Horsley Drive Business Park
Traffic Impact Assessment for a Part 4 Concept Plan Application

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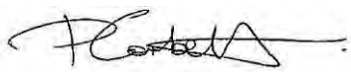
Report V01	Prepared by:	PC	10/04/2012	
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1. Introduction

1.1 Background

TRAFFIX has been commissioned by Western Sydney Parklands Trust (WSPT) to undertake a Traffic Impact Assessment for a Concept Plan application relating to the subdivision of land for the purpose of warehousing and industrial uses. The development is known as the Horsley Drive Business Park. This current application relates to the following:

- Subdivision of the approximately 21.4 hectare site,
- Demolition of all existing structures and remediation of the land,
- Bulk and detailed earthworks,
- Construction of estate infrastructure, and
- Estate landscaping.

The site is located immediately adjacent to the Smithfield-Wetherill Park Industrial Area and falls within the WSPT's functions under the *Western Sydney Parklands Act 2006* and the *Western Sydney Parklands Plan of Management 2020*.

The WSPT prepared a report entitled "*Request for DGR's – Supporting Document*" dated February 2012, to assist the Departure of Planning and Infrastructure (DoPI) in its initial consideration of the development as State Significant Development under the Environmental Planning and Assessment Act 1979 (EP&A Act). The Roads and Maritime Services (RMS) also issued a letter to the DoPI dated 5 March 2012, detailing key issues and assessment requirements for inclusion in the DG's Environmental Assessment (EA) requirements.

The DoPI issued the Director General's Environmental Assessment Requirements on the 16th March 2012, which includes the Transport and Accessibility (Construction and Operation) requirements to be included in this Traffic Impact Assessment.

1.2 Director Generals Requirements

The Director General's Environmental Assessment Requirements letter requires the following transport and accessibility issues to be assessed as part of the application:

- A strategic four step model should be undertaken to determine the traffic and transport impacts of the proposal, including consideration of traffic generation, traffic distribution, modal split and traffic assignment. The methodology and assumptions used for the modelling shall be to the satisfaction of the Roads and Maritime Services (RMS) and Transport for NSW (TfNSW).
- Provide a detailed traffic analysis of the proposal which includes a base case model, a separate model with full development, and a 10 year background traffic growth model. The traffic analysis is to be to the satisfaction of the RMS and Transport for NSW.
- Detail access and parking provisions associated with the proposed development including how compliance with the requirements of the relevant Australian Standards will be able to adhered (sic).
- Detail the proposed number of car parking spaces and compliance with appropriate parking codes.
- Demonstrate how future uses of the development will be able to make travel choices that support the achievement of State Plan targets.
- Detail existing pedestrian and cycle movements within the vicinity of the site and determine the adequacy of the proposal to meet the likely future demand for increased public transport and pedestrian and cycle access.
- Describe the measures to be implemented to promote sustainable means of transport including public transport usage and pedestrian and bicycle linkages in addition to addressing the potential for implementing a location specific sustainable travel plan and the provision of facilities to increase the non-car mode share for travel to and from the site.
- Estimate the total daily and peak hour trips anticipated to be generated by the business park, including accurate details of the current and future daily vehicle movements and assess the impacts of the traffic generated on local road networks, including intersection capacity and the potential need/associated funding for upgrading or road works, having regard to the local planning controls. The following key intersections are to be examined / modelled:

- The Horsley Drive / Cowpasture Road
- The Horsley Drive / Ferrers Road
- The Horsley Drive / Westlink M7
- Cowpasture Road / Newton Road
- Cowpasture Road / Victoria Street.

- Relevant Policies and Guidelines:
  - Guide to Traffic Generating Developments (RTA);
  - Planning Guidelines for Walking and Cycling;
  - The Metropolitan Transport Plan 2010;
  - EIS Guidelines – Road and Related Facilities (DoPI).

2. Location and Site

The Western Sydney Parklands is a 27 kilometre corridor stretching from Quakers Hill to Leppington, located in Western Sydney. A site plan of the Parklands is shown in **Figure 1**. The proposed Horsley Drive Business Park is situated within Precinct 9 of the Parklands, being approximately 2 kilometres south of Prospect Reservoir and approximately 31 kilometres west of Sydney CBD.

The site is irregular in configuration and has a total site area of 21.4 hectares. It is situated on northern-western corner of The Horsley Drive and Cowpasture Road intersection within Horsley Park and is immediately adjacent to the existing Smithfield-Wetherill Park Industrial Area.

The site is wholly within the Fairfield LGA, and comprises 18 separate land parcels, including:

- Lots 23 (part), 24 (part), 25, 28B, 30, 30A, 30B, 32 and 32A in DP13961,
- Lots 1 to 5 in DP 1098128,
- Lot 100 in DP 879680,
- Lot 1 in DP 1036933,
- Lot 10 in DP 879209, and
- Lot C in DP 103755.

The site is currently vacant with land use surrounding the site including:

- North: Parklands, including an electricity transmission line easement immediately to the north of the site.
- East: Cowpasture Road, with the Smithfield-Wetherill Park Industrial Area beyond.
- South: The Horsley Drive, with Parklands beyond, including the Lizard Log Community and Passive Recreation Hub approximately 300 metres to the south.

- West: Parklands, with a regional cycleway located immediately west of the site, and Sydney Water's Upper Canal located to the west of the cycleway, approximately 35 metres from the site boundary.

A Location and Site Plan are included respectively in **Figure 2** and **3** below.

Source: Horsley Drive Business Park: Request for DGRs - Supporting Document

Figure 1: Western Sydney Parklands

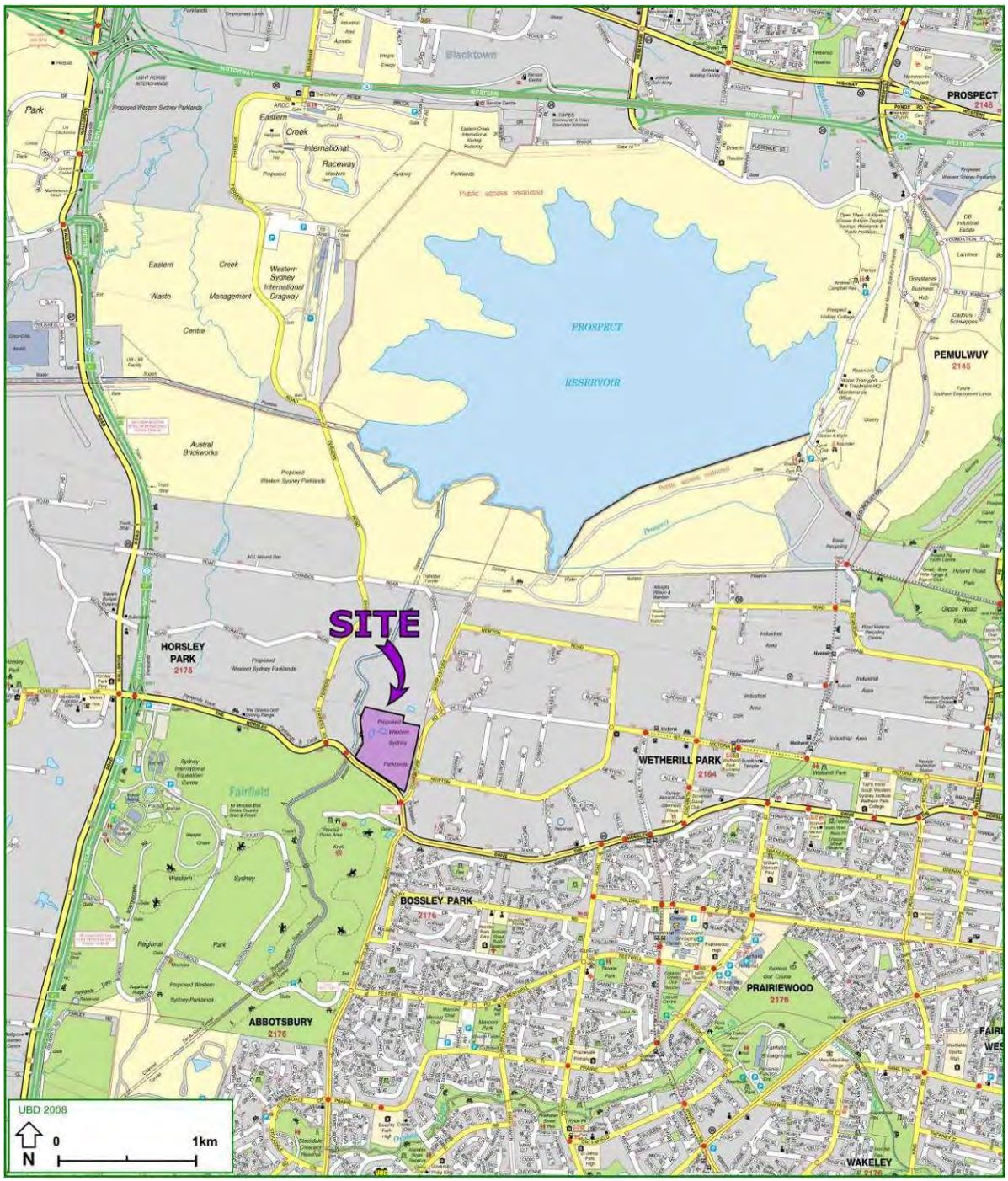

Figure 2: Location Plan

Figure 3: Site Plan (building layouts are indicative only)

3. Strategic Context

3.1 Relevant State and Local Planning Policies

The strategic context of the study area is governed by State and Regional Planning Policies. The NSW planning policies and strategies applicable to the subject site and those considered as part of the development of the Traffic Impact Assessment include:

- State Environmental Planning Policy (Infrastructure) 2007
- State Environmental Planning Policy (Western Sydney Employment Area)
- State Environmental Planning Policy (Western Sydney Parklands) 2009
- Fairfield Council Development Control Plans
- The Metropolitan Plan (2036)
- SEPP WSEA 2009
- The Metropolitan Transport Plan, and
- Planning Guidelines for Walking and Cycling.

A summary of these policies is provided below, together with an overview of local planning policies.

3.1.1 State Environmental Planning Policy (Infrastructure) 2007

This Policy contains provisions for referral of certain development applications, considered to be traffic generating development, to the RMS. The Horsley Drive Business Park is for an industrial purpose and all significant development within this Business Park will need to be referred to RMS. Notwithstanding this, it is noted that the aims of the SEPP (Infrastructure) 2007 are as follows:

(a) improving regulatory certainty and efficiency though a consistent planning regime for infrastructure and the provision of services,

(b) providing greater flexibility in the location of infrastructure and service facilities,

(c) allowing for the efficient development, redevelopment or disposal of surplus government owned land,

(d) identifying the environmental assessment category into which different types of infrastructure and services development fall (including identifying certain development of minimal environmental impact as exempt development),

(e) identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure development, and

(f) providing for consultation with relevant public authorities about certain development during the assessment process or prior to development commencing.

3.1.2 State Environmental Planning Policy (Western Sydney Employment Area)

State Environmental Planning Policy (Western Sydney Employment Area) 2009 was gazetted in August 2009. The SEPP seeks to protect and enhance the Western Sydney Employment Area ("WSEA") for future employment purposes. The aims of the SEPP are as follows:

"(a) to promote economic development and the creation of employment in the Western Sydney Employment Area by providing for development including major warehousing, distribution, freight transport, industrial, high technology and research facilities,

(b) to provide for the co-ordinated planning and development of land in the Western Sydney Employment Area,

(c) to rezone land for employment or environmental conservation purposes,

(d) to improve certainty and regulatory efficiency by providing a consistent planning regime for future development and infrastructure provision in the Western Sydney Employment Area,

(e) to ensure that development occurs in a logical, environmentally sensitive and cost-effective manner and only after a development control plan (including specific development controls) has been prepared for the land concerned,

(f) to conserve and rehabilitate areas that have a high biodiversity or heritage or cultural value, in particular areas of remnant vegetation."

The proposed developments within the Horsley Drive Business Park are generally consistent with these aims. The land has been zoned appropriately, will be developed in a staged manner and is on land that is suitable for the intended purpose.

3.1.3 State Environmental Planning Policy (Western Sydney Parklands) 2009

Clause 12 of the Parklands SEPP requires a consent authority to consider a number of matters (insofar as they are relevant) when determining an application for development on land in the Parklands. The matters include:

(a) the aim of the SEPP,

(b) the impact on drinking water catchments and associated infrastructure,

(c) the impact on utility services and easements,

(d) the impact of carrying out the development on environmental conservation areas and the natural environment, including endangered ecological communities,

(e) the impact on the continuity of the Parklands as a corridor linking core habitat such as the endangered Cumberland Plain Woodland,

(f) the impact on the Parkland's linked north-south circulation and access network and whether the development will enable access to all parts of the Parklands that are available for recreational use,

(g) the impact on the physical and visual continuity of the Parklands as a scenic break in the urban fabric of western Sydney,

(h) the impact on public access to the Western Parklands,

(i) consistency with:

(i) any plan of management for the Parklands, or

(ii) any precinct plan for a precinct of the Parklands,

(j) the impact on surrounding residential amenity,

(k) the impact on significant views,

(l) the effect on drainage patterns, groundwater, flood patterns and wetland viability,

(m) the impact on heritage items, and

(n) the impact on traffic and parking.

3.1.4 Fairfield City Wide Development Control Plan 2006 – version 17

Fairfield City Wide DCP sets the specific controls for all development within the Fairfield Council LGA. In this regard, it is noted that any further development applications within the Horsley Drive Business Park will provide an additional assessment against the DCP controls within Fairfield City Council for review and response by Council.

3.1.5 Metropolitan Strategy and Transport Plan 2031

In 2005, the Metropolitan Strategy provided a framework for growth within the Sydney Metropolitan Area to 2031. The plan identified housing and employment capacity targets within strategic centres but has been superseded by the Metropolitan Transport Plan (2036) as discussed below.

3.1.6 Metropolitan Plan 2036

The Metropolitan Plan 2036 is to be reviewed every 5 years and forms an integrated plan for Sydney to 2036. It focuses on transforming Sydney from a single-centred city to a more connected, multi centred city where the regional cities of Parramatta, Liverpool and Penrith in particular deliver increased jobs and improved services. The long term vision is to develop Sydney as a "city of cities" and includes the following objectives:

- Radial public transport links feeding into each city.
- Cross regional transport connections linking more subregions to the Global Economic Corridor, and
- A developing network of transport connections serving a range of different trips and strategic centres that support economic activity across more locations.

3.1.7 Metropolitan Transport Plan

This plan produced in 2010 provides a 25 year vision for the connection of Sydney's land use planning with the transport network. The plan incorporates ten year funding for transport infrastructure and includes the following noteworthy services:

- A $4.5 billion Western Express City Rail Service which is intended to significantly reduce commuting times between Western Sydney and the city.
- Commencement of works on the North West rail connection from Epping to Rouse Hill with an estimated cost of $6.75 billion.
- Improvement to bus services which includes 100 new buses in strategic bus corridors.
- New trains with an additional 626 rail carriages
- $158 million for cycleway
- $400 million for commuter car parks
- $483 million to deliver important freight works In Sydney
- $21.9 million of State and Federal Funded road projects.

3.1.8 Planning Guidelines for Walking and Cycling (2004)

The aim of this guideline is to assist land-use planners and other related professionals to improve consideration of walking and cycling in their work. The intention of the guideline is to ultimately create further opportunities for people to live in places with easy walking and cycling access to urban services and public transport and reducing private vehicle usage.

3.1.9 NSW Bike Plan (2010)

The Metropolitan Transport Plan committed $158 million towards improving urban cycle networks and lead to the development of the NSW Bikeplan which outlined a 10 year bicycle infrastructure plan including:

- $80 million over ten years to connect Sydney's district centres by building missing links in the Metro Sydney Bike Network.

- $78 million over ten years to fast-track subregional bike networks for Parramatta, Liverpool and Penrith to grow cycling in these three River Cities.
- At least $5 million every year for regional cities and local councils across NSW to complete neighbourhood cycleway networks.

3.1.10 Summary

The plans and strategies discussed above are relevant to the Horsley Drive Business Park and are referred to throughout this Traffic Impact Assessment report within the Public Transport and Pedestrian & Cycleway Linkages Sections 4.2 below.

4. Existing Traffic Conditions

4.1 Road Hierarchy

The road hierarchy in the vicinity of the site is shown in **Figure 4** with the following roads of particular interest:

- M7 Motorway: a major arterial road that provides Sydney with a key orbital connection between numerous radial arterial roads including the M2, M4 and M5 motorways. It runs in a north-south direction between the M2 in the north and the M5 in the south, carrying approximately 70,000vpd in the vicinity of the study area. It carries two lanes of traffic in either direction within a divided carriageway of width 38.0 metres.

- The Horsley Drive: an RMS State Road (MR 609) that runs in an east-west direction between the Hume Highway in the east and Wallgrove Road in the west, carrying approximately 20,000vpd within the study area. It generally carries two lanes of traffic in either direction within a divided carriageway of width 27.0 metres.

- Wallgrove Road: a classified road (MR 515) that runs in a north-south direction to the west of the site. It historically carried in the order of 31,500vpd, however this has reduced to approximately 20,000vpd with the completion of the M7 Motorway. The approved Northern Link Road will form a linkage with Wallgrove Road connecting with Lenore Lane / Mamre Road in the west.

- Cowpasture Road: forms part of an RMS State Road (MR 648), a Regional Road and a collector road within the study area, carrying approximately 29,000vpd. Cowpasture Road is a State Road south of its roundabout controlled intersection with The Horsley Drive, a Regional Road between its signalised intersection with The Horsley Drive and roundabout controlled intersection with Victoria Street and a collector road north of

its intersection with Victoria Street. . It carries two lanes of traffic in either direction within a divided carriageway of width 19.0 metres.

- Newton Road: a local road that runs in an east-west direction which links Victoria Street in the east with Cowpasture Road in the west. It carries a single lane of traffic in either direction within an undivided carriageway of width 8.5 metres.

- Ferrers Road: a Regional Road (RR 7153) that runs in a north-south direction between Brabham Drive in the north and The Horsley Drive in the south. It carries a single lane of traffic in either direction within an undivided carriageway of width 8.5 metres.

- Victoria Road: a Regional Road that runs in an east-west direction between Cowpasture Road in the east and Warren Road in the west. . It carries two lanes of traffic in either direction within a divided carriageway of width 22.5 metres.

- Northern Link Road: a major RTA road currently under construction by the RMS. This road will eventually provide a link between Erskine Park in the west and Wallgrove Road in the east.

It can be seen from **Figure 4** that the site is conveniently located with respect to the arterial and local road systems serving the region including access to the M7 motorway which in turn provides direct access to both the M4 and M5 motorways.

Figure 4: Road Hierarchy

4.2 General Description of Road Environment

The Horsley Drive is a major RMS State Road providing access between the M7 Motorway and the Hume Highway. In the vicinity of the site the Horsley Drive is generally constructed with a 12.8m wide undivided carriageway carrying two lanes of traffic in either direction. Parking is not permitted generally along its entire length and no footpaths or pedestrian infrastructure is provided in the vicinity of the site.

The Horsley Drive forms the major signal controlled T Junction with Cowpasture Road immediately adjacent to the site. The intersection is constructed with two through lanes on both the northbound and eastbound approaches in addition to a dual signalised left turn slip lane of length 300m for southbound vehicles turning east into Cowpasture Road; and a dual signalised right turn bay of length 80m for northbound vehicles turning east into Cowpasture Road.

Approximately 160m south of the above mentioned intersection; The Horsley Drive forms the northern approach to a roundabout controlled junction with Cowpasture Road and the access road to the Lizard Creek Park.

To the immediate east of the site Cowpasture Road forms the major approach to a roundabout controlled intersection with Newton Road with an inscribed radius of 20 metres and with generally two circulating lanes.

The general intersection layout and road geometry at these two intersections is shown in **Figure 5** below.

Figure 5: Intersections of The Horsley Drive & Cowpasture Road

4.2.1 Bus Services

The existing bus services within the vicinity of site are shown in **Figure 6**. It is evident that the site benefits from services which operate along The Horsley Drive and Cowpasture Road, with two bus stops located immediately adjacent to the south-eastern site boundary. The 813 and 814 bus services provide connections to Fairfield Railway Station which is located approximately 8 kilometres to the south-east of the site. It is however noted that these service are relatively infrequent and generally operate only during Peak periods.

4.2.2 Rail Services

The Fairfield Railway Station is located approximately 8 kilometres to the south-east of the site. **Figure 7** illustrates the location of railway station in a regional context. Direct connections between Fairfeild Railway Station and the site are available using the 814 Westbus service.

4.2.3 Cycle Network

The existing regional and local cycle networks are shown in **Figure 8** below. The site is well located with respect to the existing cycle network which links the site to the major residential land areas to the east. A major north-south cycle route also exists directly to the west of the site linking it with Eastern Creek and the regional cycle network.

