BURWOOD PLACE

42-60 Railway Parade, Burwood

Planning Proposal for Mixed Use Development

Traffic Impact Assessment

ROAD DELAY SOLUTIONS

DOCUMENT STATUS

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Cover Art provided by Architectus/Cox depicting the intended integration with Burwood Town Centre's cosmopolitan form

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EXECUTIVE SUMMARY

Road Delay Solutions has been engaged by *Holdmark Property NSW Pty Ltd* to undertake the preparation of a Traffic Impact Assessment (TIA) in support of the Planning Proposal (PP) for a mixed use development at 42-50 and 52-60 Railway Parade, Burwood, commonly known as '*Burwood Plaza*'.

The PP was lodged with Burwood Council on 28 September 2015, proposing a mixed use development.

Council, at the Council meeting on 24 May 2016, resolved to forward the PP to the Department of Planning and Environment (DPE) for a Gateway Determination, subject to minor amendments. The Department of Planning and Environment issued the Gateway Determination on 26 February 2017 (and corrected on 2 March 2017) which requires a 21 day initial consultation period with the Roads and Maritime Services.

A TIA was initially revised to reflect the requirements of the Gateway Determination in preparation for the initial consultation with the RMS and to assess the traffic impacts associated with, and to recommend infrastructure upgrades in support of, the proposed development.

This TIA has adopted the recommendations put forward in a communication by the RMS dated 2 June 2017.

Road Delay Solutions has undertaken extensive consultation with both Council officers and Council's external consultants to ensure the methodology and inputs used are in accordance with Council's exact requirements and expectations.

As a result of this consultation, this report has critically analysed and assessed the impacts of the Burwood Place development on the Burwood Town Centre road network. Extensive mesoscopic and operational modelling has analysed the following four traffic scenarios, namely...

- *2017 Base Burwood Place Development Model,*
- *2026 Base Year Model ('Do Nothing'),*
- *2026 Section 94 Infrastructure Model, and*
- *2026 Burwood Place Development Model.*

The assessment of these scenarios has concluded that, once the proposed infrastructure outlined in Council's Section 94 Contributions Plan has been implemented, any impacts of traffic generation, both vehicular and pedestrian, is benign on the town centre's road network.

A number of measures (additional to the infrastructure outlined in Council's S94 Plan) have been identified and assessed in unison to sustain the movement of traffic within the town centre and support the planned level of growth anticipated with the Burwood Place development to year 2026.

These works include…

- → *Widening of existing signalised foot crossings along Burwood Road between Wilga Street and Belmore Street to 5m,*
- → *General retention of the current traffic signal operations at the Burwood Road intersections with Railway Parade (including retention of the right turn movement for all vehicles southbound turning into Railway Parade) and Belmore Street,*
- → *The introduction of a 'scramble' phase pedestrian crossing at the Burwood Road intersection with Railway Parade,*
- → *Introduction of a partial closure of Wynne Avenue to accommodate a single trafficable lane in each direction, some 25m south of Railway Parade for a distance of approximately 30m,*
- → *The introduction of site specific access from Railway Parade,*
- → *Retention of entry from Wynne Avenue,*
- → *The introduction of traffic signal control at the intersections of…*
    - o *Railway Parade and Conder Street,*
    - o *Belmore Street and Wynne Avenue,*
    - o *Belmore Street and Conder Street, and*
    - o *Burwood Road and Victoria Street East.*

If the aforementioned measures are implemented, the impact of traffic generation associated with the Burwood Place development will be effectively and satisfactorily managed while reducing the impedence on pedestrian demands.

THE SITE

The subject site is located at 42-60 Railway Parade, Burwood, and is situated within the City of Burwood Local Government Area (LGA). The site is segmented into two (2) major components and seamlessly integrates with the surrounding Burwood Town Centre commercial and retail activities

The Burwood LGA is situated in the inner western suburbs of Sydney. Being some 7.26 km^2 in area, it is one of the smallest LGAs in the state and has a relatively high population density.

Situated on both sides of Wynne Avenue and fronting Railway Parade, the site is only some 170m west of both the Burwood Railway Station and bus interchange.

The eastern segment, at 42-50 Railway Parade, is occupied by Burwood Plaza which provides some 13,000m^2 retail. Vehicle entry to Burwood Plaza is catered for from Wynne Avenue with egress onto Belmore Street. The current Plaza loading docks are accessible from Wynne Avenue.

The western segment, at 52-60 Railway Parade, is occupied by two commercial office buildings which provide some 17,100m^2 GFA. Vehicular access to the western site is catered for from Wynne Avenue.

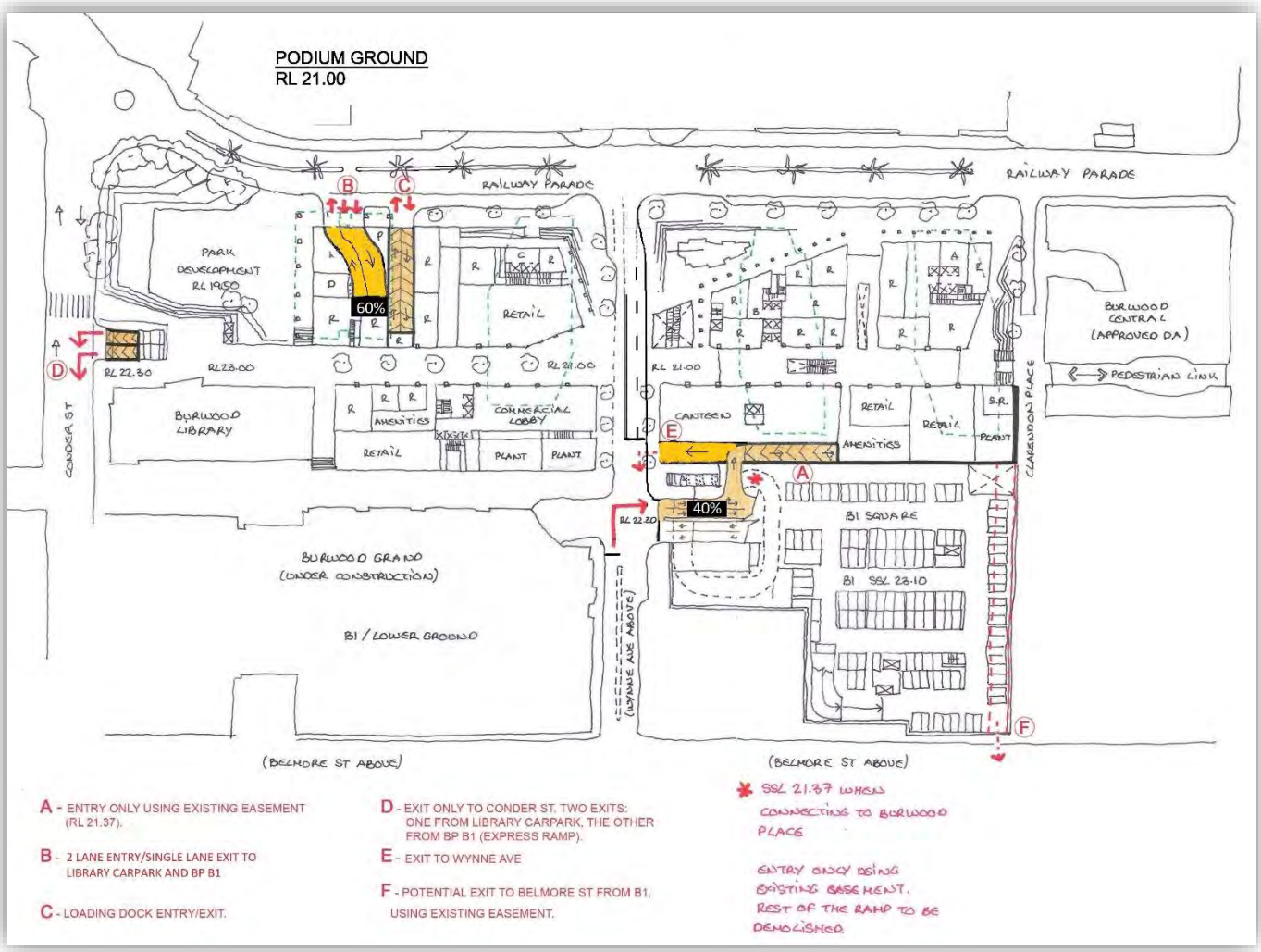
Figure ES 1 Burwood Plaza Site in Context
Source vimeo.com, 2016

PROPOSED DEVELOPMENT

The planning proposal provides for a mixed use development including approximately…

- *1,100 residential apartments,*
- *100 Hotel styled serviced apartments,*
- *27,502m² retail GFA (19,255m² GLFA) inclusive of supermarket GFA 4,200m² (2,900m² GLFA), and*
- *15,429m² (12,350m² GLFA) of commercial floor space. and*
- *A resultant FSR of some 10.53:1 for the site.*

Figure ES 2 *The Proposed Development Footprint*
Source *Cox, 2018*



Vehicular access to the site is currently under consideration from three (3) primary locations...

- → *Railway Parade servicing a maximum of 60% of development traffic, being general retail and Council Library Car Parking,*
- → *Wynne Avenue servicing the remaing 40% of development traffic, being residential, commercial and up to 10% of general retail, and*
- → *Egress onto Conder Street from both the Council Car Park and Basement B1*

The percentage use for each access point was an initial first step in defining dedicated access by use. The 60% retail entry adopted from Railway Parade was determined, through modelling, to be the maximum volume achievable at the site. While the 40% residential, commercial and some 10% retail entry was considered to be achievable and acceptable from Wynne Avenue.

There is also potential for the development, at Development Application stage, to reconfigure Wynne Avenue.

This could include a reduction in the carriageway width to one (1) lane in each direction on the section of Wynne Avenue for a distance of some 30m, from a point approximately 25m south of Railway Parade, to permit the introduction of a cosmopolitan thoroughfare (*widened footway areas*) and reinforced pedestrian mobility and continuity at the podium level, within the site.

The partial closure of Wynne Avenue will permit the travel of vehicles both northbound and southbound while maintaining accessibility to the proposed entry via the current easement from Wynne Avenue. This Wynne Avenue access will be controlled by the current traffic signals to Council's and Emerald Square car parks.

Access for resident, commercial, visitor and retail spaces is currently under consideration from both Railway Parade and Wynne Avenue.

The respective access destinations will be clearly defined on the surrounding road network via the use of signposting and on the internal ramp systems within the development's underground car park, connecting to the respective parking allocations.

Loading dock access is under consideration from Railway Parade via a dedicated driveway, some 7 metres to the east of the passenger vehicle entry.

Egress from the site is being considered from three (3) locations.

The first, a combined entry/exit on Railway Parade, permits for right and left turn entry while on exit, left turn only.

The second egress is left turn only on Conder Street. This egress caters for the 175 vehicle Council library car park and Burwood Place. Two ramps are proposed to cater for egress from Council's Library car park and the other from the Burwood Place basement car parking.

The third egress is onto Wynne Avenue, in line with the Burwood Place boundary and immediately north of the Council/B2 Car Park.

The preliminary allocation of traffic generation by access location are shown in the above figure and have been determined from the various origins of the current vehicle movements. These allocations, by access location, have been applied to the year 2026 development vehicle generation model and represent a '*worst case*' scenario.

The layout and internal machinations of the car park provisions and final access locations are yet to be finalised, subject to the preparation of architectural drawings for DA application. However, various options are being considered to increase the number of exits from Burwood Place. These options are to be investigated, in consultation with Council, prior to the DA application and include, but not be limited to...

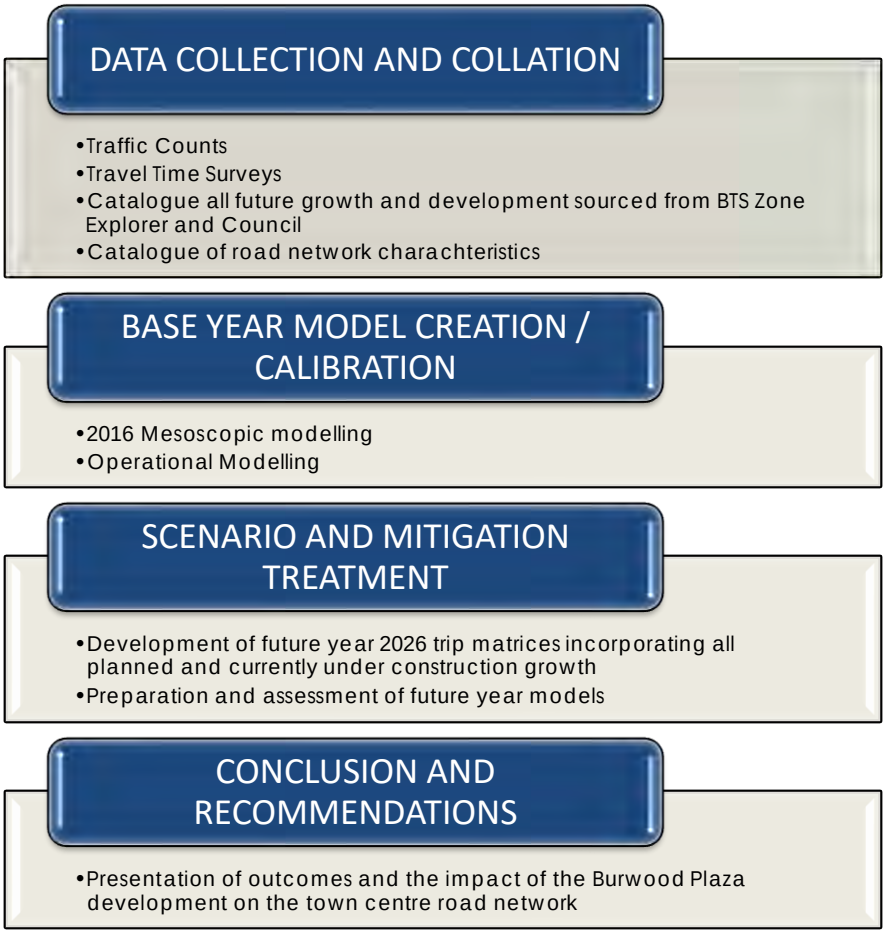
→ *Egress from the Burwood Place site onto Belmore Street via the pre existing easement.*

It is considered this option will improve and further distribute the exiting traffic onto the surrounding road network.

THE ASSESSMENT PROCESS

This report has adopted a four (4) tier, systematic approach to assessment of the road network operation under both the existing and anticipated future growth conditions. The approach taken is graphically presented below, with the key tasks outlined for each tier.

Figure ES 3 The Assessment Process
Source Road Delay Solutions, 2016



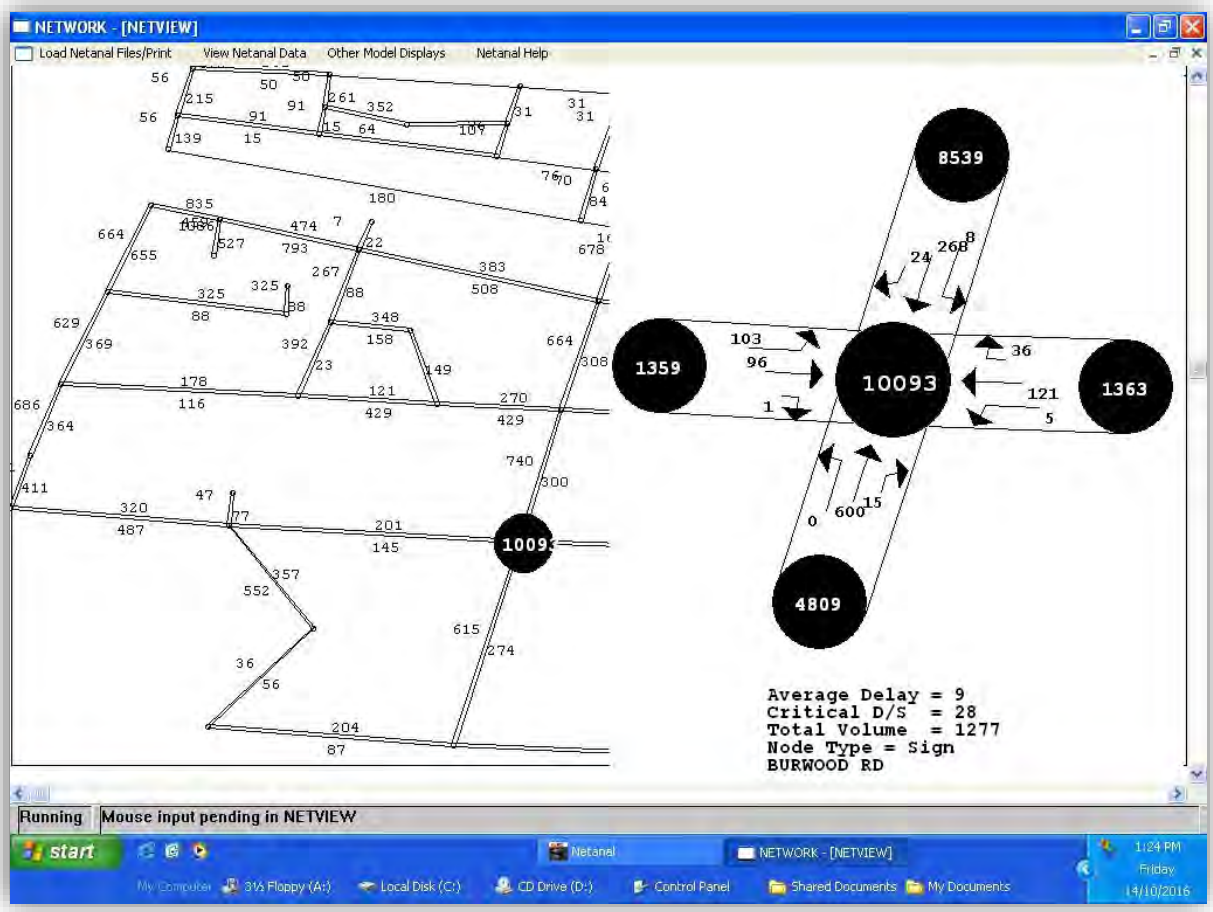
4.1 The Mesoscopic Model

The *Netanal* model utilises defined travel demand between zonal pairs, represented as assimilated traffic movements, throughout the Sydney Metropolitan Area. The program incrementally assigns vehicular traffic onto a computer based road network, developing link demand forecasts on each modelled section of road.

Netanal is a mesoscopic assignment model utilising intersection congestion levels and delays in the determination of a motorists' route choice.

Figure ES 4 The Netanal Mesoscopic Model

Source Road Delay Solutions, 2016



THE 2017 EXISTING SITUATION

The mesoscopic and operational modelling indicates that the Burwood Road route, both northbound and southbound, during both the AM and PM comuter peak periods between George Street and Belmore Street, currently operate at a satisfactory Level of Service (LoS) 'D'. Due to queuing implications there is currently little remaining capacity along this road. This is further analysed below.

Occassional residual queues are reported from several sites back through preceding intersections, impeding the coordinated traffic signal operations and the through movements.

The pedestrian phases along Burwood Road are demanded each cycle and necessitate significant time to clear before allowing left and right turn vehicle movements to be performed.

This is particularly evident, southbound, at the Burwood Road intersection with Railway Parade. With a trailing and repeat right turn from the central shared through and right lane, in conjunction with the inherent delay imposed by pedestrians on the left turn movement, 'A' phase can '*trap*' southbound motorists if the right and left turn movements are held, concurrently.

The vehicle delays observed on Burwood Road, between George Street to the north and Clarence Street to the south, are the result of…

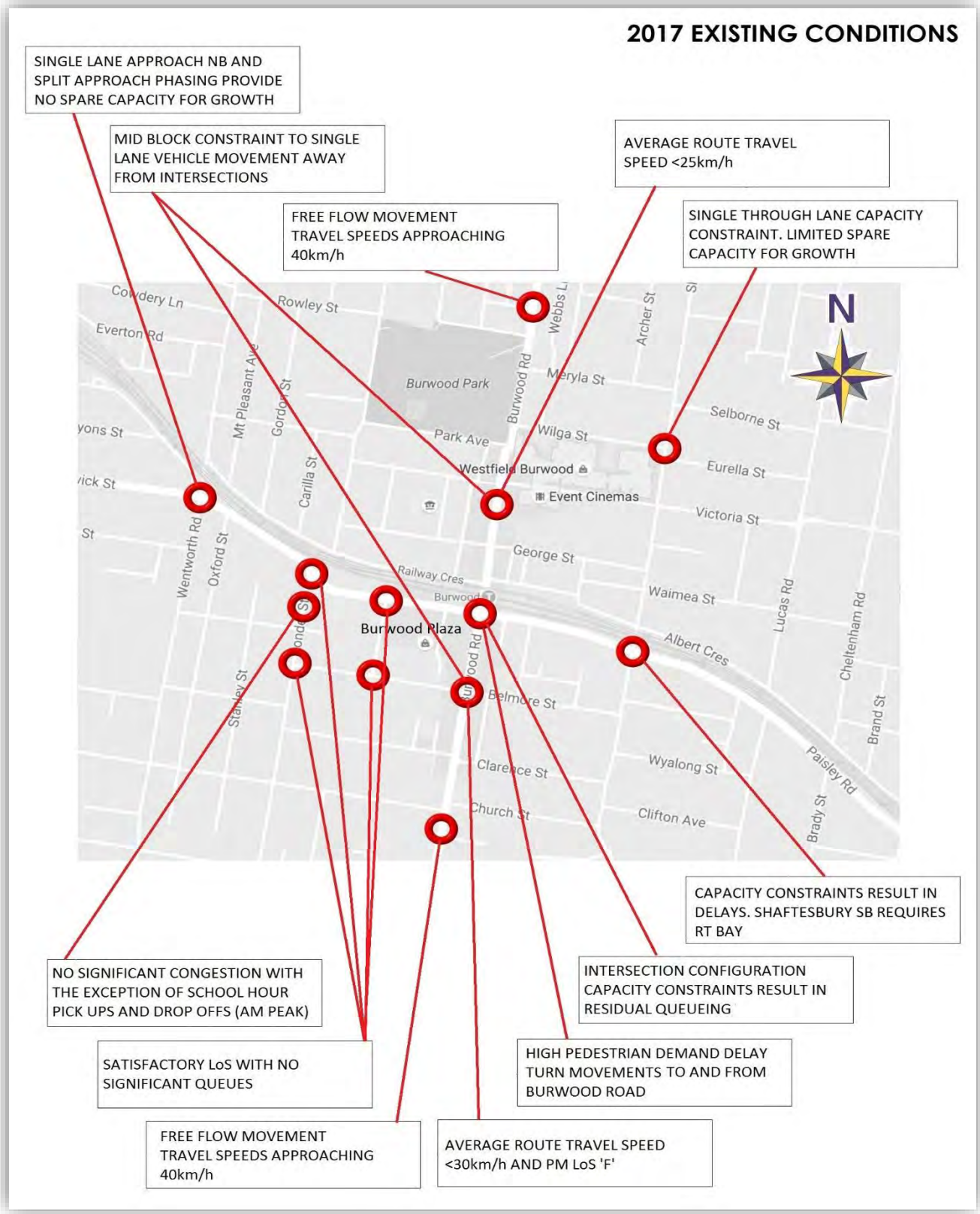
- *The short distances between intersections, in close proximity to the railway station,*
- *The incidence of pedestrian demand on cycle times and the occurance of the pedestrian 'walk' in each cycle,*
- *Buses stopping,*
- *The impacts of on street parking manouveres including drop off and pick up,*
- *The single lane southbound approach prior to George Street, and*
- *The lack of a dedicated right turn lane, southbound (existing shared through and right), at the Railway Parade intersection resulting in queueing back to the north through the preceding intersections.*

Operational analysis suggests that each intersection within the study area, in isolation, opearate within their respective vehicle capacities. However, congestion points, such as, the shared right turn and through movement southbound in Burwood Road from the centre lane at the Railway Parade intersection and the single lane, mid block, constraints imposed by on street parking, result in queueing both northbound and southbound along Burwood Road through the town centre.

These delays are typically inherent within built up town centre environments and are to be expected. Anecdotally, such vehicle congestion generally results in reduced vehicle speeds which may be conducive to improving pedestrian safety and reducing the severity of any occurring accidents while providing an unattractive route for through traffic.

The vehicle volumes on the competing parallel routes of Wentworth Road and Shaftesbury Road would appear to have increased more significantly than those on Burwood Road over the past years. Shaftesbury Road, in particular, reports a vehicle growth of approximately 10.3% over the past ten (10) years growing from some 1,652vph in 2000 to 1,825vph in 2016.

Figure ES 5 2017 Existing Conditions Summary
Source Road Delay Solutions, 2017



GROWTH FORECASTS

Investigations into the traffic impacts associated with the Burwood Place Planning Proposal have required the preparation of a mesoscopic, computer based, model.

The Bureau of Transport Statistics (*BTS*) have set the areas defining the Burwood Town Centre as Travel Zones TZ 910, 913 and 915.

The future Year trip matrices, originally produced by the *BTS* in October 2011, have been developed from a 4 step travel model established on forecast population and employment projections throughout the Metropolitan Area and assigned to a computer based transport network.

These trip tables form the basis for the *Netanal* future year trip demands and have been applied from the 2011 *BTS* travel zone (TZ) system, through the employment of an equivalency table, prepared and provided by the *BTS*.

The interpreted population data employed in the modelled trip matrices were drawn from TZs 910, 913 and 915...

- *A residential population of 8,374 persons in year 2016 is anticipated to reach 11,714 by year 2026, being an increase of 3,340 persons,*
- *Dwellings (homes and/or apartments) are set to reach 6,069 by 2026, an increase of 1,730 with an adopted occupancy rate of 1.93 persons, and*
- *The current workforce of 4,353 is expected to reach 6,051 by year 2026.*

The *BTS* data has been compared with Council's approved and known developments which lie within the *BTS* Zones 910, 913 and 915. After careful consideration and assessment it has been found that the *BTS* projections adequately encompass the approved and known development within the town centre and the Parramatta Road Urban Renewal Corridor.

The analysis also determined that the *BTS* forecast dwellings of 6,069 is in fact marginally higher than Council's current anticipated growth level achieving only 5,565 dwellings by year 2026. The *BTS* and Council growth levels are presented in the following figures.

