (3:00pm – 4:00pm) does not coincide with the road network peak hour (typically 5:00pm – 6:00pm) and accordingly the presence of a primary school in the study area will not necessarily reduce the PM peak traffic generation rate.

Traffix Group conducted a traffic generation survey of an area in Kialla Lakes (located a similar distance from the Shepparton CBD as the subject site) in July 2004. The study included a sample size of 312 dwellings, but did not include any schools or shops, so all traffic associated with these uses would be external.

The Kialla Lakes study identified traffic generation rate of 9.55 vehicle trip-ends per dwelling per day, of which 0.99 and 1.06 vehicle trip-ends per dwelling occurred in the AM and PM peak hours respectively.

While the daily traffic generation rate is consistent with Council's IDM, the peak hour traffic generation rates surveyed at Kialla Lakes were higher.

We note that the RTA Guide to Traffic Generating Developments (RTA Guide) (2002) sets out traffic generation rates for a range of developments, based on survey data

collected in New South Wales, and is generally regarded as a standard for metropolitan development characteristics.

The RTA Guide sets out a rate of 9 trips per dwelling per day, with 0.85 vehicle trip-ends per dwelling occurring during the peak hours. However the RTA Guide also states the following:

> *With new subdivisions, where standard lots are given, some additional allowance may be made for dual occupancy and group homes, where there are sufficient numbers of these types of residences.*
>
> *The Australian Model Code for Residential Development (AMCORD) assumes a daily vehicle generation rate of 10.0 per dwelling, with 10% of that taking place in the commuter peak period. The use of these figures provides some allowance for later dual occupancy development.*
>
> *Note that not all trips are external trips. As a guide, about 25% of trips are internal to the subdivision, involving local shopping, schools and local social visits. When reviewing the impact of the traffic generated on sub-regional and regional roads, some adjustment is necessary, depending on the location of shops, schools and recreational facilities.*

In the case of the Kialla Lakes study, the sample area was not large enough to include a proportion of internal trips (it was a walkable catchment). However, the proposed development includes internal schools, parks and a retail component as well as the likelihood for facilities such as a preschool, childcare and maternal and child health services within a community hub. Accordingly, up to 25% of the trips could be internal to the study area and should not be counted on the external network.

If the Kialla Lakes surveyed traffic generation rates are reduced by 25% to account for these internal trips, the external traffic generation rate would be in the order of 7.16 vehicle trip-ends per dwelling per day, of which 0.74 and 0.80 vehicle trip-ends per dwelling are likely to occur in the AM and PM peak hours respectively.

We note that the daily trip generation rate of 10 vehicle trip-ends per dwelling per day adopted in the AECOM report is likely to be too high, however the peak hour rate of 0.8 vehicle trip-ends per dwelling is generally consistent with the Kialla Lakes survey when taking into account a proportion of internal trips within the subdivision due to the large size and inclusion of school, retail, community and recreational facilities.

When considering the external impacts of the development, we believe that a rate of 8 vehicle trip-ends per dwelling per day should be adopted, with 10% occurring during the AM and PM road network peak hours.

Residential Traffic Distribution

The AECOM report indicates (at section 6.1.2) that the following distribution profile has been adopted:

- AM Peak Hour: 10% of trips entering the estate and 90% exiting.
- PM Peak Hour: 70% of trips entering the estate and 30% exiting.

While the rate adopted for the PM peak is generally consistent with our experience (65 – 70% entering), the AM peak hour appears to be too directional. In our experience, a rate of approximately 20% entering and 80% exiting occurs during the AM peak hour.

We note that the Kialla Lakes survey showed the following traffic distribution rates:

- AM Peak Hour: 18% of trips entering the estate and 82% exiting.
- PM Peak Hour: 68% of trips entering the estate and 32% exiting.

We believe that the AM peak hour distribution (in/out proportion) should be revised and re-tested. This has been undertaken, and is addressed in later sections of this report.

Retail Traffic Generation Rate

Section 6.1.4 of the AECOM report refers to the RTA Guide rates for retail developments as follows:

- Daily traffic generation rate: 121 vehicle trip-ends per 100 m^2 of GFA
- Peak hour traffic generation rate: 12.5 vehicle trip-ends per 100 m^2 of GFA

While these rates may be appropriate for retail developments in metropolitan areas, in our experience, developments in regional areas typically generate lesser traffic demands.

For example, a traffic generation survey of the Safeway Supermarket in Wonthaggi undertaken by Traffix Group in March 2009 revealed a PM peak hour traffic generation rate of 7.5 vehicle trip-ends per 100 m^2 of GFA (40% less than the RTA rate), with the peak hour occurring at 3:45pm to 4:45pm, i.e. not coinciding with the road network peak hour. During the road network peak hour (5:00pm to 6:00pm), the traffic generation rate was only 5.6 vehicle trip-ends per 100 m^2 of GFA, which is less than half the rate adopted by AECOM.

We note that the AECOM report has assumed that only 10% of the traffic attracted to the retail site will originate from traffic outside the development, with the remainder already counted (internal trips generated by the residential component).

The proposed retail component is located adjacent to Verney Road and accordingly a higher proportion of external traffic (say 20%) may be more likely.

The over-estimation of overall traffic generated by the use and the under-estimation of traffic generated externally to the study area are likely to cancel each other out, and the overall number of trips generated by the retail component adopted as being external (164 movements per day with 17 movements in the peak hours) is considered to be an appropriate assumption.

Grahamvale Primary School

We agree that any reduction in existing trips to Grahamvale Primary School should not be included in the analysis as it is not possible to predict whether or not the current pattern of enrolments from areas external to the study area will change.

However the impact of these trips is already on the surrounding road network and should not be re-counted. The AECOM analysis assumes that when the school is redeveloped, a new entry will be provided via the internal road. Grahamvale Road is a Road Zone Category 1 which is not ideal for accessing a primary school. In a green-field site, the education department would seek a site which has at least one local road frontage, and VicRoads would require that access be via a local road in preference to an arterial road if the option is available. Accordingly, we agree that it is appropriate to assume that the school access will be shifted to the internal road network when it is re-developed.

We are also satisfied that the assumptions in relation to the overall externally generated school traffic are appropriate. We note that the analysis assumes that 100% of students will be driven to school, which is appropriate for the external component having regard to the school's location. Some of the students generated internally within the development area are likely to walk or cycle.

Traffic Generation Summary

The following table summarises the anticipated external traffic based on the preceding comments. Notably, the retail and school components remain the same as adopted in the AECOM analysis, however the external component of the residential use has been reviewed (8 vehicle trip-ends per dwelling per day with 10% in the peak hour, and in/out split as per the Kialla Lakes survey).

Table 2: External Traffic Generation Summary

Land Use	Daily Trip Generation	Peak Hour Trip Generation	AM Peak		PM Peak	
			IN	OUT	IN	OUT
Residential	13,416	1,342	242	1,100	913	429
Retail	164	17	9	8	8	9
Primary School	476	238	137	101	101	137
TOTAL	14,056	1,597	388	1,209	1,022	575

Traffic Distribution

Section 6.2 of the AECOM report indicates that the traffic distribution (10% to the north, 10% to the east, 60% to the south and 20% to the west) is based on an assessment of the local attractions, employment, schools, etc, and has been agreed with the CGS Engineering Department.

We agree that the adopted distribution is appropriate having regard to the locality of the site.

Figure 6.1 of the AECOM report further distributes the traffic onto the surrounding road network, and is reproduced below:

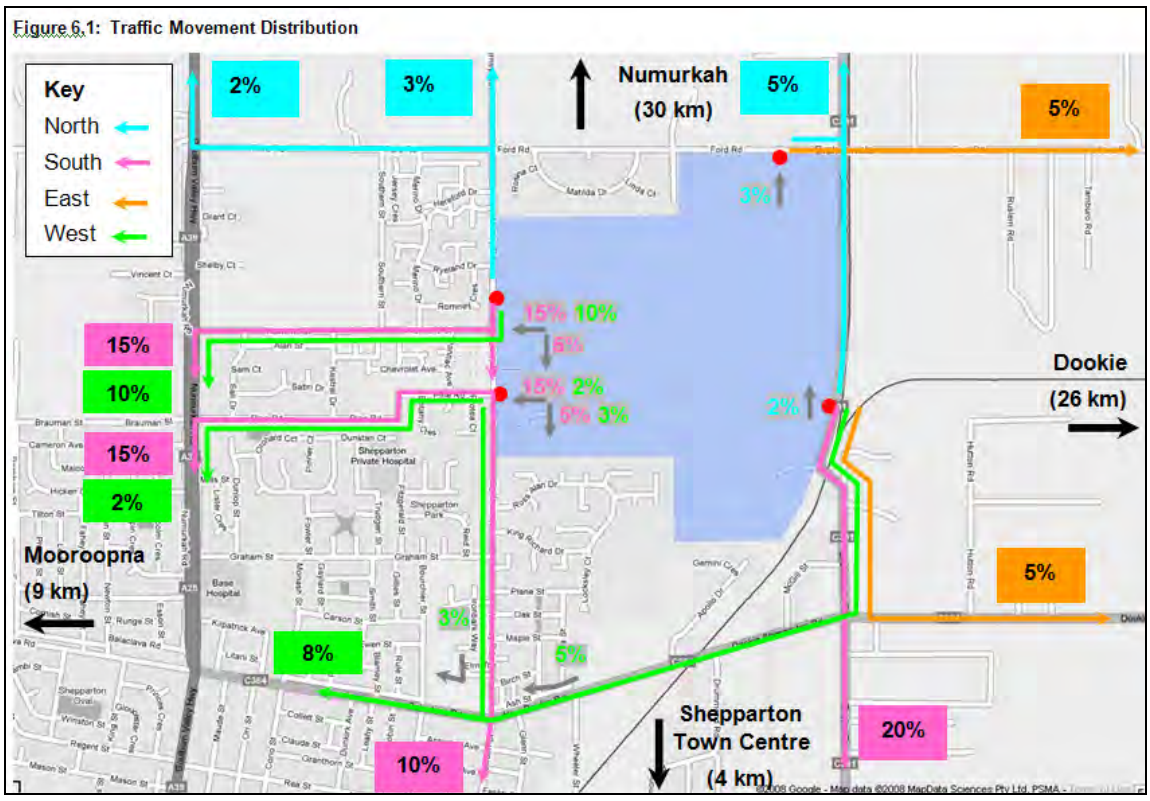

Figure 7: Traffic Distribution Assumptions – AECOM

The northbound and eastbound traffic distribution assumptions are considered to be appropriate.

However, we note that AECOM has distributed 40% of the westbound traffic to exit the development at the eastern access point. Having regard to the internal connectivity of the proposed road network, we believe that more of the westbound traffic will exit to Verney Road, and less to Grahamvale Road.

Also, 50% of the southbound traffic is shown to access Goulburn Valley Highway via either Hawkins Street or Pine Road (half via each route). Vehicles accessing Hawkins Street are required to turn right at an uncontrolled intersection (Verney Road/Hawkins Street intersection) and travel through a residential area. We would expect that the split would be skewed more to Pine Road, given that a controlled cross-intersection is proposed at that location. Some Hawkins Street traffic will also only travel as far as the neighbourhood centre (at the northeast corner of the Hawkins Street/Goulburn Valley Highway intersection) and not turn right into Goulburn Valley Highway.