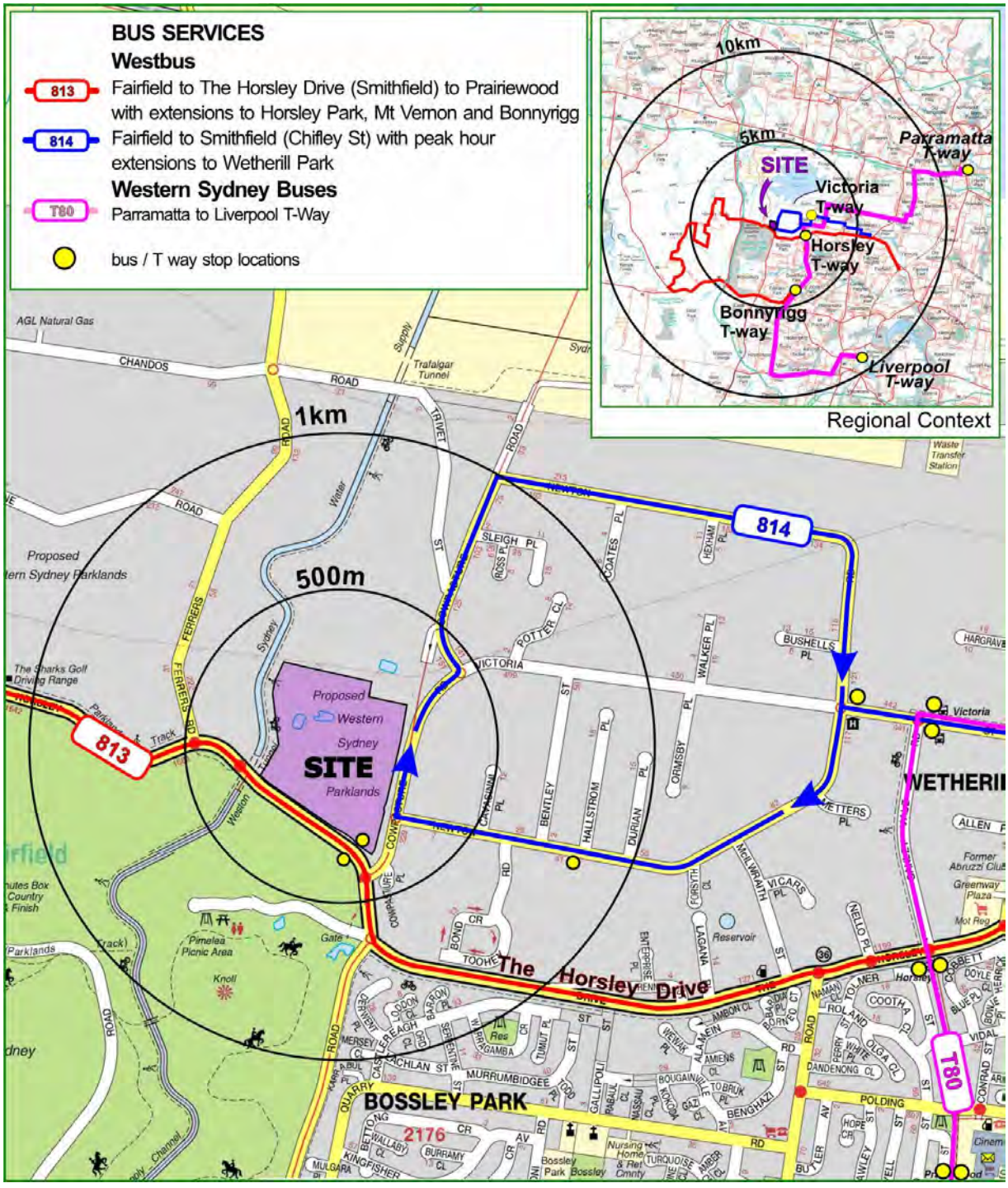

Figure 6: Bus Services

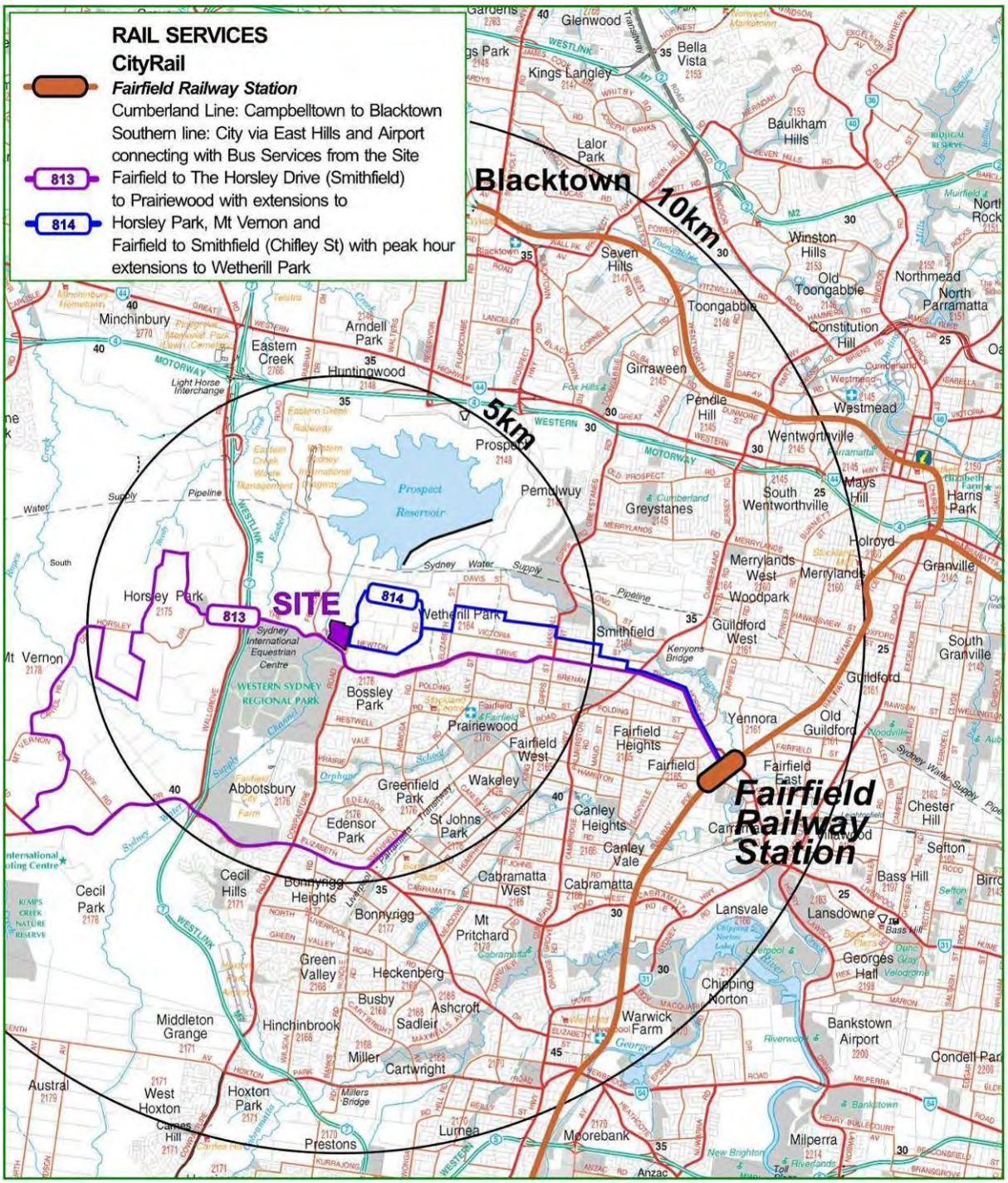

Figure 7 Rail Services

Figure 8: Cycleway Network

4.3 Existing Intersection Performances

To assess the operation of key intersections in the vicinity of the site, turning movements were surveyed at the critical intersections identified by the RMS during both the AM and PM Peak Periods. Signal Diagnostics were obtained from the RMS and these were used for the purpose of assessment. The key intersections analysed include:

- The Horsley Drive / Cowpasture Road
- The Horsley Drive / Ferrers Road
- The Horsley Drive / Westlink M7
- Cowpasture Road / Newton Road
- Cowpasture Road / Victoria Street.

The intersections were then analysed using the SIDRA computer program to determine their performance characteristics under existing traffic conditions. The SIDRA model produces a range of outputs, the most useful of which are the Degree of Saturation (DOS) and Average Vehicle Delay per vehicle (AVD). The AVD is in turn related to a level of service (LOS) criteria. These performance measures can be interpreted using the following explanations:

DOS - the DOS is a measure of the operational performance of individual intersections. As both queue length and delay increase rapidly as DOS approaches 1, it is usual to attempt to keep DOS to less than 0.9. When DOS exceeds 0.9 residual queues can be anticipated, as occurs at many major intersections throughout the metropolitan area during peak periods. In this regard, a practical limit of 1.1 can be assumed. For intersections controlled by roundabout or give way/stop control, satisfactory intersection operation is generally indicated by a DOS of 0.8 or less.

AVD - the AVD for individual intersections provides a measure of the operational performance of an intersection. In general, levels of acceptability of AVD for individual intersections depend on the time of day (motorists generally accept higher delays during peak commuter periods) and the road system being modelled (motorists are more likely to accept longer delays on side streets than on the main road system).

LOS - this is a comparative measure which provides an indication of the operating performance of an intersection as shown below:

Level of Service	Average Delay per Vehicle (sec/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control mode	At capacity and requires other control mode
F	More than 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires other control mode or major treatment.

A summary of the modelled results are provided in Table 1 below. Reference should also be made to the SIDRA outputs provided in **Appendix A** which provide detailed results for individual lanes and approaches.

It is evident from Table 1 that the network operates at a generally satisfactory level of service (LoS) during the AM and PM peak periods. It is however relevant that the LoS reported above does not accurately reflect the congestion within the network as it is a measurement of average performance across all approaches. In practice, some approaches operate with reduced LoS to that which is reported below.

Notwithstanding this, the most relevant use of the above is the comparison with the future operation of the network taking into account the proposed development yield. This is discussed further below.

Table 1: Existing Intersection Performance: AM and PM Peak Periods

Intersection Description	Control Type	Period	Degree of Saturation	Intersection Delay	Level of Service
The Horsley Drive / Westlink M7	Signals	AM	0.55	40.1	C
		PM	0.61	25.3	B
The Horsley Drive / Ferrers Road	Signal	AM	1.05	28.6	C
		PM	0.78	14.4	A
The Horsley Drive / Cowpasture Road	Priority	AM	1.04	55.5	D
		PM	0.88	34.0	C
The Horsley Drive / Cowpasture Road	Roundabout	AM	0.98	23.8	B
		PM	0.85	31.5	C
Cowpasture Road / Newton Road	Roundabout	AM	0.46	6.5	A
		PM	1.08	31.5	C
Cowpasture Road / Victoria Street.	Roundabout	AM	0.78	9.4	A
		PM	0.53	8.7	A

5. Proposed Concept Plan Application

5.1 Proposed Development

The WSPT is proposing to develop an industrial business park on the site, in a manner that is consistent with the vision, principles and strategic directions of the Parklands Plan of Management 2020. A detailed description of the Concept Plan Application is provided in the Environmental Impact Statement (EIS) prepared by McKenzie Group Consulting. In summary, the Concept Plan development for which approval is now sought comprises the following components:

- Subdivision of the site into eleven (11) development lots, an estate road and a service lot (stormwater).
- Demolition of all existing structures and remediation of land,
- Bulk and detailed earthworks,
- Construction of estate infrastructure, which will predominantly comprise warehousing distribution with ancillary office uses.
- Estate landscaping, and
- Provision of an internal estate road to serve the Business Park, which accesses the roundabout controlled intersection of Cowpasture Road and Newton Road.

The preliminary Concept Design is shown in **Appendix B** however, it is noted that aspects of the proposed development may be subject to change following detailed development design planning and environmental assessment.

6. Parking Requirements

The Concept Plan Application relates to bulk earthworks, infrastructure and subdivision only, however for the purpose of assessment a nominal gross floor area (GFA) of 95,400m^2 has been adopted to assess the parking requirements of the future development.

In this regard the Fairfield Council's DCP 12 stipulates a rate of 1 space per 80m^2 for Warehouse uses. This compares to a rate of 1 space per 300m^2 suggested for adoption in the RMS Guide to Traffic Generating Developments. Accordingly, having regard for the objectives of state planning policy as well as other precedents, a rate of 1 space per 200m^2 is proposed. A summary of these requirements is provided in **Table 2** below based on the indicative development yield of 95,400m^2.

Table 2: Council Parking Rates and Provision

Type	Number Attending	Council Parking Rates	Spaces Required
Fairfield Council	95,400m^2	1.0 spaces per 80m^2	1,193
RMS Guide	95,400m^2	1.0 spaces per 300m^2	318
Proposed Provision	95,400m^2	1.0 spaces per 200m^2	477

It is evident from Table 2 that the parking requirements under Council's DCP are excessive and represent a 375% increase over and above the suggested rates of the RMS. Accordingly adoption of the proposed rate of 1 space per 200m^2 is considered sufficient to accommodate the likely future demands of the precinct whilst achieving the planning objectives of the NSW Government.

The rate of 1 space per 200m^2 (or less) has also been adopted in other industrial precinct subdivisions within the Western Sydney Employment Area (WSEA) including areas within the Fairfield Council LGA. These include:

- Oakdale Central (MP08_0065) – 1 space per 200m^2
- Greystanes Southern Employment Lands (MP06_0181) - 1 space per 300m^2

The proposed parking provision of 1 space per 200m^2 is therefore consistent with previous approvals granted by the DoPI and adheres to the NSW Governments Strategic objectives.

Conversely, the provision of parking in accordance with Council's DCP would result in a considerable oversupply of parking and would generally encourage the use of private vehicles rather than alternative transport modes. Council's rate also reflects a provision some 375% greater than that which would be required under the RMS Guide to Traffic Generating Developments. Accordingly, the proposed rate is considered supportable having regard for the location and state objectives.

7. Traffic Modelling

7.1 Paramics

The DGR's require the future impacts of the development to be assessed using a four step strategic model. In this regard consultation was undertaken with the RMS regarding the strategic model and methodology to be adopted. Consequently the use of Paramics micro simulation model was considered the most suitable model for adoption.

The methodology and assumptions that were to underpin the analysis were confirmed in the above mentioned meeting. In general the following key aspects were identified:

- The scenarios to be investigated were to be as per the DGR's with the inclusion of an additional scenario being the Base Case + Background Traffic Growth following further consultation with the RMS. Accordingly the three Scenarios investigated include:
  - Existing Base Case
  - Existing Base Case + Growth
  - Existing Base Case + Growth + Development,
- Growth rates to be adopted were to be established through interpolation of RMS EMME2 data provided by the RMS.
- The traffic generation associated with the future development is to be assessed at the rate of 15 trips per hectare which is consistent with similar developments in the locality
- The base case model is to be independently reviewed prior to its use for scenario testing.

The results of the Paramics assessment and the methodology adopted are discussed further below.

7.2 Overview and Input Data for Base Case Models

7.2.1 Paramics Overview

Paramics is a micro simulation application that is used to replicate an areas transportation infrastructure in order to simulate the interactions of various modes of road traffic and other forms of transportation. This includes assessment of the combined effects of private vehicles, pedestrians and public transport modes (buses & rail). The program allows the user to examine a defined road network as a whole and accordingly the dynamic impacts on all intersections and vehicles within the network can be measured both numerically and visually.

Paramics allows the user to simulate the movement of each individual vehicle in a network with its individual characteristics and objectives relative to other vehicles, network constraints and environmental considerations such as acceleration and deceleration of vehicles, gap acceptance data, headways and cost impacts. This allows an analysis of queue build up and dispersion in addition to network congestion and overall levels of service.

7.2.2 Road Geometry

To identify existing road geometry, aerial photography was used and confirmed using signal layout plans and survey plans of the study area. This information was used to code the road network for the 'base' model. This provided relevant information to enable coding including lane widths, lane lengths, number of lanes, direction of travel, road positioning, speed limits, location of bus stops and intersection configurations. In addition to the above numerous site inspections were also undertaken to review parking and clearway restrictions as well as other relevant details such as traffic movement restrictions and signal phasings.

7.2.3 Traffic Signal Data

TCS and IDM data was provided by the RMS and utilised for all phase sequences of the signalised intersections of the M7 with The Horsley Drive, M7 with Wallgrove Road and The Horsley Drive with Cowpasture Road. LX Data was also provided by the RMS and utilised for intersection offsets. It should be noted that the signalised intersections in the network are all SCATS optimised signal timings are varied depending on demand. It is also noted that the maximum cycle time for all intersections was 120 seconds. Signal timings at intersections where IDM data was not available were recorded through on-site investigations.

7.2.4 Traffic Survey Data

Traffic surveys were undertaken at all critical intersections within the study area. The surveys that were undertaken are summarised below;

- Turning movement counts summarised into 15 minute intervals between 6:30am and 9:00am.
- Turning movement counts summarised into 15 minute intervals between 3:30pm and 6:00pm.
- Queue length surveys on all approaches at key intersections; and
- Pedestrian surveys at key intersections.

This data was then input into the model to provide the necessary information to allow the assessment to be undertaken. A copy of the AM and PM balanced count data is provided in **Appendix C.**

7.2.5 RMS Standard Files

The RMS provides a series of standard files for use in Paramics projects. These were used in both the AM and PM models and include the following:

- Categories,
- Configuration,
- Acceleration Profiles,
- Behaviour.

Changes to the vehicle file were undertaken to reflect the higher percentage of heavy vehicles that were observed during the traffic surveys. The vehicle proportions are discussed separately below.

7.3 Model Development

7.3.1 Network Coding

The network is shown in **Figure 9** below and includes all roads within the study area. The model was coded using aerial photographs of the area imported into Paramics and as such the model is at scale.

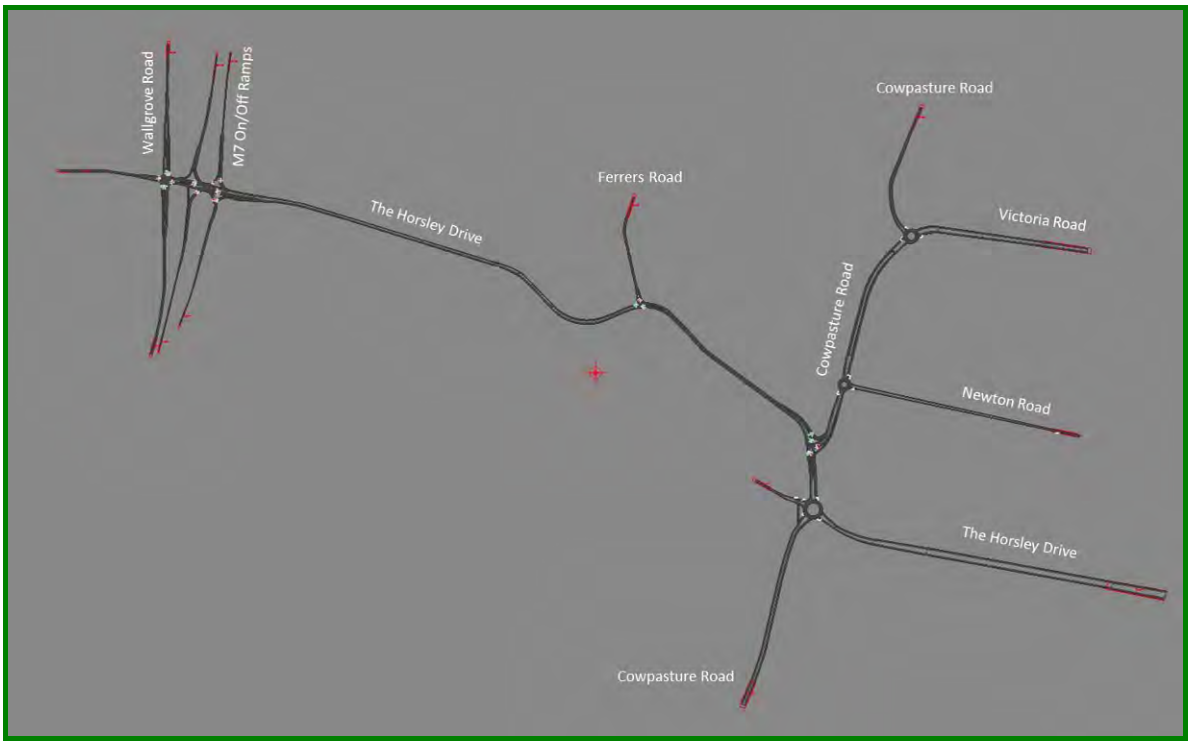

Figure 9: Extent of Model Network

7.3.2 Vehicle Classifications

The observed traffic counts differentiated between light vehicles and heavy vehicles, for the purpose of determining the percentage of heavy vehicles for adoption in the model. The traffic counts demonstrated a higher heavy vehicle percentage compared to the standard vehicle proportions provided in the RMS Guide to Paramics Microsimulation Modelling. In this regard, the standard vehicle proportions were modified to reflect the increased percentage of heavy vehicles observed through the network. The adopted vehicle proportions are provided in the Calibration Report included

in **Appendix D** below and demonstrate a heavy vehicle percentage of 8% for both the AM and PM models.

7.3.3 Peak Periods and Profiles

The traffic count data demonstrated the following AM and PM peak periods and accordingly, these time periods were adopted for the model:

- AM: 7:30am to 8:30am,
- PM: 3:30pm to 4:30pm.

Sufficient traffic count data was collected to allow traffic profiles to be established at 15 minute intervals over the AM and PM peak periods. These profiles were calculated by summing the approach volumes on all major intersections every 15 minutes and are provided in the calibration report provided in **Appendix D**.

7.4 Calibration and Validation

A summary of the critical inputs and calibration statistics is provided below. Reference should also be made to the detailed calibration report submitted with the base case models which is provided in **Appendix D**.

7.4.1 Estimation Inputs

The demand matrices were developed through the use of the Paramics Estimator tool that develops base case OD matrices by balancing turning counts, link flows and cordon flows. To assist in the process Pattern Matrices were also developed with the use of an R^2 statistical assessment through the utilisation of the observed link flows at the network boundary.