Figure ES 6 Adopted Forecast Growth Projections
Source BTS, 2016

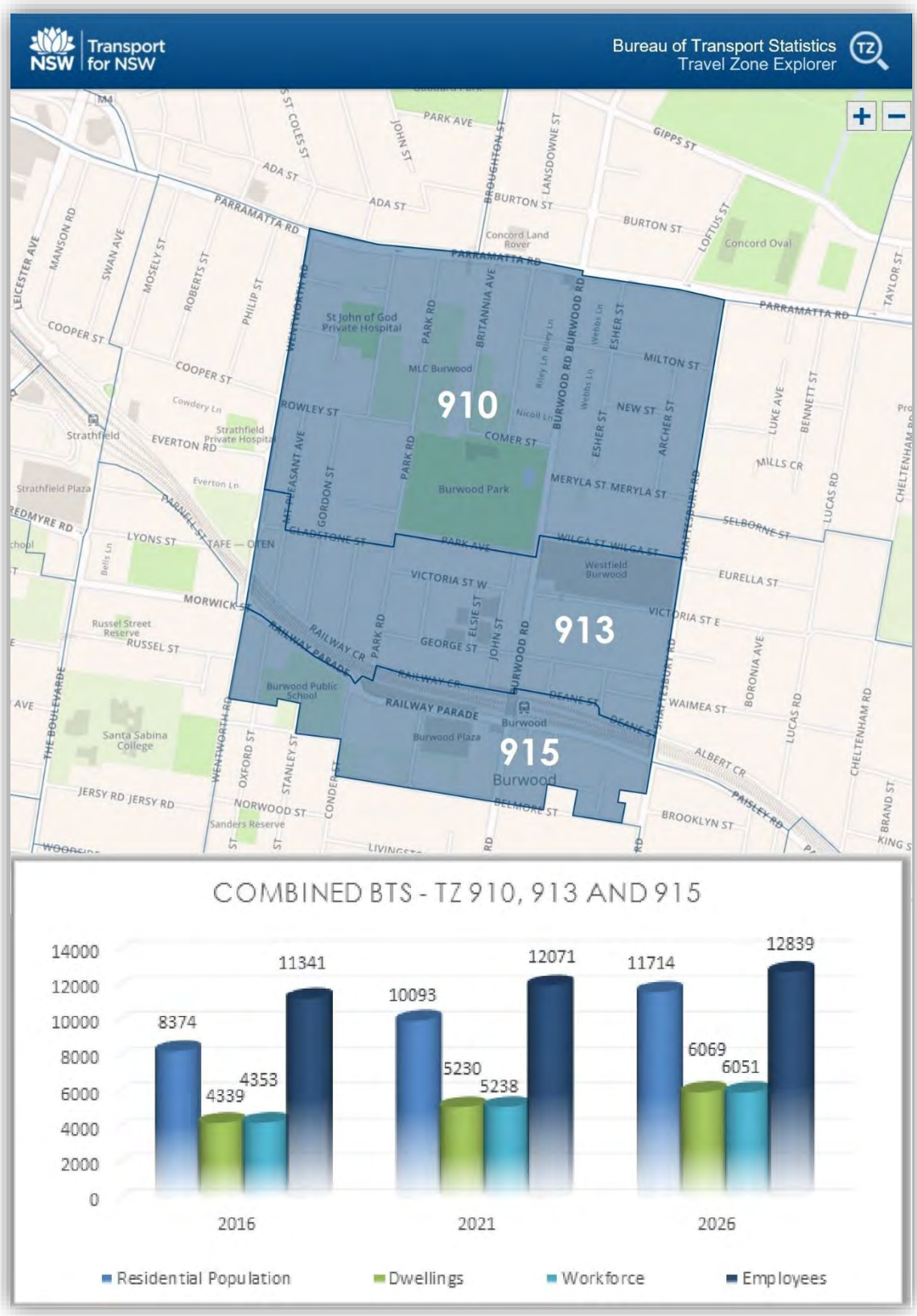


Figure ES 7 Burwood Council Approved and Planned Major Developments

Source Road Delay Solutions, 2018

CALCULATED VEHICLE GROWTH WITHIN BTS TZ 913 and 915 PLANNED DEVELOPMENT													
			Component				Generation Rate				Vehicle Generation	
Identifier BTS Zone	Address	Proposed Development	Residential Units	Retail GLFA *(70% of Site Area)*	Serviced Apartments	Commercial GLFA *(70% of Site Area)*	Residential	Retail	Serviced Apartments	Commercial	AM	PM
1 915	6 Railway Parade BURWOOD	Constructed 17 storey mixed residential flat building containing 47 residential units, 3 levels of commercial units, over 3 level of basement parking for 48 vehicles	BURWOOD CENTRAL EXISTING TRAFFIC GENERATION 2017									
2 910	48 Burwood Road BURWOOD	Construction of a 7 storey development comprising one ground floor commercial suite and twenty residential apartments over two levels of basement parking for 17 car parking spaces	20			252	0.19	0.125	0.4	0.016	8	8
3 910	11 - 13 Burwood Road BURWOOD	Construction of an 8 storey mixed use development containing commercial space, 37 residential apartments over 3 levels of basement parking for 53 vehicles	37			504	0.19	0.125	0.4	0.016	15	15
4 913	46 Park Road BURWOOD	Construction of a 5 storey residential flat building containing 14 units above basement parking	14				0.19	0.125	0.4	0.016	3	3
5 915	7 – 15 Conder Street, 2 – 10 Hornsey Street and 2 – 4 Stanley Street BURWOOD	Demolition and construction of Part 4 and 5 storey residential flat above basement parking	14				0.19	0.125	0.4	0.016	3	3
6 910	56 – 60 Burwood Road BURWOOD	Construction of 9 storey mixed use development containing 46 residential units and 1 ground floor retail suite above the basement parking	46	882			0.19	0.125	0.4	0.016	119	119
7 913	1 – 3 Gloucester Avenue and 42 – 44 Park Road BURWOOD	Construction of a 4 storey residential flat building comprising of 129 units with 2 levels of basement parking	129				0.19	0.125	0.4	0.016	25	25
8 910	35 Burwood Road BURWOOD	Construction of a 9 storey mixed use development containing ground floor commercial suites and 22 residential units above basement parking	22			420	0.19	0.125	0.4	0.016	11	11
9 913	28-34 Victoria St BURWOOD	Construction of a 33 storey mixed use building comprising 436 residential units, 3,200 retail and 4,200 commercial	436	3200		4200	0.19	0.059	0.059	0.016	339	339
10 910	32 Burwood Road BURWOOD	Construction of a 6 storey mixed use development containing ground floor commercial suites and 22 residential units above basement parking	22			252	0.19	0.125	0.4	0.016	8	8
11 913	7 Gloucester Avenue and 48 – 50 Park Road BURWOOD	Construction of a 5 storey residential flat building containing 42 units above basement parking	42			420	0.19	0.125	0.4	0.016	15	15
12 915	121 – 133 Burwood Road and 38 – 40 Railway Parade BURWOOD	Construction of a 20 storey mixed - use development consisting of 3 levels of retail suites, 1 level of restaurant, 7 levels containing 56 serviced apartments, 9 levels containing 68 residential apartments above basement parking	68	4200	56		0.19	0.125	0.4	0.016	560	560
13 910	18 – 20 Meryla Street BURWOOD	Construction of a 5 storey multi residential flat building containing 27 residential units, 3 commercial units and over 2 levels of basement parking for 33 vehicles	27			630	0.19	0.125	0.4	0.016	15	15
14 910	2A – 8 Burwood Road BURWOOD	Construction of a 9 storey residential flat building containing 50 residential units, over 2 level of basement parking for 67 vehicles	50				0.19	0.125	0.4	0.016	10	10
15 910	27 – 29 Burwood Road BURWOOD	Construction of a 9 storey mixed use development consisting of 46 residential units, 4 commercial premise units and 2 levels of basement car parking	46			525	0.19	0.125	0.4	0.016	17	17
16 913	2 -14 Elsie Street BURWOOD	Retention of 7 storeys commercial building and construction of 8 storey mixed use development containg 64 units and 2 reatil units above basement parking	64	945			0.19	0.125	0.4	0.016	130	130
17 915	Burwood Place	Construction of 3 towers of residential units, retail and commercial floor space above basement car parking	1,071	19,255	100	12,350	0.19	0.125	0.4	0.016	2848	2848
18 913	9 - 15 Deane Street and 18 - 20 George Street BURWOOD	Construction of 3 storey residential flat building above basement parking	12				0.19	0.125	0.4	0.016	2	2
		TOTALS	2120	28482	156	19553					4127	4127
		BTS TZ 910	270	0	0	2583					8246	8246
		BTS TZ 913	697	4145	0	4620					489	489
		BTS TZ 915	1,153	23,455	156	12,875					563	563

1. *Retail and commercial GLFA has been calculated as 70% of the total site area.*

6.1 Traffic Generation

All projected traffic generation rates applied to the developments within the town centre were based on the industry standard *RMS Guide to Traffic Generating Developments*.

Based on the RMS's *Technical Direction TDT 2013/04a* entitled '*Guide to Traffic Generating Developments Updated Traffic Surveys*', hereby referred to as the '*guide*', the Burwood Place development will generate 9,821 vehicle trips daily, with some 3,155 vehicle trips, including heavy vehicles, occurring during the morning and evening commuter peak periods, combined.

The applied annual growth rate is considered to be a conservatively high estimation within the study area given that the town centre is already well established, with Burwood Road operating near or at capacity during the commuter peak periods. Expectations are that with no change to the road network, the reported growth on Burwood Road from the year 2026 '*Do Nothing*' model, vehicular growth within the study area will remain low, with vehicles utilising the spare capacity on competing parallel routes.

This combined with the current high use of public transport within the Burwood Town Centre, it is anticipated the trend will continue with good mode choice options for residents.

6.2 Traffic Distribution

The traffic distribution through the town centre has been drawn from numerous sources.

Residential and commercial land use distribution has been based on the applied year 2026 *BTS* trip matrices, published in 2014 and revised in October 2016, while the retail traffic distribution has been determined by a catchment analysis of simillar operations.

Figure ES 8 Proposed Vehicle Generation

Source Road Delay Solutions, 2018

BURWOOD PLACE VEHICLE GENERATION TABLE															
Development Component	Area (Units &/or GLFA m^2)	Area (Units &/or GFA m^2)	Daily RMS Trip Rate	AM Peak Hour GLFA RMS Trip Rate/m^2	PM Peak Hour GLFA RMS Trip Rate/m^2	PM Peak Hour GLFA RMS Trip Rate/m^2	AM Peak Hour Generation (vph)	PM Peak Hour Generation (vph)	WE Peak Hour Generation (vph)	AM Outbound Trips (vph)	AM Inbound Trips (vph)	PM Outbound Trips (vph)	PM Inbound Trips (vph)	WE Outbound Trips (vph)	WE Inbound Trips (vph)
Residential Apartments	1,100	1,071	1.52	0.19	0.15	0.1	209	165	110	167	42	33	132	61	50
Serviced Apartments#	100	100	3	0.4	0.4	0.4	40	40	20	32	8	8	32	16	4
Retail Specialty Shops*	16,855	23,302	0.3403	0.059	0.059	0.075	994	994	1264	448	547	547	448	695	569
Supermarket*	3,100	4,200	0.3403	0.059	0.059	0.075	183	183	233	82	101	101	82	128	105
Commercial	12,350	15,429	0.11	0.016	0.012	0.001	198	148	12	30	168	126	22	7	5
TOTAL			9,821				1624	1531	1639	759	865	815	716	907	732

**The Supermarket and Specialty Shops Generation rate is based on RMS Technical Direction TDT 2013/04a for the highest weekday generation - 5.9vph/100m2 of GLFA.*

The retail GLFA excludes common areas such as walkways, garbage storage, unoccupied lobby areas and the shared loading dock provisions.

 # The hotel style serviced apartments have adopted the casual accommodation vehicle generation rate prescribed by the RMS of 0.4 trips per apartment during the peak periods given the proximity to Burwood Railway Station.

THE FUTURE YEAR MODELS

The future year 2026 models were run against four different infrastructure scenarios to understand and compare the impacts associated with the Burwood Place development site and Council's proposed Section 94 infrastructure. These include…

- *2017 Base Burwood Place Developmerent – The 2017 road network and trip table including the Burwood Place Development generations,*
- *2026 'Do Nothing' - The future growth run on the current 2016 road network,*
- *2026 Section 94 Model – The developed 2026 road network including the Section 94 infrastructure improvements with the future year 2026 traffic demands, excluding the Burwood Place development traffic, and*
- *2026 Development Model – The 2026 Section 94 road network including proposed infrastructure and traffic generation from the Burwood Place development.*

7.1 2017 Base Burwood Place Model

The 2017 base Burwood Place Development model is based upon the 2017 road network with the applied 2017 trip matrices, inclusive of the Burwood Place development traffic generations.

The model was developed to provide confidence in determining which infrastructure is required to satisfy the needs of the proposed Burwood Place.

The uplift from the existing Burwood Plaza can be defined as follows.

Figure ES 9 Pedestrian Uplift with the Burwood Place Development

Source Road Delay Solutions, 2018

Component	Existing	Proposed	Uplift
Jobs (direct + indirect)	386	3,145 persons	2,759 persons
Direct Jobs	319	2,145 persons	1,826 persons
Residential Population	Nil Nil	1,100 lots 2123 persons	1,100 lots 2,123 persons
Serviced Apartments Poulation	Nil Nil	100 lots 160 persons	100 lots 160 persons
Public Transpor (combined) Bus Train	216 15 201	1,762 persons 126 persons 1,636 persons	1,546 persons 111 persons 1,435 persons
Pedestrian Activity (combined)	386	3,689 persons	3,303 persons

The model indicates that the traffic volume increases on reported on Wynne Avenue, Belmore Street, Conder Street and Railway Parade, as a consequence of the development, do not alone warrant the upgrade to traffic signals of the Railway Parade and Belmore Street roundabouts.

It can be argued that the pedestrian activity uplift associated with the neighbouring developments will require improved pedestrian mobility at the key intersections of Railway Parade and Conder Street, Conder Street and Belmore Street and Belmore Street and Wynne Avenue. Each intersection has been identified in the Section 94 plan for upgrade to signalisation. The timing of signalisation is subject to the level of growth and the need for improved pedestrian safety.

7.2 2026 Base Year Model

Year 2026 was nominated as the future assessment year which is conventional practice for this form of mixed use development. The year represents a practical timeframe within which some confidence in the understanding of likely development levels and prevailing traffic patterns can be made.

The future year 2026 model was developed to understand the likely traffic impacts the general metropolitan growth, and the planned Burwood town centre developments, would have on the traffic network.

The Metropolitan arterial road network screen lines, including Parramatta Road and the Hume Highway, report an average growth in vehicular traffic of some 13.8% to year 2026.

Figure ES 10 Model Projected 10 Year Vehicle Growth

Source Road Delay Solutions, 2017

AVERAGE PROJECTED VEHICLE GROWTH TO YEAR 2026			
Road	AM PEAK	PM PEAK	WEEKEND PEAK
Burwood Road	7.8%	7.6%	8.7%
Shaftesbury Avenue	16.1%	12.1%	8.7%
Wentworth Road	11.0%	12.1%	8.5%

The reported growth on Shaftesbury Road and Wentworth Road is greater than that on Burwood Road and suggests that the congested state of Burwood Road will be unattractive to motorists until such time as capacity constraints are reduced or eliminated.

It is apparent that with the anticipated metropolitan growth, Burwood Road will operate, at a LoS 'E'. Anecdotally, it can be supposed that Burwood Road is operating at or near its theoretical capacity and will allow for no further growth in vehichular traffic while the competing parallel routes of Shaftesbury Road and Wentworth Road remain viable options.

It is considered that the level of congestion reported on Burwood Road is acceptable as it reduces the speed of vehicles within a highly pedestrianised town centre while reducing the attractiveness of the route to through traffic.

7.3 2026 Section 94 Infrastructure Model

The second scenario model of the Year 2026 was prepared inclusive of…

- *The BTS growth rates,*
- *Stage 1 of the West Connex project (M4 East – Homebush Bay Drive to Pomeroy Street/Tunnelled Pomeroy Street to City West Link Road), which is scheduled for opening in 2019, and*
- *Burwood Council's Section 94 Infrastructure Plan.*

Figure ES 11 Westconnex Stage 1 M4 East – M4 to City West Link Road
Source http://www.westconnex.com.au, 2016

The Section 94 infrastructure plan and anticipated implementation dates include…

- *Future signalised right turn movement from Burwood Road, southbound, into Belmore Street, westbound, (2016-2018),*
- *Upgrade to the signalised intersection at Burwood Road and Railway Parade, (2016-2018),*
- *New traffic signals at the intersection of Railway Parade and Conder Street, (2016-2018),*
- *Widening of Railway Parade east of Burwood Road (2024-2027),*
- *New mid-block traffic signals in Wynne Avenue (2012-2015),*
- *New traffic signals at Belmore Street and Wynne Avenue (2012-2015),*
- *New traffic signals at Belmore Street and Conder Street (2012-2015),*
- *Widening of Railway Parade adjacent to Burwood Plaza (after 2035),*
- *Streetscape upgrades in Belmore Street, Conder Street, Wynne Avenue (2012 - after 2020), and*
- *Shared zones in Conder Street and Clarendon Place (2016-2018).*

The intention of this model is to adopt the Section 94 infrastructure measures, as proposed by Council, and report the road network operation under the demands of year 2026 growth.

The Section 94 Infrastructure Plan outlines provision for modification to the Burwood Road intersection with Railway Parade. After dicussions with Council it is intended to retain the current movement conditions including the right turn from Burwood Road, southbound, into Railway Parade under the plan.

It has been reported from the modelling that with the introduction of the Section 94 improvements, the operational performance of Burwood Road, both northbound and southbound will operate at a LoS 'E', further consolidating the view that Burwood Road is operating at capacity and the competing parallel routes of Wentworth Road and Shaftesbury Road remain viable alternative paths into and out of the town centre with motorists utilising side street entry to the centre and access to the available parking provisions.

Under the Section 94 Infrastructure Plan the introduction of traffic signals in Belmore Street at Wynne Avenue and Conder Street and the further introduction of traffic signals at Railway Parade and Conder Street create a circulatory route around the development site which meets the needs of both motorists and pedestrians. The introduction of signalised pedestrian crossings at the new signal sites will improve community mobility and safety.

Modelling supports Council's view that the Burwood Road intersection with Railway Parade and also with Belmore Street, should be retained in their current form as no significant improvement is reported with the relocation of the right turn movement, southbound, in Burwood Road from Railway Parade to Belmore Street, as reported in the body of this document.

7.4 2026 Plaza Development Model

The third scenario model of the Year 2026 addresses the impacts of the Burwood Plaza Development.

The Plaza development model was specifically constructed to shape the necessary mitigation treatments to sustain the planned growth levels within and immediate Burwood town centre surrounds. The model addresses the following objectives…

- *The minimisation of impacts from development generated traffic on Burwood Road and local streets,*
- *The optimisation of traffic operations on Burwood Road during the commuter peak periods within the current road reserve constraints,*
- *To maintain and/or improve pedestrian mobility and safety within the study area, and*
- *Realise a traffic management outcome which retains a level of amenity while allowing further development necessary for economic growth within the retail and commercial sectors within the town centre.*

The major input parameters incorporated in the 2026 Plaza Development model, comprise…

- *The introduction of committed road network infrastructure improvements outlined in Burwood Council's Section 94 Plan,*
- *Trip matrices for the AM, PM and WE peak periods encapsulating the planned growth levels to year 2026, as defined by the BTS, within the Metropolitan Area, and the BTS TZ 910, 913 and 915,*
- *The introduction of traffic generation associated with the Burwood Plaza development, via the proposed access locations on Railway Parade, Belmore Street and Wynne Avenue, and*
- *A general 3% increase in pedestrian traffic associated with the population growth within the Burwood town centre.*

To achieve the objectives of this assessment, it was necessary to consider a number of treatments, including several from the Section 94 Infrastructure Plan, which will meet the amenity and capacity objectives associated with the Plaza development.

Figure ES 12 2026 Plaza Development Model – Road Network Treatment Options

Source Road Delay Solutions, 2018

Identifier	Proposed Road Network Component	Priority in Relation to Plaza Development	Reasoning
1	Widening of pedestrian crossings to 5m at select locations	Low	To increase the pedestrian capacity and attempt to reduce the incidence of demand for the pedestrian 'WALK' during each cycle.
2	Retention of right turn for all vehicles, SB on Burwood Road at Railway Parade	High	Afford buses access to the stops in Railway Parade on the northern side of Burwood Plaza.
3	Introduction of a pedestrian 'scramble' phase	High	A pedestrian 'scramble' phase will reduce the impacts of pedestrian movements on the SB left turn movement in Burwood Road.
4	Retention of current intersection configuration and phasing on Burwood Road at Belmore Street	Medium	Retention of the RT movement for all vehicle classes at Railway Parade negates the need for a dedicated RT phase from Burwood Road, SB, in Burwood Road.
5	Introduction of a partial closure of Wynne Avenue, south of Railway Parade	Low	The partial closure, or narrowing, of Wynne Avenue is proposed to consolidate continuity and pedestrian mobility at the podium level, between the two Burwood Place development sites.
6	Introduction of priority sign controlled development access in Railway Parade	High	Required to provide access to the Burwood Place development. No RT from development site onto Railway Parade to be permitted.
7	Retention of vehicular access via the traffic signal controlled intersction on Wynne Avenue	High	Required to provide access to the Burwood Place development utilising the current easement. Pedestrians are controlled at the entry by a signalised crossing.
8	Signalisation of the Railway Parade intersection with Conder Street	Medium	Signalisation will formalise pedestrian movements, efficiently manage traffic movements and allow buses to perform a 'U' turn movement to access the bus layover on the northern side of Railway Parade, adjacent to Burwood Central.
9	Signalisation of Burwood Road intersection at Victoria Street East. Buses Only RT movement from Burwood Road NB	Low	Necessary to formalise both bus and pedestrian movements. Intended to reduce the incidence of 'J' walking across Burwood Road.
10	Traffic signalisation of the Belmore Street intersection with Conder Street	Medium	Treatment will effectively manage vehicle and pedestrian movements.
11	Traffic signalisation of the Belmore Street intersection with Wynne Avenue	Medium	Treatment will effectively manage vehicle and pedestrian movements.

Burwood Plaza currently generates some 940 vehicle trips per hour during the morning and evening commuter peak periods, respectively. With the proposed mixed use development the subsequent, calculated, vehicle generation is 1,624vph during the morning AM peak and 1,531vph during the PM.

The development vehicle generation has been applied to the year 2026 trip matrices. The operational network modelling of Burwood Road reports a LoS 'E' for the morning, evening and weekend peak periods.

Detailed assessment of each key intersection and the town centre route was undertaken to determine the impact on average vehicle delay, level of service and the resultant queue lengths.

The mesoscopic modelling indicates that with the addition of the Burwood Place traffic generation, Burwood Road traffic volumes do not rise significantly. However, traffic vehicle volume increases do occur on Shaftesbury Road and Wentworth Road.

The model results would suggest that residents of the proposed Burwood Place development will opt for the less congested alternate, parallel, routes to avoid congestion and reduce travel times to their elected destinations, should they be outside the cordon of the town centre. This was evident from select link analysis of the development traffic generation movements.

The vehicular growth reported on Burwood Road is consistent with that reported between the years 2000 and 2017.

MITIGATION MEASURES

8.1 Widening of Pedestrian Crossings

Consideration has been given to widening of the marked foot crossings on Burwood Road at…

- *Victoria Road East,*
- *Dean Street,*
- *Wilga Street,*
- *Park Avenue,*
- *Railway Parade, and*
- *Belmore Street.*

The measure will increase pedestrian '*throughput*', reduce pedestrian delays and may reduce the incidence of the pedestrian '*walk phase*' being called each cycle of the traffic signals throughout the day.

Widening of the crossings will also improve pedestrian mobility within the confines of the signalised crossings and may reduce the incidence of 'J' walking.

Modelling of the widened crossings was undertaken and found to reduce pedestrian delays by up to 20 seconds per person per cycle of the traffic lights.

This action may be undertaken when each signal site undergoes reconstruction.

8.2 Burwood Road and Railway Parade

A number of options have been considered and modelled for this site. The signalised intersection is currently operating a dedicated right turn phase, from the central shared lane, on Burwood Road northbound into Railway Parade, modelling indicated no significant improvement in the network operation would result from banning the movement ot all vehicles, with the exception of buses.

Relocation of the right turn phase from Railway Parade to Belmore Street yielded no significant benefit. The action reported significant increases in vehicle delay and queues for southbound motorists.

The pedestrian demand at the intersection is high and causes delay to turn movements. To eliminate this delay a '*scramble*' pedestrian phase has been analysed. By introducing the signle walk phase all left turn movements are no longer held by the movement of pedestrians. The '*scramble'* phase is introduced as the last phase of the cycle and has been timed to coincide with the longest perpendicular walk through the intersection.

With the Burwood railway station only 170m from the Burwood Place site, the scramble walk will afford pedestrians improved connectivity and a shorter walk times with the need to perform a single crossing.

The retention of the right turn movement for all vehicles and the introduction of the scramble walk phase, the intersection reports a LoS 'D' during the week day commuter peaks and 'C' during the weekend peak.

8.3 Burwood Road and Belmore Street

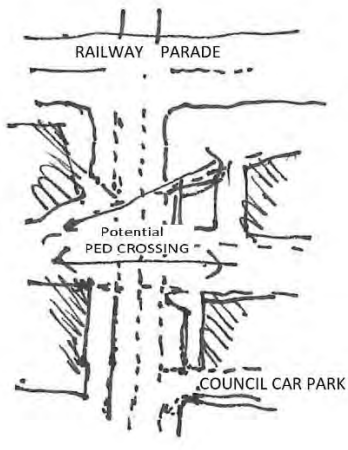
With the retention of the right turn movement for all vehicles, southbound on Burwood Road at Railway Parade, route modelling indicates that the Belmore Street intersection performs best if retained in its current state.

8.4 Wynne Avenue Partial Closure

A partial closure, or narrowing, of Wynne Avenue is proposed to consolidate continuity and pedestrian mobility at the podium level, between the two Burwood Place development sites. The partial closure is to take the form of widened footway provisions, the restriction of one (1) trafficable lane each way in Wynne Avenue, south of Railway Parade, for a distance encompassing the potential pedestrian crossing points and the introduction of a 40km/h speed limit.

Figure ES 13 Potential Wynne Avenue Treatment

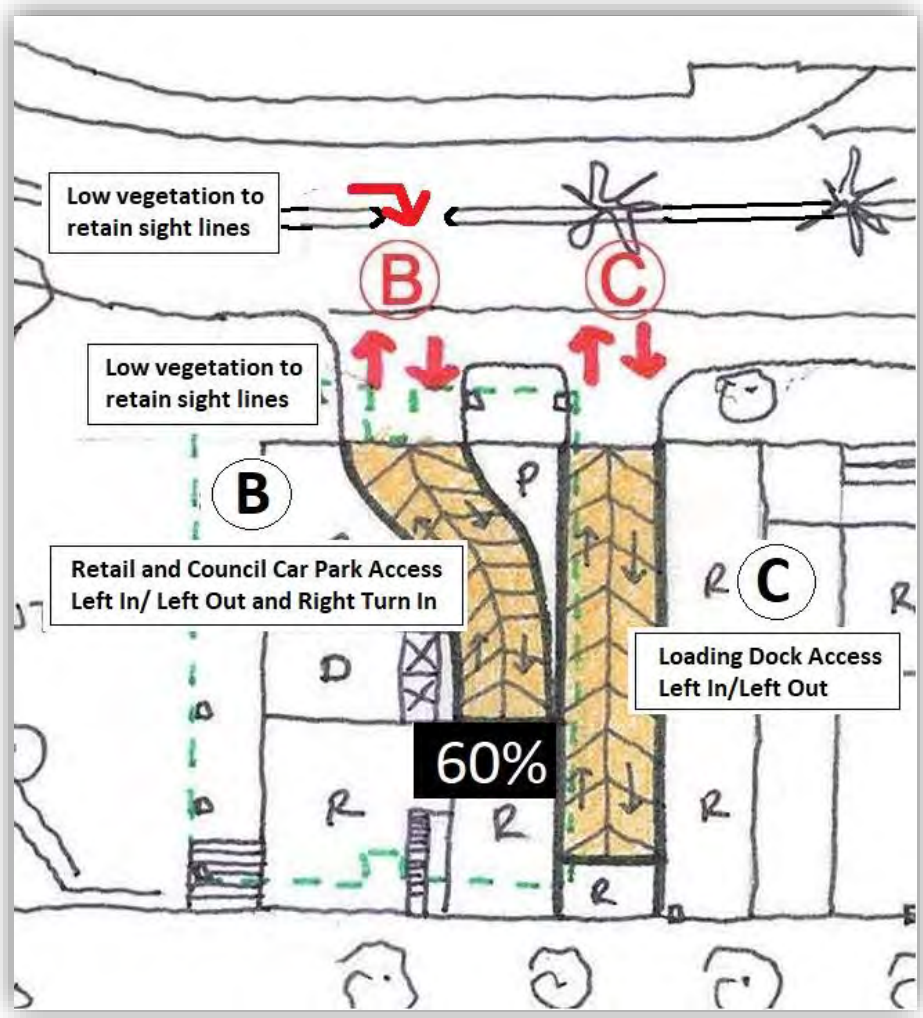
Source COX, 2018



Sidra network modelling of Conder Street with both the Belmore Street and Railway Parade intersections and the Belmore Street and Wynne Avenue intersection do not indicate any significant deterioration with the changed travel patterns associated with the Wynne Avenue partial closure. While the impact to traffic volumes on Burwood Road is reported as negligible.