A diagram with recommended revised splits is shown below.

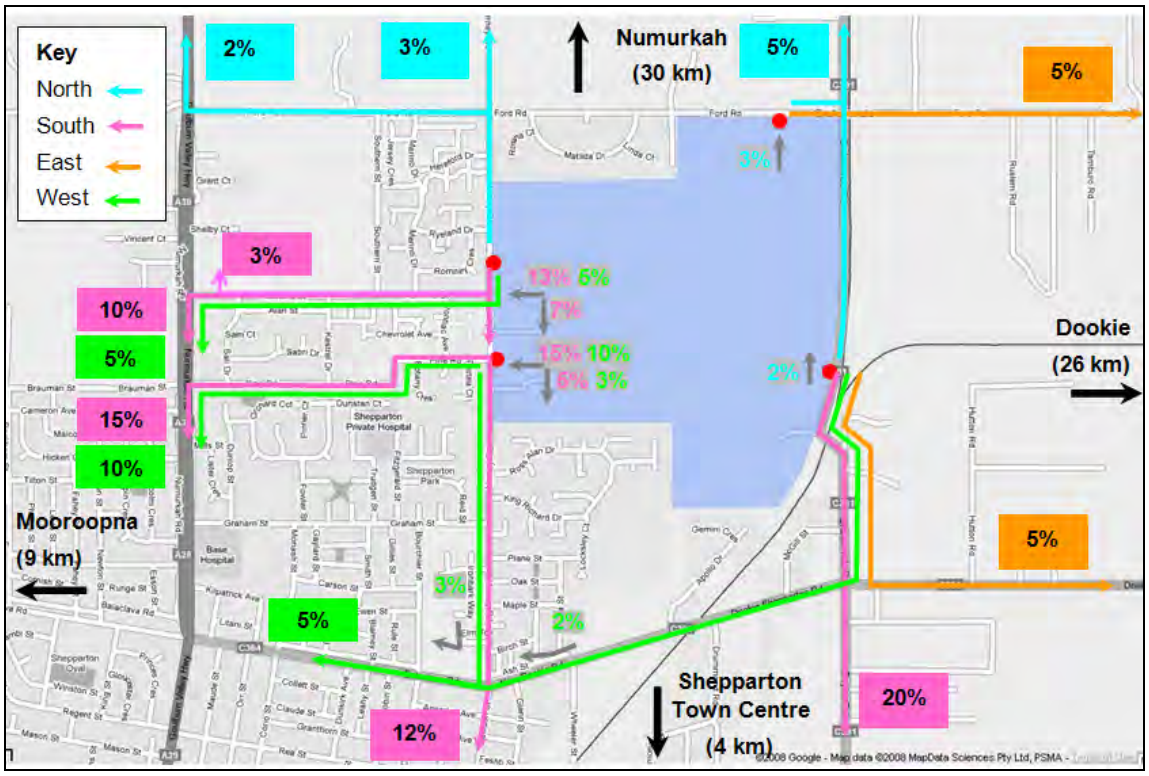

Figure 8: Recommended Modified Traffic Distribution Assumptions

The following diagram shows the additional traffic on the surrounding road network based on the distribution assumptions shown in Figure 8 and adopting a total peak-hour traffic generation of 1,597 vehicles per hour and a total daily traffic generation (on the external road network) of 14,056 vehicles per day.

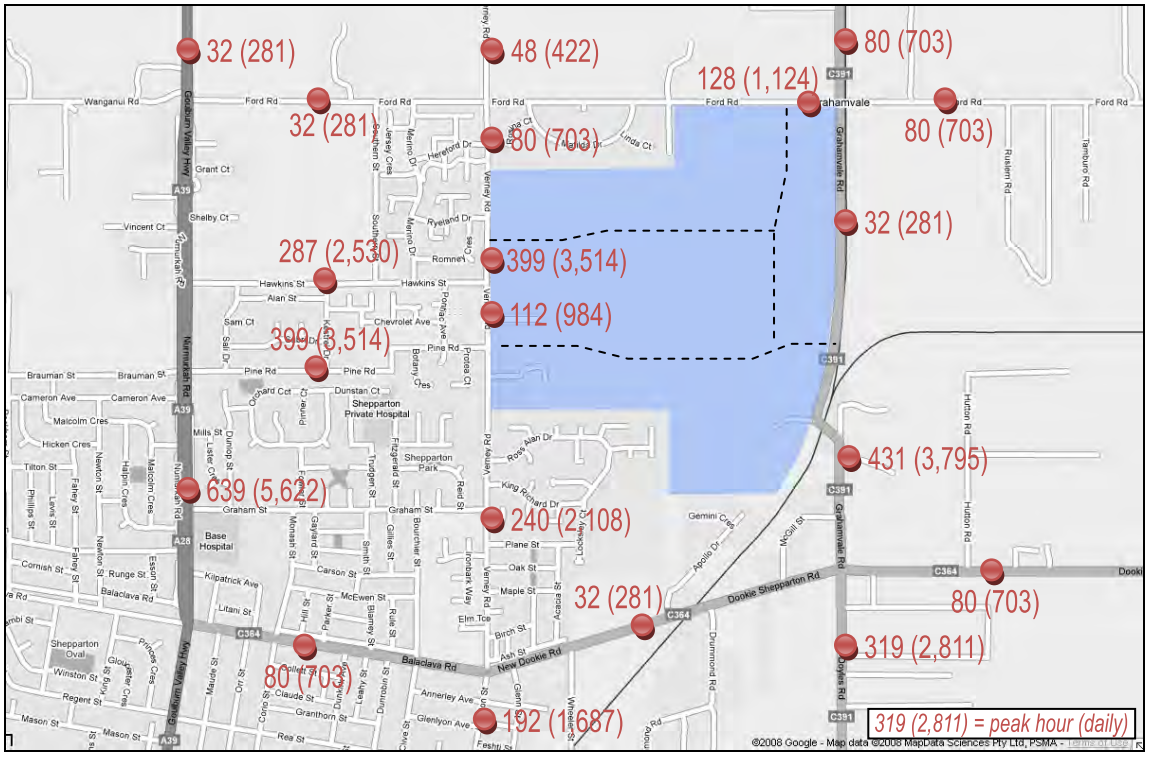

Figure 9: Additional (Site-Generated) Traffic on the Surrounding Road Network

Based on the traffic volumes shown in Figure 9 above, there is not likely to be any need for the Ford Road connection to be classified as (or designed as) as collector road.

Figure 10 below shows the recommended road layout which should be included in the PSP. While a more detailed local road network has been prepared by Smec Urban (which shows that a workable local road network can be achieved), it is recommended that the level of detail shown in the PSP be reduced.

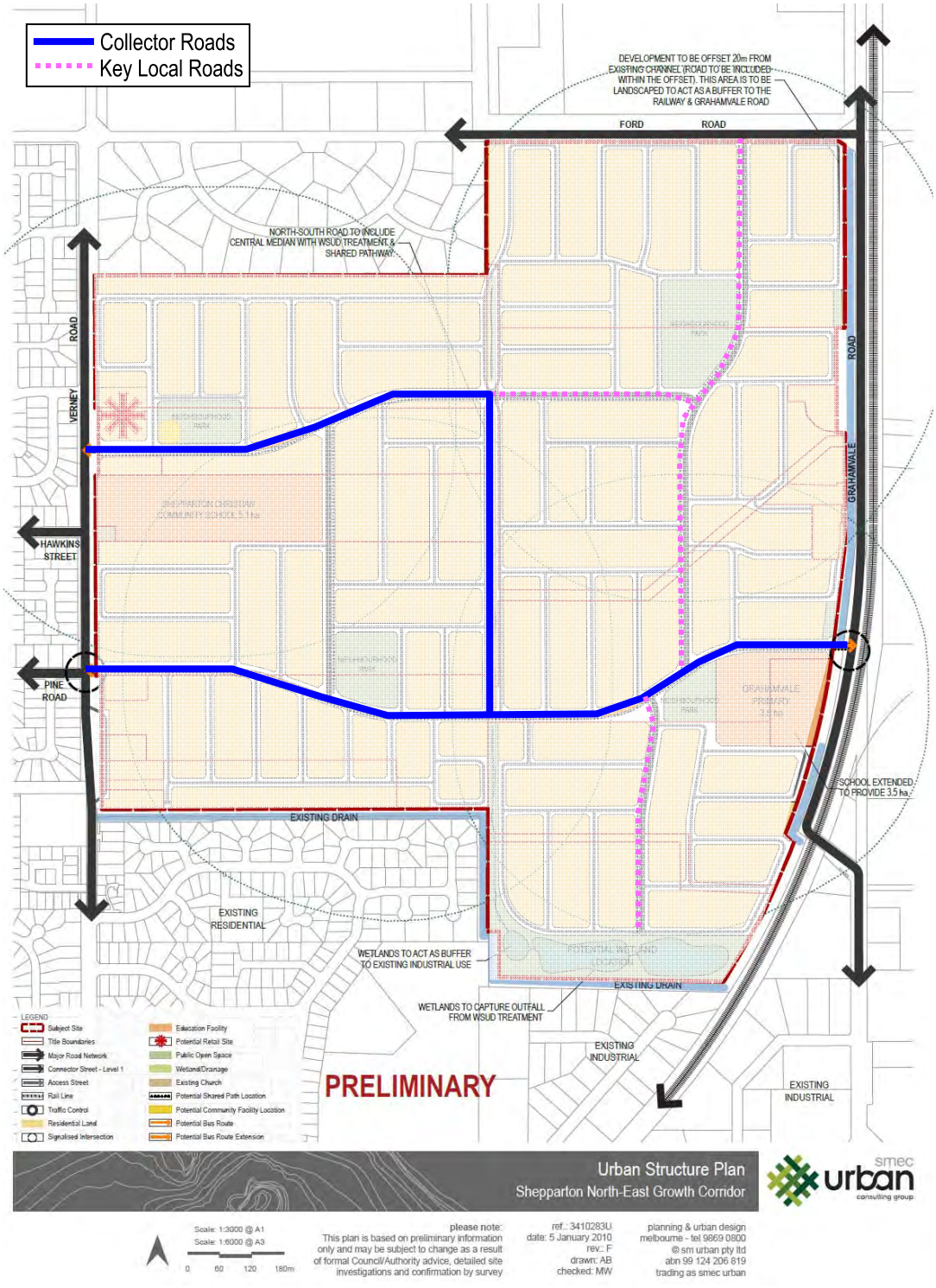

Figure 10: Recommended Road Network for PSP

5.2 Traffic Impacts – Daily Volumes

The impact on two-way daily traffic volumes on various streets surrounding the NEGC development area are set out in Table 3 below, assuming full build out.