The link flow and turn count data used in the estimation were established by balancing the surveyed data for both the AM and PM peaks so that the flow out of an upstream intersection matched flows arriving at a downstream intersection. Estimator was then able to produce an initial matrix for the AM and PM peaks, these were then further refined during the calibration process.

7.4.2 Estimation Criteria and Validation

The criteria used to calibrate and validate the model have been adopted from the Paramics Microsimulation Modelling – RTA Manual which adopts the criteria outlined in the "UK Design Manual for Roads and Bridges". This document outlines a number of validation criteria that are to be adopted depending on the type and use of the model. The following criteria are relevant:

- Links:
  - Percentage within 20% or 200 vehicles per hour (target 95%)
  - Percentage within 10% or 100 vehicles per hour (target 90%)
  - Percentage within 5% or 50 vehicles per hour (target 85%)
- Intersection Counts:
  - Greater than 85% of all individual modelled flows to have a GEH of less than 5.
  - For observed flows less than 700 vehicles per hour, at least 85% of all individual flows to be within 100 vehicles per hour of observed flows.

The above criteria was achieved for both the AM and PM peak period models with the results summarised in **Table 3 and 4** below.

Table 3: Link Statistics

Estimation Criteria	AM	PM%
Links within 200 veh/hr of modelled flows	100%	100%
Links within 100 veh/hr of modelled flows	100%	100%
Links within 50 veh/hr of modelled flows	83%	89%
Number of links with GEH <5.0	100%	100%

Table 4: Turn Count Statistics

GEH	AM Period		PM Period	
	Number of Cases	Percentage	Number of Cases	Percentage
<2	40	68%	41	71%
2-5	17	98%	17	100%
5-10	1	2%	0	0%

It is evident that both Link and Turn flows for the base case scenarios exceed (are superior to) the minimum requirements as set out by the RTA and the model is therefore considered representative of observed conditions.

7.4.3 Travel Time Assessment

Travel times through the network were undertaken during the survey period and used to calibrate the model. Appropriate travel routes were tested depending on the critical route in each peak. Each travel route was measured between 2 to 3 times between 7:00am-8:00am and 4:00pm-5:00pm with the average of the three runs used for validation purposes. The respective times are provided within the calibration report included in Appendix D. For validation purposes modelled times within 15% of the surveyed times are considered acceptable. This was achieved for both the AM and PM peak periods with the largest variation between observed and modelled times being 10.9% in the AM peak and 8.5% in the PM peak.

7.4.4 Queue Length Assessment

A queue length assessment was undertaken for both the AM and PM models. The observed max queues were then compared to the 95% queues taken from the model. A summary of the critical AM and PM queues is provided in the Calibration Report =.

7.4.5 Model Stability

As required by the RMS an assessment of the model under 5 varying Seeds was undertaken. The AM and PM models were run for the 5 standard seed numbers (28, 2894, 560, 86524 and 7771)

defined in the RMS Paramics Modelling Guide, to ensure that the model is stable and robust. The results of this assessment are provided in the calibration report.

7.4.6 Base Case Network Results

The existing signal operations are discussed in Section 5.3 above and summarised below.

Table 5: Existing Intersection Operation

Intersection Description	Control Type	Period	Degree of Saturation	Intersection Delay	Level of Service
The Horsley Drive / Westlink M7	Signals	AM	0.55	40.1	C
		PM	0.61	25.3	B
The Horsley Drive / Ferrers Road	Signal	AM	1.05	28.6	C
		PM	0.78	14.4	A
The Horsley Drive / Cowpasture Road	Priority	AM	1.04	55.5	D
		PM	0.88	34.0	C
The Horsley Drive / Cowpasture Road	Roundabout	AM	0.94	19.4	B
		PM	0.85	31.5	C
Cowpasture Road / Newton Road	Roundabout	AM	0.46	6.5	A
		PM	1.08	31.5	C
Cowpasture Road / Victoria Street.	Roundabout	AM	0.78	9.4	A
		PM	0.53	8.7	A

The on-site investigations also identified a number of existing network operational issues relevant to the assessment. These are summarised below, separately for the AM and PM periods:

AM Peak

- Extensive queuing for southbound traffic along The Horsley Drive was observed on approach to the signalised intersection with Cowpasture Road. These queues are a direct result of the operation of the roundabout controlled junction of Cowpasture Road and The Horsley Drive where queues extend north to the signalised junction of Cowpasture Road and The Horsley Drive. The

intermediate road network between these two intersections operates with considerable delays and limits the discharge of southbound vehicles.

- Considerable northbound queues on Cowpasture Road on approach to its roundabout controlled junction with The Horsley Drive were observed. These queues are a result of the high right turn movement from The Horsley Drive which operates with minimal delays.

- Considerable delays were observed for northbound vehicles accessing Ferrers Road. These queues extended south for a considerable distance and impeded northbound movements of vehicles accessing the M7 and Wallgrove Road.

PM Peak

- Southbound queues on Cowpasture Road occurred between The Horsley Drive and Newton Road. These queues limited access to Cowpasture Road from Newton Road and resulted in extensive westbound queues and delays.

- Delays at the roundabout controlled junction of The Horsley Road and Cowpasture Road were observed. In particular southbound Queues on Cowpasture Road and westbound queues on The Horsley Drive.

A summary of the key network statistics for the Existing AM and PM base case model is provided below for comparison purposes:

Table 6: 2012 Key Network Statistics (Base Model Network)

Statistic	AM Peak	PM Peak
network traffic demand	6632	6722
average network speed	36 km/h	44 km/h
Average Network Link Delay	5.1 sec	4.7 sec

7.4.7 Independent Model Audit

As required by the RMS the model was independently audited to ensure the base case model was fit for purpose. As part of the submission a Calibration report was produced and submitted with the model. The independent assessment concluded that “the base models are well calibrated and acceptable for testing future scenarios”.

8. Traffic Impacts

8.1 Scenario Testing

As discussed above the RMS requested the following scenarios to be tested to establish the impacts of the proposed development on the existing road network:

- Scenario 1: Existing Base Case
- Scenario 2: Existing Base Case + Growth
- Scenario 3: Existing Base Case + Growth + Development

In addition to that identified above, an additional scenario being Existing Base Case + Development was also undertaken. The results of which are summarised below.

8.2 Traffic Generation and Distribution

As discussed above, the traffic impacts associated with the application were assessed based on a future traffic generation of 15 trips per hectare. This generation rate was recommended by the RMS and as such adopted. The overall site includes a site area of 21.4Ha and as such results in an overall generation of 321 vehicles per hour. These trips have been proportioned with 70:30 split in the direction of peak flow and results in the following generations:

- AM Peak: 225veh in : 96veh out, and
- PM Peak: 96veh in : 225veh out, and

The distribution of these trips onto the network was undertaken using the 2006 Journey to Work Data (JTWD) for Travel Zone 1042 which represents the significant industrial precinct directly to the east of the site. A summary of the JTWD analysis and future distribution is included in Appendix E and summarised below: It is noted that the direction of travel represents the likely routes to be adopted by vehicles entering/exiting the site.

Table 7: Travel Movements

Direction of Travel (To/From)	Route	Volume	%
North	M7 & Horsley Drive	3051	49%
South	Cowpasture Road	836	13%
West	N/A	NA	0%
East	The Horsley Drive & Victoria St	2322	37%
Total		6209	100%

8.3 Scenario 2 – Base Case plus Growth

8.3.1 2022 OD Matrix Development

The growth rates were established through the interpolation of the RMS EMME2 Data for the design years of 2016 and 2026. These growth rates were established for the major road corridors of Wallgrove Road and The Horsley Drive/Cowpasture Road for both the AM and PM Peak Periods. The growth annual growth rates applied were"

- Wallgrove Road:
  - Northbound: AM: 2.7% PM:2.9%
  - Southbound: AM: 1.3% PM:2.6%
- The Horsley Drive/Cowpasture Road:
  - Northbound: AM: 1.9% PM:1.0%
  - Southbound: AM: 1.2% PM:2.0%

These rates were then applied to the relevant existing OD matrices to establish the future year network

8.3.2 2022 Network Results

Once the 2022 OD Matrices were established the model was run using the base case model network with no infrastructure upgrades.

The modelling showed extensive queuing on Ferrers Road, Cowpasture Road and The Horsley Drive with a high number of unrealised vehicles at the end of the simulation period. Signal timings and some minor network upgrades were investigated however this resulted in no considerable change in the overall operation of the network under the future year scenario. The key network statistics are summarised below in Table 8:

Table 8: 2012 key network statistics (base model network)

Statistic	AM Peak	PM Peak
network traffic demand	7448	7569
average network speed	25 km/h	25 km/h
Average Network Link Delay	8.9sec	11.7sec

The considerable increase in congestion is generally contributed to the proximity of the roundabout controlled junction and signal controlled junction of Cowpasture Road and The Horsley Drive, and the inability to coordinate major movements. The model also demonstrated considerable increases in queue lengths in the PM peak period along the northern section of Cowpasture Road adjacent to the site. Screen shots of the AM and PM network are shown in **Figures 10** and **11** below.

Accordingly after consultation with the RMS, it was deemed that the only relevant scenario to be considered in further detail would be that of the existing + development due to the considerable delays and necessary infrastructure upgrades that would be required within the network to accommodate the estimated growth which is would be outside the scope of the applicant. That is, the provision of capacity improvements to accommodate network growth in the region is rightly the responsibility of Council and RMS in undertaking their strategic planning responsibilities.

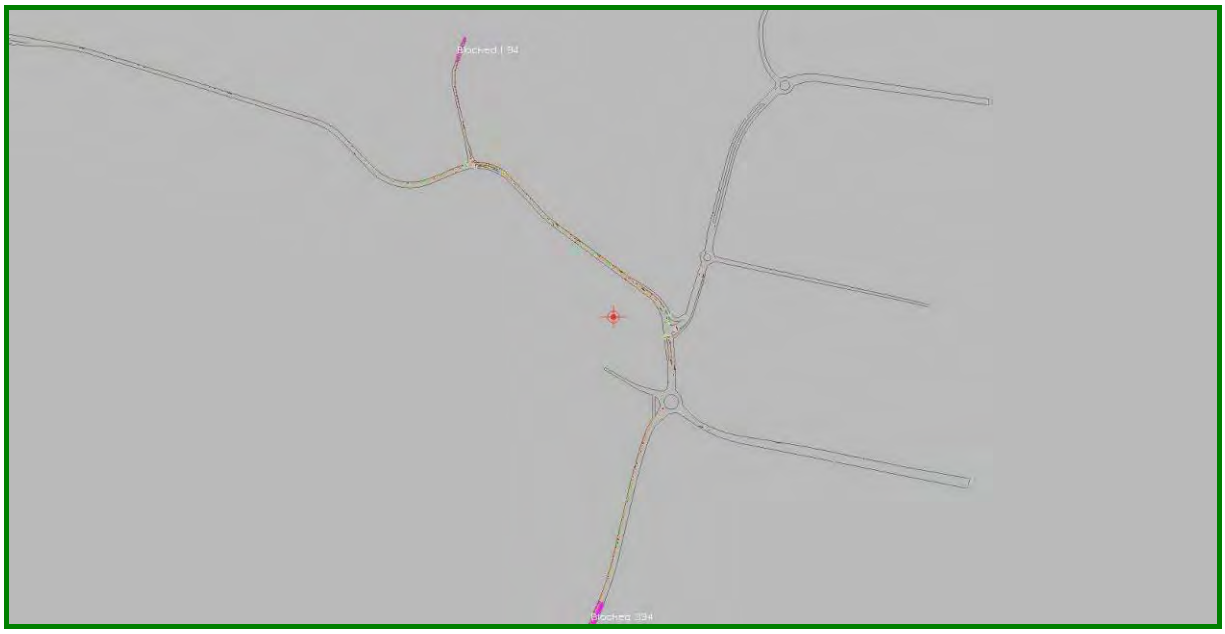

Figure 10: Scenario 1 Network Queues - AM

Figure 11: Scenario 1 Network Queues - PM

8.3.3 SIDRA Intersection Analysis

Due to the considerable queues, delays and blocking, it was not considered necessary to undertake a SIDRA intersection analysis of this Scenario.

8.4 Scenario 3 – Base Case plus Growth plus Development

8.4.1 Paramics Model

As discussed above, this Scenario was not assessed due to the considerable delays and queues measured in Scenario 2. This approach was confirmed with the RMS.

8.5 Scenario 4 – Base Case plus Development

8.5.1 Paramics Model

The estimated traffic generation and development yield were superimposed onto the existing Base Case network. The proposed access to the development was coded providing direct access from Cowpasture Road via the existing roundabout controlled junction with Newton Road. A new development zone – Zone 15, was also coded.

The model was run and indicated only minor increases in delays during the AM peak period. During the PM peak, increased delays and queues were recorded along the northern section of Cowpasture Road extending from The Horsley Drive to the east of its the intersection with Victoria Street . The model also indicated a increases in queues and delays along Newton Street and within the development.

Accordingly, upgrades to the existing network were investigated to maintain the existing LoS and delays through the network. The options tested included:

1. Provision of an additional access from The Horsley Drive to facilitate entry movements by southbound vehicles accessing the site.

2. Extension of the existing left turn auxiliary lanes on the Horsley Drive for vehicles turning east into Cowpasture Road.

3. Limiting exit movements from the proposed development to left out only onto Cowpasture Road.

4. Signalisation of the proposed future site access of Cowpasture Road and Newton Road.

These options were applied to the network to assess the benefits of each. The results of each option are summarised below:

- Options 1 and 2

Options 1 and 2 were implemented and resulted in no measureable improvement in the operation of the network during either the AM or PM peak periods. Accordingly, the implementation of these options is not recommended.

- Option 3

Option 3 investigated the impacts resulting from limiting all exit movements form the development to left out only onto Cowpasture Road. This requires all vehicles accessing the Horsley Drive undertake a U Turn manoeuvre at the intersection of Cowpasture Road and Victoria Street.

This option had no major impact on the AM peak period which operated generally as per the existing base case scenario however resulted in considerable delays southbound on Victoria Street during the PM peak period. The increased volume of the southbound through movement also resulted in increased delays to westbound vehicles on Newton Road.

It was evident that the majority of the queuing occurred as a result of residual queues from the signal controlled junction of Cowpasture Road and The Horsley Drive. Queues at this intersection currently extend to the intersection with Victoria Street and as such any spare capacity on this link is taken up from the least interrupted movements being the through movements from Cowpasture Road.

This option resulted in no major improvement in the road network to that achieved with full turning movements being permissible from the site access. As such this option has not been adopted.

- Option 4

Option 4 involved the signalisation of the existing roundabout controlled intersection of Cowpasture Road with Newton Road. The objective of this was to coordinate the major movements in the AM and PM peaks to reduce queues within Cowpasture Road. The key geometric and operational characterises of this option included:

1. Provision of a 120m right turn bay within Cowpasture Road to facilitate northbound traffic turning east into Newton Road
2. Provision of a 50m long right turn bay within Cowpasture Road to facilitate southbound traffic on Cowpasture Road turning west into the site
3. Signalised pedestrian crossings on the northern, eastern and western approaches.
4. The banning of all right turn and through movements from Newton Road onto Cowpasture Road
5. The banning of all right turn and through movements from the proposed site access
6. Signalisation of the existing left turn slip lane from Cowpasture Road to The Horsley Drive

The signalisation of the existing left turn slip lane referred to above was implemented after initial testing indicated that the left turn queues extended through the proposed intersection in the PM peak period in the Base Case + Development Scenario. The signalisation of this movement resulted in improved operation and reduced queues and was therefore adopted.

The signal phases associated with the proposed intersection were optimised in SIDRA with cycle times designed to match those achieved at the critical intersection of The Horsley Drive and Cowpasture Road. Signal off-sets between the proposed intersection and the existing intersection of Cowpasture Road and The Horsley Drive were manually varied in the model until the optimal arrangement was identified.

The implementation of the above network changes resulted in satisfactory operation of the network compared to Scenario 1 (base case model) during both the AM and PM peak periods. The phasing adopted for the proposed junction gave maximum green time to the northbound movement and right turn movement into Newton Street during the AM peak to ensure that queues did not extend to the intersection of The Horsley Drive. Similarly the phase times adopted in the PM peak gave priority to the southbound movement on Cowpasture Road and Newton Road to minimise queues and delays.

Accordingly the network upgrades identified in Scenario 4 were adopted.

8.5.2 Modelling Results of Adopted Network Upgrades

The geometric design of the proposed upgrades to the existing intersection of Cowpasture Road and Newton Road including the proposed site access is shown in **Figures 12** and **13** below. The design reflects the upgrades noted above, including the signalisation of the left turn slip lane at the critical intersection of The Horsley Drive and Cowpasture Road.

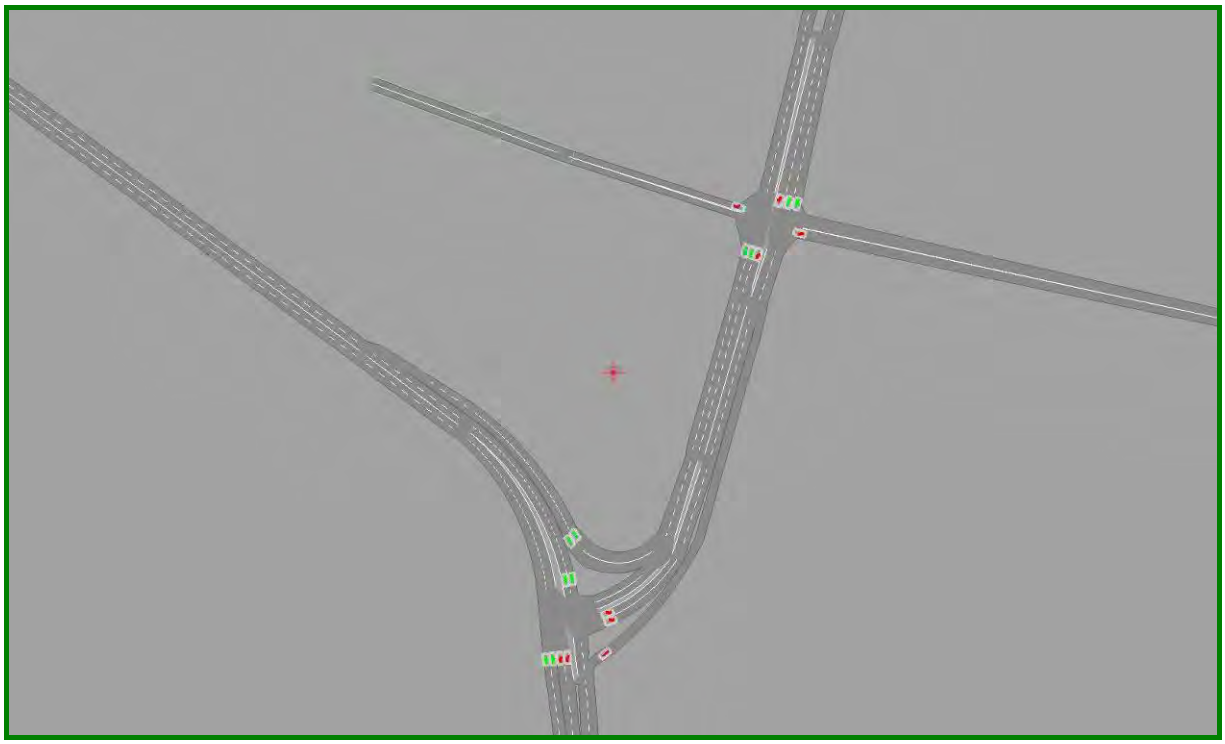

Figure 12: Proposed Network Upgrades

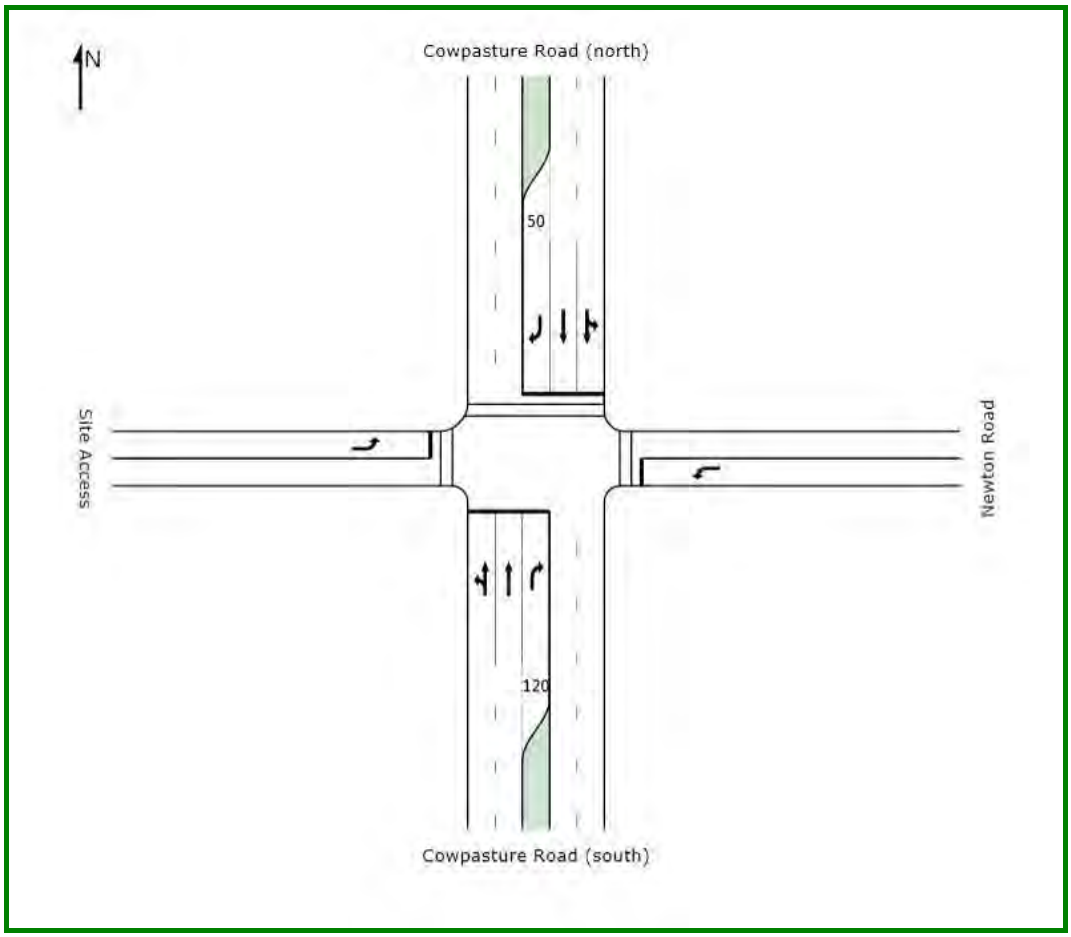

Figure 13: Proposed Intersection of Cowpasture Rd and Newton Rd Upgrades

The application seeks to ban the existing right turn movement from Newton Road onto Cowpasture Road. This is considered acceptable for the following reasons:

- This movement currently accommodates a low volume of vehicles surveyed as 17veh in the AM peak and 30veh in the PM peak.
- A number of alternate routes are available and as such coupled with the low volumes will have a negligible impact on the operation of existing intersections
- The banning of this movement results in a considerable improvement in the operation of the intersection and reduced delays to vehicles currently using Newton Road to that which would occur should the movement be retained.