8.5 Railway Parade Access

Figure ES 14 Railway Parade Access
Source COX/Road Delay Solutions, 2018



The proposed sign controlled access on Railway Parade has been found to operate at a good LoS 'A' for all peak periods. The intersection is proposed to incorporate…

- → *Sign priority control,*
- → *Adjacent western and eastern entry points, separated by some 2 metres…*
  - o *With the Western most access designated for residential, commercial, visitor and retail activity uses, and*
  - o *An Eastern driveway access to the below ground level loading docks catering for left in/left out movements only.*

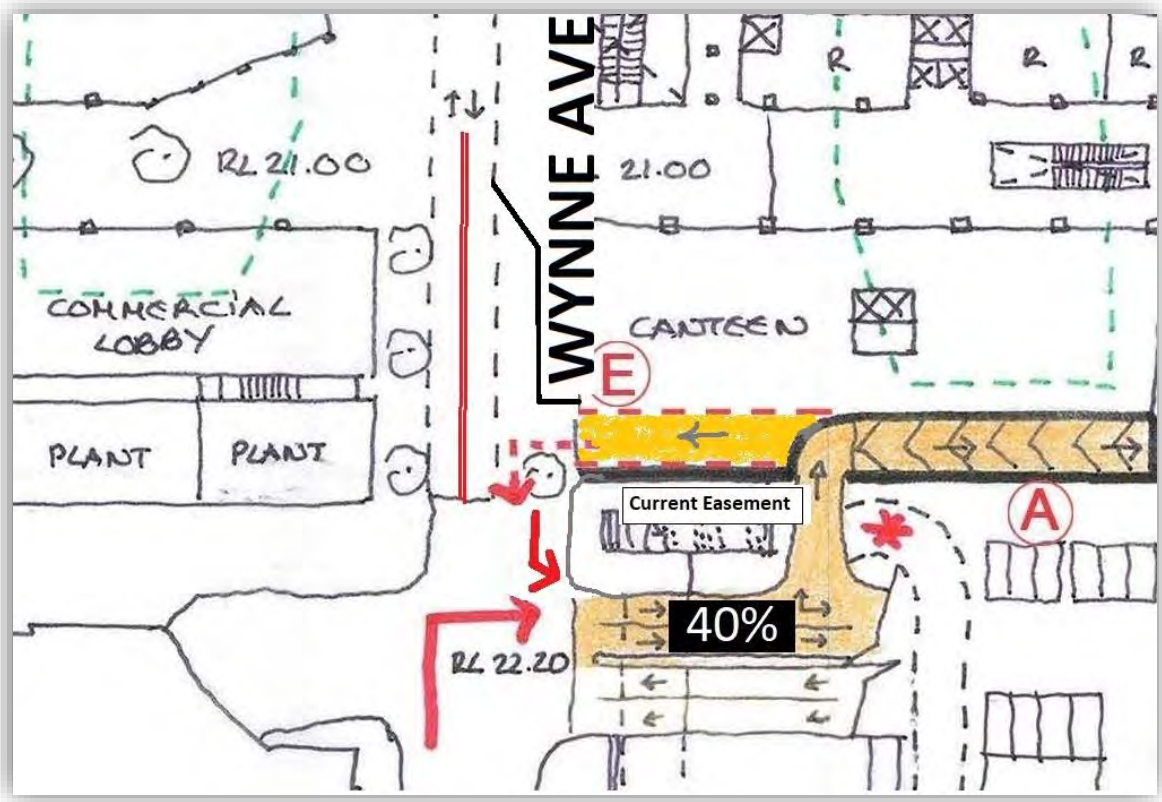
- *Modification of the central median in Railway Parade to allow for a single lane right turn movement from Railway Parade, eastbound, into the residential, commercial, visitor and retail activities,*
- *Location a minimum of 75m east from the Conder Street intersection,*
- *Clearly identified multiple lane entry for the differing uses within the site,*
- *Employment of a right turn ban from Railway Parade into the eastern loading dock access, and*
- *Employment of a right turn ban from both the western and eastern driveways onto Railway Parade.*

The access has been modelled, at this time, to cater for a maximum 60% of the development's traffic generation representing the *worst case scenario*, and be located a minimum of 75m, east from Conder Street to provide satisfactory sight distance and queueing capacity.

The final configuration, traffic composition and location will be determined during the DA design stage in consultation with Council and any key stakeholders.

8.6 Wynne Avenue Entry

Figure ES 15 Wynne Avenue Entry
Source COX/Road Delay Solutions, 2018



Consideraton is currently underway as to the viability of a possible entry to the development from Wynne Avenue. Modelling reports a LoS 'B' at the location when servicing some 40% of the Burwood Place development's traffic generation via either the current traffic signal controlled entry to the Council car park (preferred) or a sign controlled intersection, to the north of the existing traffic signals.

8.7 Conder Street Exit

A priority controlled left turn is proposed fonto Conder Street from both the Council Library and Burwood Place car parks. Two (2) ramps are proposed being…

- *A dedicated egress from the Council car park, and*
- *An express ramp from the Burwood Place Basement 1 car park.*

The two ramps are to be separated sufficiently to allow vehicles to exit either ramp at the same time and turn into the central lane on Conder Street. The ramps are to be located to the south of the relocated marked foot crossing across Conder Street and it is envisaged that 2-3 on street car parking spaces will be lost.

Modelling suggests that the ramps will carry a maximum of some 422vph onto Conder Street during the PM peak.

Detailed design of the ramps will be undertaken, in consultation with Council, and will be finalised prior to submission of the Stage 1 DA.

8.8 Current Belmore Street Exit

Historically recognised as an access location to the former Plaza, and currently operating as an egress from the roof top parking area, the right of carriageway (easement) is to be considered for use by Burwood Place prior to DA submission.

This Planning Proposal assumes no use of the current Belmore Street easement (access ramp).

8.9 Railway Parade and Conder Street

The introduction of traffic signal control is proposed under Council's Section 94 Infrastructure Plan.

The signalisation of the site will formalise pedestrian movements and effectively manage the increasing vehicle activity. The future signalised pedestrian crossings at the site should be designed 5m wide to increase the throughput and reduce the delay of pedestrians per phase.

Of critical note when introducing traffic signals at the aite is the inclusion of a 'U' turn provision for buses only in Railway Parade, westbound. Current bus lay over provisions on the northern side of Railway Parade, adjacent to Burwood Central, necessitate the need for a 'U' turn facility for buses only. Modelling of the site has reported an intersection LoS 'D' with the 'U' turn movement occurring during the intergreen period, prior to 'A' phase. The movement is to be controlled by use of an exclusive 20m long bus lane and bus lantern display.

8.10 Burwood Road and Victoria Street East

The traffic signalisation of the Burwood Road intersection with Victoria Street East to facilitate the right turn movement northbound for buses only to enable access to bus layover provisions in Victoria Street East, adjacent to Westfields.

Bus priority and a 'B' signal lantern display is proposed at the Burwood Road intersection with Victoria Street East. The bus movement is proposed to occur during the intergreen period prior to 'A' phase. The site reports a LoS 'B' during the peak periods with the linked signal offsets from Wilga Street and Park Avenue.

The area around the site has been identified as a known 'J' walking location, and with the introduction of traffic signals and the incorporation of controlled pedestrian crossings, improved pedestrian safety provisions are envisaged.

8.11 Belmore Street and Conder Street

The introduction of traffic signal control at the site is proposed under Counci'ls Section 94 Infrastructure Plan.

The signals will provide improved management and formalisation of vehicle movements and pedestrian demands.

The site reports an intersection LoS 'B' during each of the three (3) modelled peak hour periods.

8.12 Belmore Street and Wynne Avenue

The removal of the existing roundabout and introduction of traffic signal control at the site is proposed under Counci'ls Section 94 Infrastructure Plan.

Once again, the introduction of traffic signals will provide improved management and formalisation of vehicle movements and pedestrian demands while returning a satisfactory LoS.

8.13 Traffic Signals at Shaftesbury Road and George Street

The introduction of traffic signal control at the site is proposed to…

- *Facilitate safe turn movements from George Street onto Shaftesbury Road with the increase in traffic,*
- *Improve pedestrian mobility between the residential catchment to the east of Shaftesbury Road and the Burwood Railway station and retail operations at the proposed development, and*
- *Reduce the potential intrusion of traffic onto Marmaduke Street and Waimea Street.*

The proposed traffic signal operation reports a LoS 'B' during each of the modelled peak hour periods.

8.14 Traffic Signals at Burwood Road and Victoria Street East

The traffic signalisation of the Burwood Road intersection with Victoria Street East to facilitate the right turn movement northbound for buses only (Interim measure)to enable access to bus layover provisions in Victoria Street East, adjacent to the Westfield Shopping Complex.

Bus priority and a 'B' signal lantern display is proposed at the Burwood Road intersection with Victoria Street East. The bus movement is proposed to occur during the intergreen period prior to 'A' phase. The site reports a LoS 'B' during the peak periods with the linked signal offsets from Wilga Street and Park Avenue.

The area around the site has been identified as a known 'J' walking location, and with the introduction of traffic signals and the incorporation of controlled pedestrian crossings, improved pedestrian safety provisions are envisaged.

8.15 Capacity Increase on Shaftesbury Road at Wilga Street

With only single through traffic lanes on Shaftesbury Road at Wilga Street, the capacity of the traffic signal controlled intersection northbound becomes a pinch point requiring increased capacity to sustain development growth of some 300vph in the peak flow directions during the commuter peaks.

As the Victoria Street & George Street development has access from both Victoria Street and George Street, with the latter being one way, the southbound increase is not significant enough to require widening of the southbound carriageway. However, egress from the proposed development is entirely onto Shaftesbury Road and with the directional flow towards the Sydney CBD during the morning peak, the intersection reports unsatisfactory service.

The volume of through traffic, under full development of the town centre, will require the widening of Shaftesbury Road to accommodate two (2) trafficable lanes northbound and lengthening of the southbound right turn bay into Wilga Street.

CONCLUSION

Road Delay Solutions has been engaged by *Holdmark Property NSW Pty Ltd* to undertake the preparation of a Traffic Impact Assessment in support of the Planning Proposal for a mixed use development at 42-50 and 52-60 Railway Parade, Burwood, commonly known as '*Burwood Plaza*'.

Burwood is a dynamic LGA with the town centre constantly growing with planned residential, retail and commercial developments, some well into their construction phases. The Burwood Plaza redevelopment is just one of these.

Extensive mesoscopic and operational modelling has reported that vehicular growth, particularly along Burwood Road is relatively static and any further growth is shared with the competing routes of Shaftesbury Road and Wentworth Road. Shaftesbury Road, in particular, and Wentworth Road provide viable through traffic avenues between the Hume Highway to the south and Great Western Highway to the north which removes pressure from Burwood Road.

This assessment has concluded that, once the proposed infrastructure outlined in Council's Section 94 Contributions Plan has been implemented, any impacts of traffic generation, both vehicular and pedestrian, is benign on the town centre's road network.

A number of measures (in conjunction and additional to the infrastructure outlined in Council's S94 Plan) have been identified and assessed in unison to sustain the movement of traffic within the town centre and support the planned level of growth anticipated with the Burwood Place development to year 2026. These works include…

- *Widening of existing signalised foot crossings along Burwood Road between Wilga Street and Belmore Street to 5m,*
- *General retention of the current traffic signal operations at the Burwood Road intersections with Railway Parade (including retention of the right turn movement for all vehicles southbound turning into Railway Parade) and Belmore Street,*
- *The introduction of a 'scramble' phase pedestrian crossing at the Burwood Road intersection with Railway Parade,*
- *Introduction of a partial closure of Wynne Avenue to accommodate a single trafficable lane in each direction, some 25m south of Railway Parade for a distance of approximately 30m,*
- *The introduction of site specific access from Railway Parade and Wynne Avenue,*
- *The introduction of an exit only onto Conder Street from Burwood Place and Council's library car parks,*
- *Widening of Shaftesbury Road to provide two (2) through lanes in each direction at the Wilga Street intersection,*

→ *The introduction of traffic signal control at the intersections of…*

- *Railway Parade and Conder Street,*
- *Belmore Street and Wynne Avenue,*
- *Belmore Street and Conder Street,*
- *Burwood Road and Victoria Street East, and*
- *Shaftesbury Road and George Street.*

In conclusion, with the introduction of the aforementioned measures, the impact of traffic generation associated with the Burwood Place development will be effectively managed while reducing the impedence to pedestrian movement.

It is recommended that the traffic measures outlined be implemented over the coming five (5) years to retain the current service and amenity levels with the anticipated growth within the Burwood Town Centre.

Figure ES 16 Burwood Town Centre Intersection Operational Performance

Source Road Delay Solutions, 2018

BURWOOD TOWN CENTRE SIDRA NETWORK +A64+A1:M31+A1:M35+A1:M39+A64+A1:M57												
	2017 Existing			2026 'Do Nothing' Base			2026 'With Section 94'			2026 Full Development		
	AM	PM	WE	AM	PM	WE	AM	PM	WE	AM	PM	WE
Burwood Road and Victoria Street East												
DS	0.156	0.182	0.165	0.158	0.275	0.231	0.171	0.206	0.186	0.44	0.752	0.525
AVD *(sec)*	1.2	1.6	1.5	1.1	1.9	1.7	1.2	1.5	1.3	11.4	15.7	11.8
LOS	A	A	A	A	A	A	A	A	A	A	B	A
Burwood Road, Deane Street and Railway Crescent												
DS	0.881	0.711	0.723	0.288	0.772	0.755	0.671	0.72	0.819	0.871	0.731	0.883
AVD *(sec)*	19.6	14	13.9	2.4	14.7	14.1	14.2	14.3	16.3	14.2	14.1	19.8
LOS	B	A	A	A	B	B	A	B	B	A	B	B
Burwood Road and Railway Parade												
DS	0.861	0.798	0.798	0.855	0.882	0.869	0.772	0.831	0.71	0.924	0.986	0.896
AVD *(sec)*	36.3	25.5	25.5	27.4	36.3	31.2	20.8	24.9	20.3	34.2	54.6	33.3
LOS	C	B	B	B	C	C	B	B	B	C	D	C
Burwood Road and Belmore Street												
DS	1.177	0.666	0.856	0.799	0.791	0.73	1.07	0.709	0.895	0.918	0.824	0.692
AVD *(sec)*	72.3	16.4	21.1	18.9	21.5	20.4	45.7	19.9	36.1	25.5	21.9	20.8
LOS	F	B	B	B	B	B	D	B	C	B	B	B
Shaftesbury Road and Wilga Avenue												
DS	0.639	0.871	0.794	1.157	0.857	0.898	0.981	0.864	0.878	1.039	0.945	0.995
AVD *(sec)*	16.5	21.3	19.6	123	21.4	32	44.2	24.7	29.7	55.8	44.5	43.7
LOS	B	B	B	F	B	C	D	B	C	D	D	D
Shaftesbury Road and Victoria Street												
DS	0.892	0.763	0.728	0.824	0.791	0.842	0.873	0.845	0.845	0.907	0.903	0.867
AVD *(sec)*	45.2	22.4	48.8	26.4	22.1	44.2	31.9	40.8	41.9	48.7	46.4	32.5
LOS	B	B	D	B	B	D	C	C	C	D	D	C
Shaftesbury Road and George Street												
DS	0.182	0.28	0.415	0.196	0.84	0.793	0.623	1.008	1.689	0.668	0.838	0.736
AVD *(sec)*	1	1.3	1.9	0.4	3.8	3.7	2.1	6.8	28	8.8	13.4	10.5
LOS	A	A	A	A	A	A	A	A	B	A	A	A
Shaftesbury Road, Railway Parade and Paisley Street												
DS	0.91	0.84	0.84	0.829	0.856	0.762	0.853	0.854	0.854	0.925	0.876	0.852
AVD *(sec)*	44.4	41.9	37.7	34.1	45.5	26.6	29.2	39.8	31.6	49.1	41.6	41.6
LOS	D	C	C	C	D	B	C	C	C	D	C	C
Wentworth Road, Railway Parade and Morwick Street												
DS	0.879	0.975	0.84	0.796	0.975	0.807	0.911	1.121	1.129	0.911	1.174	0.919
AVD *(sec)*	43.9	61.4	37.7	33	61.4	37.8	49.8	139.1	127.7	49.8	172.2	57.8
LOS	D	E	C	C	E	C	D	F	F	D	F	D
Burwood Road and George Street												
DS	0.196	0.164	0.17	0.196	0.194	0.19	0.167	0.172	0.208	0.167	0.18	0.208
AVD *(sec)*	0.7	0.7	1	0.4	0.7	0.9	1.3	1.1	1.3	1.3	1.1	1.3
LOS	A	A	A	A	A	A	A	A	A	A	A	A
Railway Parade and Wynne Avenue												
DS	0.533	0.477	0.613	0.508	0.488	0.338	0.794	0.718	0.431	0.728	0.889	0.585
AVD *(sec)*	19.2	18.4	18.7	18.6	18.6	17.2	22.1	22.2	18.6	23.7	46.7	19.7
LOS	B	B	B	B	B	B	B	B	B	B	D	B
Railway Parade and Conder Street												
DS	0.569	0.513	0.499	0.533	0.618	0.42	0.518	0.555	0.268	0.543	0.557	0.395
AVD *(sec)*	7.2	6.6	7.2	7.6	8.4	6.7	16.8	15.3	14.7	17.8	13.9	14.1
LOS	A	A	A	A	A	A	B	B	B	B	A	A
Belmore Street and Wynne Avenue												
DS	0.202	0.259	0.291	0.143	0.231	0.279	0.717	0.618	0.554	0.489	0.654	0.547
AVD *(sec)*	5.6	5.6	5.6	5.7	6.4	6.2	19.5	15.8	13	13.1	18.1	15.1
LOS	A	A	A	A	A	A	B	B	A	A	B	B
Belmore Street and Conder Street												
DS	0.24	0.202	0.24	0.181	0.195	0.238	0.654	0.777	0.344	0.442	0.451	0.661
AVD *(sec)*	4.3	3.5	3.8	3.3	3.6	4.1	16.5	17	15.4	14.7	16.1	16.7
LOS	A	A	A	A	A	A	B	B	B	B	B	B
Railway Parade and Development Access												
DS										0.549	0.952	0.591
AVD *(sec)*										4.8	9.7	4.3
LOS										A	A	A
Wynne Avenue and Development Entry												
DS										0.566	0.541	0.522
AVD *(sec)*										18.6	18.9	17.7
LOS										B	B	B

Figure ES 17 Modelled Vehicle Projections

Source Road Delay Solutions, 2018

MESOSCOPIC MODEL HOURLY TRAFFIC VOLUME PROJECTIONS																					
	Model																				
Road Link	17AM4	26AMBT	Variance 2026 Base Model minus Existing	26AMS94B	Variance 2026 S94 Model minus Existing	26AMDV2	Variance 2026 Towers Model minus Existing	17PM3	26PMBT	Variance 2026 Base Model minus Existing	26PMS94B	Variance 2026 S94 Model minus Existing	26PMDV2	Variance 2026 Towers Model minus Existing	17AMWE6	26AMWEB	Variance 2026 Base Model minus Existing	26AMWES	Variance 2026 S94 Model minus Existing	26AMWED2	Variance 2026 Towers Model minus Existing
BURWOOD RD SB N WILGA ST	562	655	93	717	62	564	2	452	609	157	442	-10	488	36	371	627	256	429	58	374	3
WILGA ST EB	386	327	-59	404	77	347	-39	541	474	-67	516	-25	556	15	581	646	65	567	-14	552	-29
WILGA ST WB	501	479	-22	583	104	541	40	472	564	92	509	37	568	96	489	511	22	564	75	503	14
PARK AVE EB	460	482	22	411	-71	381	-79	507	507	0	490	-17	534	27	536	604	68	403	-133	391	-145
PARK AVE WB	359	415	56	398	-17	364	5	349	297	-52	343	-6	332	-17	298	264	-34	311	13	267	-31
BURWOOD RD NB S PARK AVE	487	519	32	419	-100	471	-16	486	602	116	464	-22	543	57	423	497	74	550	127	515	92
BURWOOD RD SB S PARK AVE	540	613	73	529	-84	522	-18	502	762	260	457	-45	607	105	496	778	282	515	19	504	8
BURWOOD RD SB N GEORGE ST	471	538	67	482	-56	464	-7	389	575	186	335	-54	447	58	346	651	305	417	71	389	43
GEORGE ST EB	84	244	160	212	-32	334	250	58	592	534	488	430	628	570	71	611	540	461	390	650	579
GEORGE ST WB W BURWOOD RD	140	98	-42	68	-30	39	-101	179	53	-126	43	-136	10	-169	106	58	-48	71	-35	30	-76
RAILWAY CRES WB	93	132	39	54	-78	138	45	56	193	137	42	-14	122	66	73	165	92	51	-22	107	34
DEANE ST WB	173	77	-96	67	-10	44	-129	216	106	-110	72	-144	79	-137	137	71	-66	86	-51	73	-64
BURWOOD RD NB N RAILWAY PDE	588	692	104	513	-179	630	42	569	826	257	545	-24	706	137	523	697	174	644	121	664	141
RAILWAY PDE EB W BURWOOD RD	428	469	41	408	-61	396	-32	395	596	201	282	-113	441	46	334	623	289	326	-8	322	-12
RAILWAY PDE WB E BURWOOD RD	415	334	-81	379	45	448	33	416	299	-117	474	58	582	166	448	313	-135	343	-105	394	-54
RAILWAY PDE EB E BURWOOD RD	341	390	49	291	-99	225	-116	411	451	40	566	155	421	10	400	435	35	362	-38	380	-20
BURWOOD RD NB S RAILWAY PDE	509	511	2	382	-129	362	-147	446	555	109	362	-84	432	-14	484	585	101	354	-130	398	-86
BURWOOD RD SB S RAILWAY PDE	311	308	-3	261	-47	256	-55	312	414	102	194	-118	259	-53	274	404	130	241	-33	212	-62
BURWOOD CENTRAL NB	11	10	-1	11	1	11	0	12	11	-1	13	1	13	1	11	10	-1	12	1	12	1
BURWOOD CENTRAL SB	12	12	0	12	0	12	0	22	24	2	24	2	24	2	13	14	1	14	1	14	1
RAILWAY PDE EB W WYNNE AVE	369	397	28	352	-45	440	71	472	476	4	831	359	704	232	473	434	-39	584	111	612	139
RAILWAY PDE WB W WYNNE AVE	480	388	-92	870	482	630	150	607	496	-111	910	303	990	383	463	455	-8	549	86	545	82
RAILWAY PDE EB W CONDER ST	507	689	182	361	-328	996	489	516	1188	672	638	122	1093	577	573	855	282	657	84	1153	580
RAILWAY PDE WB W CONDER ST	476	997	521	986	-11	978	502	584	699	115	1041	457	1130	546	436	606	170	528	92	763	327
CONDER ST NB	239	299	60	502	203	305	66	217	221	4	376	159	246	29	202	221	19	227	25	211	9
CONDER ST SB	212	213	1	223	10	487	275	102	294	192	353	251	497	395	183	207	24	249	66	419	236
BELMORE ST EB W BURWOOD RD	231	171	-60	162	-9	175	-56	333	464	131	498	165	350	17	403	466	63	382	-21	333	-70
BELMORE ST WB W BURWOOD RD	178	331	153	718	387	567	389	206	317	111	477	271	707	501	181	308	127	466	285	556	375
BELMORE ST WB E BURWOOD RD	138	218	80	286	68	237	99	183	241	58	326	143	464	281	144	212	68	265	121	301	157
BELMORE ST EB E BURWOOD RD	132	140	8	138	-2	150	18	160	190	30	117	-43	246	86	201	196	-5	239	38	191	-10
WYNNE AVE NB N BELMORE RD	128	401	273	777	376	266	138	132	485	353	712	580	372	240	117	259	142	359	242	163	46
WYNNE AVE SB N BELMORE RD	182	337	155	364	27	173	-9	168	238	70	457	289	167	-1	147	227	80	171	24	90	-57
CONDER ST NB S BELMORE ST	338	356	18	518	162	433	95	193	339	146	378	185	352	159	259	326	67	237	-22	311	52
CONDER ST SB N BELMORE ST	159	297	138	190	-107	425	266	228	221	-7	162	-66	553	325	231	295	64	222	-9	503	272
BELMORE ST WB E CONDER ST	90	93	3	111	18	54	-36	228	299	71	273	45	310	82	171	245	74	232	61	193	22
BELMORE ST EB E CONDER ST	197	122	-75	94	-28	206	9	146	259	113	115	-31	329	183	245	257	12	159	-86	248	3
WENTWORTH NB S RAILWAY	223	781	558	339	-442	283	60	376	444	68	319	-57	283	-93	228	220	-8	415	187	207	-21
WENTWORTH SB S RAILWAY	337	513	176	467	-46	245	-92	529	853	324	662	133	432	-97	516	390	-126	576	60	426	-90
RAILWAY WB E WENTWORTH	478	1511	1033	986	-525	978	500	598	1032	434	1041	443	1130	532	440	610	170	528	88	763	323
RAILWAY EB E WENTWORTH	516	1288	772	361	-927	996	480	517	1367	850	638	121	1093	576	581	863	282	657	76	1153	572
WENTWORTH SB N RAILWAY	643	793	150	747	-46	978	335	1002	1315	313	1066	64	1282	280	851	1056	205	1075	224	1242	391
MORWICK EB W WENTWORTH	596	515	-81	257	-258	353	-243	517	687	170	548	31	459	-58	640	618	-22	396	-244	451	-189
SHAFTESBURY NB S RAILWAY	635	656	21	729	73	772	137	613	629	16	597	-16	662	49	689	674	-15	848	159	783	94
SHAFTESBURY SB S RAILWAY	541	546	5	603	57	654	113	593	700	107	758	165	822	229	612	688	76	787	175	883	271
PAISLEY EB E SHAFTESBURY	380	355	-25	137	-218	161	-219	443	758	315	180	-263	221	-222	346	370	24	85	-261	157	-189
PAISLEY WB E SHAFTESBURY	564	104	-460	295	191	479	-85	432	74	-358	301	-131	355	-77	440	89	-351	208	-232	331	-109
SHAFTESBURY NB N RAILWAY	797	766	-31	889	123	947	150	766	738	-28	851	85	691	-75	829	831	2	1094	265	977	148
SHAFTESBURY SB N RAILWAY	521	820	299	662	-158	699	178	769	1294	525	801	32	837	68	641	956	315	862	221	889	248
RAILWAY WB W SHAFTESBURY	327	250	-77	305	55	376	49	342	183	-159	343	1	440	98	313	197	-116	206	-107	278	-35
SHAFTESBURY SB N WILGA	682	703	21	798	95	915	233	906	846	-60	963	57	1055	149	569	492	-77	690	121	863	294
WILGA EB W SHAFTESBURY	146	68	-78	130	62	116	-30	146	109	-37	140	-6	124	-22	119	87	-32	115	-4	135	16
SHAFTESBURY NB S WILGA	917	920	3	1071	151	1293	376	638	753	115	784	146	793	155	718	801	83	918	200	1151	433
SHAFTESBURY SB N VICTORIA	464	445	-19	622	177	656	192	917	777	-140	943	26	999	82	536	440	-96	633	97	711	175
VICTORIA WB E SHAFTESBURY	540	668	128	624	-44	772	232	324	465	141	405	81	511	187	324	494	170	518	194	612	288
SHAFTESBURY NB S VICTORIA	831	924	93	1010	86	975	144	594	714	120	742	148	624	30	757	888	131	895	138	931	174
VICTORIA EB W SHAFTESBURY	241	244	3	212	-32	334	93	524	592	68	488	-36	628	104	528	611	83	461	-67	650	122

TRAFFIC IMPACT ASSESSMENT

1. INTRODUCTION

1.1 Currently

Road Delay Solutions has been engaged by *Holdmark Property NSW Pty Ltd* to undertake the preparation of a Traffic Impact Assessment in support of the Planning Proposal for a mixed use development at 42-50 and 52-60 Railway Parade, Burwood, commonly known as '*Burwood Plaza*'.

The City of Burwood Local Government Area (LGA) is situated in the inner wester suburbs of Sydney. Being some 7.26 km^2 in area, it is one of the smallest local government areas in the state and has a relatively high population density.

Bordered by Concord Council (*Parramatta Road*) to the north, Canterbury Council (*Cooks River*) to the south, Strathfield Council (*The Boulevarde*) to the the west and Ashfield Council to the east, Burwood Town Centre is approximately 12km west of the Sydney CBD.