Table 3: Impacts of Site-Generated Traffic

Street	Location of Count	2010 Daily Volume*	Site Traffic	Future Total	Increase
Verney Road	North of Balaclava Road	8,304	2,108	10,412	25.4%
Hawdon Street	South of Balaclava Road	7,758	1,687	9,444	21.7%
Balaclava Road	West of Verney Road	6,686	703	7,389	10.5%
New Dookie Road	East of Verney Road	8,159	281	8,441	3.4%
Grahamvale Road	North of New Dookie Road	5,831	3,795	9,626	65.1%
Grahamvale Road	South of Ford Road	3,080	281	3,361	9.1%
Grahamvale Road	North of Ford Road	4,008	703	4,710	17.5%
Ford Road	East of Grahamvale Road	1,947	703	2,650	36.1%
Ford Road	West of Grahamvale Road	1,185	1,124	2,309	94.9%
Hawkins Street	West of Verney Road	1,888	2,530	4,418	134.0%
Pine Road	West of Verney Road	2,538	3,514	6,052	138.5%
Verney Road	North of Hawkins Street	5,786	2,530	8,316	43.7%
Verney Road	South of Hawkins Street	6,029	984	7,013	16.3%
Hawkins Street	East of Southern Street	2,840	2,530	5,370	89.1%
Verney Road	North of Ryeland Drive	4,014	703	4,717	17.5%
Ford Road	West of Verney Road	2,405	281	2,687	11.7%
Goulburn Valley Hwy	South of Pine Road	13,846	5,622	15,955	15.2%

** Growth rate of 1.5% per year from year of count to 2010. Where peak-hour traffic counts have been provided, a peak-to-daily ratio of 10% has been adopted.*

The following is noted from Table 3:

- All roads nearby to the site which are impacted by the development (with the exception of Goulburn Valley Highway) will have a future volume (following full build out of the NEGC) of less than 15,000 vehicles per day, and accordingly will not require duplication.
- Goulburn Valley Highway will have a two-way daily volume greater than 15,000 vehicles per day, and is already duplicated.
- Traffic in Verney Road will be in the order of 10,412 vehicles per day. While a single traffic lane each way is generally appropriate for this level of traffic, protected turn lanes will be required at intersections to minimise delays to through traffic.

- Traffic in Hawkins Street may double due to the development. However the future volume (in the order of 5,370 vpd) is still within acceptable limits for a collector road (up to 7,000 vpd).

- Traffic in Pine Road will more than double due to the development, but will remain within acceptable limits for a collector road.

5.3 Verney Road/Site Access Intersection

Based on the preceding assessments and assumptions, the revised future AM and PM peak hour turning movements have been determined for the year 2020. The existing volumes have been factored up by 1.5% per year, and the development traffic has been added. For the Hawkins Street and Pine Road intersections, no PM peak hour traffic count data has been collected by AECOM and accordingly the AM movements have been "reversed" for those intersections to estimate PM peak turning movements. A table showing the future peak hour turning volumes at each of the Verney Road intersections is attached at Appendix A.

The Verney Road/Site Access T-intersection has been tested during the AM and PM peak hours, using the SIDRA intersection analysis program.

The key outputs of SIDRA are Degree of Saturation (DOS), Average Delay and 95th Percentile Queue. For unsignalised intersections, a DOS of up to 0.80 is considered to be good operating conditions. For signalised intersections, a DOS of up to 0.90 is considered to be good, with a DOS of up to 0.95 being within acceptable limits. Beyond 1.00, queues and delays increase disproportionately.

The SIDRA results are summarised in the following table. Full results are attached at Appendix B.

Table 4: SIDRA Output – Verney Road/Site Access, Ultimate Volumes (2020)

Approach	DOS		Average Delay		95th %ile Queue	
	AM	PM	AM	PM	AM	PM
Verney Road (S)	0.145	0.257	3.0 s	3.9 s	4 m	11 m
Site Access (E)	0.532	0.225	14.6 s	11.1 s	31 m	8 m
Verney Road (N)	0.237	0.164	0.2 s	0.9 s	0 m	0 m

Table 4 indicates that the future (unsignalised) T-intersection of Verney Road/Northern Site Access Road will operate well within acceptable limits with minimal queues and delays on all approaches.

We note that the layout adopted in SIDRA for the above analysis is different to the layout adopted by AECOM.

The two variations are shown in Figures 11 and 12 below.

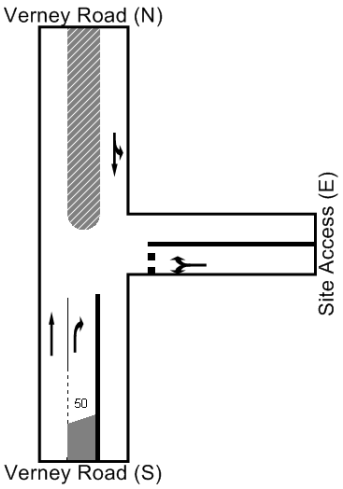

Figure 11: Recommended Layout

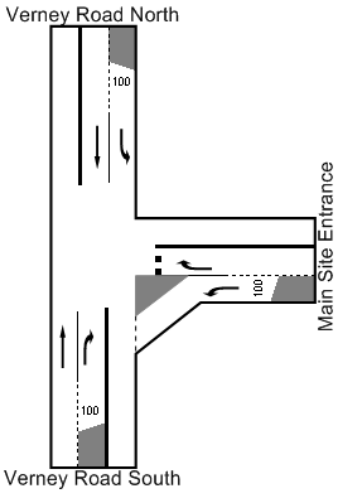

Figure 12: Layout Adopted by AECOM

The layout shown in Figure 11 is consistent with the treatment at existing intersections to the south, i.e. no left-turn lane in from the north. Traffic volumes entering from the north are very minimal, and a left-turn lane isn't necessary from a capacity perspective, as shown by the SIDRA results. Similarly, the number of vehicles turning right out of the development heading northbound is also very low, and separate right and left turn lanes out of the site are unnecessary from a traffic capacity perspective. In practise though, providing separate turn lanes will retain flexibility to upgrade/signalise the intersection in the future if required. Something between the two options shown above is recommended, with a shorter left turn lane from the north in accordance with the requirements for a 70km/h speed limit, and separate left/right lanes exiting (short left-turn lane, say 30 metres storage plus 30 metre taper, but not a slip lane).

It should be noted that Council has indicated that Verney Road must have protected right turn lanes. The Council has recently prepared a concept layout for Verney Road. The proposed cross-section of Verney Road north of Drain No.3 is one northbound lane, one southbound land and a central median which can cater for right turn lanes at intersections.

5.4 Verney Road/Site Access Intersection – Potential Relocation

Council has advised that their current position is that the Verney Road/Site Access intersection should be located further to the north to become a cross-intersection/continuation with Ryeland Drive.

This will impact upon the adopted traffic distributions, as some vehicles which were previously assumed to turn left out of the development area and then right into Hawkins Street would be likely to instead head straight across Verney Road into Ryeland Drive and then south onto Merino Drive to access Hawkins Street. The occurrence of this (and impact on Ryeland Drive and Merino Drive) is likely to be minimal though, because vehicles would need to negotiate two roundabouts (at Ryeland Drive/Merino Drive and at Merino Drive/Romney Crescent) and may experience further delays turning right into Hawkins Street.

We note that if the east-west site access road is located further to the north opposite Ryeland Drive, regardless of whether development traffic warrants intersection control, we would recommend it anyway when creating a new cross-intersection with two higher order (collector/local arterial) roads. Either traffic signals or a roundabout would operate satisfactorily.

5.5 Verney Road/Hawkins Street Intersection

The Verney Road/Hawkins Street T-intersection has been tested during the AM and PM peak hours, using the SIDRA intersection analysis program. The SIDRA results are summarised in the following table. Full results are attached at Appendix B.

Table 5: SIDRA Output – Verney Road/Hawkins Street, Ultimate Volumes (2020)

Approach	DOS		Average Delay		95th %ile Queue	
	AM	PM	AM	PM	AM	PM
Verney Road (S)	0.134	0.242	1.6 s	1.1 s	0 m	0 m
Verney Road (N)	0.266	0.192	3.8 s	4.3 s	11 m	7 m
Hawkins Street (W)	0.346	0.501	14.4 s	15.3 s	15 m	27 m

Table 5 indicates that the existing (unsignalised) T-intersection of Verney Road/Hawkins Street will continue to operate well within acceptable limits with minimal queues and delays on all approaches. The existing storage lanes are adequate and no mitigating works are required at this intersection as a result of the NEGC development.

It is noted that the AECOM assessment indicates that there will be 'excessive' delays of up to a minute for vehicles turning right from Hawkins Street, but that additional gaps will be created by the proposed signals at Pine Road.

As indicated in Section 5.5 below, we do not believe that signals should be provided at Pine Road. However, our SIDRA analysis indicates that vehicles can easily turn right out of Hawkins Street with delays of only 14 – 15 seconds during both the AM and PM peak hours, which is well within acceptable limits. The likely reason for the difference in our assessment compared with AECOM's is the assumed split of traffic entering and exiting (AECOM assumed 90% exiting during the AM peak which is higher than what we would normally expect) and also we have routed more traffic to Pine Road and less to Hawkins Street, having regard to the internal road layout and ease of access at Pine Road.

We are satisfied that no mitigating works are required at the Verney Road/Hawkins Street intersection to accommodate the NEGC development traffic.

5.6 Verney Road/Pine Road Intersection

The AECOM report proposes signals at the Verney Road/Pine Road cross-intersection (with the fourth leg created to provide access into the NECG development area), because the intersection doesn't operate satisfactorily without control.

Regardless of whether development traffic warrants intersection control, we would recommend it anyway when creating a cross-intersection with two higher order (collector/local arterial) roads.

However, the AECOM report only tests signals and doesn't consider the possibility of a roundabout. In this case, signals are not consistent with the nearby intersection treatments. There is a roundabout on Verney Road at Ford Road to the north and another large roundabout on Verney Road at Balaclava Road/New Dookie Road to the south, and we believe that a roundabout may be an appropriate treatment at the Verney Road/Pine Road intersection.

The Verney Road/Pine Road cross intersection (roundabout control) has been tested during the AM and PM peak hours, using the SIDRA intersection analysis program. The SIDRA results are summarised in the following table. Full results are attached at Appendix B.

Table 6: SIDRA Output – Verney Road/Pine Road Roundabout, Ultimate Volumes (2020)

Approach	DOS		Average Delay		95th %ile Queue	
	AM	PM	AM	PM	AM	PM
Verney Road (S)	0.444	0.617	9.3 s	8.7 s	30 m	54 m
Site Access (E)	0.525	0.191	15.6 s	10.2 s	39 m	10 m
Verney Road (N)	0.546	0.387	9.3 s	10.0 s	39 m	24 m
Pine Road (W)	0.269	0.457	11.9 s	14.2 s	15 m	31 m

Table 6 indicates that the intersection of Verney Road/Pine Road will operate well within acceptable limits with minimal queues and delays on all approaches as a roundabout. We note however that signals have the benefit of creating gaps in the traffic flow which would aid vehicles accessing nearby uncontrolled intersections on Verney Road and also provide a safe location for pedestrians to cross. Accordingly, Council will need to decide which treatment will be suitable, given that both options work from a traffic engineering perspective. We understand that Council prefer a signalised intersection treatment over a roundabout treatment.