- The proposed intersection geometry and banning of the right turn movement from Newton Street has been discussed with Council officers and is supported in principle, subject to review of critical data by Council.

Accordingly, the removal of the right turn movement is considered supportable based on the overall network improvements and delivers a significant network improvement with no unacceptable consequences. As such this has been included in all subsequent modelling. A summary of the key network statistics including these upgrades compared to those measured in the base case model are included below for both the AM and PM peak periods

Table 9: 2012 key network statistics (base model network)

Statistic	AM Peak		PM Peak	
	Existing	Future	Existing	Future
network traffic demand	6632	6902	6722	7044
average network speed	36 km/h	34 km/h	44 km/h	39.7km/h
Average Network Link Delay	5.1 sec	5.8 sec	4.7 sec	4.9 sec

Table 9 above demonstrates that the proposed variations have a minor impact on the overall delay and travel speeds within the network under both the AM and PM model. This level of delay is however considered supportable having regard for the congested nature of the network in both peaks.

The most relevant statistics are however the variations in travel times and intersection level of service. These are provided in the tables below. It should be noted that the signal timings at the intersections of Cowpasture Road with The Horsley Drive and Ferrers Road with The Horsley Drive were amended from the base case scenario to accommodate the additional traffic demand. These timings were however varied whilst still maintaining the maximum existing cycle times of 120seconds at each intersection. It is also noted that the signal times in the SIDRA analysis were optimised based on the adopted cycle times in the Paramics model. It is evident from Table 10 that the Intersection LoS is generally maintained in all scenarios with the exception of the following:

- The Horsley Drive & Cowpasture Road (signals) – LoS has reduced from “D” under existing conditions to “E” under the future scenario. This is however misleading as the reduced LoS is

associated with only a minor deterioration in delays. In this regard delays during the AM peak period have increased from 55.5sec to 57.7sec which represents an increase of only 2.2sec per vehicle.

- Cowpasture Road & Newton Road – The LoS at the intersection of Cowpasture Road and Newton Road has reduced from "A" in the under the existing scenario to "B" in the future. This is expected due to the signalisation of the intersection under the future scenario.

Table 10: Future Intersection Operation (Option 4)

Intersection Description	Control Type	Period	Degree of Saturation	Intersection Delay	Level of Service
The Horsley Drive / Westlink M7	Signals	EX AM	0.55	40.1	C
		EX PM	0.61	25.3	B
		FU AM	0.60	39.4	C
		FU PM	0.61	25.7	B
The Horsley Drive / Ferrers Road	Signals	EX AM	1.05	28.6	C
		EX PM	0.78	14.4	A
		FU AM	1.05	31.1	C
		FU PM	0.81	14.1	A
The Horsley Drive / Cowpasture Road	Signals	EX AM	1.04	55.5	D
		EX PM	0.88	34.0	C
		FU AM	1.05	57.7	E
		FU PM	0.91	40.6	C
The Horsley Drive / Cowpasture Road	Roundabout	EX AM	0.94	19.4	B
		EX PM	0.85	31.5	C
		FU AM	0.96	25.2	B
		FU PM	0.89	39.2	C
Cowpasture Road / Newton Road	Roundabout	EX AM	0.46	6.5	A
		EX PM	1.08	31.5	C
	Signals	FU AM	0.79	17.0	B
		FU PM	0.86	37.2	C
Cowpasture Road / Victoria Street.	Roundabout	EX AM	0.78	9.4	A
		EX PM	0.53	8.7	A
		FU AM	0.80	9.7	A
		FU PM	0.54	8.7	A

The relevant travel times for the AM peak periods are shown in Tables 11 and 12 respectively.

Table 11: AM Travel Time Statistics (Option 4)

Origin	Destination	Travel Times		ABS Difference	Diff (%)
		Existing	Future		
Horsley Drive – West of Wallgrove Rd	Cowpasture Road – South of The Horsley Drive	0:07:23	0:07:39	0:00:16	3.61%
	Horsley Drive – East of Cowpasture Rd	0:07:46	0:07:08	0:00:38	-8.15%
M7 Off Ramp - Southbound	Cowpasture Rd – South of The Horsley Dr	0:07:33	0:07:09	0:00:24	-5.30%
	Horsley Drive – East of Cowpasture Rd	0:07:37	0:07:09	0:00:28	-6.13%
M7 Off Ramp - Northbound	Cowpasture Road – South of The Horsley Drive	0:07:01	0:06:38	0:00:23	-5.46%
	Horsley Drive – East of Cowpasture Rd	0:07:04	0:06:43	0:00:21	-4.95%
Cowpasture Road – South of The Horsley Drive	M7 On Ramp - Northbound	0:05:20	0:05:04	0:00:16	-5.00%
	M7 On Ramp - Southbound	0:04:37	0:04:45	0:00:08	2.89%
Victoria Road – Southbound	Cowpasture Road – South of The Horsley Drive	0:02:57	0:03:13	0:00:16	9.04%
	M7 On Ramp - Northbound	0:04:55	0:05:56	0:01:01	20.68%
	M7 On Ramp - Southbound	0:04:54	0:04:54	0:00:00	0.00%
Newton Road - Westbound	Cowpasture Road – South of The Horsley Drive	0:02:19	0:02:53	0:00:34	24.46%
	M7 On Ramp - Northbound	0:04:35	0:05:07	0:00:32	11.64%
	M7 On Ramp - Southbound	0:04:03	0:04:36	0:00:33	13.58%
Ferrers Road	Cowpasture Road – South of The Horsley Drive	0:03:25	0:04:24	0:00:59	28.78%
	M7 On Ramp - Northbound	0:03:25	0:04:24	0:00:59	28.78%
Totals		**1:37:27**	**1:38:54**	**0:08:15**	**1.49%**

Table 12: PM Travel Time Statistics (Option 4)

Origin	Destination	Travel Times		ABS Difference	Diff (%)
		Existing	Future		
Horsley Drive – West of Wallgrove Rd	Cowpasture Road – South of The Horsley Drive	0:05:48	0:05:46	0:00:02	-0.57%
	Horsley Drive – East of Cowpasture Rd	0:05:41	0:05:48	0:00:07	2.05%
M7 Off Ramp - Southbound	Cowpasture Road – South of The Horsley Drive	0:04:57	0:04:59	0:00:02	0.67%
	Horsley Drive – East of Cowpasture Rd	0:04:53	0:05:08	0:00:15	5.12%
M7 Off Ramp - Northbound	Cowpasture Road – South of The Horsley Drive	0:05:24	0:05:24	0:00:00	0.00%
	Horsley Drive – East of Cowpasture Rd	0:05:06	0:05:17	0:00:11	3.59%
Cowpasture Road – South of The Horsley Drive	M7 On Ramp - Northbound	0:04:06	0:04:10	0:00:04	1.63%
	M7 On Ramp - Southbound	0:03:38	0:03:38	0:00:00	0.00%
Victoria Road – Southbound	Cowpasture Road – South of The Horsley Drive	0:04:13	0:04:14	0:00:01	0.40%
	M7 On Ramp - Northbound	0:05:40	0:05:54	0:00:14	4.12%
	M7 On Ramp - Southbound	0:05:13	0:05:23	0:00:10	3.19%
Newton Road - Westbound	Cowpasture Road – South of The Horsley Drive	0:06:27	0:03:31	0:02:56	-45.48%
	M7 On Ramp - Northbound	0:08:10	0:05:15	0:02:55	-35.71%
	M7 On Ramp - Southbound	0:08:03	0:04:49	0:03:14	-40.17%
Ferrers Road	Cowpasture Road – South of The Horsley Drive	0:03:11	0:03:16	0:00:05	2.62%
	M7 On Ramp - Northbound	0:03:14	0:03:12	0:00:02	-1.03%
Totals		1:39:09	1:31:36	0:11:01	-7.61%

Table 11 above demonstrates that the proposed development and the signalisation of the intersections of Cowpasture Road and Newton Road under Option 4 has only a minor impact on the network during the AM Peak Period. It is reiterated that the signal timings at some intersections were varied to accommodate the additional demand however these variations were generally to the detriment of the minor roads with priority given to the major through movements. In this regard the

major northbound and southbound movements are generally unchanged or improved with a maximum increased delay of 8 seconds for vehicles travelling from Cowpasture Road, south of the Horsley Drive to the M7 Motorway.

Some additional delays to movements from Ferrers Road were recorded however this was to improve the overall operation of The Horsley Drive. Travel times for vehicles traversing Victoria Road and Newton Road also increased, however this is to be expected as priority at the proposed intersection was given to the northbound vehicles to ensure queues did not extend south to The Horsley Drive.

The PM travel times detailed above in Table 12 demonstrate a reduction in the overall times through the network. The major northbound and southbound movements are generally unchanged (within 15 seconds of the base case scenario) however the signalisation has resulted in a considerable reduction in travel times for vehicles using Newton Road. The movements from Newton Road decreased by as much as 45% or 2:56 minutes from those recorded in the base case model. These reductions are a result of the improved ability for vehicles to exit Newton Road which was not previously possible due to the inability to coordinate major movements.

The Sidra intersection analysis results and proposed geometry and phase times are provided in **Appendices F and G** respectively.

8.6 Modelling Conclusions

The modeling was undertaken in accordance with the requirements of the DGR's and RMS. All scenarios required by the RMS for investigation were analyses and demonstrated that:

1. The existing network operates with limited spare capacity due to the interaction of the signalised intersection and roundabout controlled intersection of The Horsley Drive and Cowpasture Road. The inability to coordinate major movements at these intersection results in considerable delays and queues on some approaches.

2. There is insufficient capacity within the existing network to support the estimated growth as provided by the RMS. Accordingly infrastructure upgrades are required along The Horsley Drive and Cowpasture Road in the short to medium term to accommodate this growth.

3. The inability of the network to support the estimated growth resulted in only the Existing and the Existing + Development Traffic scenarios being assessed. The Existing + Growth and the Existing + Growth + Development scenarios provided inconsistent results which were deemed inappropriate for adoption or for reporting purposes.

4. The analysis demonstrated that whilst the network operates at a level approaching capacity, the additional generation of the site can be accommodated subject to the implementation of infrastructure upgrades including:

    - Signalisation of the existing roundabout controlled intersection of Cowpasture Road and Newton Road
    - Provision of a 120m right turn bay within Cowpasture Road to facilitate northbound traffic turning east into Newton Road
    - Provision of a 50m long right turn bay within Cowpasture Road to facilitate southbound traffic on Cowpasture Road turning west into the site
    - Signalised pedestrian crossings on the northern, eastern and western approaches.
    - The banning of all right turn and through movements from Newton Road onto Cowpasture Road
    - The banning of all right turn and through movements from the proposed site access
    - Signalisation of the existing left turn slip lane from Cowpasture Road to The Horsley Drive

Based on these improvements, the application is considered supportable on traffic planning grounds.

9. Alternative Transport Assessment

9.1.1 Achieving Target Mode Splits

The strategy to improve public transport facilities will be facilitated once the WSEA road network is further developed. These improved public transport facilities will assist in achieving a shift from private car usage, although this is not able to be quantified at this time. The following sections provide an overview of the existing public transport facilities and potential improvements that are available.

9.1.2 Bus Opportunities

The development benefits from existing bus services which operate along The Horsley Drive and Cowpasture Road, with two Bus Stops provided immediately adjacent to the south-eastern corner of the site. These services provide connections to such centres as Parramatta, Fairfield and Liverpool, as well as Fairfield Railway Station, which is located approximately 8 kilometres to the south-east of the site.

The Horsley Drive Business Park will itself result in a demand for additional bus services and frequencies. This demand will increase when account is taken of the cumulative effect of the proposed development and development of the WSEA more generally. The provision of these additional bus services and frequencies will therefore improve the accessibility of the site and promote a reduction in car dependency, in accordance with the State Planning Policy. In this regard, service improvements can be expected to respond to a demonstrated increase in demand over time.

9.1.3 Rail Opportunities

The Metropolitan Transport Plan produced in 2010 incorporates a ten year funding program which intends to provide a $4.5 billion Western Express City Rail Service. This service would significantly reduce commuting times between Western Sydney and the city. The project includes the construction of a new 5 kilometre tunnel linking Central Station with Redfern Station, Town Hall and Wynyard. This will allow express services from Richmond, Penrith, Blacktown and Parramatta to the Sydney CBD.

This will have a considerable impact on the accessibility of the subject site, noting the existing bus connections along Cowpasture Road and The Horsley Drive, with Fairfield Railway Station. It is

envisaged that a consolidated regional assessment would be undertaken as part of this proposal to ensure that improved services are provided to employment areas within Greater Western Sydney.

9.1.4 Cycling

The NSW Government's Metropolitan Plan for Sydney 2036 published in 2010, outlines the following objectives:

- The RMS in cooperation with local government is to continue to upgrade walking and cycling facilities, and
- That future planning of walking and cycling networks should be developed to ensure appropriate linkages with both existing and proposed public transport routes with the aim of improving overall network connectivity.

These objectives have been adopted in the NSW Bike Plan (2010) which outlines a ten-year bicycle infrastructure implementation schedule to improve the existing accessibility to local and regional bike networks. The plan states the RMS will provide on an average $5 million in 50/50 funding each year for the upgrade of cycleways and shared paths to local Councils. Additionally, the NSW Bike Plan seeks to deliver cycleways as an integrated component of road upgrades.

9.1.5 Cycling Opportunities

Cycleway / shared path upgrades are proposed by the RMS on Lenore Lane and Erskine Park Link Road (Northern Link Road) in Erskine Park and on The Horsley Drive. These will provide links to the Horsley Drive Business Park, existing commercial centres, the M7 motorway and provide a framework for the future cycleway development. It is noted that future cycleway development is dependent on future road construction and progressive development of the region.

In particular the existing M7 shared path which runs parallel to the M7 motorway between Prestons and West Baulkham Hills with an overall length of 40 kilometres provides extensive opportunities to implement future cycle networks in accordance with the objectives of the NSW Bike Plan. There are existing connections in the vicinity of the site at The Horsley Drive, Cowpasture Road, Chandos Road, The Austral Bricks access road, Wallgrove Road and Old Wallgrove Road. These connections provide a basis for potential future cycleway upgrades linking the WSEA.

The development proposes a link to the existing cycleway / shared path which is runs along the western side of the site, as shown in Figure 8. This link will further develop the cycleway / shared path network in the locality and promote alternative modes of transport.

The provision of adequate bicycle facilities including bicycle lockers / parking and showers will further encourage the use of the existing networks and will assist in the reduction of trips associated with private vehicles for the journey to work.

9.1.6 Walking

As is the case with cycleways, the NSW Government's Metropolitan Plan for Sydney 2036 seeks to improve local walking networks. Particular emphasis is placed on aligning pedestrian paths with existing public transport routes and providing pedestrian paths as an integrated part of road upgrades. Pedestrian facilities in the locality are comprised of short sections of walkways which are generally only provided adjacent to the signalised and roundabout controlled intersections of The Horsley Drive and Cowpasture Road. In this regard, the existing walkway facilities provide a poor level of amenity for pedestrians.

9.1.7 Walking Opportunities

The development will generate relatively low levels of walking demand within the Horsley Park area both to and from the site. Whilst the intention of this assessment is to encourage alternative modes of transport and specifically reduce dependency of vehicle users, it is evident that pedestrian linkages will not have any significant bearing on this objective, but will largely improve local accessibility. Nevertheless, it is acknowledged that footpaths will be provided throughout the development and along The Horsley Drive and Cowpasture Road. In addition to this, signalised pedestrian crossings will also be provided across the northern, eastern and western approaches to the proposed upgraded intersection of Cowpasture Road and Newton Road.

It is essential that the location of the Horsley Drive Business Park be placed into context with regard to pedestrian connectivity. Although it is unlikely that there will be any significant walking trips in the short to medium term, the construction of the pedestrian paths throughout the site, along The Horsley Drive and Cowpasture Road, will provide a link to the existing paths in the locality and provide a more integrated network. These facilities will also provide a safe path for pedestrians between the Horsley Drive Business Park and Bus Stops on The Horsley Drive.

9.2 Workplace Travel Plan

A Workplace Travel Plan (WTP) is the term used to describe the package of measures required by a development to promote alternative travel choices whilst reducing private vehicle usage. The WTP requires the implementation of initiatives and targets that will enable the Horsley Drive Business Park to reduce the impact of transport on the nearby environment. Such a plan is recommended to achieve the objectives of this assessment progressively over time, given the relative isolation of the subject site with respect to public transport. A suitable condition requiring this plan to be prepared and to be reviewed every 5 years is therefore considered appropriate. The plan will therefore be able to evolve in line with the ongoing development of the WSEA and the progressive implementation of public transport and other infrastructure improvements. The plan should be issued to all staff and provided in common areas and should include a Travel Information Pack as part staff induction procedures. The following initiatives should be considered:

- Local bus network maps and timetables.
- Rail network maps and timetables.
- Cycle route maps.
- Location of critical services within walking distances.
- Taxi contact numbers.

In addition opportunity exists to implement initiatives to further reduce car dependency. Initiatives implemented at similar developments which have resulted in a demonstrated reduction in car trips include:

- Promoting a car-pooling scheme for work related journeys.
- Staff sharing scheme for fleet vehicles.
- Use of taxis for work related journeys.
- Provision of a mini-bus facility and interchange area.
- Possible shuttle bus services from Fairfield Railway Station.
- Providing staff with a discount or subsidy on public transport costs.

- Employee cycling allowance.
- Provision of on-site facilities, which may include change rooms, showers, lockers and storage facilities, to encourage cycling and walking as a mode of transport.

The implementation of a shuttle bus services from Fairfield Railway Station or bus interchanges and the encouragement of car pooling is a realistic method of reducing private vehicle usage given the overall accessibility to public transport. It is therefore recommended that these services be encouraged. It is however acknowledged that the implementation of these services would be the responsibility of tenants. Having regard for the above, it is expected that a Workplace Travel Plan for staff would be prepared for all developments within the precinct, prior to issue of an occupation certificate. The transport options currently available to commuters are inhibited by a lack of development within the area, and the progressive construction of the surrounding infrastructure.

10. Conclusions

In summary:

- The application seeks approval for the subdivision and construction of major services including roads. The application does not seek approval for the construction of any built form.
- The impacts associated with the future use of the site, has been assessed in accordance with the requirements of the DGR's. A meeting was held with the RMS to confirm these requirements and the proposed methodology adopted in this report.
- The proposed parking provision of 1 space per 200m^2 is consistent with previous approvals granted by the DoPI and adheres to the NSW Governments Strategic objectives. The provision of parking in accordance with Council's DCP would result in a considerable oversupply of parking and would generally encourage the use of private vehicles rather than alternative transport modes. Council's rate also reflects a provision some 375% greater than that which would be required under the RMS Guide to Traffic Generating Developments. Accordingly, the proposed rate is considered supportable having regard for the location and state objectives.
- The impacts associated with the proposed development have been assessed using both SIDRA and Paramics. The modelling demonstrated that the proposed development will have only a minor impact on the operation of the network subject to the implementation of infrastructure upgrades identified above. These upgrades include the signalisation of the intersection of Cowpasture Road with Newton Road and the signalisation of the existing left turn slip lane from Cowpasture Road onto The Horsley Drive.
- It is recommended that a transport access guide (TAG) be developed and displayed in common areas. The aim of this is to inform residents of the alternative transport options available to them and the location of critical services. This will encourage the use of alternative transport modes and will assist in the reduction of private vehicle trips.

It is therefore concluded that the proposed development concept envisaged under the Subdivision Plan is supportable on traffic planning grounds and the proposed development will operate satisfactorily. Further detailed planning and refinement will continue through the subsequent development application process, within the context of this Concept Plan. .