The Town Centre consists of a dense mix of residential, retail and commercial activities. With considerable development interest and current planning proposals, there is potential for a significant increase in traffic during the already heavily congested commuter peak periods. Burwood Road, in particular, exhibits high congestion levels resulting in the increasing use of parallel routes such as Shaftesbury Road and Wentworth Road and further filtering through to the lower order east west roads such as, but not limited to, Victoria Street East, Belmore Street, Livingstone Street and Clarence Street.

Plans for further development under the potential in the LEP, including the Burwood Place, need to address the concerns of the local community with regard to traffic and parking impacts. Measures may be required to manage traffic volumes in residential streets but also on the higher order road network whilst maintaining amenity for residents and businesses while catering for pedestrians, cyclist and buses.

The Burwood Town Centre is identified by the Bureau for Transport Statistics (BTS) as Travel Zones (TZ) 910, 913 and 915.

Figure 1 *BTS Travel Zones – Burwood Town Centre*

Source *Transport For NSW - BTS, 2016*

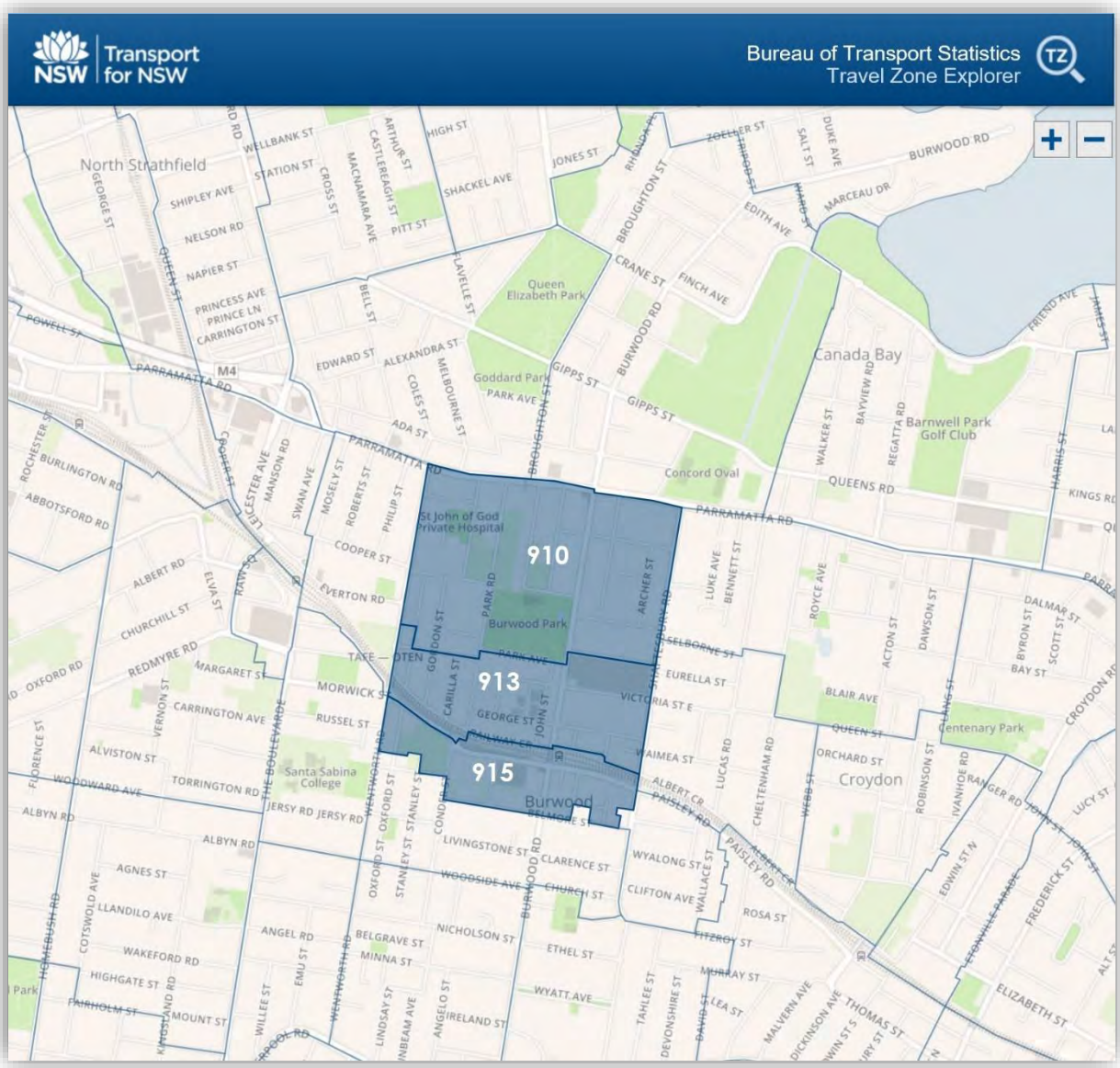


Figure 2 *Looking East on Railway Parade from Conder Street, Burwood*
Source *Google Street View, 2017*

1.2 The Site

Buwood Plaza seamlessly integrates with the surrounding Burwood Town Centre commercial and retail activities. The site is segmented into two (2) major components.

Situated on both sides of Wynne Avenue and fronting Railway Parade, the Plaza is only some 170m west of Burwood Railway Station.

The eastern segment, at 42-50 Railway Parade, is occupied by Burwood Plaza which provides some 13,000m^2 retail. Vehicle entry to Burwood Plaza is catered for from Wynne Avenue with egress onto Belmore Street. The Plaza loading docks are accessible from Wynne Avenue.

The western segment, at 52-60 Railway Parade, is occupied by two commercial office buildings which provide some 17,100m^2. Access to the western site is provided from Wynne Avenue.

In addition there is a public car park on the west site, south of the commercial buildings.

Figure 3 *Burwood Place Site in Context*
Source *vimeo.com, 2016*

The planning proposal provides for a mixed use development including some…

- *1,100 residential apartments,*
- *100 Hotel styled serviced apartments,*
- *27,502m² retail GFA (19,255m² GLFA) inclusive of supermarket GFA 4,200m² (2,900m² GLFA), and*
- *15,429m² (12,350m² GLFA) of commercial floor space. and*
- *A resultant FSR of some 10.53:1 for the site.*

1.3 Study Purpose

The purpose of this report is to qualify the impacts and recommend the necessary traffic infrastructure and parking strategy to adequately manage the performance of the Burwood Town Centre road network under the projected cumulative demands of the proposed development and anticipated future background growth in vehicular and pedestrian traffic to the horizon year 2026.

The year 2026 is commonly utilised in the assessment of developments for which planning and growth data is readily available from various government sources.

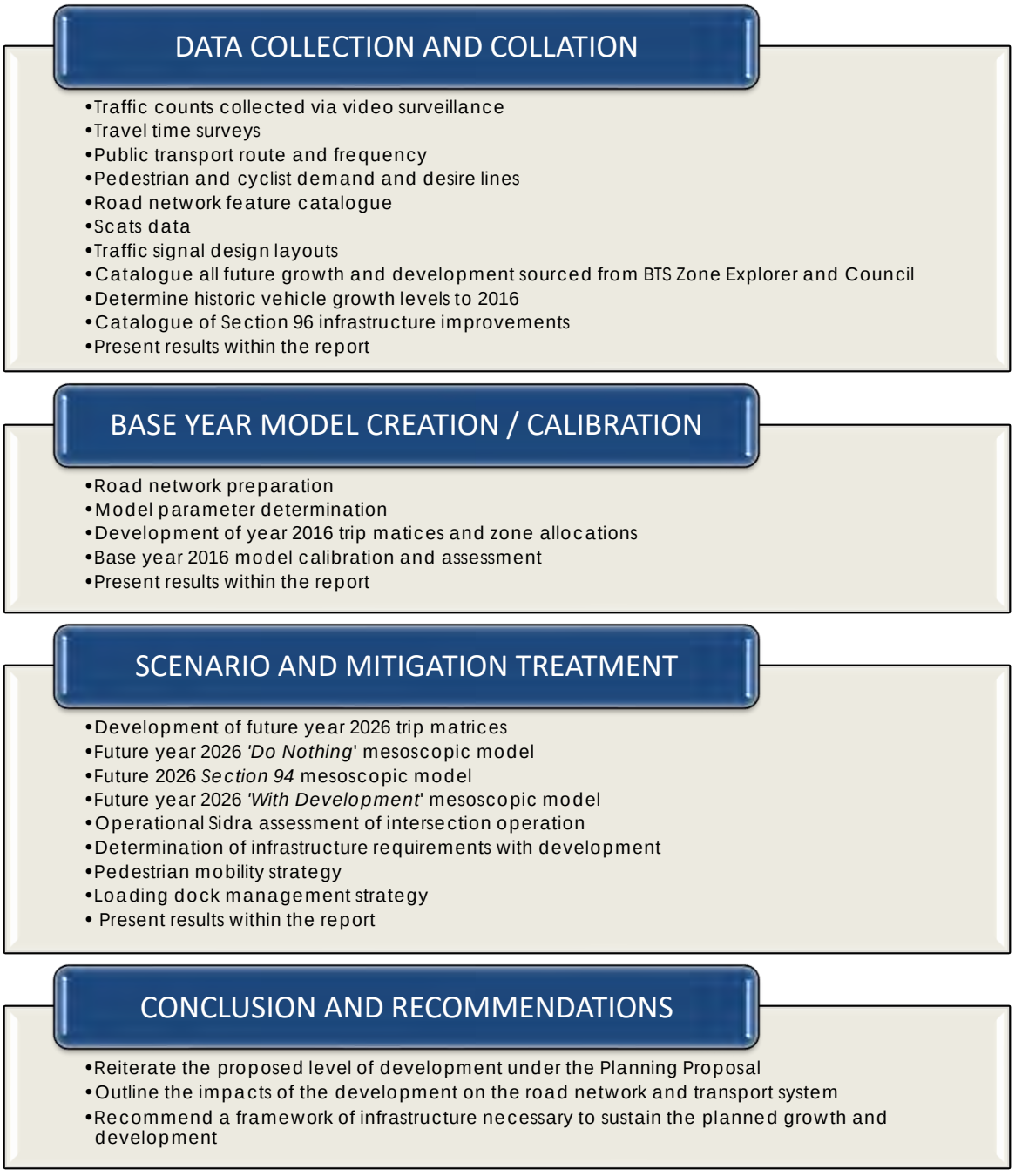
This assessment has been predicated on a computer based mesoscopic model and Sidra operational modelling by intersection control method, focusing on the Burwood Town Centre and the operation of the road network under both existing and future conditions.

1.4 The Assessment Process

This report has adopted a four (4) tier, systematic approach to assessment of the road network operation under both the existing and anticipated future conditions. The approach taken is graphically presented below, with the key tasks outlined for each tier.

Figure 4 *The Assessment Process*

Source *Road Delay Solutions, 2017*



2 EXISTING CONDITIONS

2.1 Road Network

The study area is generally bounded by Parramatta Road (GWH) to the north, Shatesbury Road to the east, Nicholson Parade to the south and Wentworth Road to the west.

The Burwood Town Centre is dominated by a grid like network of varying order roads. The following figure presents the current Road Hierachy as defined in Burwood City Council's (BCC) Development Control Plan (DCP).

This study focuses on a number of principle road corridors within the Burwood Town Centre, being...

- *Burwood Road,*
- *Railway Parade*
- *Wynne Avenue,*
- *Belmore Street,*
- *Clarendon Place,*
- *Conder Street, and*
- *Hornsey Street.*

Burwood Road

Burwood Road is the primary road corridor through the Burwood Town Centre, connecting Parramatta Road in the north to the Hume Highway and Georges River Road in the south. The road generally provides a four (4) lane undivided carriageway catering for a single through lane and on street parking lane in each direction, clear of intersections.

Key intersections on Burwood Road are signalised, including Railway Parade and Belmore Street with a 40km/hr speed limit through the town centre.

Railway Parade

Railway Parade runs parallel to and south of the railway line, through the town centre. It forms part of a connection between Croydon and Ashfield in the east and Strathfield in the west. Providing a four lane carriageway, with two traffic lanes in each direction, Railway Parade accommodates bus stops on both sides of the carriageway, including indented bus bays on the northern side in close proximity to Burwood Central.

There is a 40 kilometre per hour speed limit on Railway Parade generally, between Conder Street and Shaftesbury Road.

Wynne Avenue

Wynne Avenue connects Railway Parade with Belmore Street in the south. It provides for one traffic lane and one parking lane in each direction, clear of intersections. There are traffic signals at the intersection of Wynne Avenue with Railway Parade, and a roundabout at Wynne Avenue and Belmore Street.

Belmore Street

Belmore Street is to the south of the site. It provides access to commercial, retail and residential operations within the town centre. It caters for one traffic lane and one parking lane in each direction, clear of intersections.

The intersection of Belmore Street with Burwood Road is controlled by traffic signals.

Clarendon Place

Clarendon Place runs south from Railway Parade, on the eastern side of Burwood Plaza. It provides for two-way traffic and provides access to the rear of properties fronting Burwood Road.

There are marked pedestrian crossings in Clarendon Place at Railway Parade and at the Burwood Plaza pedestrian access.

Conder Street

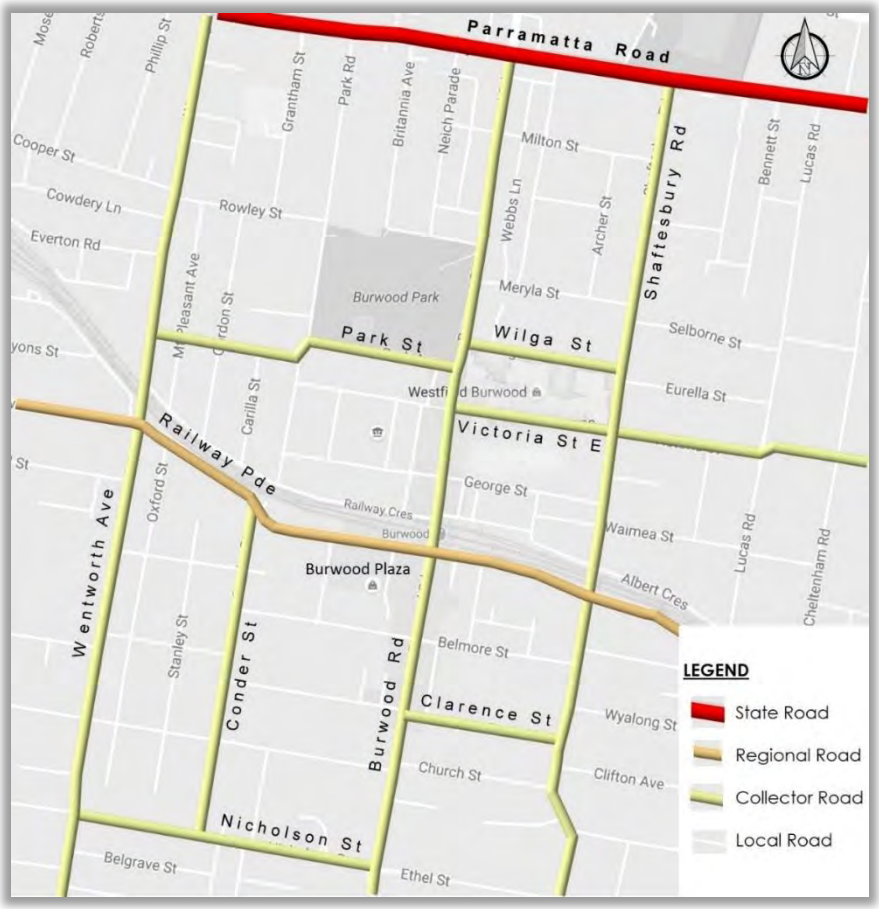
Conder Street is west of the site, running south from Railway Parade on the western side of the town centre.

The intersection of Conder Street with Railway Parade is controlled by a roundabout. Conder Street provides for one traffic lane and one parking lane in each direction, clear of intersections.

Hornsey Street

Hornsey Street connects to Conder Street and provides access along the southern side of the council offices and community facilities. It provides access to parking areas south of the site and provides a pedestrian connection between Conder Street and Wynne Avenue.

Figure 5 *Road Hierarchy*
Source *BCC DCP, Amended 2015*



Observations made during the peak periods indicate that a number of intersections in the town centre are operating near capacity during the commuter peak periods, particularly along Burwood Road.

The vehicle delays observed on Burwood Road, between George Street to the north and Clarence Street to the south, are the result of...

- *The short distances between intersections, in close proximity to the railway station,*
- *The incidence of pedestrian demand on cycle times and the occurance of the pedestrian 'walk' in each cycle,*
- *Buses stopping,*
- *The impacts of on street parking manouveres including drop off and pick up,*
- *The single lane southbound approach prior to George Street, and*
- *The lack of a dedicated right turn lane, southbound (existing shared through and right), at the Railway Parade intersection resulting in queueing back to the north through the preceding intersections.*

Sidra analysis suggests that each intersection, in isolation opearate within their respective vehicle capacities. However, with the shared right turn and through movement from the centre lane at the Railway Parade intersection and the single lane mid block constraints imposed by on street parking, queueing has been observed both northbound and southbound along Burwood Road through the town centre.

In conjunction with the capacity constraints, pedestrian demands have an impact on the timing offsets between subsequent signal sites.

These delays are typically inherent within built up town centres and are to be expected. Anecdotally, such vehicle congestion generally results in reduced vehicle speeds which may be conducive to improving pedestrian safety and reducing the severity of any occurring accidents while providing an unattractive route for through traffic.

The vehicle volumes on the competing parallel routes of Wentworth Road and Shaftesbury Road would appear to have increased more significantly than those on Burwood Road over the past years. Shaftesbury Road, in particular, reports a vehicle growth of approximately 10.3% over the past ten (10) years growing from some 1,652vph in 2000 to 1,825vph in 2016.

Site observation indicates that the Westfield Burwood is one of the largest attractors within the town centre and that some 80% of vehicles arriving at the shopping complex do so from Shaftesbury Road. Conversely, 78% of vehicles were recorded leaving the complex via Shaftesbury Road.

2.2 Public Transport Provisions

Rail

Burwood Town Centre delivers significant public transport choice with the Burwood Railway Station located centrally within the centre and numerous bus services to the Sydney CBD and regional centres.

Sydney Trains offer services from Burwood Railway Station to the Sydney CBD operate at 9-10 minute intervals, daily, with a trip duration of some 12 minutes.

The station services the following rail lines…

- *T1 North Shore Line (Berowra to Parramatta via the Sydney CBD)*
- *T1 Northern Line Hornsby and Epping to Sydney CBD via Strathfield),*
- *T1 Western Line Emu Plains and Richmond to the Sydney CBD), and*
- *T2 Inner West and South Line Campbelltown to the Sydney CBD via Granville).*

Council have outlined desired upgrades to the Burood Railway Station which is to focus on functional Urban design and capabilities. It is envisaged these changes, combined with the State Government's commitment to increase the capacity of the rail network by some 60% under the Long Term Master Plan to 2021 should ensure the station's capacity to manage the anticipated Burwood Town centre growth levels to year 2026.

Bus

Local bus services are provided by Sydney Buses. These services link Burwood with surrounding areas. There are major bus stops on Railway Parade adjacent to the site, at Burwood station, as well as other stops on Burwood Road. Bus services provide links to surrounding areas and include...

- *Route 407: Burwood – Strathfield,*
- *Route 408: Burwood – Rookwood Cemetery,*
- *Route 415: Campsie, Strathfield, Burwood, Chiswick,*
- *Route 458: Burwood, Strathfield, Rhodes, Ryde,*
- *Route 461: Burwood, Parramatta Road, city, Domain,*
- *Route 463: Burwood, Bayview Park,*
- *Route 466: Cabarita, Burwood, Strathfield, Ashfield,*
- *Route 490: Drummoyne, Burwood, Kingsgrove, Hurstville,*
- *Route 492: Drummoyne, Burwood, Kingsgrove, Rockdale,*
- *Route 525: Parramatta, Newington, Burwood, and*
- *Route 526: Sydney Olympic Park Wharf, Newington, Strathfield.*

A bus layover can be defined as a holding location for terminating bus services where buses may park before commencing a scheduled run. While Burwood Town Centre generally provides informal bus layover areas, currently Sydney Buses utilise on street, kerb side, availability in Victoria Street East, Shaftesbury Road, Railway Parade and Victoria Street.

Figure 6 *Extract from Council Media Release Burwood Railway Station*
Source *Burwood City Council, 2005*

MEDIA RELEASE **30 November, 2005**

BURWOOD COUNCIL
heritage • progress • pride

Burwood Station upgrade plan provides direction for city renewal

Council plans for the much-needed upgrade of Burwood Railway Station, with a strong focus on functional urban design, will set the benchmark for future development in the Town Centre.

In a briefing to the Burwood Chamber of Commerce today, Burwood Mayor John Faker outlined proposed concept development plans for the Railway Station which would contribute to the existing and future built form of the Town Centre.

The plans maximise opportunities for public space and public domain improvements, as well as improve the accessibility and safety of commuters.

Highlights of the Railway Station development plan commissioned by Council include:

- Relocation of the major east-west pedestrian crossing of Burwood Road from Railway Parade corner to align with station concourse;
- Opening up existing concourse area to general north-south pedestrian movement;
- Creation of a new public open space to the north of the station;
- Relocation of the main station entry to the northern side;
- Creation of new space under tracks for retail and ticketing facilities;
- Doubling the access points to platforms via stairs and lifts;
- Creation of a new public open space north of the Post Office to a landscaped area with café;
- New pedestrian underpass lined with retail outlets under Railway Parade and Burwood Road linking Station with Post Office area and Burwood Hotel;

Further Highlights of public domain plans also include proposed conversion of Deane Street (on the northern boundary of the Station) into a pedestrian mall, and the creation of a bus/taxi interchange nearby.

Cr Faker said Council commissioned the plans in 2004 to illustrate the integration of a preferred upgrade option for the Burwood Town Centre.

"Council has done all the hard work in planning for this vital upgrade. All that's needed now is for the State Government to approve them and agree on a funding mechanism to make it happen.

2.3 Pedestrians and Cyclists

The Burwood Town Centre typically accommodates high pedestrian activity with the railway station being one of the main focal points. Just over 50% of residents within the town centre utilise rail as their transport mode for journey to work (JTW).

With a residential workforce of some 4,238 persons[1], 4% travel by bus to work. Combined with retail, commercial and recreational activities, pedestrian demand within the town centre is high and is catered for by generally 3.7m wide footways, unsignalised, marked, foot crossings, and signalised crossings.

Site inspections have revealed a significant level of J-walking and mid block crossing of Burwood Road between George Street and Park Avenue, signifying a potential requirement for an additional, controlled, crossing point. There are plans to signalise the intersection of Burwood Road with Victoria Street East. This will provide the needed pedestrian crossing point and reduce the incidence of J-walking.

Select location pedestrian fencing on Burwood Road and Railway Parade direct pedestrians to the correct signalised crossings.

The DCP requires all future developments within the town centre must maintain pedestrian safety, scale and amenity.

[1] *BTS Travel Zone Explorer (based on the 2011 Census Data) Bureau of Transport Statistics, 2016*