5.7 Verney Road/New Dookie Road Intersection

The Verney Road/New Dookie Road roundabout-controlled intersection has been tested during the AM and PM peak hours, using the SIDRA intersection analysis program.

The SIDRA results are summarised in the following table. Full results are attached at Appendix B.

Table 7: SIDRA Output – Verney Road/Hawkins Street, Ultimate Volumes (2020)

Approach	DOS		Average Delay		95th %ile Queue	
	AM	PM	AM	PM	AM	PM
Hawdon Street (S)	0.514	0.798	12.0 s	19.1 s	38 m	100m
New Dookie Road	0.804	0.691	25.3 s	15.3 s	98 m	69 m
Verney Road (N)	0.874	0.493	21.7 s	9.4 s	144 m	34 m
Balaclava Road (W)	0.492	0.619	11.1 s	18.1 s	34 m	55 m

Table 7 indicates that despite adopting different traffic splits to AECOM, our SIDRA results are similar. We agree with AECOM's conclusion that the roundabout will operate within acceptable limits, albeit under congested conditions during the AM peak hour. This is likely to be largely due to the school located on the northwest corner of the intersection, as the school drop-off period in the morning coincides with the road network peak hour. It is not uncommon to experience congested conditions around schools during the peak drop-off and pick-up times.

No mitigating works are required at this intersection as a result of the NEGC development.

5.8 Hawkins Street/Goulburn Valley Highway Intersection

Section 4.1 of the AECOM report states:

> *The impact of the proposed development on the operation of the Hawkins Street/Goulbourn Valley Highway intersection has been investigated. In 2005 CGS conducted surveys of the intersection to determine whether signalisation was warranted in line with VicRoads requirements. The investigation concluded that signalisation was not warranted, but the intersection was flagged as a potential future location suitable for signalisation. Discussions with CGS suggested that the implementation of singles at this location will be required in the near future to improve existing operational and safety considerations.*
>
> *Historical traffic growth along Goulburn Valley Highway in this area has averaged 1.0% per annum. Therefore, a grown factor of 1.0% per annum has been applied to the traffic movement flows recorded in 2005 and the Hawkins Street/Goulbourn Valley Highway intersection has been modelled using SIDRA to provide an estimation of current (2008) operation.*

We note that the AECOM report is dated 17th December, 2009, and accordingly factoring up to 2008 volumes is not 'current'. The count undertaken by CGS is now five years old.

Also, Traffix Group have been previously retained by Greater Shepparton City Council in April 2009 (8 months prior to the release of the AECOM draft report) to undertake a peer review of the Traffic Impact Assessment for the proposed neighbourhood centre located at 177-193 Numurkah Road, Shepparton, prepared by John Piper Traffic Pty Ltd (JPT) dated June, 2008.

The review identified that as a result of the proposed increase in floor space at the retail centre, signalisation of the Hawkins Street/Goulburn Valley Highway intersection would be required. The JPT report also concluded the following:

> *The operation of the Hawkins Street intersection with the highway is unable to cater for the anticipated traffic generation form the development under current control and will require the installation of traffic signals. Phasing of these signals will need to incorporate a separate turn phase to accommodate the heavy right turn demand into Hawkins Street from the south (and permit a bonus left turn exit movement from Hawkins Street);*

The AECOM report provides a SIDRA analysis of the Hawkins Street/Goulburn Valley Highway intersection under signalised conditions, however it adopts a two-phase model. It is recommended that right turns on Goulburn Valley Highway be fully controlled, having regard to the existing crash history at nearby signalised intersections on Goulburn Valley Highway.

We note that the need/demand for traffic signals at the Hawkins Street/Goulburn Valley Highway intersection is generated by the presence of the retail centre (which is proposed to be expanded).

Accordingly, signalisation of the Hawkins Street/Goulburn Valley Highway intersection should not be included in the Development Contribution Plan (DCP) for the North East Growth Corridor Area. We note that the infrastructure item is not currently included in Table 15 of the PSP, and we support that position.

5.9 Grahamvale Road/Ford Road Intersection

The Grahamvale Road/Ford Road intersection has been tested during the AM and PM peak hours under both the existing conditions and ultimate development scenarios, using the SIDRA intersection analysis program.

The SIDRA results are summarised in Table 8. Full results are attached at Appendix B.

Table 8: SIDRA Output – Grahamvale Road/Ford Road, Ultimate Volumes (2020)

Approach	DOS		Average Delay		95th %ile Queue	
	Existing	Future	Existing	Future	Existing	Future
AM Peak Hour						
Grahamvale Rd (S)	0.078	0.092	1.0 s	0.9 s	4.1 m	5.0 m
Ford Road (E)	0.075	0.102	9.6 s	10.1 s	2.4 m	3.4 m
Grahamvale Rd (N)	0.090	0.102	4.5 s	4.8 s	4.4 m	5.0 m
Ford Road (W)	0.060	0.186	9.0 s	9.2 s	1.9 m	6.6 m
PM Peak Hour						
Grahamvale Rd (S)	0.063	0.069	2.4 s	2.4 s	3.5 m	3.9 m
Ford Road (E)	0.123	0.209	9.9 s	10.3 s	4.1 m	7.3 m
Grahamvale Rd (N)	0.133	0.172	2.7 s	3.3 s	7.3 m	9.5 m
Ford Road (W)	0.051	0.106	9.1 s	9.5 s	1.6 m	3.5 m

Table 8 indicates that the Grahamvale Road/Ford Road intersection will continue to operate well within acceptable limits with minimal increases to queues and delays as a result of the proposed development of the Shepparton North East growth area.

The AECOM traffic report concludes that … *'the Grahamvale Road/Ford Road intersection has plenty of capacity, even with the additional movements forecast by the development'*. Our analysis is consistent with this conclusion.

The intersection is effectively a four-way cross-intersection (not controlled by a roundabout or signals), with priority given to the major north-south traffic route. The east-west route is staggered slightly, which makes it obvious to approaching traffic to stop. We note that VicRoads' Crashstats database indicates that only one casualty crash has occurred at the Grahamvale Road/Ford Road intersection in the last five years of available data (January 2005 – December 2009), and accordingly there is no safety record to suggest that any works are required at this intersection.

Furthermore, the completion of the Shepparton Bypass will have a net benefit on the operation of Grahamvale Road and all of the intersections along it by reducing through traffic (and particularly heavy vehicle traffic), and accordingly in the ultimate scenario the Grahamvale Road/Ford Road intersection is anticipated to operate better than shown in Table 8. At any rate, Table 8 shows that the Grahamvale Road/Ford Road intersection can easily accommodate the full development of the Shepparton North East growth area without the need for any mitigating works, even if the Shepparton Bypass is not constructed.

While we would normally recommend that four-way cross-intersections between two higher order (collector/arterial) roads should be controlled (either by a roundabout or signals) regardless of whether development traffic warrants intersection control, we note that in this case the east-west roads will ultimately carry traffic volumes consistent with local access streets, not collector roads. Also, it is an existing cross-intersection, not a new one created as a result of the development, and the development traffic has only minor impacts on the operation of the intersection, with queues and delays still well within acceptable limits.

Accordingly, if it is determined that control should be provided at this location, it would be the same regardless of whether or not the Shepparton North East growth corridor were developed and accordingly any works should not be funded by the Shepparton North East growth corridor DCP.

5.10 Grahamvale Road/School Intersection

The Grahamvale Road/School Road intersection has been tested during the AM and PM peak hours under the existing and ultimate development scenarios, using the SIDRA intersection analysis program.

The SIDRA results are summarised in Table 9. Full results are attached at Appendix B.

Table 9: SIDRA Output – Grahamvale Road/School Road, Ultimate Volumes (2020)

Approach	DOS		Average Delay		95th %ile Queue	
	Existing	Future	Existing	Future	Existing	Future
AM Peak Hour						
Grahamvale Rd (S)	0.169	0.410	1.9 s	6.1 s	0.0 m	31.1 m
Grahamvale Rd (N)	0.138	0.417	0.2 s	10.9 s	0.2 m	27.2 m
School Road (W)	0.790	0.673	21.5 s	15.2 s	71.1 m	61.3 m
PM Peak Hour						
Grahamvale Rd (S)	0.194	0.662	3.9 s	6.5 s	0.0 m	68.3 m
Grahamvale Rd (N)	0.156	0.347	0.8 s	8.3 s	1.1 m	20.4 m
School Road (W)	0.430	0.360	17.6 s	13.3 s	18.3 m	20.5 m

Table 9 indicates that the existing school access point is nearing capacity and there is little scope to accommodate additional (development) traffic at this location without undertaking mitigating works.

Under the existing layout, the intersection cannot accommodate the full future development scenario. The DOS increases to 1.335 and 0.940 in the AM and PM peak hour respectively, with the school access road being the critical approach.

The 'existing conditions' turning volumes have been assumed to be consistent with the volumes shown in the appendix of the AECOM report.

The additional (site-generated) traffic has been distributed 50% in/50% out in the AM peak hour to account for staff and students accessing the school as well as residents exiting the new development area at this location. During the PM peak hour, the distribution has been assumed to be the same proportions as for all the other

intersections, noting that the school finish time does not coincide with the traditional road network peak hour.

The SIDRA results displayed in Table 9 above adopt a 'roundabout' configuration with a single approach lane on all three legs. This is consistent with the existing Grahamvale Road/New Dookie Road intersection to the south, and we understand that it is Council's preference for this intersection to be controlled by a roundabout rather than signals.

Table 9 indicates that a roundabout controlled intersection at the school access road intersection with Grahamvale Road will operate within acceptable limits following full development of the site.

We note that a roundabout will increase delays to through traffic on Grahamvale Road. However, once the Shepparton Bypass is constructed, the through traffic carrying function of Grahamvale Road will be significantly downgraded, and accordingly we do not see this as being a significant concern.

The roundabout will facilitate the significant right-turn movement out of the development area.

It should be noted that VicRoads is likely to prefer a signalised intersection due to the ability of signals to accommodate pedestrians, however we do not expect any significant pedestrian crossing movements at this location given the rural uses on the east side of Grahamvale Road, and note that any school crossing is likely to be located within the Shepparton North East development area to the west of Grahamvale Road away from the intersection.

5.11 Car Parking Provision Rates

The AECOM traffic report refers (at Section 5.2) to the revised draft Clause 52.06 parking rates recommended by the Advisory Committee appointed by the Minister for Planning.

While these rates have not yet been formally adopted into the Planning Scheme, we agree that significant weight should be given to the rates at such time that a permit application is received for the development of the retail area.

We note that the revised (draft) rates include separate provisions depending on whether or not the development is located within an activity centre. We consider that the proposed retail floor space (1,350 m^2 in total including a 900 m^2 convenience supermarket) is not significant enough to warrant classification as an activity centre (a full line supermarket is typically in the order of 3,500 m^2) where on-street parking is also available as part of the total supply and accordingly the "standard" rates set out in the revised draft Clause 52.06 would be appropriate in this case.