Appendix A

MOVEMENT SUMMARY

Site: M7 On/Off - Ramp / The Horsley Drive - EX AM

M7 and The Horlsey Drive, Horsley Park
Existing - AM
Signals - Fixed Time Cycle Time = 110 seconds (User-Given Cycle Time)

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: M7 On / Off-Ramp (South)											
S_L	L	59	8.0	0.056	11.7	LOS A	0.6	4.2	0.26	0.69	42.6
S_R	R	484	8.0	0.536	44.0	LOS D	11.3	84.8	0.92	0.81	18.1
Approach		543	8.0	0.536	40.5	LOS C	11.3	84.8	0.84	0.79	19.5
East: The Horsley Drive											
E_L	L	157	8.0	0.309	20.3	LOS B	3.7	27.7	0.48	0.73	45.0
E_T	T	483	8.0	0.473	40.0	LOS C	10.9	81.4	0.89	0.78	29.7
6	R	251	8.0	0.250	41.0	LOS C	5.2	38.9	0.81	0.76	32.6
Approach		891	8.0	0.473	36.8	LOS C	10.9	81.4	0.79	0.77	32.8
North: M7 On / Off-Ramp (North)											
N_L	L	537	8.0	0.547	45.9	LOS D	12.6	94.0	0.90	0.83	19.7
N_R	R	37	8.0	0.082	38.9	LOS C	1.5	11.2	0.79	0.69	19.7
Approach		574	8.0	0.547	45.5	LOS D	12.6	94.0	0.89	0.82	19.7
West: The Horsley Drive											
W_L	L	25	8.0	0.023	10.7	LOS A	0.2	1.1	0.18	0.67	54.3
W_T	T	565	8.0	0.553	41.0	LOS C	13.1	97.9	0.91	0.80	29.3
12	R	34	8.0	0.090	38.6	LOS C	0.7	5.5	0.75	0.66	33.7
Approach		624	8.0	0.553	39.6	LOS C	13.1	97.9	0.87	0.79	30.2
All Vehicles		2632	8.0	0.553	40.1	LOS C	13.1	97.9	0.84	0.79	27.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	11	2.2	LOS A	0.0	0.0	0.20	0.20
P2	Across S approach	11	32.1	LOS D	0.0	0.0	0.76	0.76
P5	Across N approach	11	10.0	LOS B	0.0	0.0	0.43	0.43
P6	Across N approach	11	32.1	LOS D	0.0	0.0	0.76	0.76
All Pedestrians		44	19.1	LOS B			0.54	0.54

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: M7 On/Off - Ramp / The Horsley Drive - EX PM

M7 and The Horlsey Drive, Horsley Park
Existing - AM
Signals - Fixed Time Cycle Time = 95 seconds (Optimum Cycle Time - Minimum Delay)

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: M7 On / Off-Ramp (South)											
S_L	L	49	8.0	0.057	13.8	LOS A	0.9	6.4	0.57	0.73	39.6
S_R	R	182	8.0	0.427	48.5	LOS D	4.2	31.4	0.99	0.78	16.8
Approach		232	8.0	0.427	41.1	LOS C	4.2	31.4	0.90	0.77	19.5
East: The Horsley Drive											
E_L	L	440	8.0	0.608	15.9	LOS B	7.3	54.7	0.49	0.76	48.8
E_T	T	757	8.0	0.384	18.1	LOS B	10.3	77.2	0.64	0.68	42.9
6	R	477	8.0	0.473	24.8	LOS B	5.9	43.9	0.87	0.79	41.4
Approach		1674	8.0	0.608	19.4	LOS B	10.3	77.2	0.66	0.73	43.9
North: M7 On / Off-Ramp (North)											
N_L	L	273	8.0	0.290	26.1	LOS B	3.5	26.5	0.90	0.79	28.6
N_R	R	44	8.0	0.208	46.9	LOS D	2.0	14.8	0.97	0.74	17.2
Approach		317	8.0	0.290	29.0	LOS C	3.5	26.5	0.91	0.78	26.4
West: The Horsley Drive											
W_L	L	54	8.0	0.057	11.7	LOS A	0.5	3.4	0.27	0.68	53.1
W_T	T	569	8.0	0.516	34.1	LOS C	11.1	82.9	0.88	0.79	32.4
12	R	35	8.0	0.101	48.5	LOS D	0.8	6.2	0.91	0.69	29.7
Approach		658	8.0	0.516	33.0	LOS C	11.1	82.9	0.84	0.77	33.5
All Vehicles		2880	8.0	0.608	25.3	LOS B	11.1	82.9	0.75	0.75	37.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	11	2.5	LOS A	0.0	0.0	0.23	0.23
P2	Across S approach	11	26.5	LOS C	0.0	0.0	0.75	0.75
P5	Across N approach	11	18.3	LOS B	0.0	0.0	0.62	0.62
P6	Across N approach	11	26.5	LOS C	0.0	0.0	0.75	0.75
All Pedestrians		44	18.5	LOS B			0.59	0.59

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Horsley Dr & Cowpasture Rd - EX AM

Horsley Drive and Cowpasture Rd
Signals - Fixed Time Cycle Time = 115 seconds (Optimum Cycle Time - Minimum Delay)

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: The Horsley Drive (south)											
2	T	1155	8.0	0.387	3.2	LOS A	8.9	66.3	0.30	0.27	46.8
3	R	467	8.0	1.000[3]	91.2	LOS F	19.6	146.9	1.00	1.05	8.8
Approach		1622	8.0	1.000	28.6	LOS C	19.6	146.9	0.50	0.50	20.9
East: Cowpasture Road											
4	L	165	8.0	0.271	35.1	LOS C	7.1	53.2	0.87	0.79	20.1
6	R	291	8.0	0.951	82.6	LOS F	9.9	74.3	1.00	1.09	10.8
Approach		456	8.0	0.951	65.3	LOS E	9.9	74.3	0.95	0.98	13.0
North: The Horsley Drive (north)											
7	L	893	8.0	0.510	15.0	LOS B	9.7	72.8	0.43	0.72	42.9
8	T	1213	8.0	1.038	117.8	LOS F	62.9	470.6	1.00	1.54	13.8
Approach		2105	8.0	1.038	74.2	LOS F	62.9	470.6	0.76	1.20	19.5
All Vehicles		4183	8.0	1.038	55.5	LOS D	62.9	470.6	0.68	0.90	19.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	Across E approach	11	16.2	LOS B	0.0	0.0	0.53	0.53
All Pedestrians		11	16.2	LOS B			0.53	0.53

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Horsley Dr & Cowpasture Rd - EX PM

Horsley Drive and Cowpasture Rd
Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

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: The Horsley Drive (south)											
2	T	1040	8.0	0.463	12.9	LOS A	14.8	110.8	0.61	0.54	30.7
3	R	144	8.0	0.718	66.6	LOS E	4.0	30.1	1.00	0.84	11.5
Approach		1184	8.0	0.718	19.4	LOS B	14.8	110.8	0.65	0.58	25.5
East: Cowpasture Road											
4	L	609	8.0	0.748	33.4	LOS C	23.7	177.1	0.99	0.99	21.0
6	R	914	8.0	0.881	56.3	LOS D	25.9	194.1	1.00	0.98	14.7
Approach		1523	8.0	0.881	47.1	LOS D	25.9	194.1	0.99	0.98	16.7
North: The Horsley Drive (north)											
7	L	300	8.0	0.131	9.6	LOS A	1.4	10.5	0.20	0.65	47.9
8	T	1306	8.0	0.875	37.4	LOS C	35.7	266.8	0.97	1.01	33.2
Approach		1606	8.0	0.875	32.3	LOS C	35.7	266.8	0.83	0.94	34.8
All Vehicles		4314	8.0	0.881	34.0	LOS C	35.7	266.8	0.84	0.85	26.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	Across E approach	11	20.7	LOS C	0.0	0.0	0.63	0.63
All Pedestrians		11	20.7	LOS C			0.63	0.63

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Newton Dr - EX AM

Cowpasture Road & Newton Road
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: Cowpasture Road (south)											
2	T	723	8.0	0.456	3.6	LOS A	3.8	28.1	0.15	0.34	41.4
3	R	757	8.0	0.456	9.1	LOS A	3.8	28.1	0.13	0.62	41.2
Approach		1480	8.0	0.456	6.4	LOS A	3.8	28.1	0.14	0.48	41.3
East: Newton Road											
4	L	273	8.0	0.279	5.4	LOS A	1.5	11.1	0.40	0.53	43.3
6	R	18	8.0	0.279	10.0	LOS A	1.5	11.1	0.40	0.75	41.0
Approach		291	8.0	0.279	5.6	LOS A	1.5	11.1	0.40	0.54	43.1
North: Cowpasture Road (south)											
7	L	75	8.0	0.163	8.7	LOS A	0.9	6.7	0.66	0.73	41.8
8	T	183	8.0	0.163	7.8	LOS A	0.9	6.7	0.66	0.70	42.1
Approach		258	8.0	0.163	8.1	LOS A	0.9	6.7	0.66	0.71	42.0
All Vehicles		2028	8.0	0.456	6.5	LOS A	3.8	28.1	0.24	0.52	41.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Newton Dr - EX PM

Cowpasture Road & Newton Road
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: Cowpasture Road (south)											
2	T	218	8.0	0.144	3.6	LOS A	1.0	7.2	0.16	0.34	41.3
3	R	226	8.0	0.144	9.1	LOS A	1.0	7.2	0.15	0.61	41.1
Approach		444	8.0	0.144	6.4	LOS A	1.0	7.2	0.16	0.48	41.2
East: Newton Road											
4	L	534	8.0	1.079	99.9	LOS F	37.8	282.6	1.00	3.56	14.7
6	R	32	8.0	1.079	104.5	LOS F	37.8	282.6	1.00	3.56	15.0
Approach		565	8.0	1.079	100.1	LOS F	37.8	282.6	1.00	3.56	14.7
North: Cowpasture Road (north)											
7	L	44	8.0	0.537	5.9	LOS A	2.5	18.9	0.44	0.60	43.4
8	T	989	8.0	0.537	4.7	LOS A	2.5	18.9	0.44	0.49	43.7
Approach		1034	8.0	0.537	4.8	LOS A	2.5	18.9	0.44	0.49	43.6
All Vehicles		2043	8.0	1.079	31.5	LOS C	37.8	282.6	0.53	1.34	27.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Horsley Drive - EX AM

Cowpasture Rd & Horsley Drive
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: Cowpasture Road											
2	T	1016	8.0	0.929	18.3	LOS B	16.7	124.8	1.00	1.35	43.5
3	R	655	8.0	0.929	27.8	LOS B	16.0	119.6	1.00	1.37	38.5
Approach		1671	8.0	0.929	22.0	LOS B	16.7	124.8	1.00	1.36	41.3
East: The Horsley Drive (east)											
4	L	161	8.0	0.327	7.0	LOS A	2.8	20.8	0.66	0.60	47.5
5	T	2	8.0	0.327	5.3	LOS A	2.8	20.8	0.66	0.53	47.5
6	R	604	8.0	0.327	13.6	LOS A	2.8	20.8	0.67	0.72	44.3
Approach		767	8.0	0.327	12.2	LOS A	2.8	20.8	0.67	0.69	44.9
North: The Horsley Drive (north)											
7	L	980	8.0	0.941	25.1	LOS B	24.5	183.4	0.95	1.35	23.6
8	T	398	8.0	0.522	8.6	LOS A	4.2	31.3	0.72	0.77	39.5
9	R	1	8.0	0.522	16.4	LOS B	4.2	31.3	0.72	0.99	35.1
Approach		1379	8.0	0.941	20.3	LOS B	24.5	183.4	0.88	1.18	26.7
West: Park Access											
10	L	2	8.0	0.017	9.6	LOS A	0.1	0.7	0.89	0.77	20.2
11	T	1	8.0	0.017	9.4	LOS A	0.1	0.7	0.89	0.76	20.2
12	R	2	8.0	0.017	14.6	LOS B	0.1	0.7	0.89	0.85	20.8
Approach		5	8.0	0.017	11.6	LOS A	0.1	0.7	0.89	0.80	20.5
All Vehicles		3822	8.0	0.941	19.4	LOS B	24.5	183.4	0.89	1.16	38.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Horsley Drive - EX PM

Cowpasture Rd & Horsley Drive
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: Cowpasture Road											
2	T	435	8.0	0.424	7.0	LOS A	2.7	20.0	0.75	0.60	52.2
3	R	286	8.0	0.424	15.5	LOS B	2.5	18.7	0.75	0.92	47.1
Approach		721	8.0	0.424	10.4	LOS A	2.7	20.0	0.75	0.73	49.9
East: The Horsley Drive (east)											
4	L	458	8.0	0.845	68.7	LOS E	44.9	335.6	1.00	1.29	20.8
5	T	4	8.0	0.845	67.1	LOS E	44.9	335.6	1.00	1.29	20.8
6	R	743	8.0	0.845	91.1	LOS F	44.9	335.6	1.00	1.47	18.5
Approach		1205	8.0	0.845	82.5	LOS F	44.9	335.6	1.00	1.40	19.3
North: The Horsley Drive (north)											
7	L	816	8.0	0.727	9.0	LOS A	8.2	61.3	0.58	0.68	38.8
8	T	1100	8.0	0.777	6.6	LOS A	10.5	78.8	0.59	0.60	41.1
9	R	1	8.0	0.777	14.4	LOS A	10.5	78.8	0.59	0.92	36.8
Approach		1917	8.0	0.777	7.6	LOS A	10.5	78.8	0.59	0.63	40.1
West: Park Access											
10	L	6	8.0	0.024	4.9	LOS A	0.1	0.8	0.72	0.65	21.3
11	T	6	8.0	0.024	4.7	LOS A	0.1	0.8	0.72	0.64	21.2
12	R	1	8.0	0.024	10.0	LOS A	0.1	0.8	0.72	0.91	21.8
Approach		14	8.0	0.024	5.2	LOS A	0.1	0.8	0.72	0.67	21.3
All Vehicles		3857	8.0	0.845	31.5	LOS C	44.9	335.6	0.75	0.89	28.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Ferrers Rd & Horsley Dr - EX AM

Ferrers Rd & Horsley Dr
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

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
East: Horsley Drive (east)											
5	T	866	8.0	0.344	0.6	LOS A	1.8	13.7	0.08	0.07	67.9
6	R	459	8.0	1.045	120.7	LOS F	38.4	287.1	1.00	1.19	15.0
Approach		1325	8.0	1.045	42.2	LOS C	38.4	287.1	0.40	0.45	30.7
North: Ferrers Road											
7	L	557	8.0	0.672	18.3	LOS B	16.7	124.9	0.75	0.80	34.9
9	R	24	8.0	0.197	56.8	LOS E	1.2	9.0	0.99	0.71	21.1
Approach		581	8.0	0.672	19.9	LOS B	16.7	124.9	0.76	0.80	34.0
West: Horsley Drive (west)											
10	L	38	8.0	0.793	30.1	LOS C	31.2	233.7	0.86	0.96	39.5
11	T	1548	8.0	0.793	20.2	LOS B	31.5	235.6	0.87	0.80	40.7
Approach		1586	8.0	0.793	20.5	LOS B	31.5	235.6	0.87	0.81	40.6
All Vehicles		3493	8.0	1.045	28.6	LOS C	38.4	287.1	0.67	0.67	35.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	5	13.0	LOS B	0.0	0.0	0.51	0.51
All Pedestrians		5	13.0	LOS B			0.51	0.51

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Ferrers Rd & Horsley Dr - EX PM

Ferrers Rd & Horsley Dr
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

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
East: Horsley Drive (east)											
5	T	1609	8.0	0.569	1.9	LOS A	4.2	31.7	0.18	0.17	64.7
6	R	344	8.0	0.784	51.0	LOS D	16.2	120.9	0.96	0.88	27.5
Approach		1954	8.0	0.784	10.6	LOS A	16.2	120.9	0.32	0.29	52.4
North: Ferrers Road											
7	L	600	8.0	0.593	11.2	LOS A	12.3	91.7	0.55	0.73	39.5
9	R	64	8.0	0.411	48.2	LOS D	3.0	22.2	0.96	0.75	23.2
Approach		664	8.0	0.593	14.8	LOS B	12.3	91.7	0.59	0.73	37.0
West: Horsley Drive (west)											
10	L	18	8.0	0.601	31.1	LOS C	18.4	137.5	0.79	0.96	38.6
11	T	1006	8.0	0.601	21.3	LOS B	18.6	139.0	0.80	0.71	40.2
Approach		1024	8.0	0.601	21.5	LOS B	18.6	139.0	0.80	0.71	40.1
All Vehicles		3642	8.0	0.784	14.4	LOS A	18.6	139.0	0.50	0.49	45.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	5	17.4	LOS B	0.0	0.0	0.59	0.59
All Pedestrians		5	17.4	LOS B			0.59	0.59

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Victoria St & Cowpasture Rd - EX AM

Victoria Street & Cowpasture Road
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: Cowpasture Road (south)											
1	L	247	8.0	0.256	6.6	LOS A	1.6	11.6	0.31	0.52	49.8
2	T	494	8.0	0.256	5.4	LOS A	1.6	11.6	0.32	0.45	50.6
Approach		741	8.0	0.256	5.8	LOS A	1.6	11.6	0.32	0.47	50.4
North: Victoria Street											
8	T	156	8.0	0.109	5.2	LOS A	0.6	4.1	0.25	0.43	51.2
9	R	127	8.0	0.109	11.8	LOS A	0.5	4.1	0.26	0.65	45.6
Approach		283	8.0	0.109	8.2	LOS A	0.6	4.1	0.26	0.53	48.4
West: Cowpasture Road (west)											
10	L	585	8.0	0.781	12.8	LOS A	8.2	61.6	0.84	1.05	44.4
12	R	102	8.0	0.781	18.5	LOS B	8.2	61.6	0.84	1.11	41.6
Approach		687	8.0	0.781	13.7	LOS A	8.2	61.6	0.84	1.06	44.0
All Vehicles		1712	8.0	0.781	9.4	LOS A	8.2	61.6	0.52	0.72	47.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Victoria St & Cowpasture Rd - EX PM

Victoria Street & Cowpasture Road
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: Cowpasture Road (south)											
1	L	87	8.0	0.116	7.8	LOS A	0.7	5.5	0.59	0.63	48.2
2	T	162	8.0	0.116	7.0	LOS A	0.7	5.5	0.60	0.60	48.6
Approach		249	8.0	0.116	7.3	LOS A	0.7	5.5	0.59	0.61	48.5
North: Victoria Street											
8	T	832	8.0	0.533	6.1	LOS A	3.8	28.2	0.52	0.53	49.1
9	R	467	8.0	0.533	12.9	LOS A	3.7	27.6	0.53	0.74	45.0
Approach		1299	8.0	0.533	8.6	LOS A	3.8	28.2	0.52	0.61	47.5
West: Cowpasture Road (west)											
10	L	164	8.0	0.351	6.6	LOS A	2.0	15.1	0.40	0.53	49.0
12	R	226	8.0	0.351	12.3	LOS A	2.0	15.1	0.40	0.71	45.4
Approach		391	8.0	0.351	9.9	LOS A	2.0	15.1	0.40	0.64	46.8
All Vehicles		1939	8.0	0.533	8.7	LOS A	3.8	28.2	0.51	0.61	47.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Appendix B

Western Sydney Parklands

STAGE 1 - PROPOSED DEVELOPMENT SITE AREAS

LOT No.	SITE AREA
LOT 1-1	13 567 m2
LOT 1-2	16 417 m2
LOT 1-3	19 190 m2
OSD BASIN	1 780 m2
ACCESS ROAD	6 994 m2
SUBTOTAL	57 948 m2

STAGE 2 - PROPOSED DEVELOPMENT SITE AREAS

LOT No.	SITE AREA
LOT 2-1	19 014 m2
LOT 2-2	20 029 m2
LOT 2-3	10 297 m2
LOT 2-4	25 384 m2
SUBTOTAL	74 724 m2

STAGE 3 - PROPOSED DEVELOPMENT SITE AREAS

LOT No.	SITE AREA
LOT 3-1	15 447 m2
LOT 3-2	30 922 m2
LOT 3-3	9 894 m2
LOT 3-4	9 923 m2
LOT 3-5	9 976 m2
ACCESS ROAD	6 789 m2
SUBTOTAL	82 951 m2
TOTAL	**215 623 m2**

DEVELOPMENT DATA

TOTAL SITE AREA	215 623 m2
TOTAL ACCESS ROAD	13 783 m2
OSD BASIN	1780 m2
DEVELOPABLE SITE AREA (INCLUDING LANDSCAPE AREA)	200 060 m2

NOTE:
DRAINAGE CHANNEL EXCLUDED FROM TOTAL SITE AREA

NSW GOVERNMENT Western Sydney Parklands Trust

hansen yuncken BUILDING VALUE

project
HORSLEY DRIVE BUSINESS PARK
CNR HORSLEY DRIVE & COWPASTURE ROAD, WETHERILL PARK, NSW

CONCEPTARCHITECTURE P/L
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title
CONCEPT
LOT PLAN