Figure 7 *Burwood Road J-Walking*
Source *Road Delay Solutions, 2016*

Figure 8 *City Rail Network*

Source *Transport Sydney Trains, 2016*

Figure 9 *Intercity Rail Network*

Source *Transport Sydney Trains, 2016*

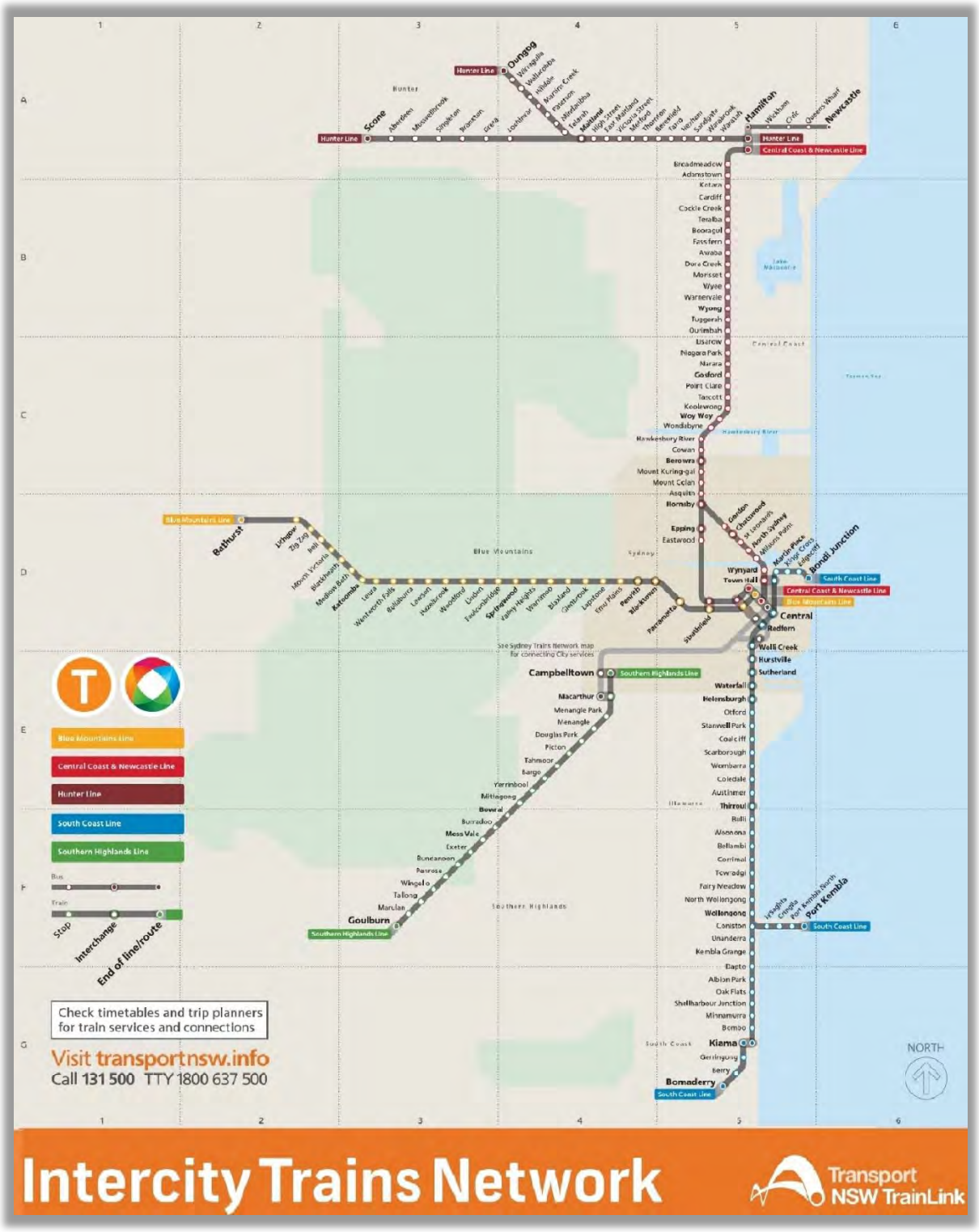


Figure 10 *Bus Network Routes 407 and 408*

Source *Transport Sydney Trains, 2016*

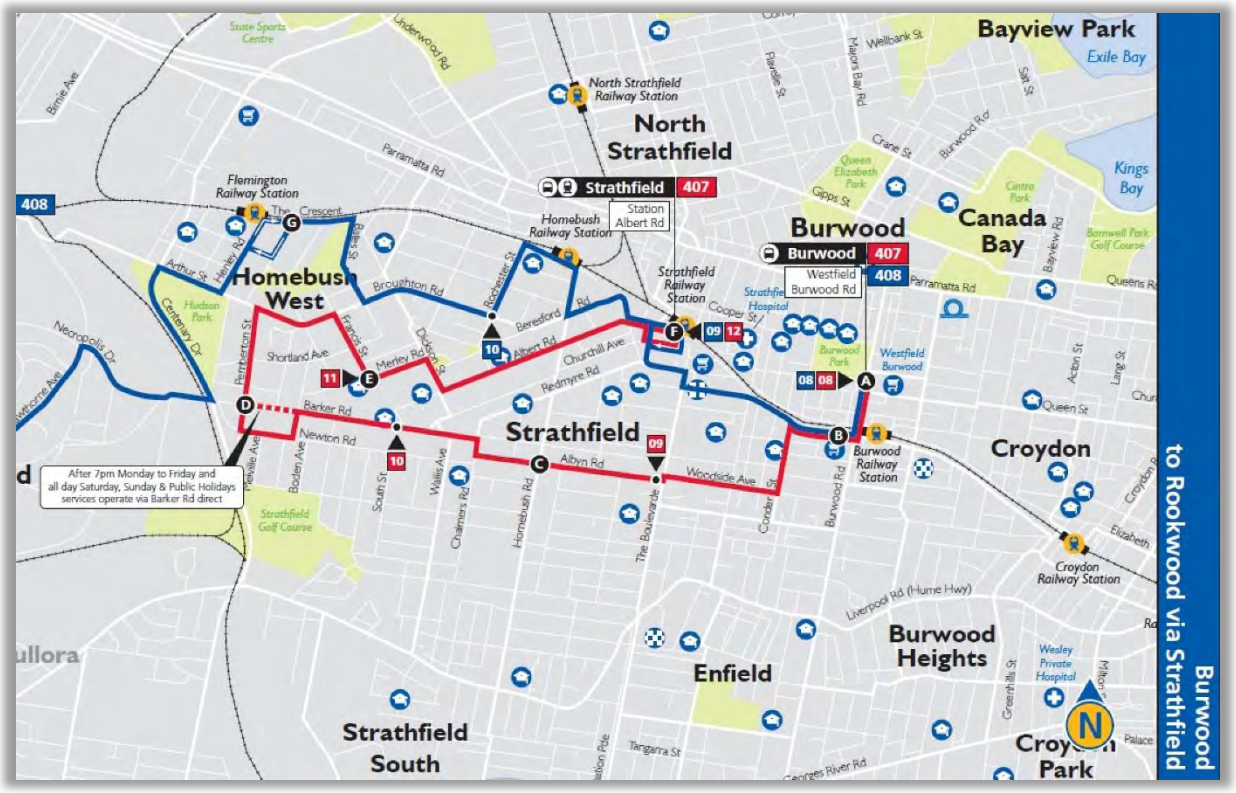


Figure 11 *Bus Network Route 461*

Source *Transport Sydney Trains, 2016*

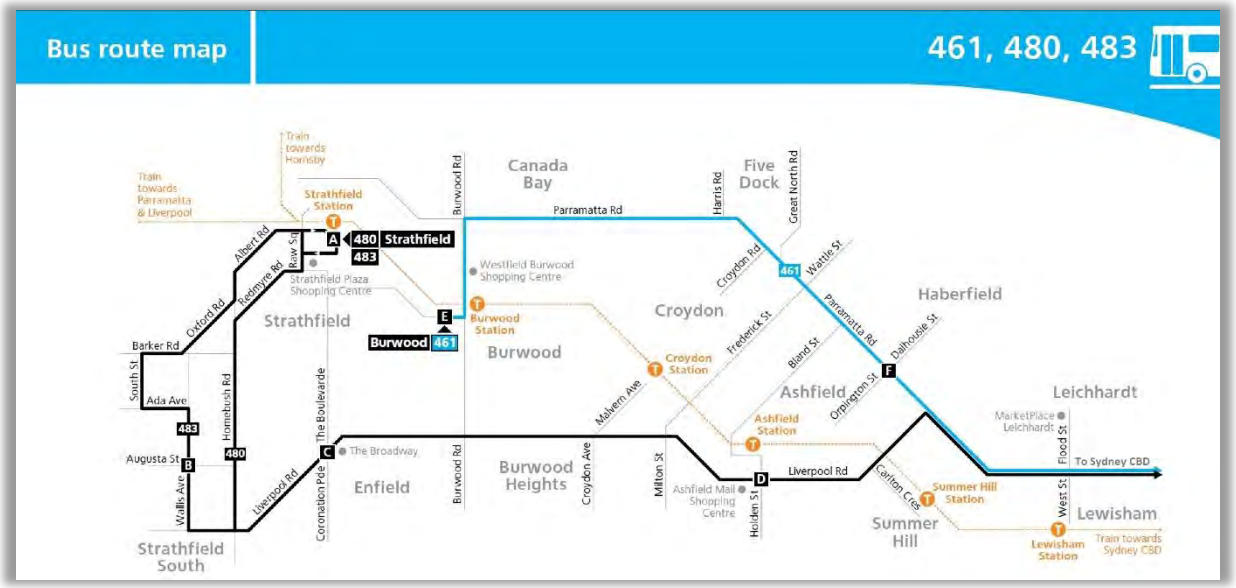


Figure 12 Bus Network Route 415

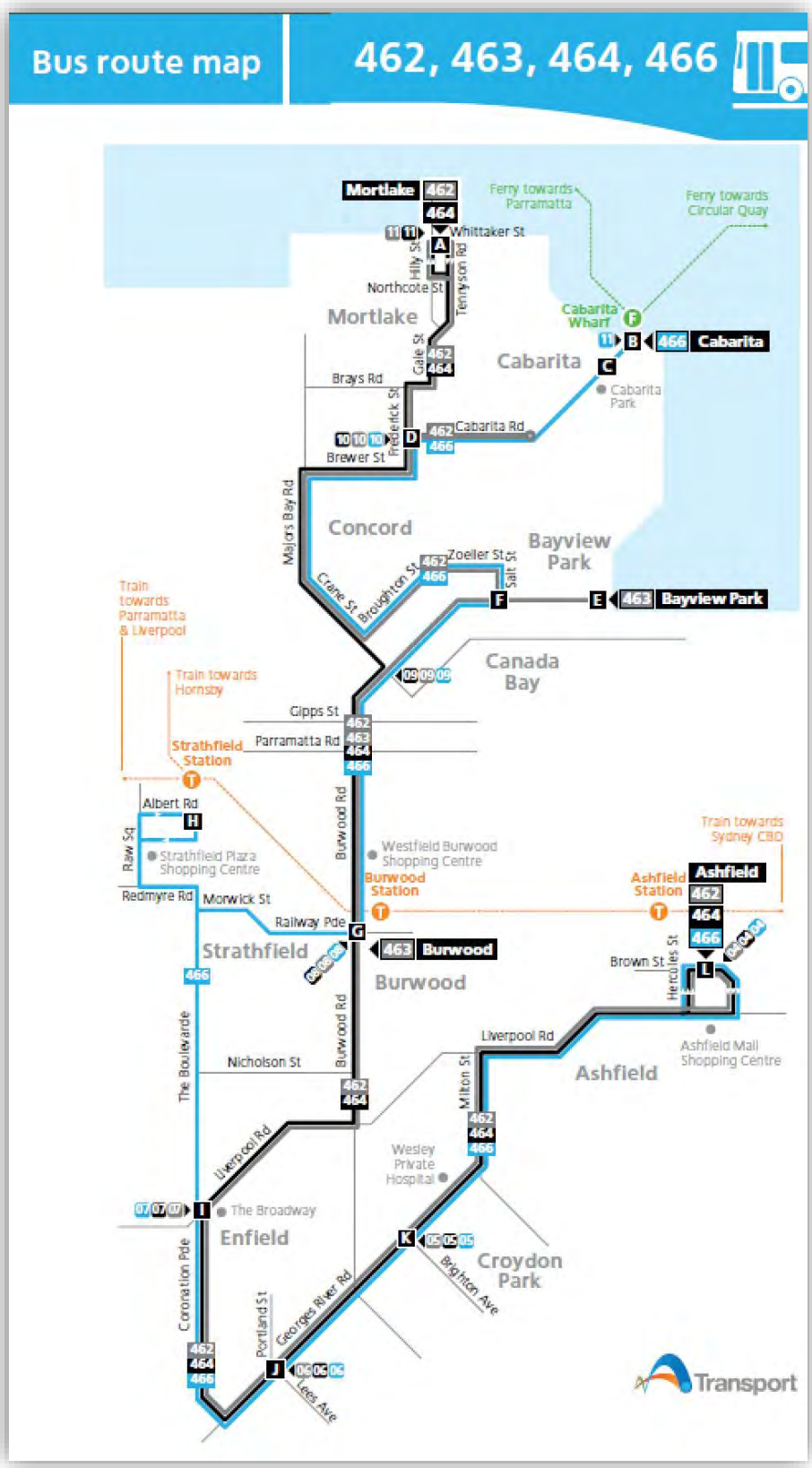
Source Transport Sydney Trains, 2016

Figure 13 *Bus Network Route 458*

Source *Transport Sydney Trains, 2016*

Figure 14 *Bus Network Route 463 and 466*

Source *Transport Sydney Trains, 2016*



2.4 Parking

Parking activities has a significant impact on the movement of traffic within the Burwood Town Centre.

Burwood Council undertook a parking survey in December 2011[2] to better understand the impacts of a newly implemented parking strategy. From the survey computer based models were developed to understand the different factors influencing parking choice in Burwood Town Centre. This study has drawn from the fore mentioned survey in appreciating the behaviour of motorists and their impacts in utilising the available town centre parking provisions.

Parking choice is provided and catered for by Council in various forms such as…

- *The use of formalised controlled parking stations,*
- *Free, timed on street parking,*
- *Metered on street parking,*
- *Metered off street car parking, and*
- *Private property parking.*

The pursuit of parking and the associated parking manoeuvres by motorists, given the available on street parking along Burwood Road and within the side streets, impedes the movement of through traffic and increases travel times.

Parking cost and the proximity to rail, bus, retail and commercial services heavily influence the attractiveness of parking choice. The free on street parking in Burwood Road is consistently full and desired by motorists accessing the adjacent retail, commercial and service operations.

[2] '*Parking Behaviour of Burwood Town Centre', Alex Karki, 2015*

A catalogue of the available parking choice is presented in the following figure.

Figure 15 Burwood Town Centre Parking

Source 'Parking Behaviour of Burwood Town Centre', Alex Karki, 2015

DATA COLLECTION

3.1 Data Sources

A broad range of data has been collected in preparing this assessment…

- *Traffic counts at key intersections (Austraffic, 2016),*
- *Origin and destination to confirm traffic patterns (Road Delay Solutions, 2016),*
- *Travel time surveys along Burwood Road (Road Delay Solutions, 2016),*
- *Parking occupancy rates (Road Delay Solutions, 2016),*
- *Bus routes and frequency (State Buses, 2016),*
- *Train routes and frequency (Sydney Trains, 2016),*
- *Road network catalogue (Road Delay Solutions, 2016), and*
- *Traffic signal operation data (RMS, 2000, 2005, 2016).*

Traffic data from previous studies and papers have been utilised to derive historical growth and variations in traffic patterns within the Burwood Town Centre…

- *'Parking Behaviour of Burwood Town Centre', Alex Karki, 2015,*
- *'Burwood Town Centre Proposed Bus Strategy, URS, 2007,*
- *'Burwood Town Centre Bus Strategy - Review and Analysis', Parsons Brinkerhoff, 2006,*
- *'Burwood Town Centre Growth', Transport and Traffic Planning Associates, 2005, and*
- *'Burwood Town Centre & Environs – Preparation of Traffic Model', Parsons Brinkerhoff, 2004.*

3.2 Traffic Counts

The existing morning (AM), evening (PM) and Saturday (WE) traffic data has been collected and collated by *Austraffic on Thursday 9 June, 2016, and Saturday 11 June, 2016*, and *ROAR Data* on Thursday 20 July 2017 and Saturday 22 July 2017, for…

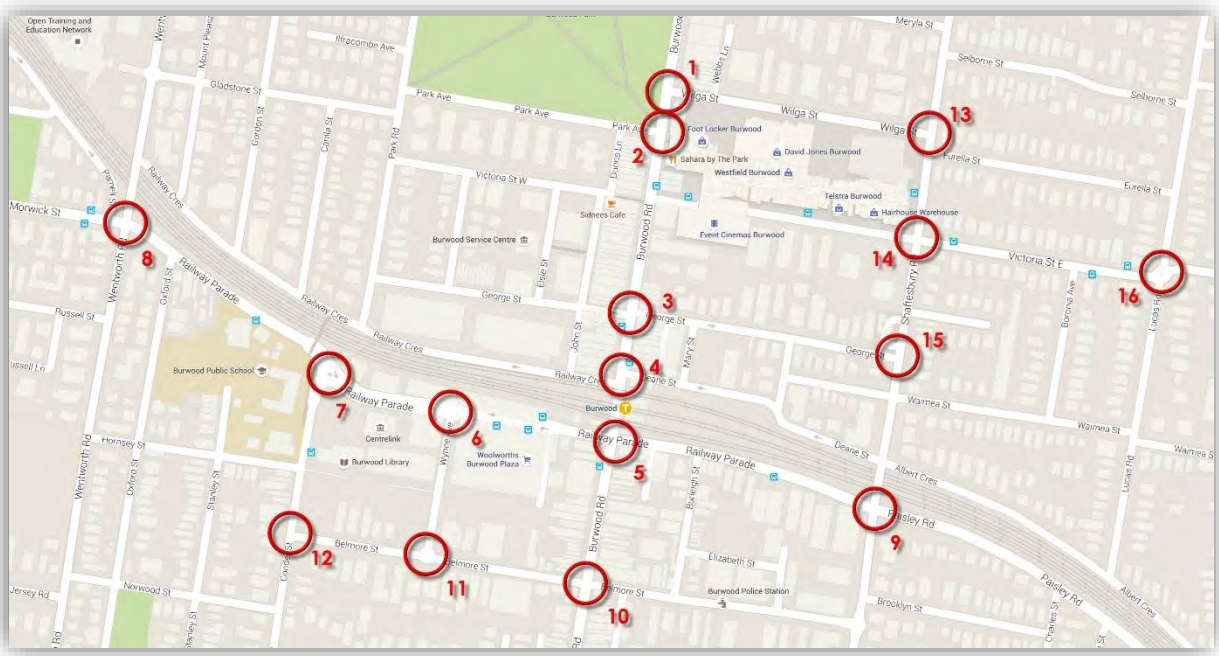
- *The weekday AM commuter peak 8:00am till 9:00am,*
- *The weekday PM commuter peak 4:00pm till 6:00pm, and*
- *The weekend Saturday AMWE peak 12.00 till 1:00pm.*

Traffic surveys were conducted over 2 hours during each commuter peak at the following intersections…

1. *Burwood Road and Wilga Street,*
2. *Burwood Road and Park Avenue,*
3. *Burwood Road and George Street,*
4. *Burwood Road, Deane Street and Railway Crescent,*
5. *Burwood Road and Railway Parade,*
6. *Railway Parade and Wynne Avenue,*

7. *Railway Parade and Conder Street,*
8. *Railway Parade, Wentworth Road, and Morwick Street,*
9. *Shaftesbury Road, Railway Parade and Paisley Street,*
10. *Burwood Road and Belmore Street,*
11. *Belmore Street and Wynne Avenue,*
12. *Belmore Street and Conder Street,*
13. *Shaftesbury Road and Wilga Street,*
14. *Shaftesbury Road and Victoria Street,*
15. *Shaftesbury Road and George Street, and*
16. *Victoria Street, Lucas Road and Queen Street.*

Figure 16 Traffic Count Locations
Source Road Delay Solutions, 2017



Appendix A presents the traffic survey data utilised in the coding and calibration of the base year 2017 model.

Given the nature of the trip matrix development process and traffic zone placement, the collected traffic flows had to be '*balanced*'. Typically, this consisted of minor adjustments to specific turn movements to ensure that adjacent intersections had consistent upstream and downstream volumes. These 'gains and losses' occur when vehicles leave the carriageway into individual driveways, park on street or turn into intermediate side streets between the counted intersections. This fine level of detail is, typically, not accommodated in computer based mesoscopic traffic models.

3.3 Travel Time Surveys

Travel time data was collected along Burwood Road, between Wilga Street in the north to Belmore Street in the south, on Thursday 9 June, 2016 during the morning and evening commuter peak periods and Saturday 11 June, 2016 between 11am and 1pm.

Travel time data was collected along Shaftesbury Road, between Wilga Street in the north and Clarence Street in the south, on Thursday 20 July, 2017 during the morning and evening commuter peak periods and Saturday 22 July, 2017 between 11am and 1pm.

Travel times were collected every 15 minutes over a two (2) hour period in each of the peak periods, averaged, and then compared against the modelled travel time outputs for the routes assessed...

ROUTE 1 – Burwood Road Northbound

- *Belmore Street northbound to Wilga Street.*

ROUTE 2 – Burwood Road Southbound

- *Wilga Street southbound to Belmore Street.*

ROUTE 3 – Shaftesbury Road Northbound

- *Clarence Street northbound to Wilga Street.*

ROUTE 4 – Shaftesbury Road Southbound

- *Wilga Street southbound to Clarence Street.*

Figure 17 *Travel Time Corridors*

Source *Google Maps, 2017*

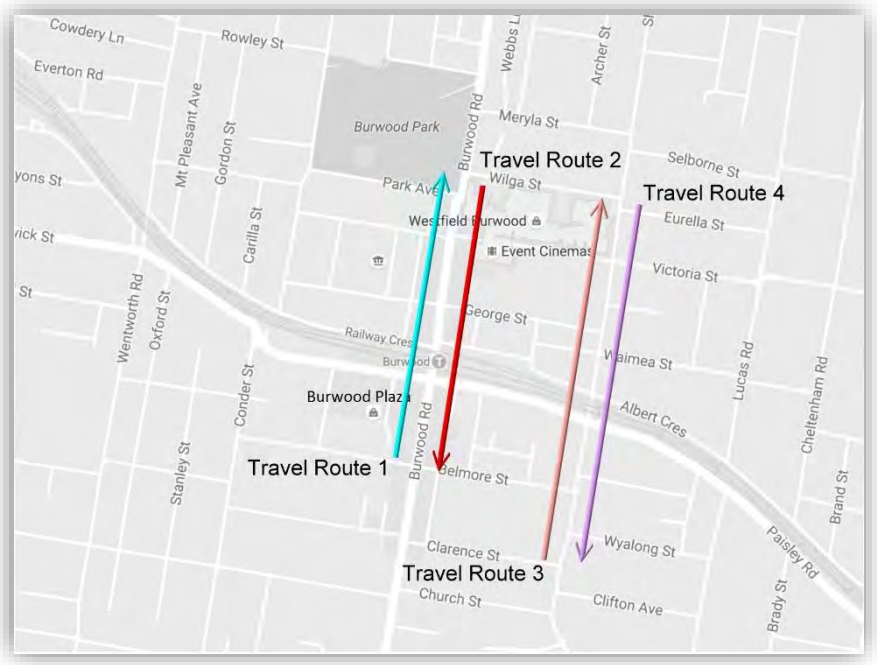


Table 1 *2017 Calibrated Travel Route 1*

Source *Road Delay Solutions, 2017*

ROUTE 1	AVG SURVEYED		MODEL 16AM28		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 8539 BELMORE STREET						
RAILWAY PARADE	0.9	10.00	0.78	11.25	0.15	-13.33%
RAILWAY CRESCENT	1.1	13.64	1.08	13.67	0.25	-1.82%
GEORGE STREET	1.3	14.77	1.17	16.29	0.32	-10.00%
VICTORIA STREET EAST	1.4	18.00	1.27	19.82	0.42	-9.29%
PARK AVENUE	1.9	16.11	1.72	17.94	0.51	-9.47%
WILGA STREET	2.0	16.80	1.77	18.94	0.56	-11.50%
TOTALS	2.0	14.89	1.77	16.32	0.56	-11.50%

ROUTE 1	AVG SURVEYED		MODEL 16PM23		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 8539 BELMORE STREET						
RAILWAY PARADE	0.76	11.84	0.71	12.50	0.15	-6.58%
RAILWAY CRESCENT	1.04	14.42	0.99	15.00	0.25	-4.81%
GEORGE STREET	1.8	10.67	1.08	17.74	0.32	-40.00%
VICTORIA STREET EAST	1.2	21.00	1.18	21.44	0.42	-1.67%
PARK AVENUE	1.71	17.89	1.62	19.00	0.51	-5.26%
WILGA STREET	1.78	18.88	1.68	20.03	0.56	-5.62%
TOTALS	1.78	15.78	1.68	17.62		-5.62%

ROUTE 1	AVG SURVEYED		MODEL 16AMWE17		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 8539 BELMORE STREET						
RAILWAY PARADE	0.77	11.69	0.71	12.50	0.15	-7.79%
RAILWAY CRESCENT	1.04	14.42	0.96	15.47	0.25	-7.69%
GEORGE STREET	1.07	17.94	1.05	18.25	0.32	-1.87%
VICTORIA STREET EAST	1.18	21.36	1.15	21.99	0.42	-2.54%
PARK AVENUE	1.71	17.89	1.59	19.36	0.51	-7.02%
WILGA STREET	1.78	18.88	1.65	20.39	0.56	-7.30%
TOTALS	1.78	17.03	1.65	17.99		-7.30%

Note The Modelled travel speeds are corrected to reflect mid block and downstream intersection vehicle delay(s) and congestion.

Table 2 *2017 Calibrated Travel Times Route 2*

Source *Road Delay Solutions, 2017*

ROUTE 2	AVG SURVEYED		MODEL 16AM28		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 10096 WILGA STREET						
PARK AVENUE	0.28	10.71	0.28	10.00	0.05	0.00%
VICTORIA STREET EAST	0.48	17.50	0.4	21.10	0.14	-16.67%
GEORGE STREET	0.54	26.67	0.5	29.14	0.24	-7.41%
RAILWAY CRESCENT	0.71	26.20	0.73	25.89	0.31	2.82%
RAILWAY PARADE	1.5	16.40	1.41	17.56	0.41	-6.00%
BELMORE STREET	1.9	17.78	1.75	19.23	0.56	-7.41%
TOTALS	1.9	19.21	1.75	20.49	0.56	-7.41%

ROUTE 2	AVG SURVEYED		MODEL 16PM23		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 10096 WILGA STREET						
PARK AVENUE	0.31	9.68	0.28	12.50	0.05	-9.68%
VICTORIA STREET EAST	0.39	21.54	0.4	15.00	0.14	2.56%
GEORGE STREET	0.61	23.61	0.5	17.74	0.24	-18.03%
RAILWAY CRESCENT	0.85	21.88	0.7	21.44	0.31	-17.65%
RAILWAY PARADE	1.52	16.18	1.38	19.00	0.41	-9.21%
BELMORE STREET	1.87	17.97	1.74	20.03	0.56	-6.95%
TOTALS	1.87	18.48	1.74	17.62		-6.95%

ROUTE 2	AVG SURVEYED		MODEL 16WE17		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 10096 WILGA STREET						
PARK AVENUE	0.27	11.11	0.28	10.00	0.05	3.70%
VICTORIA STREET EAST	0.43	19.53	0.4	21.10	0.14	-6.98%
GEORGE STREET	0.62	23.23	0.5	29.14	0.24	-19.35%
RAILWAY CRESCENT	0.8	23.25	0.73	26.88	0.31	-8.75%
RAILWAY PARADE	1.48	16.62	1.41	17.90	0.41	-4.73%
BELMORE STREET	1.74	19.31	1.76	19.34	0.56	1.15%
TOTALS	1.74	18.84	1.76	20.73		1.15%

Note The Modelled travel speeds are corrected to reflect mid block and downstream intersection vehicle delay(s) and congestion.

Table 3 *2017 Calibrated Travel Times Route 3*

Source *Road Delay Solutions, 2017*

ROUTE 3	AVG SURVEYED		MODEL 16AM28		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 10092 CLARENCE ST						
BELMORE ST	0.27	37.78	0.25	49	0.17	-7.41%
RAILWAY PDE	0.58	26.90	0.54	28.34	0.26	-6.90%
DEANE ST	0.62	34.84	0.64	33.36	0.36	3.23%
WAIMEA ST	0.78	35.38	0.75	37.03	0.46	-3.85%
GEORGE STREET	0.81	37.04	0.79	38.3	0.5	-2.47%
VICTORIA ST EAST	1.27	28.82	1.24	29.33	0.61	-2.36%
WILGA STREET	1.4	31.08	1.35	31.92	0.72	-2.88%
TOTALS	1.4	33.12	1.35	35.33	0.72	-2.88%

ROUTE 3	AVG SURVEYED		MODEL 16PM23		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 10092 CLARENCE ST						
BELMORE ST	0.21	48.57	0.2	50.00	0.17	-4.76%
RAILWAY PDE	0.64	24.38	0.62	24.60	0.26	-3.13%
DEANE ST	0.74	29.19	0.73	29.57	0.36	-1.35%
WAIMEA ST	0.82	33.66	0.83	33.35	0.46	1.22%
GEORGE STREET	0.89	33.71	0.87	34.67	0.5	-2.25%
VICTORIA ST EAST	1.32	27.73	1.29	28.31	0.61	-2.27%
WILGA STREET	1.51	28.61	1.4	30.90	0.72	-7.28%
TOTALS	1.51	32.26	1.4	33.06		-7.28%

ROUTE 3	AVG SURVEYED		MODEL 16AMWE17		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 10092 CLARENCE ST						
BELMORE ST	0.21	48.57	0.22	50.00	0.17	4.76%
RAILWAY PDE	0.54	28.89	0.51	30.06	0.26	-5.56%
DEANE ST	0.65	33.23	0.61	35.04	0.36	-6.15%
WAIMEA ST	0.78	35.38	0.72	38.61	0.46	-7.69%
GEORGE STREET	0.8	37.50	0.76	39.86	0.5	-5.00%
VICTORIA ST EAST	1.3	28.15	1.26	28.99	0.61	-3.08%
WILGA STREET	1.48	29.19	1.37	31.58	0.72	-7.43%
TOTALS	1.48	34.42	1.37	36.31		-7.43%

Note The Modelled travel speeds are corrected to reflect mid block and downstream intersection vehicle delay(s) and congestion.

Table 4 *2017 Calibrated Travel Times Route 4*

Source *Road Delay Solutions, 2017*

ROUTE 4	AVG SURVEYED		MODEL 16AM28		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 4798 WILGA ST						
VICTORIA STREET EAST	0.48	13.75	0.49	13.75	0.11	2.08%
GEORGE STREET	0.61	21.64	0.59	21.87	0.22	-3.28%
WAIMEA ST	0.65	24.00	0.63	24.42	0.26	-3.08%
DEANE ST	0.79	27.34	0.74	29.39	0.36	-6.33%
RAILWAY PDE	1.18	23.39	1.14	24.26	0.46	-3.39%
BELMORE ST	1.31	25.19	1.23	26.73	0.55	-6.11%
CLARENCE ST	1.5	28.42	1.4	30.8	0.72	-7.89%
TOTALS	1.5	23.39	1.4	24.46	0.72	-7.89%

ROUTE 4	AVG SURVEYED		MODEL 16PM23		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 4798 WILGA ST						
VICTORIA STREET EAST	0.44	15.00	0.45	15.00	0.11	2.27%
GEORGE STREET	0.54	24.44	0.55	23.48	0.22	1.85%
WAIMEA ST	0.68	22.94	0.64	24.34	0.26	-5.88%
DEANE ST	0.8	27.00	0.74	29.31	0.36	-7.50%
RAILWAY PDE	1.27	21.73	1.23	22.61	0.46	-3.15%
BELMORE ST	1.4	23.57	1.31	25.03	0.55	-6.43%
CLARENCE ST	1.58	27.34	1.48	29.06	0.72	-6.33%
TOTALS	1.58	23.15	1.48	24.12	0.72	-6.33%

ROUTE 4	AVG SURVEYED		MODEL 16AMWE17		Distance km	TIME Diff %
	TIME (minutes)	SPEED km/hr	TIME (minutes)	SPEED km/hr		
Start Node = 4798 WILGA ST						
VICTORIA STREET EAST	0.51	12.94	0.54	12.50	0.11	5.88%
GEORGE STREET	0.63	20.95	0.64	20.20	0.22	1.59%
WAIMEA ST	0.76	20.53	0.68	22.67	0.26	-10.53%
DEANE ST	0.84	25.71	0.79	27.57	0.36	-5.95%
RAILWAY PDE	1.21	22.81	1.16	23.90	0.46	-4.13%
BELMORE ST	1.35	24.44	1.25	26.36	0.55	-7.41%
CLARENCE ST	1.58	27.34	1.42	30.42	0.72	-10.13%
TOTALS	1.58	22.10	1.42	23.37	0.72	-10.13%

Note The Modelled travel speeds are corrected to reflect mid block and downstream intersection vehicle delay(s) and congestion.