5.12 Public Transport Considerations

The Planning Scheme requires that 95% of dwellings be within 800 metres walking distance of an existing or proposed bus stop. It should be noted that the Department of Transport guidelines is that it is desirable that residents should have access to a bus service within 400 metres walking distance.

The following diagram shows a potential bus route and bus stop locations, having consideration for these requirements, and also of the proposed internal road layout and connections to the external road network.

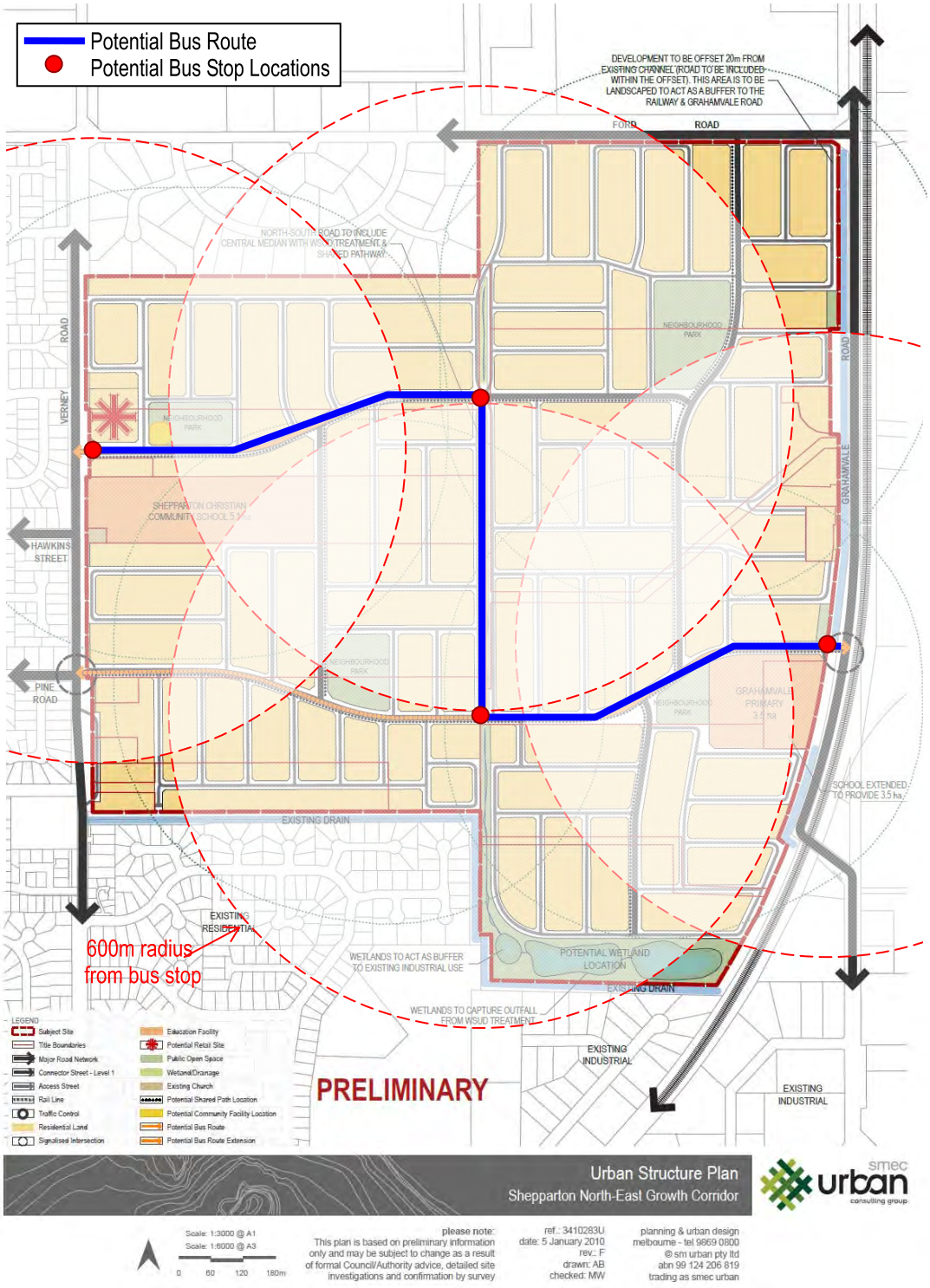

Figure 13: Possible Bus Route and Bus Stop Locations

The circles shown in Figure 13 are approximately 600 metres radius from the recommended bus stop locations rather than 800 metres (as per the Planning Scheme requirement), to account for possible longer street walking distances. Figure 13 shows that the majority if not all of the dwellings within the development area would be within 800 metres street walking distance of one of the four bus stops.

The Department of Transport have provided the following comments to Council in their letter dated 10th December, 2009, with regard to the future public transport provisions for the North East Growth Corridor:

> *It is critical that the development road networks take into account future public transport needs and allow for the accommodation of appropriate public transport networks. Considering this* [the draft structure plan] *could also be strengthened by the inclusion of a commitment to give greater priority to pedestrians and cyclists and create a local environment that encourages walking and cycling.*
>
> *Sufficient allowance should be made for bus access and storage on all major roads, which includes the provision of bus bays and associated infrastructure. In addition, traffic control devices should be designed in accord with the guidelines, so as to facilitate and not impede bus operations.*
>
> *Buses are the key form of public transport in the study area. The current Connelly Park Route operates along Merino Drive, located 290 metres west of Verney Road, the western boundary of the growth area. Assuming that development staging occurs as indicated in the Strategic Issues Paper (i.e. from the western boundary), there is an opportunity to service the initial development using the current service. The current service operates on an hourly frequency on weekdays.*
>
> *There is potential to achieve better initial coverage of the growth area if the Connelly Park route were to be redirected to Verney Road in lieu of the Merino Drive segment, however this would also require appropriate cycling and pedestrian connectivity pathways to provide access to the potential bus service in Verney Road.*
>
> *To ultimately service the Shepparton North East Growth Corridor, one additional bus would be required in the Shepparton Transit Network. The potential route currently shown on the preliminary plan is not appropriate as it does not provide sufficient penetration or coverage – DOT minimum service levels specify a catchment buffer or 400m for bus routes. Options regarding entry/exit points from the developments and the associated internal route will require further consideration.*
>
> *DOT recommends the inclusion of walking and cycling networks in subsequent plans. Connectivity should be enhanced between key attractors, such as the identified parks and schools, and also at the interfaces between the study are and neighbouring areas.*

We note that while DOT suggests that the potential route currently shown on the preliminary plan does not provide sufficient penetration or coverage, it would provide sufficient coverage subject to the future route extending north along Grahamvale Road, west along Ford Road and then south along Verney Road, with stops provided at appropriate locations, as indicated in Figure 14 below. Note that the circles shown in Figure 14 are approximately 400 metres radius.

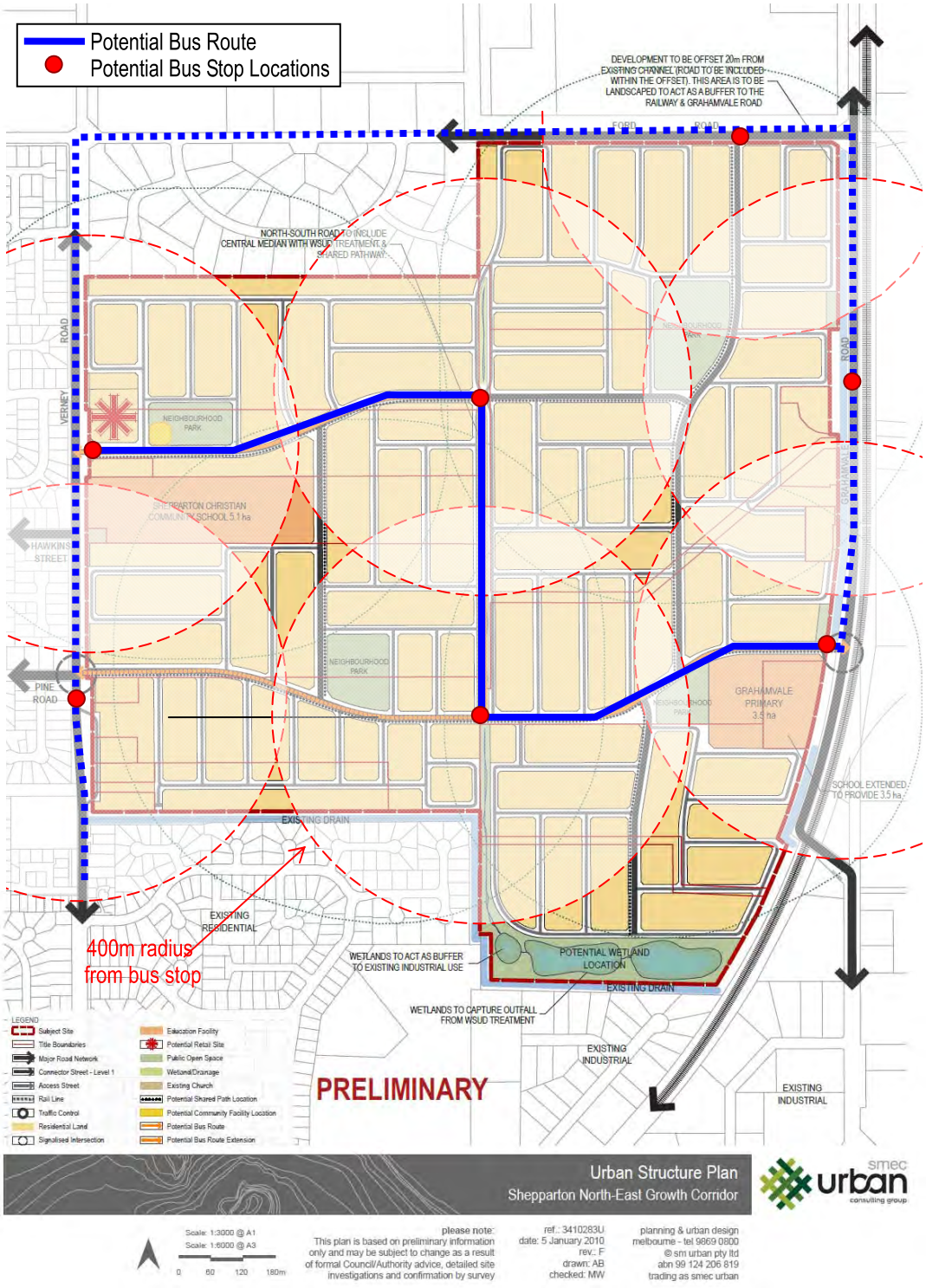

Figure 14: Possible Bus Route (Including External Components) and Bus Stop Locations

5.13 Road Hierarchy

It is noted that Council requires consideration of the Infrastructure Design Manual (IDM) hierarchy of roads for the proposed subdivision.

Furthermore, having regard to the ultimate predicted traffic volumes on Verney Road, it is Council's preference for a service road to be constructed along Verney Road for the length of the North East Growth Corridor (study area).