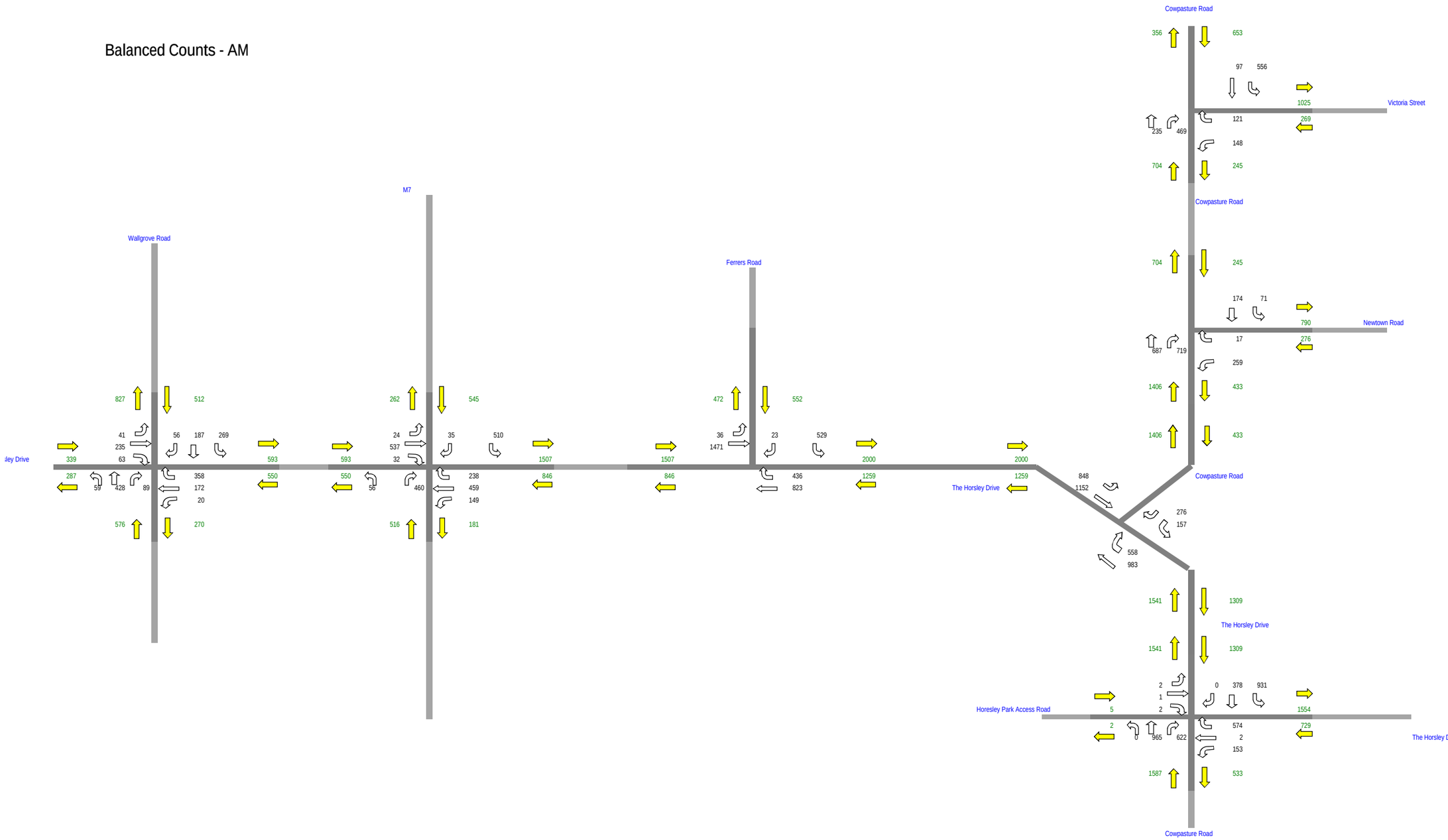
date 23.05.2012

scale 1:1500 @ A1

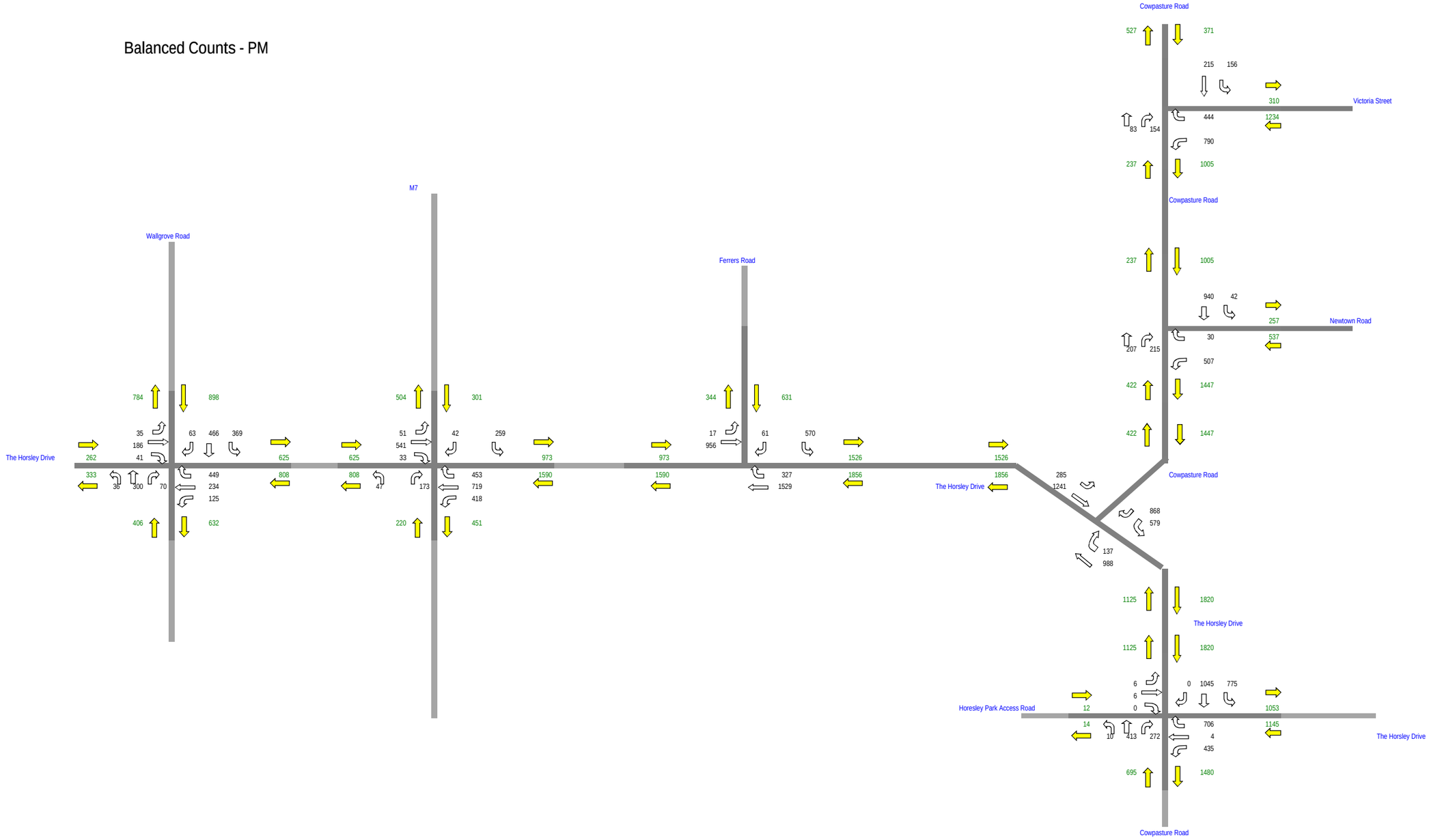
drawing no. HY-HW-MP-004 rev A

Appendix C

Balanced Counts - AM



Balanced Counts - PM



Appendix D

Ref 12.096l01v1

traffix
traffic & transport planners

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17 May 2012

Bitzios Consulting
Studio 23, 3 Gladston Street
Newtown, NSW 2042

Attention: Stephen Read

Re: Horsley Park Business Park – Paramics Micro Simulation Calibration Report

Dear Stephen,

TRAFFIX has been commissioned by the Western Sydney Parklands Trust to undertake a Paramics Micro Simulation Assessment in response to the Director General's Environmental Assessment Requirements dated 16 March 2012. The application relates to the construction of a industrial park on lands located on the corner of The Horsley Drive and Cowpasture Road, Horsley Park.

The requirements of the modelling were set out in the Roads and Maritime Services (RMS) letter dated 5 March 2012 and confirmed in a meeting held between the RMS and TRAFFIX dated 16 April 2012.

The purpose of this report is to provide the calibration and validation data for the purpose of obtaining approval for the base case models prior to the commencement of the scenario testing.

In this regard the base case model has been assessed taking due account of the RMS Guide to Paramics Microsimulation Modelling and other relevant documentation.

- Site and Study Area

Site

The site is located approximately 1.8 kilometres south of Prospect Reservoir and approximately 30 kilometres west of Sydney CBD. More specifically, it is situated on the north western corner of the signalised 'T'-junction of the The Horsley Drive and Cowpasture Road, Horsley Park.

The site is irregular in configuration with a total site area of 213,833m^2.

Vehicular access is proposed via an internal roadway which is to intersect to the roundabout controlled intersection of Cowpasture Road and Newtown Road. The proposed internal roadway will convert the existing 3-way roundabout into a 4-way roundabout.

Study Area

The study area for the Paramics model will generally be confined within Horsley Park with the following roads / streets to be included the assessment:

- M7: an RMS State Road the runs in a north-south direction between the M2 in the north and the M5 in the south, carrying approximately 70,000 vpd in the vicinity of the study area. The M7 forms one of Sydney's major north-south corridors. It carries two lanes of traffic in either direction within a divided carriageway of width 38.0 metres.
- The Horsley Drive an RMS State Road (MR 609) that runs in an east-west direction between the Hume Highway in the east and Wallgrove Road in the west, carrying approximately 20,000 vpd within the study area. . It generally carries two lanes of traffic in either direction within a divided carriageway of width 27.0 metres.
- Wallgrove Road: an RMS State Road (MR 515) that runs in a north-south direction between the Great Western Highway in the north and Elizabeth Drive in the south, carrying approximately 20,000 vpd within the study area. It carries a single lane of traffic in either direction within an undivided carriageway of width 8.5 metres.
- Cowpasture Road: forms part of an RMS State Road, a Regional Road and a collector road within the study area, carrying approximately 29,000 vpd within the study area. Cowpasture Road is a State Road south of its roundabout controlled intersection with The Horsley Drive, a Regional Road between its signalised intersection with The Horsley Drive and roundabout controlled intersection with Victoria Street and a collector road north of its intersection with Victoria Street. . It carries two lanes of traffic in either direction within a divided carriageway of width 19.0 metres.
- Newton Road: a local road that runs in an east-west direction which links Victoria Street in the east with Cowpasture Road in the west. . It carries a single lane of traffic in either direction within an undivided carriageway of width 8.5 metres.
- Ferrers Road: a Regional Road (RR 7153) that runs in a north-south direction between Brabham Drive in the north and The Horsley Drive in the south. It carries a single lane of traffic in either direction within an undivided carriageway of width 8.5 metres.
- Victoria Road: a Regional Road that runs in an east-west direction between Cowpasture Road in the east and Warren Road in the west. . It carries two lanes of traffic in either direction within a divided carriageway of width 22.5 metres.

Input Data

Road Geometry

To identify existing road geometry, aerial photography was used and confirmed using signal layout plans and survey plans of the study area. This information was used to code the road network for the 'base' model. This information provided relevant information to enable coding including lane widths, lane lengths, number of lanes, direction of travel, road positioning, speed limits, location of bus stops and intersection configurations. In addition to the above numerous site inspections were also undertaken to review parking and clearway restrictions as well as other relevant details such as traffic movement restrictions and signal phasings.

Traffic Signal Data

TCS data was provided by the RMS and utilised for all phase sequences of the signalised intersections of the M7 / The Horsley Drive, M7 / Wallgrove Road and The Horsley Drive / Cowpasture Road. LX Data was also provided by the RMS and utilised for intersection offsets. It should be noted that the signalised intersections in the network are all SCATS optimised signal timings are varied depending on demand. It is also noted that the maximum cycle time for all intersections was 120 seconds.

Traffic Survey Data

Traffic surveys were undertaken at all critical intersections within the study area on Thursday the 5th April 2012. The surveys that were undertaken are summarised below;

- Turning movement counts summarised into 15 minute intervals between 6:30am and 9:00am.
- Turning movement counts summarised into 15 minute intervals between 3:30pm and 6:00pm.
- Queue length surveys on all approaches at key intersections only.
- Pedestrian surveys at key intersections only.

RMS Standard Files

The RMS provides a series of standard files for use in Paramics projects. These were used in both the AM and PM models and include the following:

- Categories,
- Configuration,
- Acceleration Profiles,
- Behaviour.

Changes to the vehicle file were undertaken to reflect the higher percentage of heavy vehicles that were observed during the traffic surveys. The vehicle proportions are discussed separately below.

Model Development

Network Coding

The network is shown in **Figure 1** below and includes all roads within the study area. The model was coded using aerial photographs of the area imported into Paramics and as such the model is at scale.

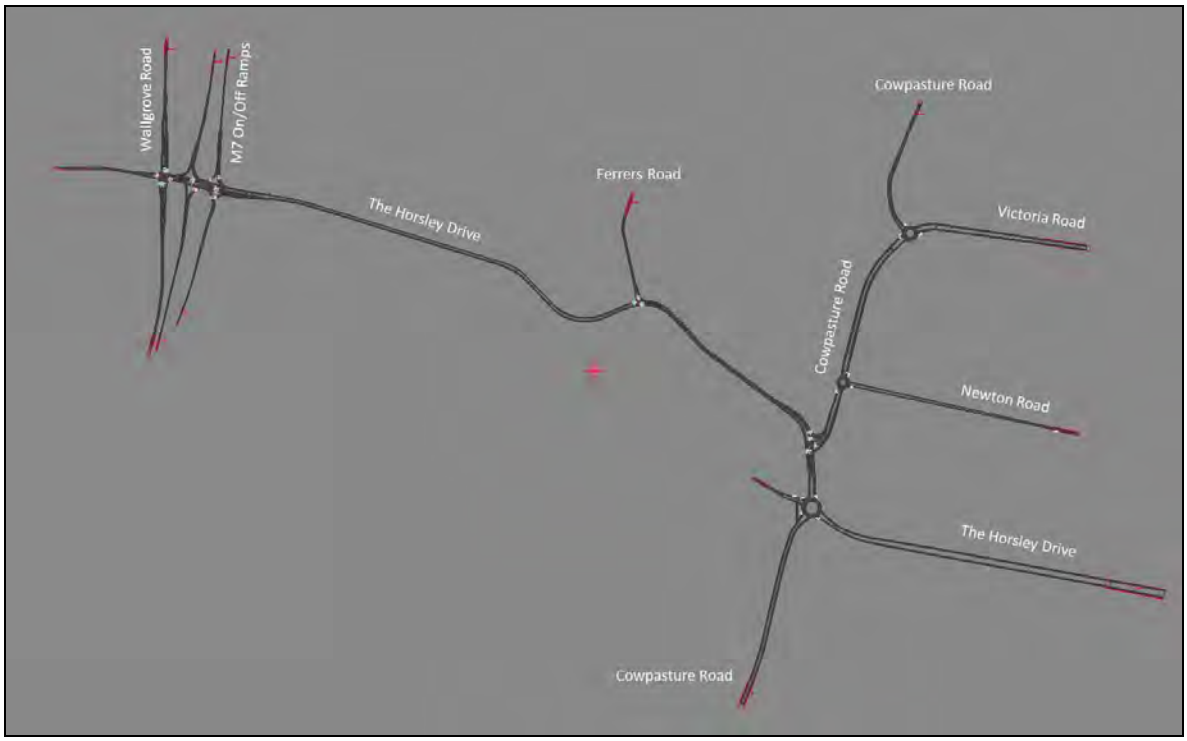


Figure 1: Extent of Model Network

Demand Zones

Following coding of the road network, demand zones were added to the model. Demand zones were positioned on the perimeter of the model and provide connections for through traffic on each external link. A total of 14 zones were created and are also shown in **Figure 1**.

Vehicle Classifications

The observed traffic counts differentiated between light vehicles and heavy vehicles, for the purpose of determining the percentage of heavy vehicles. The traffic counts demonstrated a higher heavy vehicle percentage compared to the standard vehicle proportions provided in the RMS Guide to Paramics Microsimulation Modelling. In this regard, the standard vehicle proportions were modified to reflect the increased percentage of heavy vehicles. The assumed vehicle classification proportions are given in Table 1 below.

Table 1: Vehicle Proportions

Type No.	Vehicle	Proportion
1	Small Car	25.96%
2	Medium Car	36.00%
3	Large Car	21.25%
4	Taxi	1.28%
5	LGV	7.01%
6	STA Mini Bus	0.00%
7	Non-STA Mini Bus	0.00%
8	STA Bus	0.00%
9	Non STA Bus	0.00%
10	OD Bus	0.10%
11	Rigid (Light)	1.00%
12	Rigid (Medium)	4.72%
13	Rigid (Heavy)	1.00%
14	Semi (Light)	0.23%
15	Semi (Medium)	0.84%
16	Semi (Heavy)	0.33%
17	B-Double (Light)	0.15%
18	B-Double (Medium)	0.12%
19	B-Double (Heavy)	0.10%
	Total	100%

Peak Periods and Profiles

The traffic count data demonstrated the following AM and PM peak periods and accordingly, these time periods were adopted for the model:

- AM: 7:30am to 8:30am,
- PM: 3:30pm to 4:30pm.

Sufficient traffic count data was collected to allow traffic profiles to be established at 15 minute intervals over the AM and PM peak periods. Table 2 provides these profiles, calculated by summing the approach volumes on all major intersections every 15 minutes.

Table 2: Traffic Profiles

AM Period	% of Peak	PM Period	% of Peak
0730-0745	26%	1530-1545	26%
0745-0800	25%	1545-1600	25%
0800-0815	25%	1600-1615	25%
0815-0830	24%	1615-1630	24%

Model Calibration and Validation

Estimation Inputs

The demand matrices were developed through the use of the Paramics Estimator tool that develops base case OD matrices by balancing turning counts, link flows and cordon flows. To assist in the process Pattern Matrices was also developed with the use of an R^2 assessment and utilisation of the observed link flows at the network boundary.

The link flow and turn count data used in the estimation was established by balancing the surveyed data for both the AM and PM peaks so that the flow out of an upstream intersection matched flows arriving at a downstream intersection. Estimator was then able to produce an initial matrix for the AM and PM peaks, however these were then further refined during the calibration process.

Validation Statistics

The models were validated with the use of GEH statistics, comparisons of link and turn counts and queue lengths and model stability plots. GEH is considered the most effective measure in this case as it places greater relative emphasis on high volume movements compared to low volume movements. For example, volumes along The Horsley Drive were more heavily weighted than those along Ferrers Road.

Estimation Criteria

The criteria used to calibrate and validate the models have been adopted from the Paramics Microsimulation Modelling – RMS Manual which adopts the criteria outlined in the “UK Design

Manual for Roads and Bridges". This document outlines a number of validation criteria, however these are to be adopted depending on the type and use of the model. In this case the following criteria have been adopted (it should however be noted that non compliance with these criteria does not necessarily indicate an incorrect model and the validation guidelines should be viewed in that context, as a guide in the assessment process):

Links Flows:

- Percentage within 20% or 200 vehicles per hour (target 95%).
- Percentage within 10% or 100 vehicles per hour (target 90%).
- Percentage within 5% or 50 vehicles per hour (target 85%).

Intersection Counts:

- Greater than 85% of all individual modelled flows to have a GEH of less than 5.

Travel Times:

- Average modelled travel time compared with average observed travel time with 95% confidence interval.

Queue Lengths:

- A range of the modelled queue lengths should be compared against the observed queue lengths to ensure they are similar.

Model Stability:

- A graph of the network vehicles over the simulation time period is to demonstrate consistency between model runs.

AM Model Validation

The AM model was calibrated to the balanced turning movements and estimation criteria discussed above. The summary of the key validation statistics for the AM period are as follows:

Link Flows:

Table 3: AM Link Statistics

AM Period	% of Links
Links within 20% or 200 veh/hr of modelled flows	100%
Links within 10% or 100 veh/hr of modelled flows	100%
Links within 5% or 50 veh/hr of modelled flows	83%

Number of links with GEH <5.0	100%

Table 3 demonstrates that 100% of links are within 100 veh/hr of modelled flows and 100% of links have a GEH of less than 5. Accordingly, the link statistic requirements have been satisfied having regard for the abovementioned estimation criteria.

Intersection Counts:

Table 4: AM Turn Count Statistics

GEH	Number of Cases	Percentage
<2	40	69%
2-5	17	29%
5-10	1	2%

Table 4 demonstrates that 98% of individual modelled counts have a GEH of less than 5. Accordingly, the intersection count link requirements have been satisfied having regard for the aforementioned estimation criteria.

Travel Times:

Travel times were also measured along the main routes on Thursday the 5th April 2012. Each travel route was measured between 2 to 3 times between 7:00am-8:00am and 4:00pm-5:00pm with the average of the three runs used for validation purposes. The routes tested and respective times are provided in **Table 5**. For validation purposes modelled times within 15% of the surveyed times are considered acceptable.

Table 5: AM Travel Time Statistics

From Zone No.	To Zone No.	Surveyed (sec)	Modelled (sec)	Difference
3	12	410	443	8.1%
3	11	420	466	10.9%
6	9	360	396	10.0%
9	3	360	343	-4.7%
12	7	290	273	-5.9%
11	3	310	283	-8.7%

Table 5 demonstrates that the modelled travel times are within 11% of the surveyed times and accordingly, the travel times requirements have also been satisfied.