Results indicate a maximum difference of <10.5% between the collated field data and modelled travel times. *RMS* guidelines require average modelled travel times to have a differential not greater than 15% or one (1) minute from the observed travel times for the entire route collected.

3.4 Origin and Destination Survey

A simple number plate survey was undertaken to determine the travel patterns of motorists travelling along Burwood Road.

The data was used for comparison and calibration with select link data from the base year 2016 model. The model, once calibrated, reported a maximum route difference, compared with the collected field data, of some 16.6%, being the northbound route (D to A) on Burwood Road during the morning peak. Generally, all other routes yielded an absolute average difference less than 7.5%.

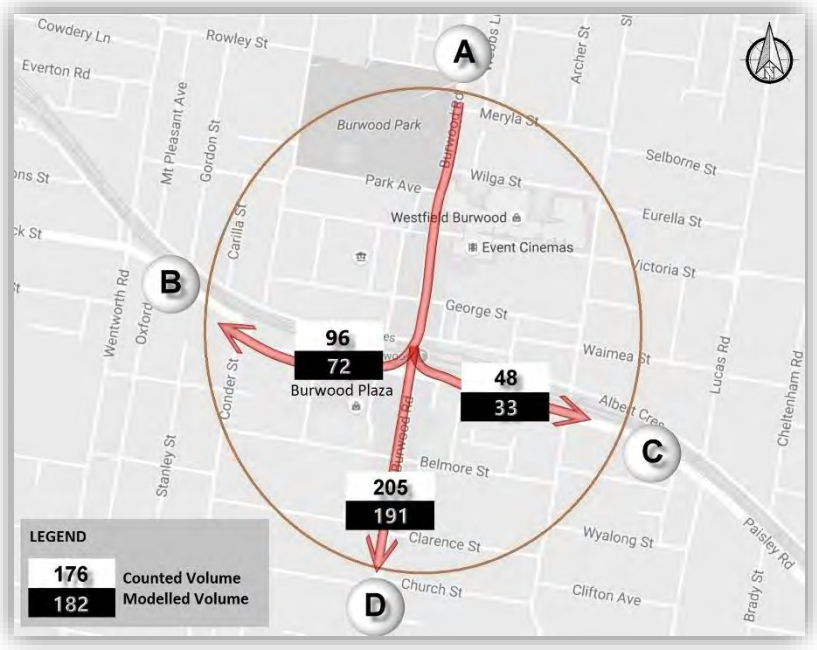
Figure 18 O/D Survey Boundary and Locations
Source Road Delay Solutions, 2016

Figure 19 Northbound O/D Survey

Source Road Delay Solutions, July 2016

Figure 20 Southbound O/D Survey

Source Road Delay Solutions, July 2016



3.5 Vehicle Growth to 2016

To determine the historic vehicle growth on Burwood Road, data has been drawn from previous studies and compared with the volumes presented in the collected traffic counts at select intersections.

Figure 21 *AM Vehicle Growth*
Source *Road Delay Solutions, 2016*

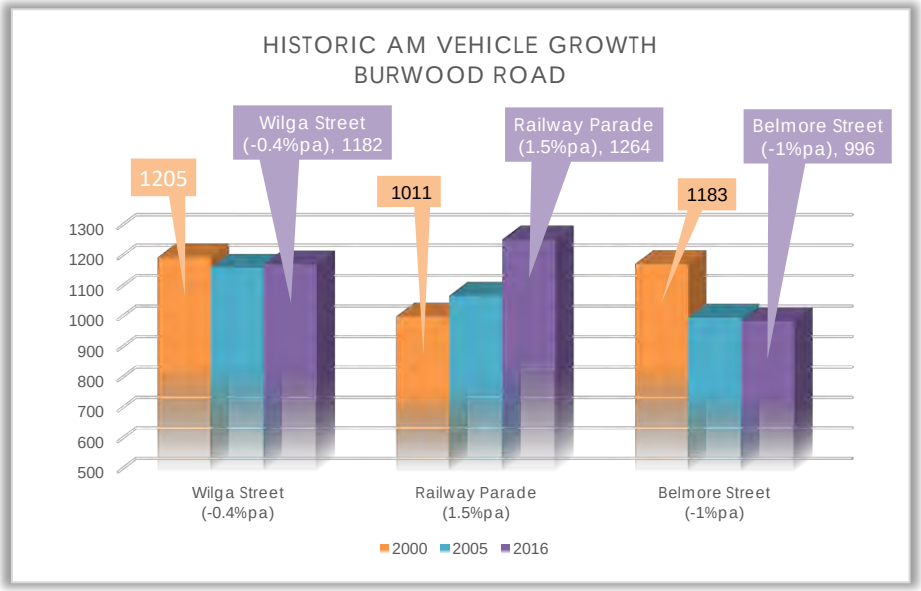
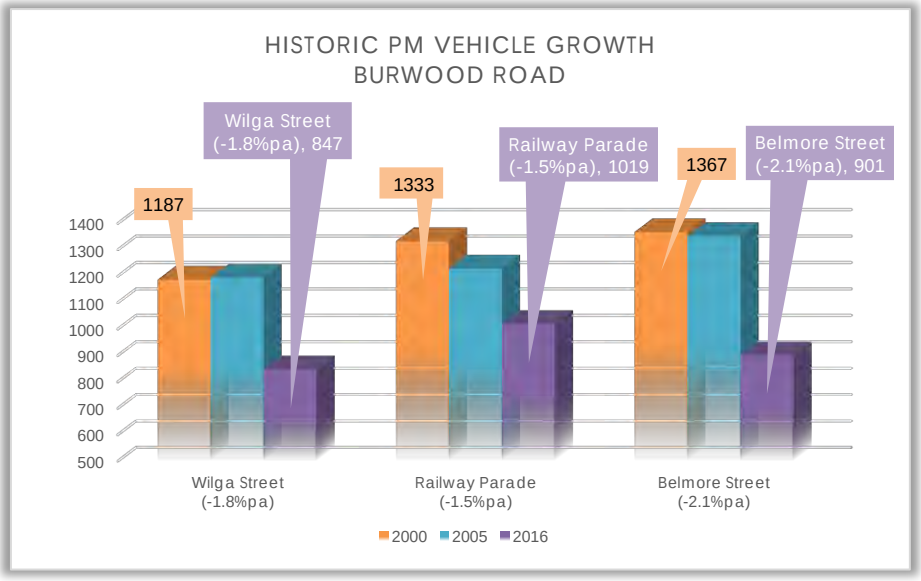


Figure 22 *PM Vehicle Growth*
Source *Road Delay Solutions, 2016*



All indicators suggest that there has been a negative vehicle growth within the town centre over the past 16 years between year 2000 and 2016.

3.6 Mode Share

Residents within the Burwood Town Centre have a significant mode choice and rely heavily on the available rail and bus services during the commuter peaks.

The current predominant available transport mode choices for JTW have been catalogued from those available within, or adjacent to, the town centre, and as defined within the *BTS* TZs 913 and 915.

The latest Household Travel Survey (HTS) data indicates that the average weekday trips have grown by 1.0% between 2009/10 and 2010/11, which was slower than the 1.6% rate of population growth in the Sydney Statistical Division (SSD).

The private motor vehicle remains the dominant mode of transport embraced by the wider Sydney community. However, the *BTS* reports the town centre exhibits a significant public transport share, with a higher than metropolitan average of 56% of JTW trips attributed to the available train and bus modes.

In line with NSW 2021 targets, growth in public transport trips has been higher than growth in private vehicle passenger trips. Vehicle driver trips have increased by 1.5%, while train and bus trips increased by 2.6% and 2.3%, respectively. These inherent increases can be attributed to increased traffic congestion on the arterial road system, greater frequency of public transport services and improved intermodal/interchange provisions. This is clearly evident within the Burwood Town Centre, and in particular on Burwood Road, with the reported average reduction in vehicle growth since year 2000.

With a walking distance of only 170m between the Burwood Place site and Burwood Railway Station, combined with the convenience of available bus provisions, public transport remains the dominant mode choice for JTW by residents within, and in close proximity to, the town centre.

Planners invariably work on the basis that commuter bus users will walk no more than 400 metres from home to the nearest stop. Data suggests travellers will walk further to catch a train. Therefore, the maximum walk distance to a station has been adopted as 800 metres within the model.

Travel surveys have shown the median walk distance to a bus in heavily built up areas of Sydney and Melbourne is some 500 metres, with only 25% walking more than 800 metres. The

data, anecdotally, suggests that train travellers infrequently elect to walk more than 800 metres if the prevailing pedestrian environment is condusive.

Bicycle to train is an ever growing opportunity for both efficiency and health choices. This may offer some relief from commuter traffic generation but it is considered negliable in this instance as no significant cycle provisions are currently provided at the railway station.

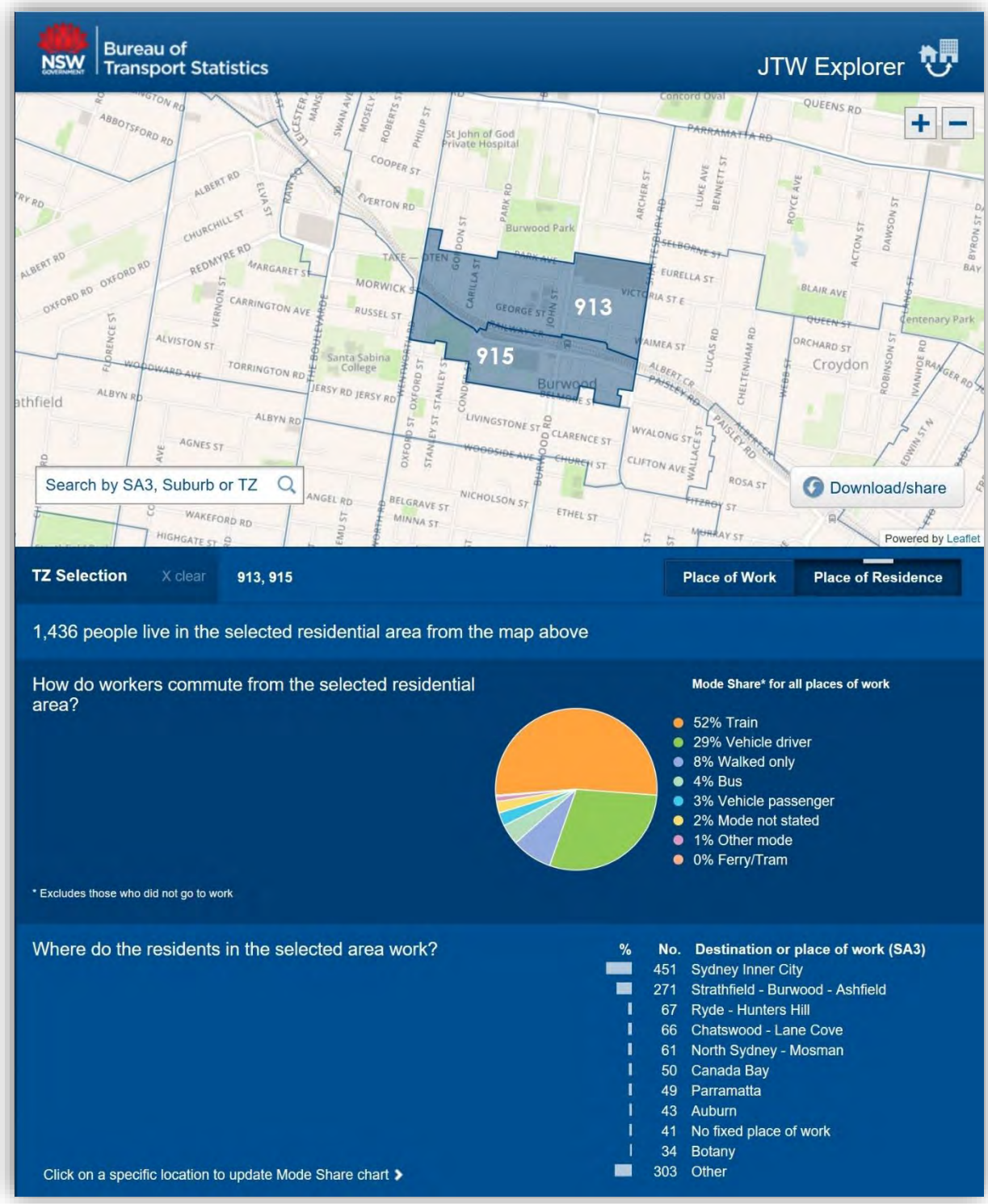
It can therefore be concluded that…

- → *The distance between the Burwood Place site and Burwood Railway Station will promote public transport mode choice with future population growth within the town centre,*
- → *The public transport network provides significant opportunity for a reduction in the dependence in private vehicle usage, and*
- → *Retail and commercial patrons also have significant opportunity to employ public transport modes.*

While all indicators would suggest that the current public transport services within the town centre provide significant opportunity for mode shift, none has been adopted in the mesoscopic modelling for the plaza development. The full traffic generation of 1,605vph during the AM commuter peak and 1,515vph during the PM has been incorporated into the model trip matrices to provide a conservative '*worst case*' assessment.

Figure 23 *Burwood Town Centre JTW Mode Share*

Source *BTS JTW Exporer, 2017*



THE MESOSCOPIC MODEL

The *Netanal* model utilises defined travel demand between zonal pairs, represented as assimilated traffic movements, throughout the Sydney Metropolitan Area. The program incrementally assigns vehicular traffic onto a computer based road network, developing link demand forecasts on each modelled section of road.

Netanal is a mesoscopic assignment model utilising intersection congestion levels and delays in the determination of a motorists' route choice.

4.1 Route Selection

Route selection between zonal pairs is determined on the basis of the shortest travel cost ('*time is money*'), considering the inherent intersection delays, and associated parameters, incurred along possible routes, the road hierarchy, various behavioural characteristics and a number of empirical social economic considerations. Parameters such as link capacity, speed, gap acceptance, phase timings at signalised intersections, toll charges and distance are coded into the model, by the user, from which the program determines the relative vehicular delays on each competing route, selecting, after undertaking a prescribed number of iterations, the route with the shortest travel time and/or least delay. Costs and travel time are relative within the Netanal model. Time penalties are applied to turn movements, stops and delays, etc... which in turn have a corresponding travel cost.

In the most general form, this 'cost' represents a combination of factors which the program takes into account when choosing routes through the road network. The most important of these factors are time and distance. Also where tolls are charged for the use of a specific section of road, these costs are included in the driver's route choice and are based on a driver's willingness to pay the toll based upon published data from the *RMS* and *BTS*.

The process which *Netanal* employs to determine the 'cost' of travel on competing paths, equates heavily to travel time. Time penalties for turning manoeuvres, vehicle delays, and tolls each increase the cost and time of travel on competing routes.

Toll value, on a specific link, is included indirectly by converting the monetary toll value to time (in minutes) based on the driver's perceived value of time and socio economic proclivity to pay the toll. This 'time value of the toll' is applied as a 'penalty' to the link and is known as the Toll Diversion Penalty (TDP).

The premise on which the future year modelling has been based, specifically the route selection process, is the current value of time. Toll values, toll diversion penalties and socio economic decision making defaults, have not been increased with CPI or standard of living projections beyond the current year.

4.2 Incremental Assignment

In order to reflect the impact of intersection congestion on route selection, *Netanal* assigns the traffic from the trip table as a series of equal increments. This process is outlined below…

- → *The process commences by identifying competing routes with the shortest travel times, for each origin-destination zone pair, with no traffic using the roads (ie based on sign-posted speed limits, green lights, etc). Known colloquially as increment 0 (zero), the link and intersection delays, accumulated over the modelled one hour period, are tabulated for later reference.*
- → *The first incremental run of the model imposes the time delays recorded during Increment 0 and adds the delays to the travel time of each route. During the increment, routes yielding the lowest travel time between zonal pairs are chosen. Again the resultant delays on each route, inclusive of intersections, are recorded by the program.*
- → *Each subsequent increment performs ongoing route selection based on recorded delays and the resultant route travel times. As delays stabilise, so too does the route selection within the model, until the optimum number of increments are run.*

At the completion of the nominated number of incremental runs, the optimum routes and vehicle demands, on each link, are reported.

Incremental convergence is employed to determine the projective stability and optimum number of increments to be adopted for a model run. The process of incremental convergence involves the running of sensitivity models reflecting a differing number of increments, with the projected volumes on a select number of key links, reported.

Once the differential change between the projected volumes, on each reported link, minimises, the model is considered stable and the resultant number of increments are utilised in the project model runs.

For this project, 20 increments were found to provide stability in link demand.

4.3 Assignment Calculations

Netanal calculates travel time on the basis of the capacity related, geometric and operational characteristics of roads and intersections defining the road network. The following are specifically incorporated in the calculation of road network and route operations for the mid-block section of each link.

4.4 Speed-flow relationships

As traffic volume increases, speeds on roads decrease and the relationships within the *Netanal* software take this into account. The speed is based on the ratio of the traffic flow to the nominated road capacity. *Netanal* assumes free flow conditions on links up to a set value for the degree of saturation (DS). This value is set to equal 90%. When traffic flows on a particular link exceeds the DS set value, the speed drops according to a speed flow relationship, to the power of four.

4.5 Transit Lanes

The proportion of traffic using the transit and non-transit lanes on a section of road is based on *RMS* surveys of Epping Road, Military Road and Victoria Road. This surveys reported that the transit lanes operated to a maximum of 50% of the adjacent trafficable lane. Illegal use was reported as 25% while the DS of the adjacent lane was below 0.75.

With an increase above 0.75 in the adjacent lane, a proportionate increase in the illegal use of the transit lane results. *Netanal* applies this principle on all transit lanes, within the model.

The program assumes a 40% maximum usage of T3 transit lanes while the DS of the adjacent lane remains below 0.75. The program further assumes the illegal usage of a T3 lane is the same as that of a T2.

Bus lanes, and bus stops can be included as part of the network. *Netanal* can report on travel time changes on these routes.

4.6 Ancillary Effects on Road Network Operation

On-street parking, speed limits, LATM devices (eg speed humps, raised thresholds, road narrowings, etc...), pedestrian crossings and toll plazas all add time/cost penalties during the route selection choice.

4.7 Tollways

A delay of seven seconds per vehicle is applied at toll plazas that have manual or automatic payment collection at the toll plaza. Manual and automatic toll collection has ceased in Sydney. Replaced by electronic tolling, no toll plaza delay is invoked within the model. Consideration must be given to any reduced speeds at a specified toll location, where signposted. This is done by specifying the regulated speed on the link through toll point within the model so as to accurately model the vehicle travel time.

Tolls are collected in dollars but have the effect of making a route less attractive by an invoked time penalty. Therefore, the toll cost must be converted to a time value that can be attributed to the relevant route within *Netanal* to reflect additional travel time in the route selection choice. This conversion factor is the TDP, and is expressed in minutes per dollar.

Those network characteristics which may vary across a 24hr time of day operation, such as transit lanes, bus lanes, parking restrictions, toll fees, turn prohibitions, etc... are included in the network definition and further impact on the assignment route selection.

Intersection delay, calculated within the model, employs the *Austroad's* and *AARB* established formulae for the control of intersections operating as give way or stop sign, roundabout or traffic signals. For the latter the benefits of Sydney's coordinated signal control system, SCATS, on improved traffic flow, is incorporated. *SCATES* are run to dynamically emulate the SCATS operation at all signalised intersections, so designated, within the model. A '*cost*' penalty is added to the travel time to represent the delay that is associated with any pedestrian conflict at a marked crossing and/or any left turns and/or opposing traffic for right turns.

Netanal specifically calculates both the mid-block capacity and intersection performance. The model is therefore able to calculate queue lengths based on lane availability by time of day when traffic demand exceeds capacity and incorporate this queuing delay in the calculation of travel time during route choice.

If the travel time remains lower on a particular route with queues, *Netanal* will continue to assign traffic to that route until such time as the queue results in a time delay that makes an alternative route more attractive.

4.8 Projected Intersection Turn Movements

Netanal produces the hourly intersection turn movement demands at each node (intersection) within the mesoscopic model. These specific outputs have been employed in this project to provide the critical projected turn movements, within the study area, to enable the operational micro analysis, utilising the *Sidra* program, at key intersections.

Inherently, the predictive nature of mesoscopic modelling and the location of zone generators is one of the primary factors impacting on the volume of traffic reported at each intersection. Zones harbour vehicle generation based on land use within a precinct boundary, generally representing several hectares. Zones are often located within the model based upon, but not limited to…

- *Their context within the precinct in relation to the primary direction of traffic flow to and from the zone,*
- *Generally, central within a zone boundary (subject to finer disaggregation as land use dictates),*
- *Representation of a major vehicle generator within the precinct, such as school, large apartment block, shopping centre, car park, significant commercial operation, recreational grounds, etc… , and*
- *To allow the even distributiuon of traffic onto the arterial road network while limiting the intrusion of through traffic within local communities, unless identified from field observations.*

In some instances, the zone location may propagate errors at some intersections, in close proximity to high vehicle generation. A zone may be located so as to avoid the unwanted or unkikely trip diversion or '*rat runs*' within a local precinct attempting to access the arterial road network.

Significant effort is placed on locating the zones within the model to effectively assign vehicles onto the road network.

4.9 The SIDRA Model

SIDRA is utilised in this report to verify the mesoscopic model outputs and enable the assessment of lane based vehicle operation within the road network. The affects of oversaturation, upstream and down stream lane blockages at multiple intersections by differing intersection control methods are assessed diligently and without bias.

SIDRA provides the means by which to assess and report the Network, Route and Intersection operations concurrently. The results presented in this report reflect the findings reported from the *SIDRA* models following exportation of the projected turn volumes and residual queue lengths from the *Netanal* model.

5 2017 MODEL CALIBRATION

5.1 General

This section provides a concise framework for the verification, validation and calibration of the base year 2017 traffic model, assimilating the current study area road network and it's operational conditions.

Mesoscopic modelling lies between large strategic macro modelling and detailed microsimulation modelling, and is used to model relatively large areas (e.g. at the suburb level) while capturing detailed intersection operation effects on congestion and driver route choice. A mesoscopic traffic model has been created as part of this study using the *Netanal* software, which allows for the capacity and queuing effects of each intersection within the network to be assessed, as well as the cumulative effects of this congestion on adjacent intersections and route choice throughout the network.

The model utilises land use information and its traffic generation as inputs, along with road network details such as intersection geometry and road link speeds, number of lanes and capacity limitations. The model then calculates delays for the available routes through the network from each origin "zone" to each destination "zone" and assigns the generated traffic to the network based on comparable travel times. This allows intersection performance outputs (delays, levels of capacity usage, turning volumes etc.) and network travel times to be extracted, along with a range of other statistics valuable for option comparison.

A detailed outline of the software operation is provided earlier in this report.

5.2 Input Data

Appendix A presents the current traffic volumes collected by *Austraffic* in vehicles per hour, travelling on the surrounding road network. This data has been utilised in the calibration procedure of the mesoscopic model to align the projected model volumes with the current traffic flow and distribution, within the study area.

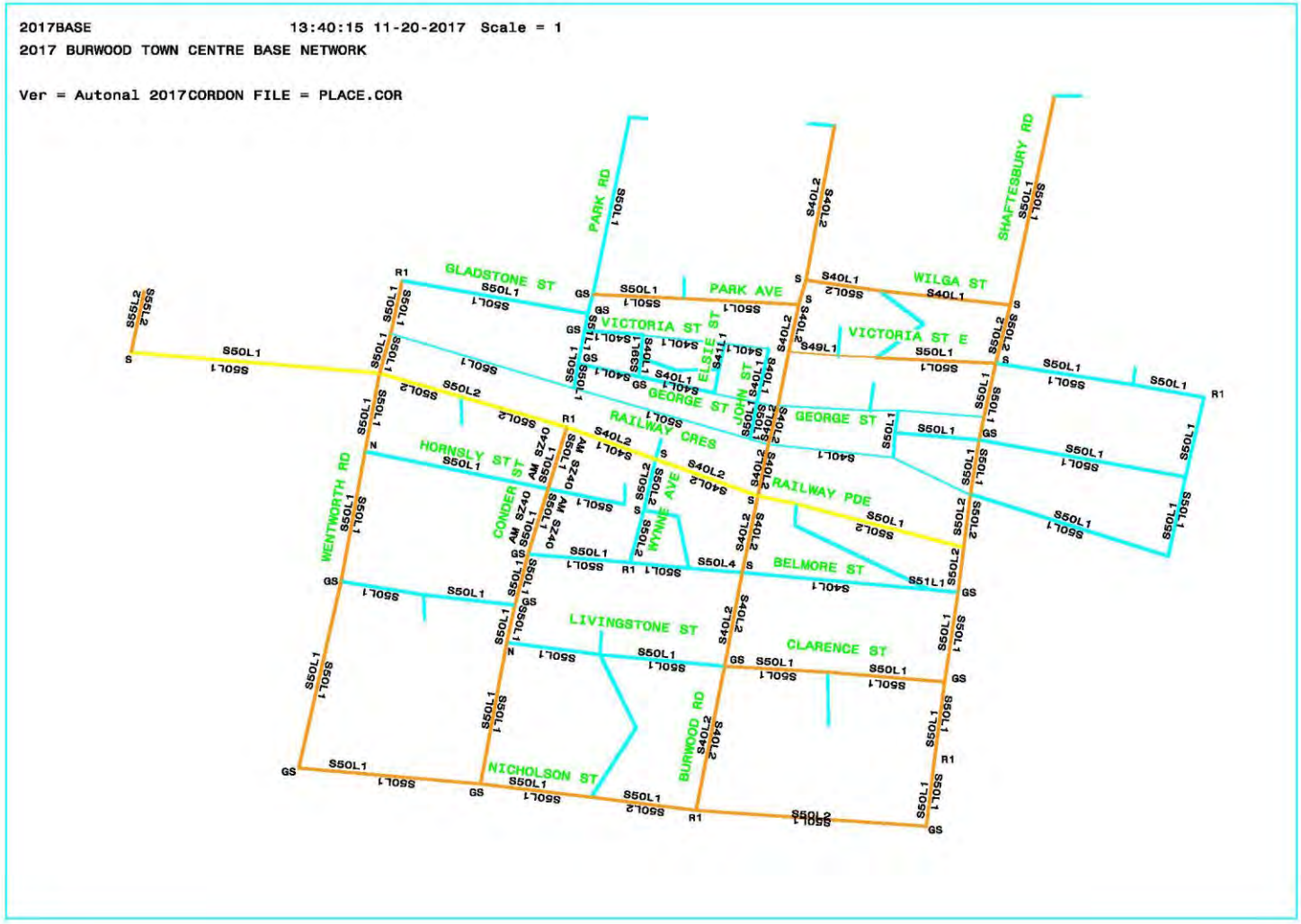
A detailed audit and catalogue of the town centre road network, and surrounds, has been undertaken ensuring the accuracy of the network platform onto which the developed morning, evening and Saturday peak trip matrices have been assigned.

Generally, the network characteristics catalogued were…

- *Road hierarchy,*
- *Road alignment,*
- *Number of lanes by peak period,*
- *Transit corridors,*
- *Regulated link speeds,*
- *Intersection control modes,*
- *Traffic signal timing offsets,*
- *Gap acceptance timing,*
- *Turn penalties pertaining to intersection geometries, and*
- *Lane capacities.*

Figure 24 *Mesoscopic Road Network Cordon*

Source *Road Delay Solutions, 2017*



5.3 2017 Base Year Model

The geographic region modelled (*Sydney Statistical Division or Sydney SD*) is represented by a trip matrix (*trip table*), that details the individual travel demands between origin and destination pairs. Each distinct area representing a trip origin or end is called a '*Zone*'. The Sydney *Netanal* model contains some 998 zones, following disaggregation. These elements define areas of homogenous land use (eg. residential, industrial, retail, commercial, education, airports, hospitals), enclosed and linked, by physical features such as major roads, railways and rivers, which is known as the network.

The trip table specifies the number of car and truck trips travelling between zones, within the modelled area. The boundaries of these zones for the Sydney Metropolitan Area were originally defined in 1996, by the *NSW Department of Transport's Transport Data Centre* (TDC), and have been generic across all traffic and transport modelling activities undertaken in Sydney. New boundaries were defined by *TDC* in 2006 and again in 2011, with an equivalency table, prepared by the *TDC*, employed to rationalise the current projected land use and trip distribution patterns with the *Netanal* zonal structure.