6 TRIGGER POINTS FOR DCP ITEMS

In general, any intersection treatments proposed under the DCP for the Shepparton North East growth corridor would not be needed from day 1 from a traffic capacity perspective, but should generally be constructed in accordance with the staging of the various subdivisions.

In order to ensure that adequate funding is available for the various traffic treatments it may be appropriate to allow a certain number of lots to be created prior to the requirement for intersection works.

For the Verney Road access points, the east-west connector roads and associated carriageway works (turn lanes, etc.) in Verney Road should be constructed at the time that the land either side of the proposed connector road is developed, but the installation of signals could be delayed until say, the issue of a certificate of compliance for the 100th lot which takes access to Verney Road via the connector road.

For the east-west connector road intersection with Grahamvale Road (school road), the current school intersection is currently operating close to capacity as a Give-Way controlled intersection. However, the trigger point for undertaking intersection works is more difficult, because it is not clear as to how or when the school will be relocated. We would suggest that the existing school access point be retained until such time that the east-west connector road is constructed. The east-west connector road/Grahamvale Road intersection should be constructed as a controlled intersection at the time that it is built, and then the school traffic can be diverted onto the new east-west connector and the existing school access point closed.

We understand that the development horizon for the Shepparton North East growth corridor is in the order of 20 years and the western side is likely to be developed before the eastern side. Accordingly, the Grahamvale Road/school (east-west connector) intersection is likely to be at least 10 – 15 years away.

7 RECOMMENDATIONS

Having visited the site, perused relevant documents and plans and undertaken assessments of traffic generation and distribution, we recommend the following: -

a) Section 4.6 of the draft PSP should be reviewed/modified as discussed at Table 1 of this report.

b) The road network shown in the final version of the PSP should be less prescriptive and just show collector and key local roads, to allow developers more flexibility, especially having consideration for the existing irrigation channels (PUZ1) if they are to be retained in separate ownership.

c) The PSP should allow for temporary connections to the external road network so that developers are not land locked (if they wish to develop before their neighbour and there isn't an ultimate connection proposed from their property), and the PSP should require the temporary connections to be removed at the developer's cost at such time that alternative access becomes available at the preferred locations.

d) The road layout may need to be reviewed to minimise the number of road connections across the PUZ1 (irrigation channel) and the DCP may need to include contributions to construct any road connections across the PUZ1, given that there is no incentive for the current owner (likely to be the water authority) to pay for the road construction.

e) The PSP should include street cross-section diagrams/requirements for all road types within the PSP area, as a minimum a connector road, a local access road and an access place (up to 300 vpd), and the cross-sections adopted should generally accord with Council's Infrastructure Design Manual, with the collector road cross-section to be in accordance with the Public Transport Guidelines for Land Use & Development (2008).

f) A bus route is not likely to be nominated by the Director of Public Transport until well after developers have completed subdivisions so in order to ensure bus stops are provided by development proponents, funding should be collected via DCP's. We understand that bus stops (shelters) currently cost in the order of $20,000 each and perhaps in the order of 4 might be needed within the development area.

g) A 'public transport plan' should be included in the PSP, and should be referred to the Department of Transport (DOT) by Council for comment. A possible plan is shown in Figure 14 of this report, although we understand this may need to be amended to reflect Council's current position that the Verney Road/Site Access intersection should be located further north to become a cross-intersection/continuation with Ryeland Drive.

h) The internal road connecting to Ford Road should be classified as a 'key local road' and not a connector road based on predicted traffic volumes on this link.

i) Verney Road will require protected turn lanes (as per AECOM recommendation) to minimise delay to through traffic having regard to the traffic volumes on this route.

j) The northern site access point to Verney Road should be constructed with separate right-turn and left turn lanes on Verney Road (suitable for a 70km/h speed limit – likely to be shorter than shown in the AECOM report), and left and right turn stand-up lanes (not a slip lane) exiting the study area. Alternatively, if the access road is located opposite Ryeland Drive, it should be a controlled cross-intersection (signals or a roundabout).

k) A roundabout could be considered at the Verney Road/Pine Road intersection when the fourth leg is constructed (as opposed to signals), as it will operate well within acceptable limits and a roundabout is consistent with the existing cross-intersection treatments on Verney Road to the north and south. However, we note that Council prefers signals along Verney Road in preference to roundabout treatments as they have the benefit of creating gaps in through traffic on Verney Road on the departure side of the signals and are safer for pedestrians and cyclists.

l) The need for the signalisation of the Hawkins Street/Goulburn Valley Highway intersection is generated by the adjacent retail development regardless of whether the NEGC is developed or not and accordingly the infrastructure item should not be included in the PSP/DCP, unless the traffic contributed by the development generates a requirement for additional or longer traffic lanes, in which case only that component should be charged in the DCP. Further investigation may be needed in this regard. The road authority should consider the possibility of fully controlling the right turns at the intersection, having consideration for the right turn crash history at the nearby existing signals on Goulburn Valley Highway.

m) No mitigating works are required at the Ford Road/Grahamvale Road intersection from a traffic capacity perspective and the crash statistics do not suggest that works are required from a safety perspective.

n) A controlled intersection treatment will ultimately be required at the Grahamvale Road/School Road (new east-west connector) intersection to accommodate the development traffic. We note that Council's preference is for a roundabout-controlled intersection, which has been tested and will operate satisfactorily under the ultimate development scenario and is consistent with the existing nearby intersection treatments on Grahamvale Road to the south.

o) Properties adjacent to Verney Road should be oriented to face Verney Road, but should not take direct access, i.e. access should be provided via service roads.

p) DCP items should generally be constructed in accordance with the staging of the various subdivisions, i.e. as the adjacent land is developed, but should allow for the early stages up to a certain trigger point (say 100 lots) to be developed prior to the required completion of intersection works to ensure that adequate DCP funds are available, and noting that from a traffic capacity perspective the intersections will cope with initial traffic volumes without the need for control.

Future Traffic Volumes – Verney Road Intersections

APPENDIX A

Verney Road/Site Access Intersection - Future (2020)

AM	Left	Through	Right
South	0	260	97
East	302	0	36
North	12	411	0
West	0	0	0

PM	Left	Through	Right
South	0	411	256
East	144	0	17
North	31	260	0
West	0	0	0

Verney Road/Hawkins Street Intersection - Future (2020)

AM	Left	Through	Right
South	57	240	0
East	0	0	0
North	0	447	266
West	117	0	67

PM	Left	Through	Right
South	67	434	0
East	0	0	0
North	0	253	151
West	232	0	57

Verney Road/Pine Road Intersection - Future (2020)

AM	Left	Through	Right
South	115	278	31
East	97	206	12
North	4	510	13
West	14	66	152

PM	Left	Through	Right
South	152	497	82
East	46	98	6
North	10	291	14
West	13	174	115

Verney Road/New Dookie Road Intersection - Future (2020)

AM	Left	Through	Right
South	99	208	91
East	113	236	123
North	154	489	101
West	82	248	78

PM	Left	Through	Right
South	79	463	41
East	99	267	201
North	100	302	41
West	81	187	94

SIDRA Output

APPENDIX B

SIDRA INTERSECTION

Movement Summary

Verney Road / Site Access

AM Peak - Future (2020)

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Verney Road (S)										
2	T	274	5.1	0.145	0.0	LOS A	0	0.00	0.00	60.0
3	R	102	4.9	0.116	11.0	LOS B	4	0.49	0.77	46.2
Approach		**376**	**5.1**	**0.145**	**3.0**	**LOS A**	**4**	**0.13**	**0.21**	**55.5**
Site Access (E)										
4	L	318	5.0	0.532	14.6	LOS B	31	0.65	1.01	43.0
6	R	38	5.3	0.535	14.8	LOS B	31	0.65	1.00	42.7
Approach		**356**	**5.1**	**0.532**	**14.6**	**LOS B**	**31**	**0.65**	**1.01**	**42.9**
Verney Road (N)										
7	L	13	7.7	0.236	8.4	LOS A	0	0.00	0.67	49.0
8	T	433	5.1	0.237	0.0	LOS A	0	0.00	0.00	60.0
Approach		**446**	**5.2**	**0.237**	**0.2**	**LOS A**		**0.00**	**0.02**	**59.6**
All Vehicles		**1178**	**5.1**	**0.535**	**5.5**	**Not Applicable**	**31**	**0.24**	**0.38**	**52.3**

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Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: Verney Rd/Site Access AM Peak
P:\Synergy\Projects\GRP1\GRP12088\Sidra\12088 sidra.aap
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SIDRA INTERSECTION

Movement Summary

Verney Road / Site Access

PM Peak - Future (2020)

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Verney Road (S)										
2	T	433	5.1	0.229	0.0	LOS A	0	0.00	0.00	60.0
3	R	269	4.8	0.257	10.3	LOS B	11	0.45	0.74	46.9
Approach		**702**	**5.0**	**0.257**	**3.9**	**LOS A**	**11**	**0.17**	**0.28**	**54.2**
Site Access (E)										
4	L	152	5.3	0.226	11.1	LOS B	8	0.45	0.73	46.1
6	R	18	5.6	0.225	11.4	LOS B	8	0.45	0.84	45.8
Approach		**170**	**5.3**	**0.225**	**11.1**	**LOS B**	**8**	**0.45**	**0.74**	**46.1**
Verney Road (N)										
7	L	33	6.1	0.163	8.4	LOS A	0	0.00	0.67	49.0
8	T	274	5.1	0.164	0.0	LOS A	0	0.00	0.00	60.0
Approach		**307**	**5.2**	**0.164**	**0.9**	**LOS A**		**0.00**	**0.07**	**58.6**
All Vehicles		**1179**	**5.1**	**0.257**	**4.2**	**Not Applicable**	**11**	**0.17**	**0.29**	**53.9**

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Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: Copy of Verney Rd/Site Access AM Peak
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SIDRA INTERSECTION

Movement Summary

Verney Road / New Dookie Road

AM Peak - Future (2020, incl. development traffic)

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Hawdon Street (S)										
1	L	104	4.8	0.515	11.5	LOS B	38	0.81	0.86	45.7
2	T	219	5.0	0.514	10.6	LOS B	38	0.81	0.85	46.6
3	R	96	5.2	0.513	15.6	LOS B	38	0.81	0.83	42.5
Approach		**419**	**5.0**	**0.514**	**12.0**	**LOS B**	**38**	**0.81**	**0.85**	**45.3**
New Dookie Road (E)										
4	L	119	5.0	0.804	24.7	LOS C	98	1.00	1.28	35.8
5	T	248	4.8	0.805	23.7	LOS C	98	1.00	1.28	36.4
6	R	129	4.7	0.806	28.7	LOS C	98	1.00	1.18	34.1
Approach		**496**	**4.8**	**0.804**	**25.3**	**LOS C**	**98**	**1.00**	**1.25**	**35.6**
Verney Road (N)										
7	L	162	4.9	0.876	21.8	LOS C	144	1.00	1.23	37.6
8	T	515	5.0	0.874	20.9	LOS C	144	1.00	1.23	38.2
9	R	106	4.7	0.876	25.9	LOS C	144	1.00	1.16	35.7
Approach		**783**	**5.0**	**0.874**	**21.7**	**LOS C**	**144**	**1.00**	**1.22**	**37.7**
Balaclava Road (W)										
10	L	86	4.7	0.491	10.8	LOS B	34	0.75	0.82	46.4
11	T	261	5.0	0.492	9.9	LOS A	34	0.75	0.80	46.9
12	R	82	4.9	0.491	14.9	LOS B	34	0.75	0.80	43.1
Approach		**429**	**4.9**	**0.492**	**11.1**	**LOS B**	**34**	**0.75**	**0.80**	**46.0**
All Vehicles		**2127**	**4.9**	**0.876**	**18.5**	**LOS B**	**144**	**0.91**	**1.07**	**39.9**