Queue Lengths:

The queue lengths were observed on approach to all key intersections at 15 minute intervals over the AM and PM surveyed periods. **Table 6** provides a comparison between the range of observed queue lengths and the 95th percentile modelled queue lengths for each of the key intersections.

Table 6: AM Comparison of Queue Lengths

Intersection	Direction	Observed Queue Range	95% Percentile Modelled Queue
M7 / The Horsley Drive	SB	13-27 veh.	12 veh
	NB	6-14 veh.	5 veh
	WB	8-18 veh.	7 veh
	EB	7-9 veh.	12 veh
The Horsley Drive / Ferrers Road	SB	10-15 veh.	29 veh
	WB	17-35 veh.	33 veh
	EB	20-27 veh.	32 veh
The Horsley Drive / Cowpasture Road	SB	17-75 veh.	81 veh
	NB	12-23 veh.	17 veh
	WB	5-10 veh.	5 veh
The Horsley Drive / Cowpasture Road / Horsley Park Access Road	SB	14-22 veh.	16 veh
	NB	20-30 veh.	43 veh
	WB	2-5 veh.	4 veh
	EB	0 veh.	2 veh

It can be seen from Table 6 that the 95% percentile modelled queue lengths are comparable with the observed queue ranges and therefore the modelled queues are considered representative.

Model Stability:

A model is considered 'stable' when it produces similar and comparable results between runs. The AM model has been run 5 times using the 5 standard seed numbers (28, 2894, 560, 86524 and 7771) defined in the RMS Paramics Modelling Guide, to ensure that the model is stable and robust. **Figure 3** shows the number of vehicles in the network over the AM peak period of 7:30-8:30am. It is noted that each run included a 15 minute warm-up period prior to the start of data collection period.

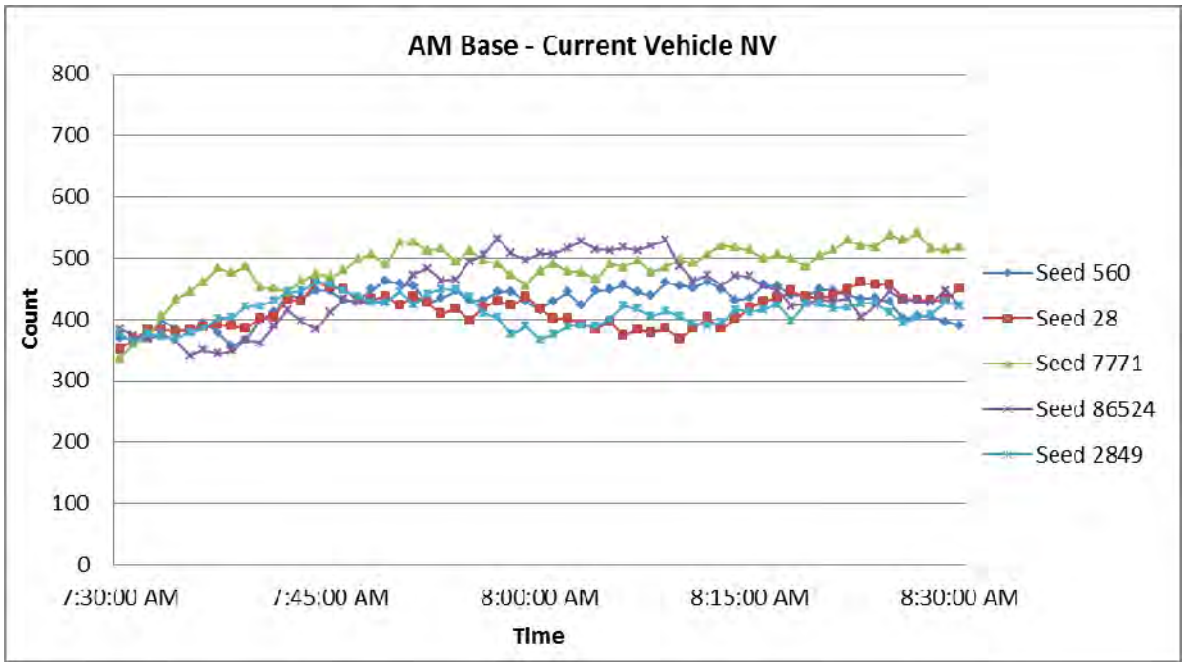


Figure 3: AM Base Stability Graph

Figure 3 demonstrates that the number of vehicles in the network are comparable between the various runs over the period 7:30-8:30am. The AM model is therefore considered stable. It is noted that Seed 86524 has been used for the generation of AM model results.

The above model statistics therefore meet the requirements of the RMS and represent an accurate model for the AM peak period between 7:30am and 8:30am. The 2012 base AM model is therefore considered adequate for future year scenarios testing and assessment and adequately reflects existing conditions.

PM Model Validation

The PM model was also calibrated to the balanced turning movements and estimation criteria discussed previously. The key validation statistics for the PM peak are as follows:

Link Flows:

Table 6: PM Link Statistics

AM Period	% of Links
Links within 200 veh/hr of modelled flows	100%
Links within 100 veh/hr of modelled flows	100%
Links within 50 veh/hr of modelled flows	89%
Number of links with GEH <5.0	100%

Table 6 demonstrates that 100% of links are within 100 veh/hr of modelled flows and 100% of links have a GEH of less than 5. Accordingly, the link statistic requirements have been satisfied having regard for the RMS estimation criteria.

Intersection Counts:

Table 7: PM Turn Count Statistics

GEH	Number of Cases	Percentage
<2	41	71%
2-5	17	29%
5-10	58	100%

Table 7 demonstrates that 100% of individual modelled counts have a GEH of less than 5. Accordingly, the intersection count link requirements have been satisfied having regard for the RMS estimation criteria.

Travel Times:

Table 8 provides a comparison between the observed and modelled travel times. For validation purposes modelled times within 15% of the surveyed times are considered acceptable.

Table 8: PM Travel Times

From Zone No.	To Zone No.	Surveyed (sec)	Modelled (sec)	Difference
3	11	350	341	-2.6%
6	9	250	266	6.4%
11	5	375	345	-8.0%
4	9	295	282	-1.0%
9	3	340	348	8.5%

Table 8 demonstrates that the modelled travel times are within 10% of the surveyed times and accordingly, the travel time requirement has been satisfied.

Queue Lengths:

Table 9 provides a comparison between the range of observed queue lengths and the 95th percentile modelled queue lengths for each of the key intersections.

Table 9: PM Comparison of Queue Lengths

Intersection	Direction	Observed Queue Range	95% Percentile Modelled Queue
M7 / The Horsley Drive	SB	6-10 veh.	3 veh
	NB	5-8 veh.	3 veh
	WB	10-14 veh.	10 veh
	EB	8-10 veh.	9 veh
The Horsley Drive / Ferrers Road	SB	8-15 veh.	15 veh
	WB	9-16 veh.	19 veh
	EB	10-19 veh.	11 veh
The Horsley Drive / Cowpasture Road	SB	24-46 veh.	46 veh
	NB	12-20 veh.	11 veh
	WB	18-25 veh.	28 veh

The Horsley Drive / Cowpasture Road / Horsley Park Access Road	SB	16-21 veh.	15 veh
	NB	5-10 veh.	4 veh
	WB	10-25 veh.	29 veh
	EB	0 veh.	0 veh

It can be seen from Table 9 that the 95% percentile modelled queue lengths are comparable with the observed queue ranges and are therefore considered representative.

Model Stability:

The PM model has also been run 5 times using the 5 standard seed numbers defined in the RMS Paramics Modelling Guide. **Figure 4** shows the number of vehicles in the network over the PM peak period of 3:30-4:30pm.

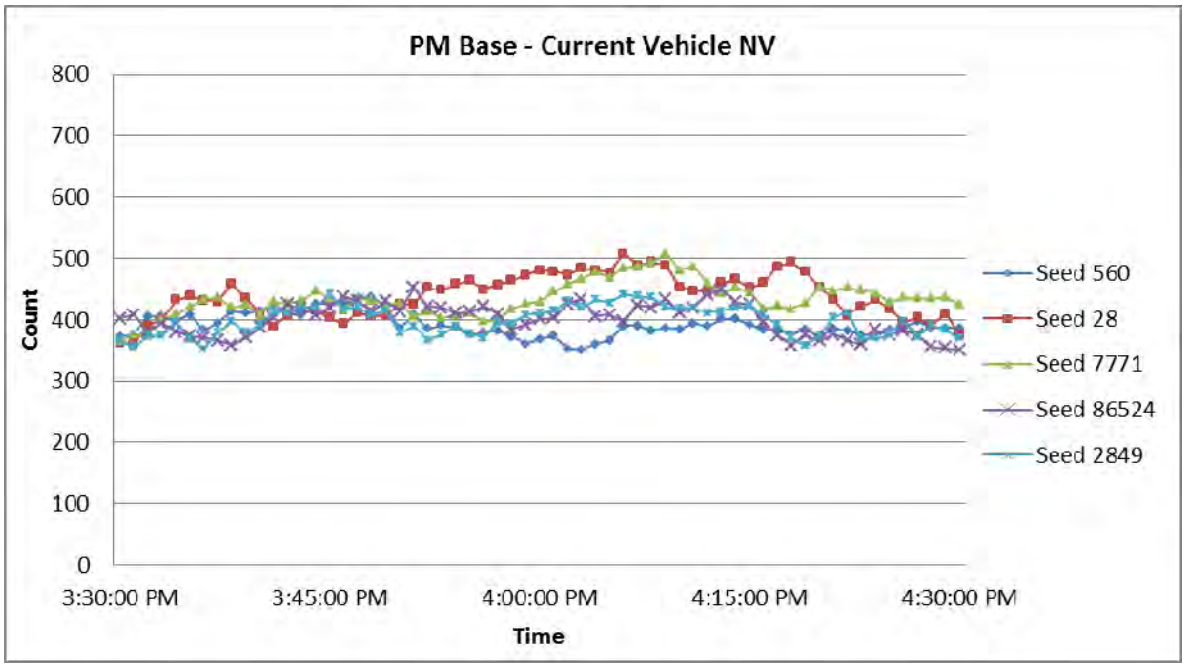


Figure 4: PM Base Stability Graph

Figure 4 demonstrates that the PM model is also stable and therefore, is an acceptable base model. It is noted that Seed 28 has been used for the generation of PM model results.

The above model statistics therefore meet the requirements of the RMS and represent an accurate model for the PM peak period between 3:30pm and 4:30pm. The 2012 base PM model is therefore considered adequate for future year scenarios testing and assessment and adequately reflects existing conditions.

- Summary

The calibration and validation of the AM and PM base models demonstrates that the models are stable and representative of the observed traffic conditions. In this regard, both the AM and PM models are considered adequate for future year scenarios testing and assessment.

If you have any questions or would like to discuss the models further please do not hesitate to contact the undersigned.

Yours faithfully

traffix

Andrew Johnson
Associate Engineer

Appendix E

Site Generation

Generation to be assessed at rate of 15veh/hr/ha based on RMS correspondance dated 8th May 2012

Generation Rate	15
Site area	21
Site Generation	321
Generation Split	70:30

AM Generation	
In	225
Out	96

PM Generation	
In	96
Out	225

Traffic Distribution Assumptions

1. East vehicles 65% via Horsley Drive, 25% via Victoria Street, 10% via Newton Rd
2. North 70% via M7, 20% via Wallgrove Road, 10% via Ferrers Road
3. South 50% via Cowpasture, 50% via M7

Future Distribution

	AM		PM	
Direction	**In**	**Out**	**In**	**Out**
North	30	47	47	30
South	110	13	13	110
East	0	36	36	0
West	84	0	0	84
Total	**225**	**96**	**96**	**225**

Traffic TO Input Travel Zone to Nominated 1042

SSD Description	SSD No.	Direction of Travel To	Direction of Travel From	Car Driver	Train	Bus	Vehicle Passanger	Other	Not Stated	Stayed At Home
Inner Sydney	505	south	north	59	0	0	0	0	0	0
Eastern Suburbs	510	south	north	22	0	0	0	0	0	0
St George-Sutherland	515	north	south	216	0	0	6	0	27	0
Canterbury-Bankstown	520	west	east	252	5	0	20	7	9	1
Fairfield - Liverplool	525	west	east	2070	12	66	280	34	103	63
Outer South Western Sydney	530	north	south	620	33	0	45	11	39	9
Inner Western Sydney	535	south	north	100	0	0	0	5	3	3
Central Western Sydney	540	south	north	585	9	23	35	18	30	4
Outer Western Sydney	545	south	north	930	10	0	53	9	60	5
Blacktown	553	south	north	826	10	0	94	14	56	22
Lower Northern Sydney	555	south	north	97	0	0	3	0	9	0
Central Northern Sydney	560	south	north	392	0	0	16	9	25	0
Northern Beaches	565	south	north	40	0	0	0	0	0	0
Total Trips				6209	79	89	552	107	361	107

Direction of Travel Summary To SSD	Volume	%
Northbound	836	13%
Southbound	3051	49%
Eastbound	0	0%
Westbound	2322	37%
Total	6209	100%

Direction of Travel Summary From SSD	Volume	%
Northbound	3051	49%
Southbound	836	13%
Eastbound	2322	37%
Westbound	0	0%
Total	6209	100%

Appendix F

MOVEMENT SUMMARY

Site: M7 On/Off - Ramp / The Horsley Drive - FU AM

M7 and The Horlsey Drive, Horsley Park
Existing - AM
Signals - Fixed Time Cycle Time = 105 seconds (User-Given Cycle Time)

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: M7 On / Off-Ramp (South)											
S_L	L	59	8.0	0.056	11.8	LOS A	0.6	4.2	0.27	0.69	42.4
S_R	R	502	8.0	0.594	44.3	LOS D	11.6	86.8	0.94	0.82	18.0
Approach		561	8.0	0.594	40.9	LOS C	11.6	86.8	0.87	0.80	19.3
East: The Horsley Drive											
E_L	L	163	8.0	0.322	20.9	LOS B	3.9	29.0	0.50	0.74	44.5
E_T	T	496	8.0	0.496	39.2	LOS C	10.8	81.0	0.90	0.79	30.1
6	R	282	8.0	0.269	38.7	LOS C	5.5	41.5	0.81	0.76	33.7
Approach		941	8.0	0.496	35.9	LOS C	10.8	81.0	0.80	0.77	33.3
North: M7 On / Off-Ramp (North)											
N_L	L	618	8.0	0.601	44.0	LOS D	13.9	104.3	0.91	0.84	20.3
N_R	R	37	8.0	0.087	39.0	LOS C	1.5	11.0	0.81	0.69	19.7
Approach		655	8.0	0.601	43.7	LOS D	13.9	104.3	0.90	0.83	20.3
West: The Horsley Drive											
W_L	L	25	8.0	0.023	10.8	LOS A	0.2	1.2	0.20	0.67	54.0
W_T	T	588	8.0	0.589	40.2	LOS C	13.2	99.1	0.92	0.81	29.6
12	R	34	8.0	0.085	36.1	LOS C	0.7	5.2	0.74	0.66	34.9
Approach		647	8.0	0.589	38.9	LOS C	13.2	99.1	0.89	0.80	30.5
All Vehicles		2804	8.0	0.601	39.4	LOS C	13.9	104.3	0.86	0.80	27.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	11	2.3	LOS A	0.0	0.0	0.21	0.21
P2	Across S approach	11	31.2	LOS D	0.0	0.0	0.77	0.77
P5	Across N approach	11	10.5	LOS B	0.0	0.0	0.45	0.45
P6	Across N approach	11	31.2	LOS D	0.0	0.0	0.77	0.77
All Pedestrians		44	18.8	LOS B			0.55	0.55

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: M7 On/Off - Ramp / The Horsley Drive - FU PM

M7 and The Horlsey Drive, Horsley Park
Existing - AM
Signals - Fixed Time Cycle Time = 98 seconds (User-Given Cycle Time)

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: M7 On / Off-Ramp (South)											
S_L	L	49	8.0	0.058	13.7	LOS A	0.9	6.5	0.56	0.73	39.7
S_R	R	182	8.0	0.441	50.2	LOS D	4.3	32.5	1.00	0.78	16.4
Approach		232	8.0	0.441	42.4	LOS C	4.3	32.5	0.90	0.77	19.0
East: The Horsley Drive											
E_L	L	440	8.0	0.607	15.9	LOS B	7.3	54.6	0.49	0.76	48.8
E_T	T	780	8.0	0.385	17.7	LOS B	10.7	80.1	0.62	0.67	43.2
6	R	558	8.0	0.513	24.6	LOS B	7.0	52.4	0.87	0.80	41.5
Approach		1778	8.0	0.607	19.4	LOS B	10.7	80.1	0.67	0.73	44.0
North: M7 On / Off-Ramp (North)											
N_L	L	304	8.0	0.300	25.8	LOS B	4.0	29.9	0.89	0.79	28.8
N_R	R	44	8.0	0.214	48.6	LOS D	2.1	15.3	0.97	0.74	16.8
Approach		348	8.0	0.300	28.7	LOS C	4.0	29.9	0.90	0.79	26.6
West: The Horsley Drive											
W_L	L	54	8.0	0.060	11.8	LOS A	0.5	3.6	0.28	0.69	52.9
W_T	T	582	8.0	0.544	36.0	LOS C	11.9	88.9	0.90	0.80	31.5
12	R	35	8.0	0.104	50.2	LOS D	0.9	6.4	0.92	0.69	29.2
Approach		671	8.0	0.544	34.8	LOS C	11.9	88.9	0.85	0.78	32.6
All Vehicles		3028	8.0	0.607	25.7	LOS B	11.9	88.9	0.75	0.75	37.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	11	2.5	LOS A	0.0	0.0	0.22	0.22
P2	Across S approach	11	27.9	LOS C	0.0	0.0	0.76	0.76
P5	Across N approach	11	19.6	LOS B	0.0	0.0	0.63	0.63
P6	Across N approach	11	27.9	LOS C	0.0	0.0	0.76	0.76
All Pedestrians		44	19.5	LOS B			0.59	0.59

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Horsley Dr & Cowpasture Rd - FU AM

Horsley Drive and Cowpasture Rd
Signals - Fixed Time Cycle Time = 111 seconds (User-Given Cycle Time)

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: The Horsley Drive (south)											
2	T	1255	8.0	0.431	3.8	LOS A	10.6	79.1	0.34	0.31	44.9
3	R	440	8.0	1.000[3]	102.7	LOS F	19.6	146.9	1.00	1.15	8.0
Approach		1695	8.0	1.000	29.5	LOS C	19.6	146.9	0.51	0.53	20.4
East: Cowpasture Road											
4	L	198	8.0	0.338	39.1	LOS C	9.0	67.4	0.89	0.81	18.8
6	R	346	8.0	0.995	95.6	LOS F	12.8	95.5	1.00	1.19	9.6
Approach		544	8.0	0.995	75.1	LOS F	12.8	95.5	0.96	1.05	11.7
North: The Horsley Drive (north)											
7	L	1026	8.0	0.472	14.8	LOS B	11.1	83.1	0.44	0.73	43.1
8	T	1213	8.0	1.050	125.5	LOS F	63.5	475.2	1.00	1.61	13.2
Approach		2239	8.0	1.050	74.7	LOS F	63.5	475.2	0.74	1.21	19.4
All Vehicles		4478	8.0	1.050	57.7	LOS E	63.5	475.2	0.68	0.93	18.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	Across E approach	11	16.2	LOS B	0.0	0.0	0.54	0.54
All Pedestrians		11	16.2	LOS B			0.54	0.54

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Horsley Dr & Cowpasture Rd - FU PM

Horsley Drive and Cowpasture Rd
Signals - Fixed Time Cycle Time = 120 seconds (User-Given Cycle Time)

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: The Horsley Drive (south)											
2	T	1040	8.0	0.483	16.4	LOS B	17.9	133.6	0.64	0.57	27.4
3	R	177	8.0	0.863	79.3	LOS F	5.9	43.9	1.00	0.95	10.0
Approach		1217	8.0	0.863	25.6	LOS B	17.9	133.6	0.69	0.63	21.8
East: Cowpasture Road											
4	L	682	8.0	0.879	41.9	LOS C	38.0	284.2	0.92	0.94	18.2
6	R	1047	8.0	0.894	56.6	LOS E	32.4	242.4	0.99	0.97	14.6
Approach		1729	8.0	0.894	50.8	LOS D	38.0	284.2	0.96	0.96	15.9
North: The Horsley Drive (north)											
7	L	356	8.0	0.158	9.6	LOS A	1.8	13.3	0.19	0.65	47.9
8	T	1306	8.0	0.909	49.7	LOS D	43.8	327.6	1.00	1.07	29.3
Approach		1662	8.0	0.909	41.1	LOS C	43.8	327.6	0.83	0.98	31.3
All Vehicles		4608	8.0	0.909	40.6	LOS C	43.8	327.6	0.84	0.88	23.9

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	Across E approach	11	24.1	LOS C	0.0	0.0	0.63	0.63
All Pedestrians		11	24.1	LOS C			0.63	0.63