The assignment process, described above, essentially determines the anticipated route selection made by motorists between the '*origin*' and '*destination*' zones during a designated time period. The total number of trips between all the zonal pairs produces the projected traffic volumes reported by the model. *Netanal* model's the road network assignment over a 1hour period.

The base 2017 trip matrices were originally developed and published by the *TDC* in October 2014 and were subject to revision by the *TDC* in October 2016. Extensive disagregation of the vehicle distribution and trip demands between zonal pairs has been undertaken by *Road Delay Solutions* for the one (1) hour morning and evening peak trip tables to accurately reflect and assimilate the operation of the Sydney Metropolitan Area road network and in particular, focusing on the Burwood Town Centre.

The land use assumptions adopted in the year 2017 trip matrices, conform with those published by *TDC* and have been further advanced through numerous calibration processes throughout the Sydney Metropolitan Area.

5.4 Verification

Verification is the process of determining if the computer code, that implements the modelling logic, produces the desired output for a given set of input data and/or parameters.

A model is considered successful if the outputs are consistent, in terms of both magnitude and direction, with results from the direct application of the logic on which the code within the software is based.

The *Netanal* software package produces travel forecasts generally based upon travel time and cost rather than shortest distance and/or gravity principles.

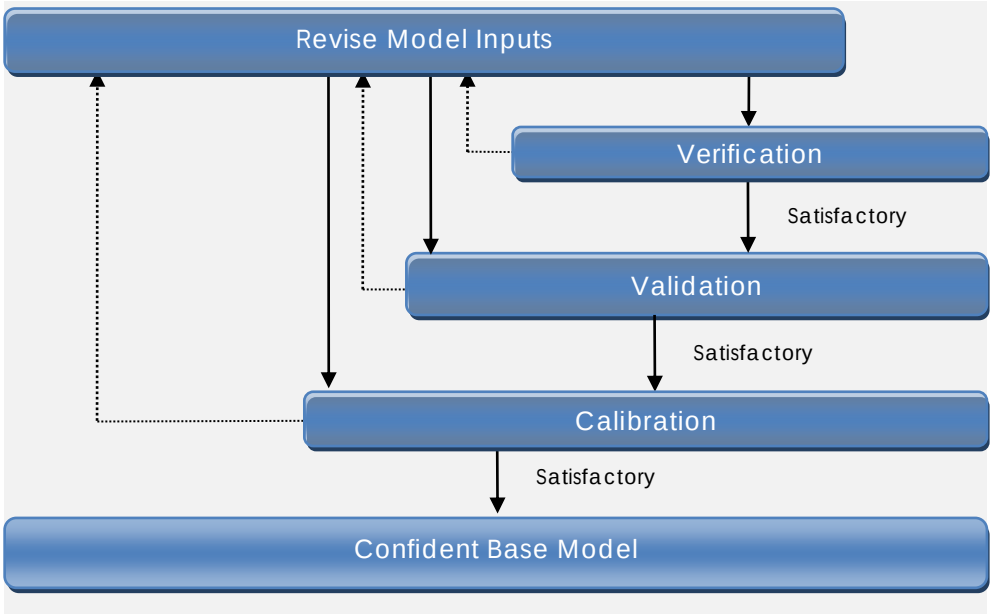
Netanal determines the invoked link and intersection delays predicated upon capacity and intersection control method, during a model assignment run, to effectively produce travel times between origins and destinations.

Based on these times, route selection within the model is influenced by the determined travel times on each modelled or alternate route. Preferred travel routes will be those yielding the lowest travel times, with a direct correlation to the vehicle operating costs.

Each intersection within the model is run at the operational level to determine the respective vehicle delays through the intersection and these are in turn added to the link delays.

The *Netanal* model has been verified by the former *RTA*, with reference found in *Part 2* of the '*Economic Analysis Manual*'.

Figure 25 The Correctness Procedure
Source Road Delay Solutions, 2016



5.5 Validation

The term applied to the fundamental method of assessing the effectiveness of the calibration procedure and its underlying principles in achieving an acceptable level of calibration.

To assess the model calibration, a formula known as the '*GEH Statistic*'[3] has been employed to rationalise the differential between the modelled and actual counted traffic volumes, on selected turn movements and links.

Turns and links with low volumes and a higher differential between the modelled and counted volumes, while possibly exhibiting a high percentage of inaccuracy, are considered less critical than links accommodating higher volumes. The GEH Statistic balances the relative priority of each link based on the counted volume, during the model calibration process. The GEH statistic is computed by the *Netanal* program.

[3] The GEH Statistic named after Geoffrey E. Havers, who invented it in the 1970s while working as a transport planner in London, England. In a mathematical form it is similar to a chi-squared test, but is not considered a true statistical test. Rather, it is an empirical formula that proves useful for a variety of traffic analysis purposes.

Figure 26 The GEH Statistic

Source Road Delay Solutions, 2016

$$GEH = \sqrt{\frac{(E-V)^2}{(E+V)/2}}$$

where… E = Predicted model volume V = Actual field counted volume

Four criteria were used to ensure the model was adequately calibrated (as per the RMS guidelines)…

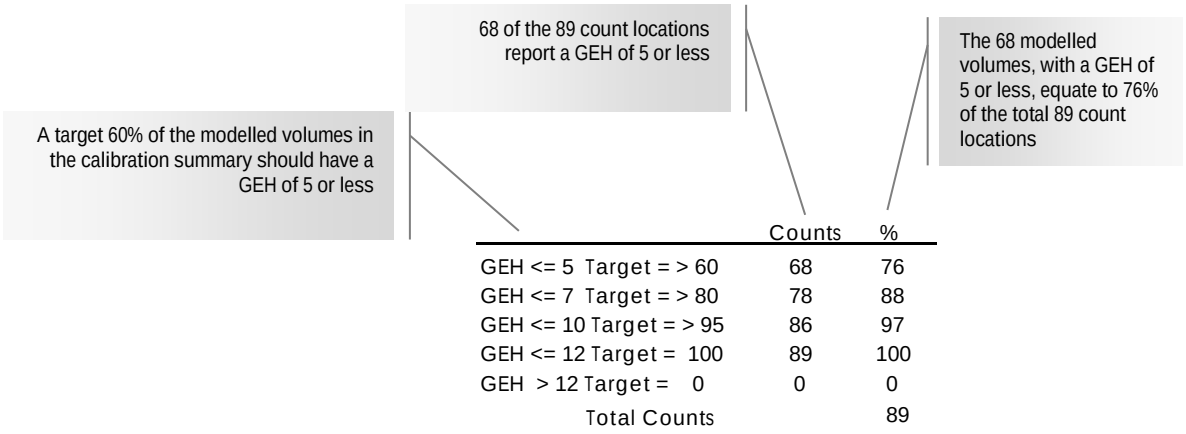
- *A minimum of 85% of turn volumes with a GEH < 5,*
- *A minimum of 95% of link volumes with a GEH < 5,*
- *No volumes yielding a GEH > 10, and*
- *A minimum R-squared value of 0.9 for both link and turn volumes.*

A range of GEH targets have been realistically set to achieve the prescribed Level of Accuracy (LoA), noted in the calibration synopsis. The targets highlight the percentage and weighted degree of difference between modelled volumes and the collected field data. For link volumes, a GEH value of 5 or less was adopted for the model and is presented in the report.

The figure below describes the components of the GEH Statistic and the typical targets employed in the calibration of the base year models.

Figure 27 A Typical GEH Output

Source Road Delay Solutions, 2016



Note: The above figure is indicative only. It presents a representation of the typical turn volume results for a hyperthetical model. The actual GEH results for this project are presented in the following section.

5.6 Calibration

Defined as the process of model parameter and input manipulation to achieve a prescribed differential between actual local traffic volumes and those modelled.

Calibration is, fundamentally, the transparent production of output, controlled by the value of input parameters on the basis of available field data. The success or failure of the calibration process, is determined by the accurate and logical evaluation of the collected and available field data employed in the selected input parameters.

From the collected intersection counts, all turn movements at the counted intersection and links at the mid block count locations have been calibrated, individually, to ensure the integrity of the trip distribution and volume flows within the study area and surrounds.

Table 5 2016 GEH Calibrated Link and Turn Results

Source Road Delay Solutions, 2017

Accuracy	AM Peak Turns	PM Peak Turns	WE Peak Turns
GEH >= 10	0%	0%	0%
GEH >= 5 <= 10	5%	8%	11%
GEH < 5	95%	92%	89%

An R-squared value, in excess of 0.961 was achieved for the AM, PM and WE modelled peak periods

Accuracy	AM Peal Links	PM Peak Links	WE Peak Links
GEH >= 10	0%	0%	0%
GEH >= 5 <= 10	0%	0%	0%
GEH < 5	100%	100%	100%

The calibration synopsis of traffic flows, on key routes, was output from the base 2017 AM, PM and WE peak models for the purpose of brevity. The *Calibration Synopsis* clearly shows that the link volumes achieved the required level of accuracy in accordance with *RMS* guidelines.

The zonal information, contained within the matrices, has been disaggregated in accordance with data collated during various studies conducted by *Road Delay Solutions Pty Ltd*, generally yielding a mean absolute screen line calibration Level of Accuracy (LoA) of some 15-20%.

The traffic volume calibration process for this project has adopted a standard deviation of 15% of the absolute mean, constituting an accepted LoA within the study area, while a deviation of 25% defines the LoA through the Sydney SD.

It should be noted that the *Netanal* program is a mesoscopic demand model, which reflects the total volume of traffic on a link, including residual traffic queues at the end of the modelled

one-hour time period. This is in contrast to the counted volume, collected in the field data, which only records those vehicles passing a given point during the same period.

Unless the residual queue is added to the count volume, it is safe to assume, that a count location will frequently report a lower traffic volume than those projected within the model, where significant vehicle queues exist at a site.

Discrepancies between adjacent intersection counts (known as gains and losses) are to be expected and an error in the order of some 3-4% was exhibited by the collected field data on Burwood Road.

5.7 2017 AM Peak Calibration Synopsis

Calibration Summary for Model 17AM4
Network = 2017BASE Trip Table = 17AM4
2017 AM Peak CALIBRATED BASE MODEL
Observed Counts versus Modelled Volumes

Location.....	Node	Node	Count	Model	Diff	Diff%	GEH
BURWOOD RD SB N WILGA	1348	10096	493	562	69	14	3
WILGA ST EB	10096	4020	365	386	21	6	1
WILGA ST WB	4020	10096	506	501	-5	-1	0
PARK AVE EB	8542	10097	449	460	11	2	1
PARK AVE WB	10097	8542	409	359	-50	-12	3
BURWOOD RD NB S PARK A	4800	10097	508	487	-21	-4	1
BURWOOD RD SB S PARK A	10097	4800	493	540	47	10	2
BURWOOD RD SB N GEORGE	4800	8541	420	471	51	12	2
GEORGE ST EB	8541	1356	63	84	21	33	2
GEORGE ST WB W BURWOOD	8541	8506	153	140	-13	-8	1
RAILWAY CRES WB	8544	1365	144	93	-51	-35	5
DEANE ST WB	8543	8544	133	173	40	30	3
BURWOOD RD NB N RAILWA	10094	8544	679	588	-91	-13	4
RAILWAY PDE EB W BURWO	8544	10094	473	428	-45	-10	2
RAILWAY PDE WB E BURWO	8522	10094	409	415	6	1	0
RAILWAY PDE EB E BURWO	10094	8522	334	341	7	2	0
BURWOOD RD NB S RAILWA	8539	10094	636	509	-127	-20	5
BURWOOD RD SB S RAILWA	10094	8539	368	311	-57	-15	3
BURWOOD CENTRAL NB	8533	848	7	11	4	57	1
BURWOOD CENTRAL SB	848	8533	9	12	3	33	1
RAILWAY PDE EB W WYNNE	8554	8533	423	369	-54	-13	3
RAILWAY PDE WB W WYNNW	8533	8554	452	480	28	6	1
RAILWAY PDE EB W CONDE	1361	8554	564	507	-57	-10	2
RAILWAY PDE WB W CONDE	8554	1361	592	476	-116	-20	5
CONDER ST NB	8557	8525	267	239	-28	-10	2
CONDER ST SB	8554	8525	218	212	-6	-3	0
BELMORE ST EB W BURWOO	8523	8539	164	231	67	41	5
BELMORE ST WB W BURWOO	8539	8523	196	178	-18	-9	1
BELMORE ST WB E BURWOO	8228	8539	162	138	-24	-15	2
BELMORE ST EB E BURWOO	8539	8228	111	132	21	19	2
WYNNE AVE NB N BELMORE	8555	8524	100	128	28	28	3
WYNNE AVE SB N BELMORE	8533	8524	184	182	-2	-1	0
CONDER ST NB S BELMORE	8559	8557	396	338	-58	-15	3
CONDER ST SB N BELMORE	8525	8557	199	159	-40	-20	3
BELMORE ST WB E CONDER	8555	8557	142	90	-52	-37	5
BELMORE ST EB E CONDER	8557	8555	236	197	-39	-17	3
WENTWORTH NB S RAILWAY	1367	4820	252	223	-29	-12	2
WENTWORTH SB S RAILWAY	4820	1367	374	337	-37	-10	2
RAILWAY WB E WENTWORTH	1361	4820	517	478	-39	-8	2
RAILWAY EB E WENTWORTH	4820	1361	590	516	-74	-13	3
WENTWORTH SB N RAILWAY	8536	4820	644	643	-1	-0	0
MORWICK EB W WENTWORTH	4813	4820	599	596	-3	-1	0
SHAFTESBURY NB S RAILW	8556	4803	726	635	-91	-13	3
SHAFTESBURY SB S RAILW	4803	8556	623	541	-82	-13	3
PAISLEY EB E SHAFTESBU	4803	4804	402	380	-22	-5	1
PAISLEY WB E SHAFTESBU	4804	4803	490	564	74	15	3
SHAFTESBURY NB N RAILW	4803	8537	886	797	-89	-10	3
SHAFTESBURY SB N RAILW	8537	4803	636	521	-115	-18	5
RAILWAY WB W SHAFTESBU	4803	8522	434	327	-107	-25	5
SHAFTESBURY SB N WILGA	10089	4798	557	682	125	22	5
WILGA EB W SHAFTESBURY	4020	4798	180	146	-34	-19	3
SHAFTESBURY NB S WILGA	10095	4798	809	917	108	13	4
SHAFTESBURY SB N VICTO	4798	10095	390	464	74	19	4

VICTORIA WB E SHAFTESB	8528	10095	502	540	38	8	2
SHAFTESBURY NB S VICTO	8552	10095	779	831	52	7	2
VICTORIA EB W SHAFTESB	4036	10095	222	241	19	9	1

Summary of GEH Calibration Validation

	Counts	%
GEH <= 5 Target = > 60%	56	100
GEH <= 7 Target = > 80%	56	100
GEH <= 10 Target = > 95%	56	100
GEH <= 12 Target = 100%	56	100
GEH > 12 Target = 0%	0	0
Total Counts	56	

Mean, Mean Absolute Difference (MAD) & +/- 10% MAD Analysis - Model 17AM4

Note.... A Mean, a Mean Absolute Difference (MAD) & a MAD +/- 10% Count Variability Analysis is calculated and the results given below. The 10% MAD count variation endeavours to cater for the known 20% variation in daily traffic volumes, errors and discrepancies in SCATS and other count methods.

Observed Count Range	Mean	MAD ABS	MAD +-10%	Counts
	%	%	%	
0001 to 0500	1.63	12.66	2.66	38
0501 to 1000	5.18	10.87	0.87	18
1001 to 1500	0.00	0.00	0.00	0
1501 to 2000	0.00	0.00	0.00	0
2001 to 2500	0.00	0.00	0.00	0
2501 to 3000	0.00	0.00	0.00	0
3001 to 3500	0.00	0.00	0.00	0
3501 to 4000	0.00	0.00	0.00	0
4001 to 5000	0.00	0.00	0.00	0
5001 to Maximum	0.00	0.00	0.00	0
Total of Counts 0001 to Maximum Range	3.46	11.74	1.74	56
Total of Counts 0501 to Maximum Range	5.18	10.87	0.87	18

5.8 2017 PM Peak Calibration Synopsis

Calibration Summary for Model 17PM3
Network = 2017BASE Trip Table = 17PM3
2017 PM Peak CALIBRATED BASE MODEL
Observed Counts versus Modelled Volumes

Location.....	Node	Node	Count	Model	Diff	Diff%	GEH
BURWOOD RD SB N WILGA	1348	10096	439	452	13	3	1
WILGA ST EB	10096	4020	480	541	61	13	3
WILGA ST WB	4020	10096	565	472	-93	-16	4
PARK AVE EB	8542	10097	499	507	8	2	0
PARK AVE WB	10097	8542	365	349	-16	-4	1
BURWOOD RD NB S PARK A	4800	10097	415	486	71	17	3
BURWOOD RD SB S PARK A	10097	4800	485	502	17	4	1
BURWOOD RD SB N GEORGE	4800	8541	475	389	-86	-18	4
GEORGE ST EB	8540	8552	22	12	-10	-45	2
GEORGE ST WB W BURWOOD	8541	8506	178	179	1	1	0
RAILWAY CRES WB	8544	1365	41	56	15	37	2
DEANE ST WB	8543	8544	210	216	6	3	0
BURWOOD RD NB N RAILWA	10094	8544	532	569	37	7	2
RAILWAY PDE EB W BURWO	8544	10094	474	395	-79	-17	4
RAILWAY PDE WB E BURWO	8522	10094	417	416	-1	-0	0
RAILWAY PDE EB E BURWO	10094	8522	374	411	37	10	2
BURWOOD RD NB S RAILWA	8539	10094	479	446	-33	-7	2
BURWOOD RD SB S RAILWA	10094	8539	325	312	-13	-4	1
BURWOOD CENTRAL NB	8533	848	16	12	-4	-25	1
BURWOOD CENTRAL SB	848	8533	18	22	4	22	1
RAILWAY PDE EB W WYNNE	8554	8533	523	472	-51	-10	2
RAILWAY PDE WB W WYNNE	8533	8554	624	607	-17	-3	1
RAILWAY PDE EB W CONDE	1361	8554	586	516	-70	-12	3
RAILWAY PDE WB W CONDE	8554	1361	607	584	-23	-4	1
CONDER ST NB	8557	8525	301	217	-84	-28	5
CONDER ST SB	8525	8557	255	228	-27	-11	2
BELMORE ST EB W BURWOO	8523	8539	327	333	6	2	0
BELMORE ST WB W BURWOO	8539	8523	178	206	28	16	2
BELMORE ST WB E BURWOO	8228	8539	265	183	-82	-31	5
BELMORE ST EB E BURWOO	8539	8228	210	160	-50	-24	4
WYNNE AVE NB N BELMORE	8555	8524	192	132	-60	-31	5
WYNNE AVE SB N BELMORE	8524	8555	107	121	14	13	1
CONDER ST NB S BELMORE	8559	8557	218	193	-25	-11	2
CONDER ST SB N BELMORE	8525	8557	255	228	-27	-11	2
BELMORE ST WB E CONDER	8555	8557	246	228	-18	-7	1
BELMORE ST EB E CONDER	8557	8555	164	146	-18	-11	1
BELMORE ST EB W WYNNE	8557	8555	156	146	-10	-6	1
WENTWORTH NB S RAILWAY	1367	4820	283	376	93	33	5
WENTWORTH SB S RAILWAY	4820	1367	495	529	34	7	2
RAILWAY WB E WENTWORTH	1361	4820	588	598	10	2	0
RAILWAY EB E WENTWORTH	4820	1361	617	517	-100	-16	4
WENTWORTH SB N RAILWAY	8536	4820	854	1002	148	17	5
MORWICK EB W WENTWORTH	4813	4820	553	517	-36	-7	2
SHAFTESBURY NB S RAILW	8556	4803	594	613	19	3	1
SHAFTESBURY SB S RAILW	4803	8556	683	593	-90	-13	4
PAISLEY EB E SHAFTESBU	4803	4804	415	443	28	7	1
PAISLEY WB E SHAFTESBU	4804	4803	452	432	-20	-4	1
SHAFTESBURY NB N RAILW	4803	8537	846	766	-80	-9	3
SHAFTESBURY SB N RAILW	8537	4803	879	769	-110	-13	4
RAILWAY WB W SHAFTESBU	4803	8522	376	342	-34	-9	2
SHAFTESBURY SB N WILGA	10089	4798	999	906	-93	-9	3
WILGA EB W SHAFTESBURY	4020	4798	154	146	-8	-5	1
SHAFTESBURY NB S WILGA	10095	4798	601	638	37	6	1

SHAFTESBURY SB N VICTO	4798	10095	884	917	33	4	1
VICTORIA WB E SHAFTESB	8528	10095	304	324	20	7	1
SHAFTESBURY NB S VICTO	8552	10095	698	594	-104	-15	4
VICTORIA EB W SHAFTESB	4036	10095	568	524	-44	-8	2

Summary of GEH Calibration Validation

	Counts	%
GEH <= 5 Target = > 60%	57	100
GEH <= 7 Target = > 80%	57	100
GEH <= 10 Target = > 95%	57	100
GEH <= 12 Target = 100%	57	100
GEH > 12 Target = 0%	0	0
Total Counts	57	

Mean, Mean Absolute Difference (MAD) & +/- 10% MAD Analysis - Model 17PM3

Note.... A Mean, a Mean Absolute Difference (MAD) & a MAD +/- 10% Count Variability Analysis is calculated and the results given below. The 10% MAD count variation endeavours to cater for the known 20% variation in daily traffic volumes, errors and discrepancies in SCATS and other count methods.

Observed Count Range	Mean	MAD ABS	MAD +-10%	Counts
	%	%	%	
0001 to 0500	2.25	10.49	0.49	38
0501 to 1000	4.90	9.34	0.00	19
1001 to 1500	0.00	0.00	0.00	0
1501 to 2000	0.00	0.00	0.00	0
2001 to 2500	0.00	0.00	0.00	0
2501 to 3000	0.00	0.00	0.00	0
3001 to 3500	0.00	0.00	0.00	0
3501 to 4000	0.00	0.00	0.00	0
4001 to 5000	0.00	0.00	0.00	0
5001 to Maximum	0.00	0.00	0.00	0
Total of Counts 0001 to Maximum Range	3.67	9.87	0.00	57
Total of Counts 0501 to Maximum Range	4.90	9.34	0.00	19

5.9 2017 WE Peak Calibration Synopsis

Calibration Summary for Model 17AMWE6
Network = 2017BASE Trip Table = 17AMWE6
2017 WEEKEND Peak CALIBRATED BASE MODEL
Observed Counts versus Modelled Volumes

Location.....	Node	Node	Count	Model	Diff	Diff%	GEH
BURWOOD RD SB N WILGA	1348	10096	397	371	-26	-7	1
WILGA ST EB	10096	4020	577	581	4	1	0
WILGA ST WB	4020	10096	601	489	-112	-19	5
PARK AVE EB	8542	10097	504	536	32	6	1
PARK AVE WB	10097	8542	339	298	-41	-12	2
BURWOOD RD NB S PARK A	4800	10097	364	423	59	16	3
BURWOOD RD SB S PARK A	10097	4800	565	496	-69	-12	3
BURWOOD RD SB N GEORGE	4800	8541	412	346	-66	-16	3
GEORGE ST EB	8541	8506	68	106	38	56	4
GEORGE ST WB W BURWOOD	8541	8506	83	106	23	28	2
RAILWAY CRES WB	8544	1365	57	73	16	28	2
DEANE ST WB	8543	8544	82	137	55	67	5
BURWOOD RD NB N RAILWA	10094	8544	534	523	-11	-2	0
RAILWAY PDE EB W BURWO	8544	10094	416	334	-82	-20	4
RAILWAY PDE WB E BURWO	8522	10094	424	448	24	6	1
RAILWAY PDE EB E BURWO	10094	8522	422	400	-22	-5	1
BURWOOD RD NB S RAILWA	8539	10094	492	484	-8	-2	0
BURWOOD RD SB S RAILWA	10094	8539	361	274	-87	-24	5
BURWOOD CENTRAL NB	8533	848	15	11	-4	-27	1
BURWOOD CENTRAL SB	848	8533	9	13	4	44	1
RAILWAY PDE EB W WYNNE	8554	8533	522	473	-49	-9	2
RAILWAY PDE WB W WYNNE	8533	8554	475	463	-12	-3	1
RAILWAY PDE EB W CONDE	1361	8554	563	573	10	2	0
RAILWAY PDE WB W CONDE	8554	1361	473	436	-37	-8	2
CONDER ST NB	8557	8525	217	202	-15	-7	1
CONDER ST SB	8554	8525	224	183	-41	-18	3
BELMORE ST EB E WYNNE	8555	8523	164	205	41	25	3
BELMORE ST WB W BURWOO	8539	8523	172	181	9	5	1
BELMORE ST WB E BURWOO	8228	8539	162	144	-18	-11	1
BELMORE ST EB E BURWOO	8539	8228	211	201	-10	-5	1
WYNNE AVE NB N BELMORE	8555	8524	132	117	-15	-11	1
WYNNE AVE SB N BELMORE	8524	8555	84	70	-14	-17	2
CONDER ST NB S BELMORE	8559	8557	220	259	39	18	3
CONDER ST SB N BELMORE	8525	8557	278	231	-47	-17	3
BELMORE ST WB E CONDER	8555	8557	168	171	3	2	0
BELMORE ST EB E CONDER	8557	8555	236	245	9	4	1
WENTWORTH NB S RAILWAY	1367	4820	252	228	-24	-10	2
WENTWORTH SB S RAILWAY	4820	1367	496	516	20	4	1
RAILWAY WB E WENTWORTH	1361	4820	343	440	97	28	5
RAILWAY EB E WENTWORTH	4820	1361	573	581	8	1	0
WENTWORTH SB N RAILWAY	8536	4820	738	851	113	15	4
MORWICK EB W WENTWORTH	4813	4820	603	640	37	6	1
SHAFTESBURY NB S RAILW	8556	4803	635	689	54	9	2
SHAFTESBURY SB S RAILW	4803	8556	664	612	-52	-8	2
PAISLEY EB E SHAFTESBU	4803	4804	416	346	-70	-17	4
PAISLEY WB E SHAFTESBU	4804	4803	445	440	-5	-1	0
SHAFTESBURY NB N RAILW	4803	8537	925	829	-96	-10	3
SHAFTESBURY SB N RAILW	8537	4803	656	641	-15	-2	1
RAILWAY WB W SHAFTESBU	4803	8522	388	313	-75	-19	4
SHAFTESBURY SB N WILGA	10089	4798	537	569	32	6	1
WILGA EB W SHAFTESBURY	4020	4798	154	119	-35	-23	3
SHAFTESBURY NB S WILGA	10095	4798	713	718	5	1	0

SHAFTESBURY SB N VICTO	4798	10095	441	536	95	22	4
VICTORIA WB E SHAFTESB	8528	10095	373	324	-49	-13	3
SHAFTESBURY NB S VICTO	8552	10095	730	757	27	4	1
VICTORIA EB W SHAFTESB	4036	10095	434	528	94	22	4

Summary of GEH Calibration Validation

	Counts	%
GEH <= 5 Target = > 60%	56	100
GEH <= 7 Target = > 80%	56	100
GEH <= 10 Target = > 95%	56	100
GEH <= 12 Target = 100%	56	100
GEH > 12 Target = 0%	0	0
Total Counts	56	

Mean, Mean Absolute Difference (MAD) & +/- 10% MAD Analysis - Model 17AMWE6

Note.... A Mean, a Mean Absolute Difference (MAD) & a MAD +/- 10% Count Variability Analysis is calculated and the results given below. The 10% MAD count variation endeavours to cater for the known 20% variation in daily traffic volumes, errors and discrepancies in SCATS and other count methods.