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Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Verney Road / New Dookie Road

PM Peak - Future (2020, incl. development traffic)

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Hawdon Street (S)										
1	L	83	4.8	0.798	19.5	LOS B	100	1.00	1.18	39.1
2	T	487	4.9	0.798	18.6	LOS B	100	1.00	1.18	39.8
3	R	43	4.7	0.796	23.6	LOS C	100	1.00	1.09	37.0
Approach		**613**	**4.9**	**0.798**	**19.1**	**LOS B**	**100**	**1.00**	**1.17**	**39.5**
New Dookie Road (E)										
4	L	104	4.8	0.689	14.3	LOS B	69	0.89	0.98	43.2
5	T	281	5.0	0.690	13.4	LOS B	69	0.89	0.98	44.0
6	R	212	5.2	0.691	18.4	LOS B	69	0.89	0.94	40.4
Approach		**597**	**5.0**	**0.691**	**15.3**	**LOS B**	**69**	**0.89**	**0.96**	**42.5**
Verney Road (N)										
7	L	105	4.8	0.493	9.7	LOS A	34	0.71	0.74	46.7
8	T	318	5.0	0.493	8.7	LOS A	34	0.71	0.72	47.1
9	R	43	4.7	0.494	13.7	LOS B	34	0.71	0.74	43.8
Approach		**466**	**4.9**	**0.493**	**9.4**	**LOS A**	**34**	**0.71**	**0.73**	**46.7**
Balaclava Road (W)										
10	L	85	4.7	0.620	17.5	LOS B	55	0.97	1.10	40.6
11	T	197	5.1	0.619	16.6	LOS B	55	0.97	1.10	41.3
12	R	99	5.1	0.619	21.6	LOS C	55	0.97	1.00	38.2
Approach		**381**	**5.0**	**0.619**	**18.1**	**LOS B**	**55**	**0.97**	**1.08**	**40.3**
All Vehicles		**2057**	**5.0**	**0.798**	**15.6**	**LOS B**	**100**	**0.90**	**0.99**	**42.0**

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- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Verney Road / Hawkins Street

AM Peak - Future (2020, incl. development traffic)

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Verney Road (S)										
1	L	60	5.0	0.033	8.4	LOS A	0	0.00	0.67	49.0
2	T	253	5.1	0.134	0.0	LOS A	0	0.00	0.00	60.0
Approach		**313**	**5.1**	**0.134**	**1.6**	**LOS A**		**0.00**	**0.13**	**57.5**
Verney Road (N)										
8	T	471	5.1	0.250	0.0	LOS A	0	0.00	0.00	60.0
9	R	280	5.0	0.266	10.3	LOS B	11	0.45	0.73	46.9
Approach		**751**	**5.1**	**0.266**	**3.8**	**LOS A**	**11**	**0.17**	**0.27**	**54.4**
Hawkins Street (W)										
10	L	123	4.9	0.346	14.4	LOS B	15	0.53	0.80	43.1
12	R	71	5.6	0.346	14.5	LOS B	15	0.53	0.88	43.0
Approach		**194**	**5.2**	**0.346**	**14.4**	**LOS B**	**15**	**0.53**	**0.83**	**43.1**
All Vehicles		**1258**	**5.1**	**0.346**	**4.9**	**Not Applicable**	**15**	**0.18**	**0.32**	**53.0**

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Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: Verney Rd/Hawkins St - AM Peak
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SIDRA INTERSECTION

Movement Summary

Verney Road / Hawkins Street

PM Peak - Future (2020, incl. development traffic)

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Verney Road (S)										
1	L	71	5.6	0.040	8.4	LOS A	0	0.00	0.67	49.0
2	T	457	5.0	0.242	0.0	LOS A	0	0.00	0.00	60.0
Approach		**528**	**5.1**	**0.242**	**1.1**	**LOS A**		**0.00**	**0.09**	**58.2**
Verney Road (N)										
8	T	266	4.9	0.141	0.0	LOS A	0	0.00	0.00	60.0
9	R	159	5.0	0.192	11.5	LOS B	7	0.54	0.81	45.7
Approach		**425**	**4.9**	**0.192**	**4.3**	**LOS A**	**7**	**0.20**	**0.30**	**53.7**
Hawkins Street (W)										
10	L	244	4.9	0.501	15.3	LOS C	27	0.65	1.01	42.3
12	R	60	5.0	0.500	15.4	LOS C	27	0.65	0.99	42.2
Approach		**304**	**4.9**	**0.501**	**15.3**	**LOS C**	**27**	**0.65**	**1.00**	**42.3**
All Vehicles		**1257**	**5.0**	**0.501**	**5.6**	**Not Applicable**	**27**	**0.23**	**0.38**	**52.0**

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Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: Verney Rd/Hawkins St - PM Peak
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SIDRA INTERSECTION

Movement Summary

Verney Road / Pine Road

AM Peak - Future (2020, incl. development traffic)

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Verney Road (S)										
1	L	121	5.0	0.445	9.7	LOS A	30	0.61	0.70	46.8
2	T	293	5.1	0.444	8.8	LOS A	30	0.61	0.67	47.3
3	R	33	6.1	0.446	12.9	LOS B	30	0.61	0.71	44.4
Approach		**447**	**5.1**	**0.444**	**9.3**	**LOS A**	**30**	**0.61**	**0.68**	**46.9**
Site Access (E)										
4	L	102	4.9	0.526	16.1	LOS B	39	0.88	1.02	41.7
5	T	217	5.1	0.525	15.2	LOS B	39	0.88	1.01	42.4
6	R	13	7.7	0.520	19.3	LOS B	39	0.88	0.95	39.6
Approach		**332**	**5.1**	**0.525**	**15.6**	**LOS B**	**39**	**0.88**	**1.01**	**42.1**
Verney Road (N)										
7	L	4	20.0	0.556	10.1	LOS B	39	0.66	0.75	46.6
8	T	537	5.0	0.546	9.2	LOS A	39	0.66	0.70	47.0
9	R	14	7.1	0.538	13.3	LOS B	39	0.66	0.73	44.2
Approach		**556**	**5.2**	**0.546**	**9.3**	**LOS A**	**39**	**0.66**	**0.70**	**46.9**
Pine Road (W)										
10	L	15	6.7	0.268	10.0	LOS B	15	0.58	0.72	46.9
11	T	69	4.3	0.268	9.2	LOS A	15	0.58	0.69	47.4
12	R	160	5.0	0.269	13.2	LOS B	15	0.58	0.73	44.4
Approach		**244**	**4.9**	**0.269**	**11.9**	**LOS B**	**15**	**0.58**	**0.72**	**45.3**
All Vehicles		**1579**	**5.1**	**0.556**	**11.0**	**LOS B**	**39**	**0.68**	**0.76**	**45.6**

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Following Queue
- Density for continuous movement

SIDRA INTERSECTION

Movement Summary

Verney Road / Pine Road

PM Peak - Future (2020, incl. development traffic)

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Verney Road (S)										
1	L	160	5.0	0.618	9.0	LOS A	54	0.54	0.61	47.1
2	T	523	5.0	0.617	8.1	LOS A	54	0.54	0.58	47.6
3	R	86	4.7	0.619	12.2	LOS B	54	0.54	0.65	44.6
Approach		**769**	**4.9**	**0.617**	**8.7**	**LOS A**	**54**	**0.54**	**0.60**	**47.2**
Site Access (E)										
4	L	48	4.2	0.190	10.6	LOS B	10	0.61	0.74	46.6
5	T	103	4.9	0.191	9.7	LOS A	10	0.61	0.71	47.3
6	R	6	14.3	0.189	13.8	LOS B	10	0.61	0.75	43.9
Approach		**158**	**5.1**	**0.191**	**10.2**	**LOS B**	**10**	**0.61**	**0.72**	**46.9**
Verney Road (N)										
7	L	11	9.1	0.393	10.7	LOS B	24	0.68	0.78	46.5
8	T	306	4.9	0.387	9.8	LOS A	24	0.68	0.75	46.9
9	R	15	6.7	0.385	13.9	LOS B	24	0.68	0.76	43.8
Approach		**332**	**5.1**	**0.387**	**10.0**	**LOS B**	**24**	**0.68**	**0.75**	**46.8**
Pine Road (W)										
10	L	14	7.1	0.452	13.5	LOS B	31	0.82	0.92	43.9
11	T	183	4.9	0.456	12.6	LOS B	31	0.82	0.91	44.7
12	R	121	5.0	0.457	16.7	LOS B	31	0.82	0.86	41.5
Approach		**318**	**5.0**	**0.457**	**14.2**	**LOS B**	**31**	**0.82**	**0.89**	**43.4**
All Vehicles		**1577**	**5.0**	**0.619**	**10.3**	**LOS B**	**54**	**0.63**	**0.70**	**46.2**

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Following Queue
- Density for continuous movement

MOVEMENT SUMMARY

Site: AM existing

Ford Road/Grahamvale Road Intersection
AM Peak Hour
Existing Conditions
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	2	3.0	0.078	8.6	LOS A	0.6	4.1	0.24	0.79	49.0
2	T	136	3.0	0.078	0.4	LOS A	0.6	4.1	0.24	0.00	55.4
3	R	7	3.0	0.078	9.0	LOS A	0.6	4.1	0.24	0.99	48.9
Approach		145	3.0	0.078	1.0	LOS A	0.6	4.1	0.24	0.06	55.0
East: Ford Road (E)											
4	L	6	3.0	0.074	9.8	LOS A	0.3	2.4	0.34	0.59	47.3
5	T	18	3.0	0.075	8.5	LOS A	0.3	2.4	0.34	0.60	48.2
6	R	42	3.0	0.075	10.0	LOS B	0.3	2.4	0.34	0.72	47.2
Approach		66	3.0	0.075	9.6	LOS B	0.3	2.4	0.34	0.68	47.5
North: Grahamvale Road (N)											
7	L	27	3.0	0.090	8.8	LOS A	0.6	4.4	0.29	0.59	48.4
8	T	79	3.0	0.090	0.6	LOS A	0.6	4.4	0.29	0.00	53.8
9	R	42	3.0	0.090	9.1	LOS A	0.6	4.4	0.29	0.79	48.3
Approach		148	3.0	0.090	4.5	LOS A	0.6	4.4	0.29	0.33	51.1
West: Ford Road (W)											
10	L	6	3.0	0.060	9.7	LOS A	0.3	1.9	0.35	0.63	47.6
11	T	34	3.0	0.060	8.4	LOS A	0.3	1.9	0.35	0.61	48.3
12	R	14	3.0	0.060	9.9	LOS A	0.3	1.9	0.35	0.73	47.4
Approach		54	3.0	0.060	9.0	LOS A	0.3	1.9	0.35	0.64	48.0
All Vehicles		414	3.0	0.090	4.7	NA	0.6	4.4	0.29	0.33	51.3