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Horsley Drive - FU AM

Cowpasture Rd & Horsley Drive
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: Cowpasture Road											
2	T	1032	8.0	0.975	27.9	LOS B	23.8	177.7	1.00	1.63	36.6
3	R	655	8.0	0.975	38.1	LOS C	22.3	167.1	1.00	1.63	33.1
Approach		1686	8.0	0.975	31.8	LOS C	23.8	177.7	1.00	1.63	35.1
East: The Horsley Drive (east)											
4	L	161	8.0	0.353	7.1	LOS A	3.1	23.0	0.68	0.61	47.3
5	T	2	8.0	0.353	5.4	LOS A	3.1	23.0	0.68	0.54	47.3
6	R	661	8.0	0.353	13.7	LOS A	3.1	23.0	0.69	0.72	44.2
Approach		824	8.0	0.353	12.4	LOS A	3.1	23.0	0.69	0.70	44.8
North: The Horsley Drive (north)											
7	L	1005	8.0	0.966	30.7	LOS C	29.6	221.4	0.97	1.51	20.8
8	T	405	8.0	0.531	8.7	LOS A	4.3	32.3	0.72	0.78	39.3
9	R	1	8.0	0.531	16.5	LOS B	4.3	32.3	0.72	1.00	35.0
Approach		1412	8.0	0.966	24.3	LOS B	29.6	221.4	0.90	1.30	24.0
West: Park Access											
10	L	2	8.0	0.018	10.5	LOS A	0.1	0.7	0.89	0.78	20.1
11	T	1	8.0	0.018	10.3	LOS A	0.1	0.7	0.89	0.77	20.0
12	R	2	8.0	0.018	15.5	LOS B	0.1	0.7	0.89	0.85	20.7
Approach		5	8.0	0.018	12.5	LOS A	0.1	0.7	0.89	0.81	20.3
All Vehicles		3927	8.0	0.975	25.0	LOS B	29.6	221.4	0.90	1.32	34.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Horsley Drive - FU PM

Cowpasture Rd & Horsley Drive
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: Cowpasture Road											
2	T	442	8.0	0.436	7.2	LOS A	2.8	20.8	0.76	0.62	52.1
3	R	286	8.0	0.436	15.7	LOS B	2.6	19.4	0.76	0.94	47.1
Approach		728	8.0	0.436	10.5	LOS A	2.8	20.8	0.76	0.74	49.9
East: The Horsley Drive (east)											
4	L	458	8.0	0.890	95.2	LOS F	58.9	440.4	1.00	1.65	16.6
5	T	4	8.0	0.890	93.5	LOS F	58.9	440.4	1.00	1.65	16.6
6	R	768	8.0	0.890	114.0	LOS F	58.9	440.4	1.00	1.74	15.8
Approach		1231	8.0	0.890	106.9	LOS F	58.9	440.4	1.00	1.71	16.1
North: The Horsley Drive (north)											
7	L	873	8.0	0.776	9.7	LOS A	10.0	74.7	0.63	0.72	37.7
8	T	1116	8.0	0.788	6.7	LOS A	11.1	82.8	0.61	0.61	40.9
9	R	1	8.0	0.788	14.6	LOS B	11.1	82.8	0.61	0.92	36.7
Approach		1989	8.0	0.788	8.0	LOS A	11.1	82.8	0.62	0.66	39.5
West: Park Access											
10	L	6	8.0	0.024	5.0	LOS A	0.1	0.8	0.73	0.66	21.2
11	T	6	8.0	0.024	4.8	LOS A	0.1	0.8	0.73	0.65	21.2
12	R	1	8.0	0.024	10.1	LOS A	0.1	0.8	0.73	0.91	21.8
Approach		14	8.0	0.024	5.3	LOS A	0.1	0.8	0.73	0.67	21.3
All Vehicles		3962	8.0	0.890	39.2	LOS C	58.9	440.4	0.76	1.00	24.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Ferrers Rd & Horsley Dr - FU AM

Ferrers Rd & Horsley Dr
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

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
East: Horsley Drive (east)											
5	T	917	8.0	0.362	0.6	LOS A	2.0	14.9	0.08	0.07	67.9
6	R	464	8.0	1.057	129.4	LOS F	40.3	301.8	1.00	1.21	14.2
Approach		1381	8.0	1.057	43.9	LOS D	40.3	301.8	0.39	0.45	30.0
North: Ferrers Road											
7	L	568	8.0	0.714	20.9	LOS B	18.7	139.6	0.81	0.83	33.4
9	R	24	8.0	0.230	58.3	LOS E	1.2	9.2	1.00	0.71	20.8
Approach		593	8.0	0.714	22.4	LOS B	18.7	139.6	0.82	0.82	32.6
West: Horsley Drive (west)											
10	L	38	8.0	0.838	33.6	LOS C	37.3	278.6	0.90	0.99	37.4
11	T	1671	8.0	0.838	23.7	LOS B	37.5	280.2	0.90	0.87	38.3
Approach		1708	8.0	0.838	23.9	LOS B	37.5	280.2	0.90	0.88	38.3
All Vehicles		3682	8.0	1.057	31.1	LOS C	40.3	301.8	0.70	0.71	33.9

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	5	12.5	LOS B	0.0	0.0	0.50	0.50
All Pedestrians		5	12.5	LOS B			0.50	0.50

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Ferrers Rd & Horsley Dr - FU PM

Ferrers Rd & Horsley Dr
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

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
East: Horsley Drive (east)											
5	T	1714	8.0	0.597	1.9	LOS A	4.8	36.2	0.20	0.18	64.7
6	R	356	8.0	0.810	52.3	LOS D	17.2	128.4	0.97	0.90	27.1
Approach		2069	8.0	0.810	10.6	LOS A	17.2	128.4	0.33	0.30	52.3
North: Ferrers Road											
7	L	605	8.0	0.612	11.8	LOS A	13.0	97.5	0.57	0.74	39.1
9	R	64	8.0	0.420	50.5	LOS D	3.0	22.7	0.98	0.76	22.6
Approach		669	8.0	0.612	15.5	LOS B	13.0	97.5	0.61	0.74	36.6
West: Horsley Drive (west)											
10	L	18	8.0	0.601	29.9	LOS C	18.7	140.2	0.78	0.97	39.4
11	T	1051	8.0	0.601	20.0	LOS B	19.0	141.8	0.78	0.70	41.1
Approach		1068	8.0	0.601	20.2	LOS B	19.0	141.8	0.78	0.70	41.1
All Vehicles		3807	8.0	0.810	14.1	LOS A	19.0	141.8	0.51	0.49	45.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	5	16.2	LOS B	0.0	0.0	0.57	0.57
All Pedestrians		5	16.2	LOS B			0.57	0.57

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Victoria St & Cowpasture Rd - FU AM

Victoria Street & Cowpasture Road
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: Cowpasture Road (south)											
1	L	251	8.0	0.259	6.6	LOS A	1.6	11.9	0.31	0.52	49.8
2	T	500	8.0	0.259	5.5	LOS A	1.6	11.9	0.33	0.45	50.6
Approach		751	8.0	0.259	5.8	LOS A	1.6	11.9	0.32	0.47	50.3
North: Victoria Street											
8	T	162	8.0	0.114	5.2	LOS A	0.6	4.3	0.28	0.43	51.0
9	R	127	8.0	0.114	11.9	LOS A	0.6	4.3	0.28	0.66	45.6
Approach		289	8.0	0.114	8.1	LOS A	0.6	4.3	0.28	0.53	48.4
West: Cowpasture Road (west)											
10	L	585	8.0	0.802	13.5	LOS A	8.9	66.8	0.86	1.09	43.8
12	R	118	8.0	0.802	19.1	LOS B	8.9	66.8	0.86	1.14	41.2
Approach		703	8.0	0.802	14.4	LOS A	8.9	66.8	0.86	1.10	43.3
All Vehicles		1743	8.0	0.802	9.7	LOS A	8.9	66.8	0.53	0.73	47.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Victoria St & Cowpasture Rd - FU PM

Victoria Street & Cowpasture Road
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: Cowpasture Road (south)											
1	L	95	8.0	0.127	7.9	LOS A	0.8	6.0	0.59	0.63	48.2
2	T	177	8.0	0.127	7.0	LOS A	0.8	6.0	0.60	0.60	48.5
Approach		272	8.0	0.127	7.3	LOS A	0.8	6.0	0.60	0.61	48.4
North: Victoria Street											
8	T	838	8.0	0.537	6.2	LOS A	3.8	28.7	0.52	0.54	49.0
9	R	467	8.0	0.537	12.9	LOS A	3.8	28.1	0.54	0.74	45.0
Approach		1305	8.0	0.537	8.6	LOS A	3.8	28.7	0.53	0.61	47.5
West: Cowpasture Road (west)											
10	L	164	8.0	0.360	6.7	LOS A	2.1	15.5	0.42	0.54	48.9
12	R	229	8.0	0.360	12.3	LOS A	2.1	15.5	0.42	0.72	45.4
Approach		394	8.0	0.360	10.0	LOS A	2.1	15.5	0.42	0.65	46.7
All Vehicles		1971	8.0	0.537	8.7	LOS A	3.8	28.7	0.52	0.62	47.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Newton Dr - FU PM

Cowpasture Road & Newton Road
Signals - Fixed Time Cycle Time = 120 seconds (User-Given Cycle Time)

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: Cowpasture Road (south)											
1	L	88	8.0	0.131	13.9	LOS A	1.7	12.9	0.21	0.77	43.9
2	T	218	8.0	0.131	5.4	LOS A	1.8	13.3	0.21	0.18	38.4
3	R	226	8.0	0.352	27.5	LOS B	6.8	50.9	0.55	0.74	30.2
Approach		533	8.0	0.352	16.2	LOS B	6.8	50.9	0.36	0.51	34.3
East: Newton Road											
4	L	534	8.0	0.862	50.3	LOS D	32.6	244.2	0.98	0.96	22.7
Approach		534	8.0	0.862	50.3	LOS D	32.6	244.2	0.98	0.96	22.7
North: Cowpasture Road (north)											
7	L	53	8.0	0.857	44.6	LOS D	36.3	271.9	0.96	0.99	25.0
8	T	1196	8.0	0.857	37.9	LOS C	36.5	272.9	0.96	0.95	25.1
9	R	9	8.0	0.130	71.4	LOS F	0.6	4.3	0.98	0.68	20.3
Approach		1258	8.0	0.857	38.5	LOS C	36.5	272.9	0.96	0.95	25.1
West: Site Access											
10	L	237	8.0	0.574	48.6	LOS D	12.0	89.9	0.91	0.83	25.7
Approach		237	8.0	0.574	48.6	LOS D	12.0	89.9	0.91	0.83	25.7
All Vehicles		2561	8.0	0.862	37.2	LOS C	36.5	272.9	0.83	0.85	25.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	Across E approach	11	19.8	LOS B	0.0	0.0	0.58	0.58
P5	Across N approach	11	54.2	LOS E	0.0	0.0	0.95	0.95
P7	Across W approach	11	19.8	LOS B	0.0	0.0	0.58	0.58
All Pedestrians		33	31.3	LOS D			0.70	0.70

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Cowpasture Rd & Newton Dr - FU AM

Cowpasture Road & Newton Road
Signals - Fixed Time Cycle Time = 111 seconds (User-Given Cycle Time)

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: Cowpasture Road (south)											
1	L	206	0.0	0.413	16.3	LOS B	8.0	58.3	0.35	0.82	41.8
2	T	723	8.0	0.413	8.1	LOS A	8.0	59.9	0.35	0.31	34.2
3	R	757	15.0	0.555	8.8	LOS A	4.3	33.7	0.18	0.66	41.6
Approach		1686	10.2	0.555	9.4	LOS A	8.0	59.9	0.27	0.53	39.4
East: Newton Road											
4	L	273	8.0	0.239	10.0	LOS A	3.9	28.9	0.29	0.69	40.5
Approach		273	8.0	0.239	10.0	LOS A	3.9	28.9	0.29	0.69	40.5
North: Cowpasture Road (north)											
7	L	75	8.0	0.789	65.5	LOS E	7.5	55.8	1.00	0.93	19.7
8	T	183	8.0	0.789	58.7	LOS E	7.7	57.4	1.00	0.93	19.9
9	R	22	0.0	0.266	66.8	LOS E	1.2	8.7	0.99	0.71	21.1
Approach		280	7.4	0.789	61.2	LOS E	7.7	57.4	1.00	0.92	20.0
West: Site Access											
10	L	102	8.0	0.229	39.6	LOS C	4.1	31.0	0.79	0.78	28.8
Approach		102	8.0	0.229	39.6	LOS C	4.1	31.0	0.79	0.78	28.8
All Vehicles		2341	9.5	0.789	17.0	LOS B	8.0	59.9	0.38	0.61	34.1

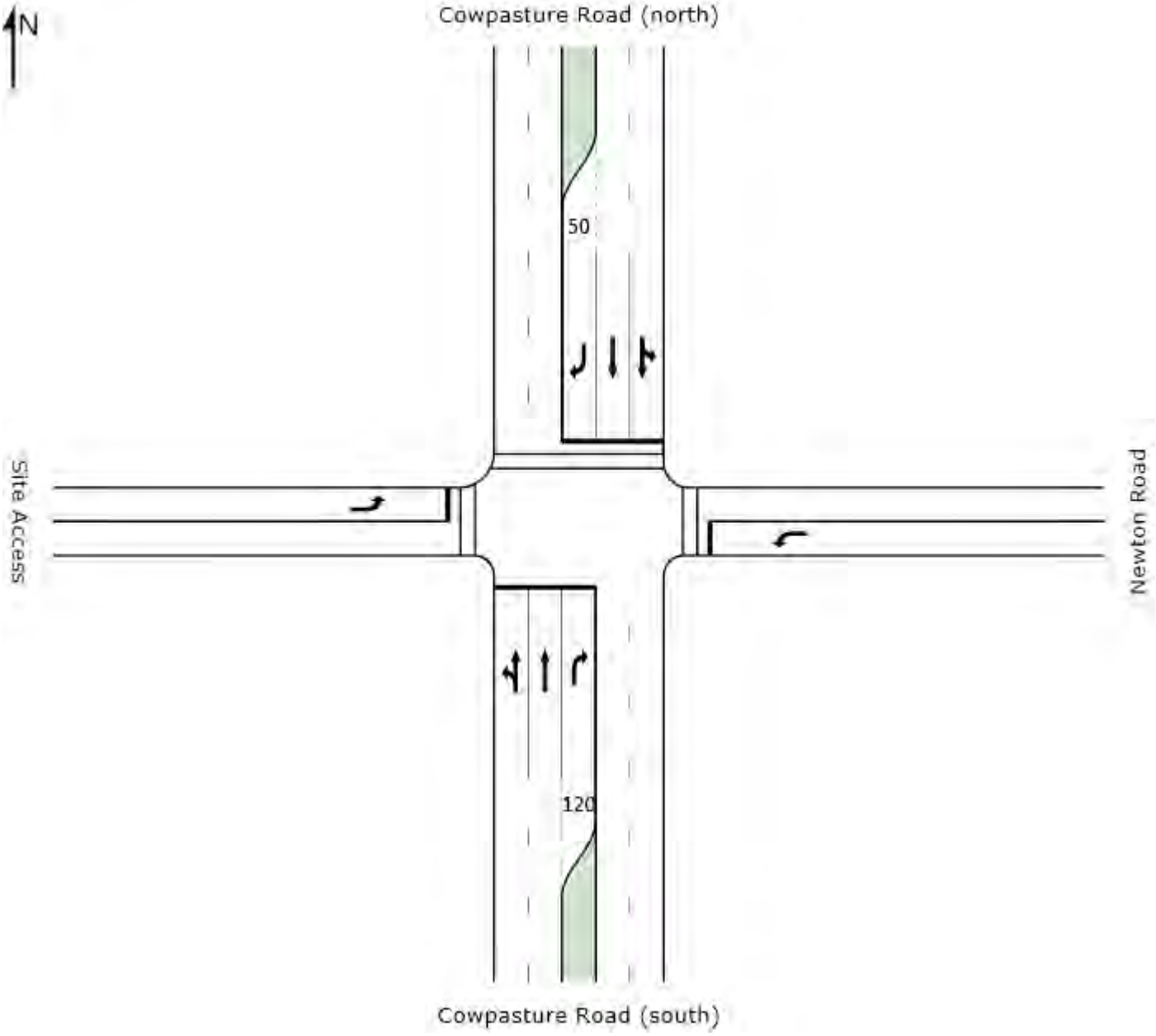
Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	Across E approach	11	49.7	LOS E	0.0	0.0	0.95	0.95
P5	Across N approach	11	49.7	LOS E	0.0	0.0	0.95	0.95
P7	Across W approach	11	49.7	LOS E	0.0	0.0	0.95	0.95
All Pedestrians		33	49.7	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Appendix G


N
Cowpasture Road (north)
50
Site Access
Newton Road
120
Cowpasture Road (south)

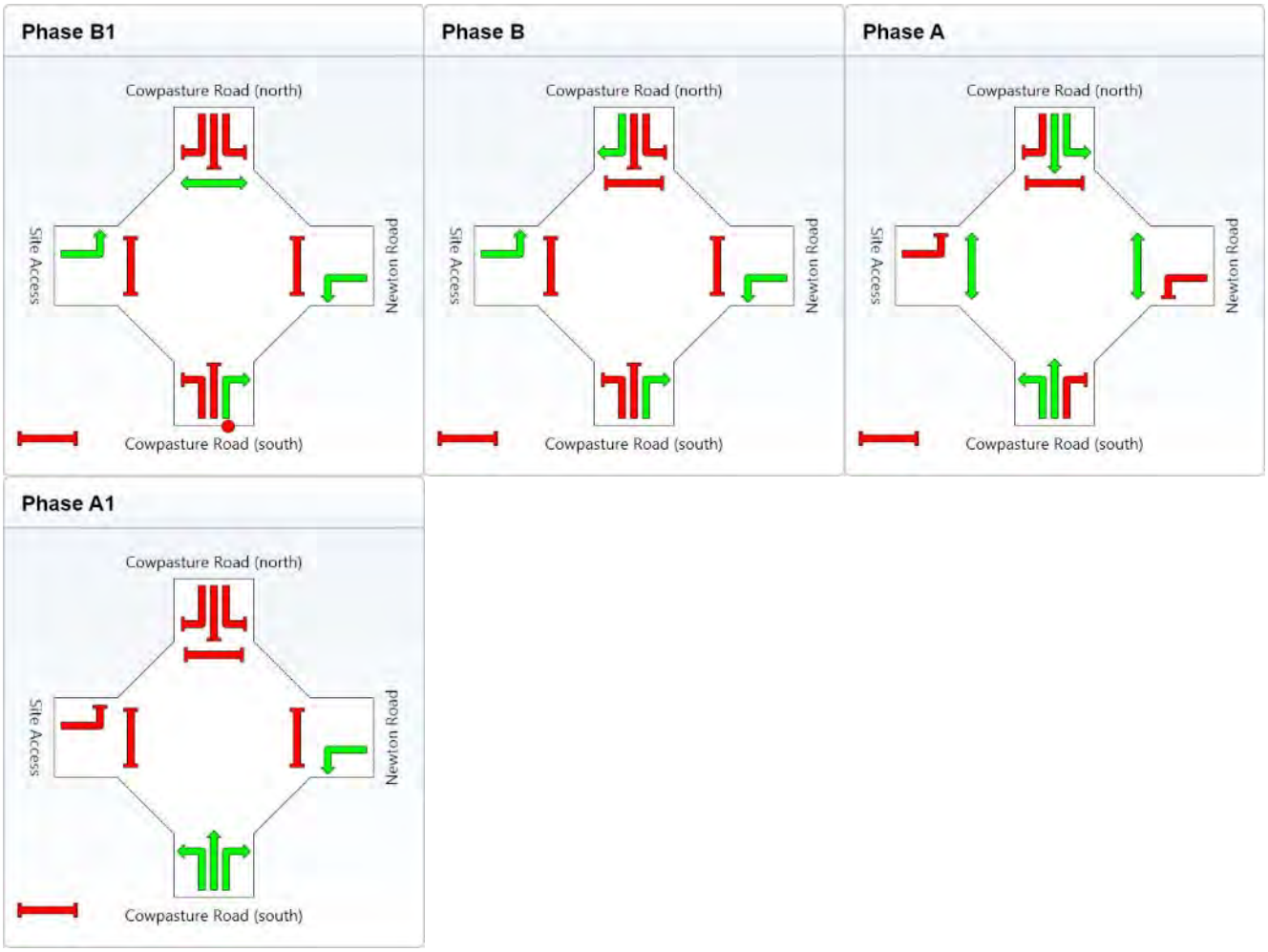
PHASING SUMMARY

Cowpasture Road & Newton Road
Signals - Fixed Time Cycle Time = 111 seconds (User-Given Cycle Time)

Phase times determined by the program
Green Split Priority for Coordinated Movements applies
Sequence: Opposed Turns
Input Sequence: B1, B, A, A1
Output Sequence: B1, B, A, A1

Phase Timing Results

Phase	B1	B	A	A1
Green Time (sec)	22	6	12	47
Yellow Time (sec)	3	3	3	3
All-Red Time (sec)	3	3	3	3
Phase Time (sec)	28	12	18	53
Phase Split	25 %	11 %	16 %	48 %



PHASING SUMMARY

Cowpasture Road & Newton Road
Signals - Fixed Time Cycle Time = 120 seconds (User-Given Cycle Time)

Phase times determined by the program
Green Split Priority for Coordinated Movements applies
Sequence: Opposed Turns
Input Sequence: B1, B, A, A1
Output Sequence: B1, B, A, A1

Phase Timing Results

Phase	B1	B	A	A1
Green Time (sec)	22	6	57	11
Yellow Time (sec)	3	4	3	3
All-Red Time (sec)	3	2	3	3
Phase Time (sec)	28	12	63	17
Phase Split	23 %	10 %	53 %	14 %