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: AM future

Ford Road/Grahamvale Road Intersection
AM Peak Hour
Future Conditions (with development traffic)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	2	3.0	0.092	8.6	LOS A	0.7	5.0	0.25	0.78	49.1
2	T	163	3.0	0.092	0.4	LOS A	0.7	5.0	0.25	0.00	55.3
3	R	7	3.0	0.092	9.0	LOS A	0.7	5.0	0.25	0.99	48.9
Approach		173	3.0	0.092	0.9	LOS A	0.7	5.0	0.25	0.05	54.9
East: Ford Road (E)											
4	L	6	3.0	0.102	10.5	LOS B	0.5	3.4	0.40	0.60	46.7
5	T	33	3.0	0.102	9.2	LOS A	0.5	3.4	0.40	0.64	47.6
6	R	42	3.0	0.102	10.7	LOS B	0.5	3.4	0.40	0.78	46.5
Approach		81	3.0	0.102	10.1	LOS B	0.5	3.4	0.40	0.71	47.0
North: Grahamvale Road (N)											
7	L	27	3.0	0.102	9.0	LOS A	0.7	5.0	0.32	0.56	48.3
8	T	85	3.0	0.102	0.7	LOS A	0.7	5.0	0.32	0.00	53.2
9	R	52	3.0	0.102	9.2	LOS A	0.7	5.0	0.32	0.79	48.3
Approach		164	3.0	0.102	4.8	LOS A	0.7	5.0	0.32	0.34	50.7
West: Ford Road (W)											
10	L	47	3.0	0.186	10.0	LOS A	0.9	6.6	0.38	0.67	47.3
11	T	103	3.0	0.186	8.7	LOS A	0.9	6.6	0.38	0.67	48.2
12	R	14	3.0	0.187	10.3	LOS B	0.9	6.6	0.38	0.78	47.1
Approach		164	3.0	0.186	9.2	LOS B	0.9	6.6	0.38	0.68	47.8
All Vehicles		582	3.0	0.186	5.6	NA	0.9	6.6	0.33	0.40	50.4

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: PM existing

Ford Road/Grahamvale Road Intersection
PM Peak Hour
Existing Conditions
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	5	3.0	0.063	9.3	LOS A	0.5	3.5	0.37	0.62	48.9
2	T	94	3.0	0.063	1.0	LOS A	0.5	3.5	0.37	0.00	53.0
3	R	13	3.0	0.063	9.5	LOS A	0.5	3.5	0.37	0.91	48.9
Approach		112	3.0	0.063	2.4	LOS A	0.5	3.5	0.37	0.13	52.3
East: Ford Road (E)											
4	L	15	3.0	0.123	10.1	LOS B	0.6	4.1	0.41	0.66	47.0
5	T	29	3.0	0.123	8.9	LOS A	0.6	4.1	0.41	0.64	47.8
6	R	60	3.0	0.123	10.4	LOS B	0.6	4.1	0.41	0.76	46.8
Approach		104	3.0	0.123	9.9	LOS B	0.6	4.1	0.41	0.71	47.1
North: Grahamvale Road (N)											
7	L	56	3.0	0.133	8.7	LOS A	1.0	7.3	0.27	0.68	48.7
8	T	180	3.0	0.133	0.4	LOS A	1.0	7.3	0.27	0.00	54.6
9	R	11	3.0	0.133	9.0	LOS A	1.0	7.3	0.27	0.87	48.6
Approach		246	3.0	0.133	2.7	LOS A	1.0	7.3	0.27	0.19	52.9
West: Ford Road (W)											
10	L	9	3.0	0.051	9.8	LOS A	0.2	1.6	0.31	0.62	47.4
11	T	26	3.0	0.051	8.6	LOS A	0.2	1.6	0.31	0.62	48.5
12	R	8	3.0	0.051	10.1	LOS B	0.2	1.6	0.31	0.74	47.2
Approach		44	3.0	0.051	9.1	LOS B	0.2	1.6	0.31	0.64	48.0
All Vehicles		506	3.0	0.133	4.7	NA	1.0	7.3	0.32	0.32	51.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: PM future

Ford Road/Grahamvale Road Intersection
PM Peak Hour
Future Conditions (with development traffic)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	5	3.0	0.068	9.4	LOS A	0.5	3.9	0.39	0.60	48.9
2	T	104	3.0	0.069	1.1	LOS A	0.5	3.9	0.39	0.00	52.6
3	R	13	3.0	0.069	9.7	LOS A	0.5	3.9	0.39	0.91	48.9
Approach		122	3.0	0.069	2.4	LOS A	0.5	3.9	0.39	0.12	52.1
East: Ford Road (E)											
4	L	15	3.0	0.211	10.9	LOS B	1.0	7.3	0.48	0.70	46.3
5	T	86	3.0	0.210	9.6	LOS A	1.0	7.3	0.48	0.71	47.2
6	R	60	3.0	0.209	11.2	LOS B	1.0	7.3	0.48	0.83	46.2
Approach		161	3.0	0.209	10.3	LOS B	1.0	7.3	0.48	0.76	46.7
North: Grahamvale Road (N)											
7	L	56	3.0	0.172	8.8	LOS A	1.3	9.5	0.28	0.64	48.6
8	T	203	3.0	0.172	0.5	LOS A	1.3	9.5	0.28	0.00	54.2
9	R	45	3.0	0.171	9.0	LOS A	1.3	9.5	0.28	0.84	48.5
Approach		304	3.0	0.172	3.3	LOS A	1.3	9.5	0.28	0.24	52.2
West: Ford Road (W)											
10	L	25	3.0	0.106	10.2	LOS B	0.5	3.5	0.32	0.63	47.0
11	T	54	3.0	0.106	9.0	LOS A	0.5	3.5	0.32	0.66	48.0
12	R	8	3.0	0.107	10.5	LOS B	0.5	3.5	0.32	0.79	46.8
Approach		87	3.0	0.106	9.5	LOS B	0.5	3.5	0.32	0.66	47.6
All Vehicles		675	3.0	0.209	5.6	NA	1.3	9.5	0.35	0.40	50.2

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: AM Peak Existing

Grahamvale Road/School Road Intersection
AM Peak Hour
Existing Conditions
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	95	3.0	0.052	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	323	3.0	0.169	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		418	3.0	0.169	1.9	LOS A	0.0	0.0	0.00	0.15	57.1
North: Grahamvale Road (N)											
8	T	263	3.0	0.138	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
9	R	6	3.0	0.007	10.3	LOS B	0.0	0.2	0.43	0.66	46.8
Approach		269	3.0	0.138	0.2	LOS B	0.0	0.2	0.01	0.02	59.6
West: New (School) Road (W)											
10	L	34	3.0	0.783	21.3	LOS C	9.9	71.1	0.82	1.40	37.7
12	R	443	3.0	0.790	21.5	LOS C	9.9	71.1	0.82	1.34	37.7
Approach		477	3.0	0.790	21.5	LOS C	9.9	71.1	0.82	1.35	37.7
All Vehicles		1164	3.0	0.790	9.5	NA	9.9	71.1	0.34	0.61	47.6

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.

Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: AM Peak Roundabout

Grahamvale Road/School Intersection
AM Peak Hour
Future Conditions (Roundabout)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	322	3.0	0.410	6.6	LOS A	4.3	31.1	0.17	0.52	50.0
2	T	323	3.0	0.410	5.6	LOS A	4.3	31.1	0.17	0.42	51.0
Approach		645	3.0	0.410	6.1	LOS A	4.3	31.1	0.17	0.47	50.5
North: Grahamvale Road (N)											
8	T	263	3.0	0.417	10.5	LOS B	3.8	27.2	0.85	0.87	46.5
9	R	23	3.0	0.414	16.2	LOS B	3.8	27.2	0.85	0.94	43.4
Approach		286	3.0	0.417	10.9	LOS B	3.8	27.2	0.85	0.88	46.2
West: New (School) Road (W)											
10	L	51	3.0	0.674	10.9	LOS B	8.5	61.3	0.76	0.78	45.6
12	R	671	3.0	0.673	15.5	LOS B	8.5	61.3	0.76	0.84	42.7
Approach		721	3.0	0.673	15.2	LOS B	8.5	61.3	0.76	0.83	42.9
All Vehicles		1653	3.0	0.673	10.9	LOS B	8.5	61.3	0.55	0.70	46.1

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: PM Peak Existing

Grahamvale Road/School Road Intersection
PM Peak Hour
Existing Conditions
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	331	3.0	0.182	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	371	3.0	0.194	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		701	3.0	0.194	3.9	LOS A	0.0	0.0	0.00	0.31	54.2
North: Grahamvale Road (N)											
8	T	298	3.0	0.156	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
9	R	22	3.0	0.033	12.3	LOS B	0.2	1.1	0.56	0.78	44.9
Approach		320	3.0	0.156	0.8	LOS B	0.2	1.1	0.04	0.05	58.6
West: New (School) Road (W)											
10	L	12	3.0	0.429	17.5	LOS C	2.5	18.3	0.74	1.01	40.4
12	R	185	3.0	0.431	17.6	LOS C	2.5	18.3	0.74	1.00	40.4
Approach		197	3.0	0.430	17.6	LOS C	2.5	18.3	0.74	1.00	40.4
All Vehicles		1218	3.0	0.430	5.3	NA	2.5	18.3	0.13	0.36	52.4

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: PM Peak Roundabout

Grahamvale Road/School Intersection
PM Peak Hour
Future Conditions (Roundabout)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Grahamvale Road (S)											
1	L	639	3.0	0.661	6.9	LOS A	9.5	68.3	0.35	0.51	49.0
2	T	371	3.0	0.662	5.9	LOS A	9.5	68.3	0.35	0.43	49.6
Approach		1009	3.0	0.662	6.5	LOS A	9.5	68.3	0.35	0.48	49.2
North: Grahamvale Road (N)											
8	T	298	3.0	0.347	7.6	LOS A	2.8	20.4	0.60	0.65	48.0
9	R	45	3.0	0.346	13.3	LOS B	2.8	20.4	0.60	0.83	45.5
Approach		343	3.0	0.347	8.3	LOS B	2.8	20.4	0.60	0.67	47.6
West: New (School) Road (W)											
10	L	22	3.0	0.362	8.9	LOS A	2.9	20.5	0.61	0.68	46.8
12	R	331	3.0	0.360	13.6	LOS B	2.9	20.5	0.61	0.77	44.2
Approach		353	3.0	0.360	13.3	LOS B	2.9	20.5	0.61	0.76	44.4
All Vehicles		1705	3.0	0.662	8.3	LOS A	9.5	68.3	0.46	0.58	47.8

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.