Observed Count Range	Mean	MAD ABS	MAD +-10%	Counts
	%	%	%	
0001 to 0500	1.62	13.11	3.11	39
0501 to 1000	0.77	6.82	0.00	17
1001 to 1500	0.00	0.00	0.00	0
1501 to 2000	0.00	0.00	0.00	0
2001 to 2500	0.00	0.00	0.00	0
2501 to 3000	0.00	0.00	0.00	0
3001 to 3500	0.00	0.00	0.00	0
3501 to 4000	0.00	0.00	0.00	0
4001 to 5000	0.00	0.00	0.00	0
5001 to Maximum	0.00	0.00	0.00	0
Total of Counts 0001 to Maximum Range	1.20	10.01	0.01	56
Total of Counts 0501 to Maximum Range	0.77	6.82	0.00	17

5.10 Travel Times

As previously discussed, travel time surveys were undertaken on Burwood Road to assist in validating and calibrating the base model.

Results indicate a maximum difference of -7.41% difference between the collated field data and modelled travel times. RMS guidelines require average modelled travel times to have a differential not greater than 15% or one (1) minute from the observed travel times for the entire route collected.

The calibrated travel times are considered acceptable within the parameters of current modelling practices and *RMS* guidelines.

Figure 28 2017 AM Calibrated Base Model

Source Road Delay Solutions, 2017

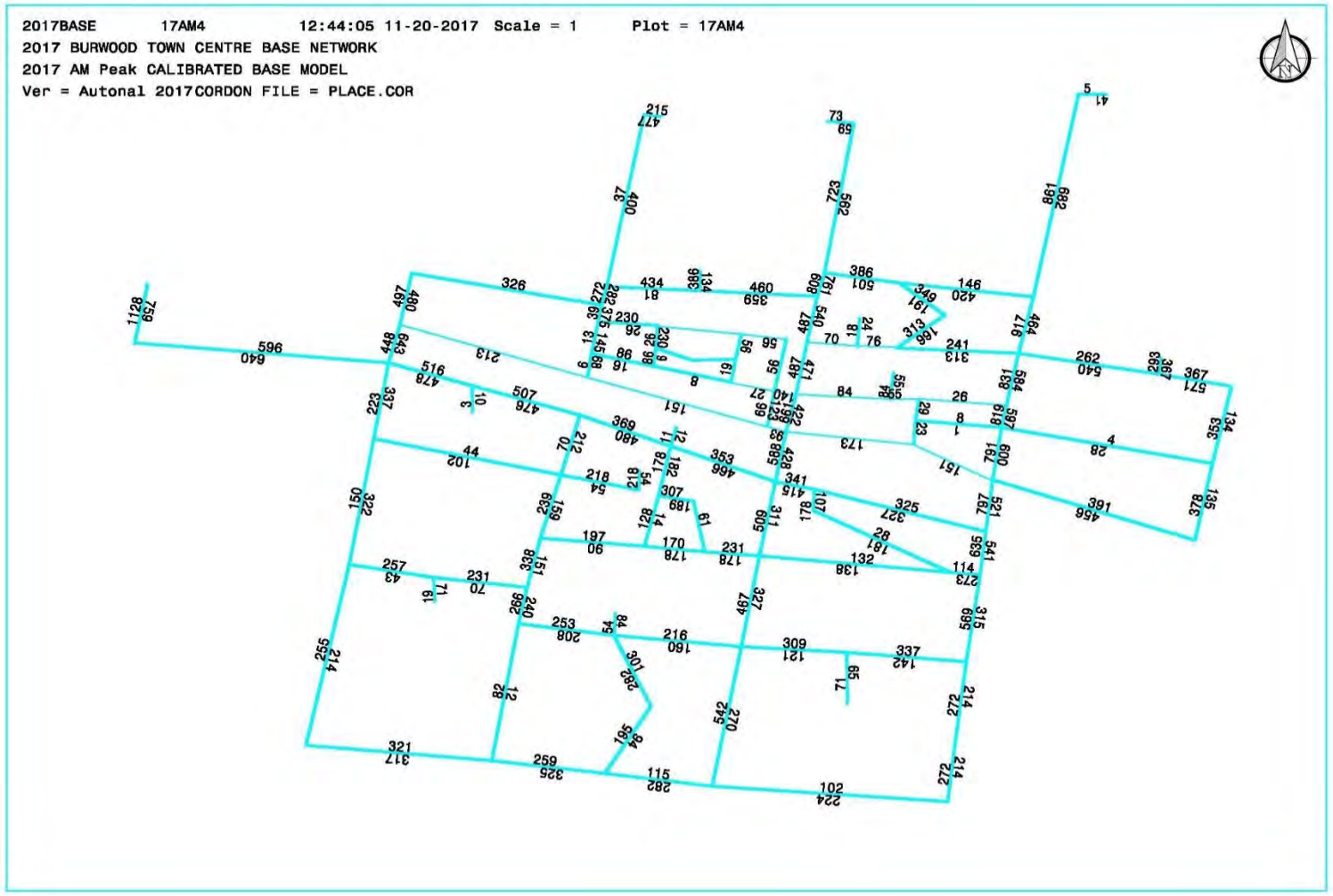


Figure 29 *2017 PM Calibrated Base Model*

Source *Road Delay Solutions, 2017*

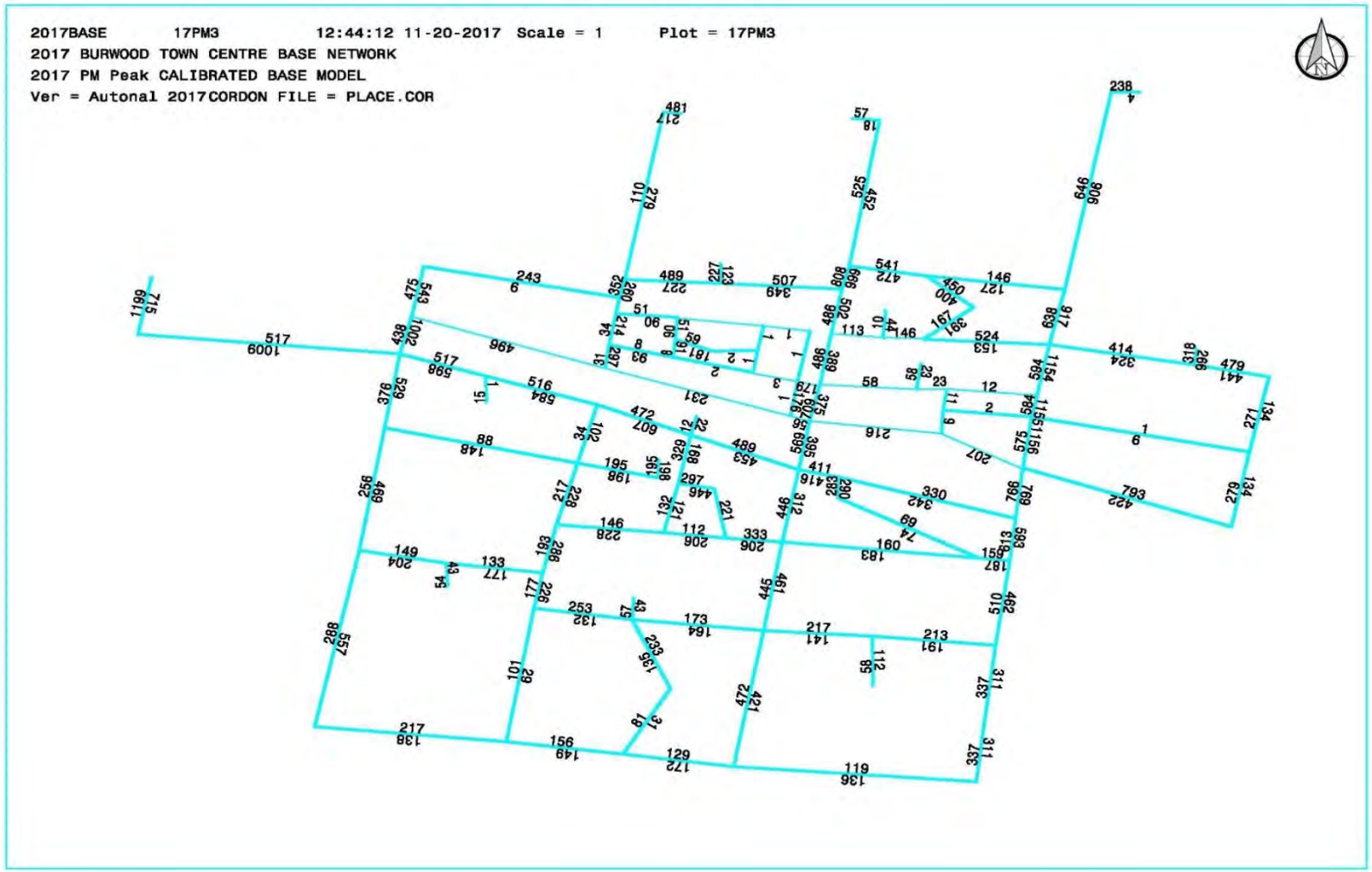
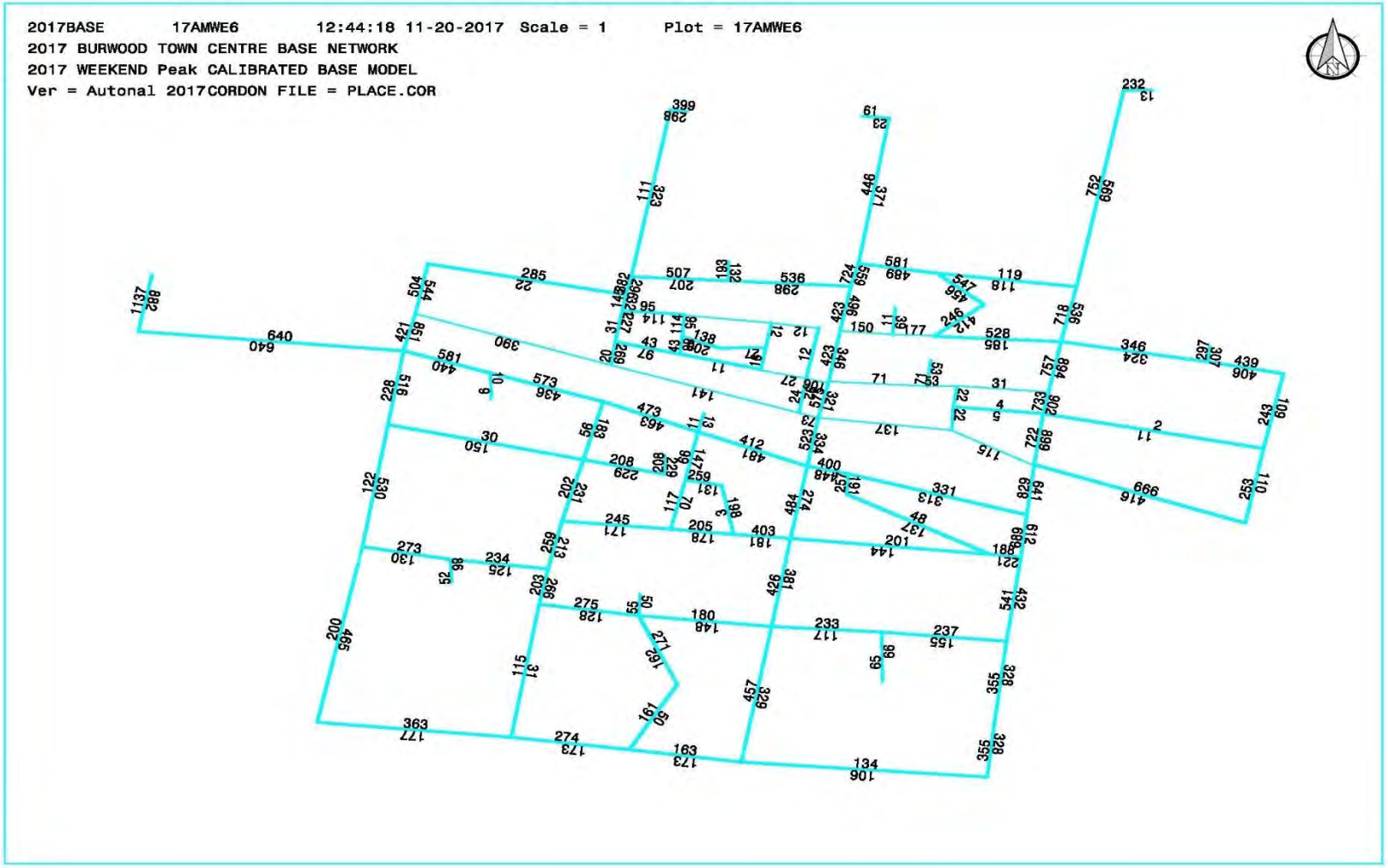


Figure 30 2017 WE Calibrated Base Model

Source Road Delay Solutions, 2017



5.11 Operational Performances

The mesoscopic modelling indicates that the Burwood Road route, both northbound and southbound, during both the AM and PM comuter peak periods between George Street and Belmore Street, currently operate at a satisfactory Level of Service (LoS) 'D',

Occassional residual queues are reported from several sites through preceding intersections, impeding the coordinated traffic signal operations and the through movements.

The pedestrian phases along Burwood Road are demanded each cycle and necessitate significant time to clear before allowing left and right turn vehicle movements to be performed.

This is particularly evident, southbound, at the Burwood Road intersection with Railway Parade. With a trailing and repeat right turn from the central shared through and right lane, in conjunction with the inherent delay imposed by pedestrians on the left turn movement, 'A' phase can '*trap*' southbound motorists if the right and left turn movements are held, concurrently.

Site observations also indicated, that particularly during the morning peak and to a lesser degree during the evening peak, drop offs and pick ups at the Burwood railway station, made from the southbound kerb side lane preceding and following the pedestrian fence at Deane Street and Railway Parade, respectively, caused some minor delays when coinciding with the 'A' phase display at the Railway Parade intersection.

Sidra coordinated network modelling has also been undertaken, adopting a 100 second cycle length and program generated offsets to better determine the operational performance of Burwood Road during the morning and evening peak periods under the current traffic demands.

The route along Burwood Road, between George Street to the north and Clarence Street to the south, reports to operate at an unsatisfactory LoS 'E' in both directions during the AM and PM peak periods with an average travel speed generally less than 25km/h covering the 850m route distance. The incidence of residual queueing along the route can be attributed to the generally single lane capacity and there is no immediate opportunity, within the current road reserve, to widen and improve the route capacity and performance.

The weekend peak traffic volumes within the network, for a typical Saturday, are marginally less than those exhibited during the week day commuter peak periods.

Pedestrian activity is reduced with the reduction in Journey to Work and commercial trips and can primarily be attributed to retail activity through the centre.

Reporting an unsatisfactory LoS 'E' for the Burwood Road route during the weekend peak between George Street and Clarence Street, the road network constraints on a weekend remain the same as during the commuter peak periods.

On street parking, mid block and intersection capacity constraints and high pedestrian activity are the primary factors contributing to lower vehicle speeds and residual queueing or '*spillback*'.

Figure 31 *2017 SIDRA 7 Modelled Road Network*

Source *Sidra/Road Delay Solutions, 2017*

NETWORK LAYOUT

Network: N101 [2017 AM Base Burwood Town Centre]

SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
0107	NA	2017 AM Shaftesbury Rd, Railway Pde and Paisley St
0144	NA	2017 AM Shaftesbury Rd and Wilga St
0784	NA	2017 AM Shaftesbury Road and Victoria Street
GW01	NA	2017 AM Shaftesbury Rd and George St
GW02	NA	2017 AM Shaftesbury Rd and Deane St
GW04	NA	2017 AM Burwood Rd and Victoria St
GW03	NA	2017 AM Burwood Rd and George St
0174	NA	2017 AM Burwood Rd and Deane St
0014	NA	2017 AM Burwood Rd and Railway Pde
1639	NA	2017 AM Burwood Rd and Belmore St
1843	NA	2017 AM Railway Pde and Wynne Ave
R0001	NA	2017 AM Railway Pde and Conder St
R0002	NA	2017 AM Belmore St and Wynne Ave
GW05	NA	2017 AM Belmore St and Conder St
1183	NA	2017 AM Wentworth Rd, Railway Pde and Morwick St

Figure 32 2017 AM Network Summary

Source Road Delay Solutions, 2017

NETWORK SUMMARY

Network: N101 [2017 AM Base Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	2.54			
Speed Efficiency	0.33			
Congestion Coefficient	3.04			
Travel Speed (Average)	19.7 km/h		2.4 km/h	13.6 km/h
Travel Distance (Total)	6907.6 veh-km/h		466.5 ped-km/h	10151.7 pers-km/h
Travel Time (Total)	349.9 veh-h/h		198.0 ped-h/h	746.3 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	23202 veh/h		13777 ped/h	37584 pers/h
Arrival Flows (Total for all Sites)	23031 veh/h		13777 ped/h	37195 pers/h
Demand Flows (Entry Total)	5793 veh/h			
Midblock Inflows (Total)	1936 veh/h			
Midblock Outflows (Total)	-1843 veh/h			
Percent Heavy Vehicles (Demand)	3.9 %			
Percent Heavy Vehicles (Arrival)	3.9 %			
Degree of Saturation	1.261			
Control Delay (Total)	209.51 veh-h/h		98.28 ped-h/h	444.44 pers-h/h
Control Delay (Average)	32.7 sec		25.7 sec	43.0 sec
Control Delay (Worst Lane)	291.9 sec			
Control Delay (Worst Movement)	291.9 sec		44.8 sec	291.9 sec
Geometric Delay (Average)	1.6 sec			
Stop-Line Delay (Average)	31.2 sec			
Queue Storage Ratio (Worst Lane)	1.39			
Total Effective Stops	16569 veh/h		10402 ped/h	36242 pers/h
Effective Stop Rate	0.72 per veh	2.4 per km	0.76 per ped	0.97 per pers
Proportion Queued	0.62		0.76	0.89
Performance Index	1620.7		255.7	1876.5
Cost (Total)	16152.81 $/h	2.34 $/km	4988.43 $/h	21141.23 $/h
Fuel Consumption (Total)	1068.9 L/h	154.7 mL/km		
Fuel Economy	15.5 L/100km			
Carbon Dioxide (Total)	2525.7 kg/h	365.6 g/km		
Hydrocarbons (Total)	0.281 kg/h	0.041 g/km		
Carbon Monoxide (Total)	2.343 kg/h	0.339 g/km		
NOx (Total)	3.204 kg/h	0.464 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 26.2 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	11,136,870 veh/y	6,612,885 ped/y	18,040,170 pers/y
Delay	100,563 veh-h/y	47,173 ped-h/y	213,331 pers-h/y
Effective Stops	7,953,333 veh/y	4,993,160 ped/y	17,396,020 pers/y
Travel Distance	3,315,652 veh-km/y	223,913 ped-km/y	4,872,806 pers-km/y
Travel Time	167,959 veh-h/y	95,018 ped-h/y	358,238 pers-h/y
Cost	7,753,347 $/y	2,394,444 $/y	10,147,790 $/y
Fuel Consumption	513,090 L/y		
Carbon Dioxide	1,212,322 kg/y		

Figure 33 2017 AM 95th % Queue Ratios

Source Road Delay Solutions, 2017

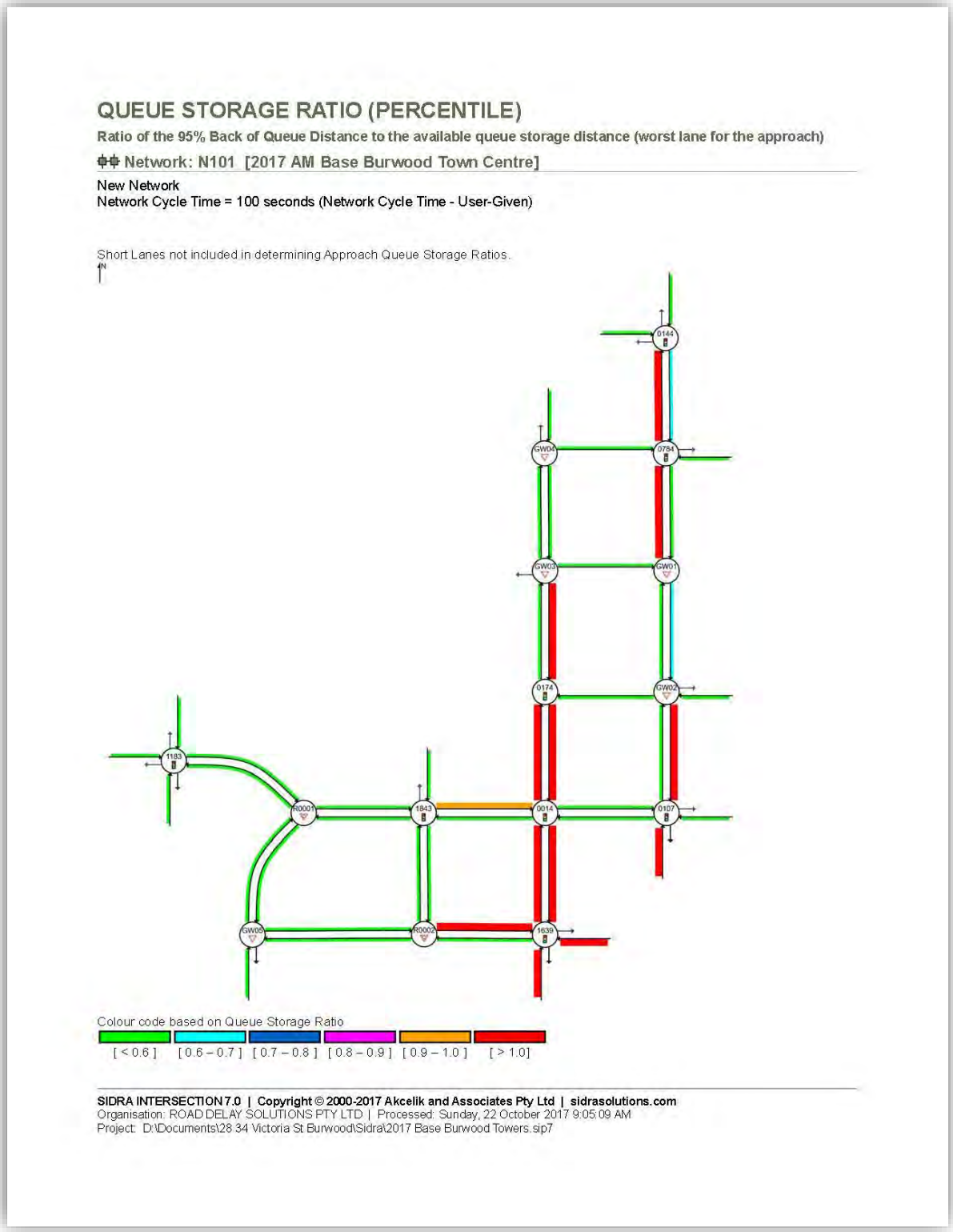


Figure 34 2017 PM Network Summary

Source Road Delay Solutions, 2017

NETWORK SUMMARY

Network: N101 [2017 PM Base Burwood Town Centre]

New Network
Network Cycle Time = 110 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.30			
Speed Efficiency	0.40			
Congestion Coefficient	2.52			
Travel Speed (Average)	23.8 km/h		2.2 km/h	16.2 km/h
Travel Distance (Total)	7226.7 veh-km/h		479.9 ped-km/h	10510.5 pers-km/h
Travel Time (Total)	303.5 veh-h/h		216.8 ped-h/h	647.2 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	22775 veh/h		14157 ped/h	36200 pers/h
Arrival Flows (Total for all Sites)	22775 veh/h		14157 ped/h	36200 pers/h
Demand Flows (Entry Total)	5663 veh/h			
Midblock Inflows (Total)	1720 veh/h			
Midblock Outflows (Total)	-849 veh/h			
Percent Heavy Vehicles (Demand)	3.2 %			
Percent Heavy Vehicles (Arrival)	3.2 %			
Degree of Saturation	0.975			
Control Delay (Total)	161.05 veh-h/h		114.30 ped-h/h	343.04 pers-h/h
Control Delay (Average)	25.5 sec		29.1 sec	34.1 sec
Control Delay (Worst Lane)	87.9 sec			
Control Delay (Worst Movement)	87.9 sec		49.9 sec	87.9 sec
Geometric Delay (Average)	1.7 sec			
Stop-Line Delay (Average)	23.7 sec			
Queue Storage Ratio (Worst Lane)	1.21			
Total Effective Stops	13513 veh/h		10184 ped/h	29886 pers/h
Effective Stop Rate	0.59 per veh	1.9 per km	0.72 per ped	0.83 per pers
Proportion Queued	0.58		0.72	0.83
Performance Index	1291.4		273.4	1564.8
Cost (Total)	12595.25 $/h	1.74 $/km	5464.22 $/h	18059.47 $/h
Fuel Consumption (Total)	965.5 L/h	133.6 mL/km		
Fuel Economy	13.4 L/100km			
Carbon Dioxide (Total)	2277.4 kg/h	315.1 g/km		
Hydrocarbons (Total)	0.229 kg/h	0.032 g/km		
Carbon Monoxide (Total)	2.067 kg/h	0.286 g/km		
NOx (Total)	2.212 kg/h	0.306 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 23.1 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	10,931,870 veh/y	6,795,285 ped/y	17,376,030 pers/y
Delay	77,303 veh-h/y	54,864 ped-h/y	164,659 pers-h/y
Effective Stops	6,486,367 veh/y	4,888,106 ped/y	14,345,130 pers/y
Travel Distance	3,468,799 veh-km/y	230,334 ped-km/y	5,045,020 pers-km/y
Travel Time	145,672 veh-h/y	104,080 ped-h/y	310,677 pers-h/y
Cost	6,045,721 $/y	2,622,825 $/y	8,668,545 $/y
Fuel Consumption	463,457 L/y		
Carbon Dioxide	1,093,135 kg/y		

Figure 35 2017 PM 95th % Queue Ratios

Source Road Delay Solutions, 2017

Figure 36 2017 WE Network Summary

Source Road Delay Solutions, 2017

NETWORK SUMMARY

Network: N101 [2017 WE Base Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS F			
Travel Time Index	2.14			
Speed Efficiency	0.29			
Congestion Coefficient	3.42			
Travel Speed (Average)	17.6 km/h		2.2 km/h	13.5 km/h
Travel Distance (Total)	6789.3 veh-km/h		468.6 ped-km/h	9917.9 pers-km/h
Travel Time (Total)	386.8 veh-h/h		212.5 ped-h/h	737.3 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	22092 veh/h		13836 ped/h	34838 pers/h
Arrival Flows (Total for all Sites)	21888 veh/h		13836 ped/h	34577 pers/h
Demand Flows (Entry Total)	5637 veh/h			
Midblock Inflows (Total)	1795 veh/h			
Midblock Outflows (Total)	-1538 veh/h			
Percent Heavy Vehicles (Demand)	3.2 %			
Percent Heavy Vehicles (Arrival)	3.2 %			
Degree of Saturation	1.559			
Control Delay (Total)	252.04 veh-h/h		112.38 ped-h/h	445.28 pers-h/h
Control Delay (Average)	41.5 sec		29.2 sec	46.4 sec
Control Delay (Worst Lane)	551.5 sec			
Control Delay (Worst Movement)	553.2 sec		46.5 sec	553.2 sec
Geometric Delay (Average)	1.8 sec			
Stop-Line Delay (Average)	39.7 sec			
Queue Storage Ratio (Worst Lane)	1.13			
Total Effective Stops	14235 veh/h		10363 ped/h	30774 pers/h
Effective Stop Rate	0.65 per veh	2.1 per km	0.75 per ped	0.89 per pers
Proportion Queued	0.59		0.75	0.86
Performance Index	1417.6		270.1	1687.7
Cost (Total)	15314.73 $/h	2.26 $/km	5354.93 $/h	20669.66 $/h
Fuel Consumption (Total)	1061.6 L/h	156.4 mL/km		
Fuel Economy	15.6 L/100km			
Carbon Dioxide (Total)	2502.5 kg/h	368.6 g/km		
Hydrocarbons (Total)	0.259 kg/h	0.038 g/km		
Carbon Monoxide (Total)	2.211 kg/h	0.326 g/km		
NOx (Total)	2.136 kg/h	0.315 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 12.4 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	10,603,960 veh/y	6,641,179 ped/y	16,722,190 pers/y
Delay	120,977 veh-h/y	53,941 ped-h/y	213,736 pers-h/y
Effective Stops	6,832,890 veh/y	4,974,182 ped/y	14,771,550 pers/y
Travel Distance	3,258,849 veh-km/y	224,909 ped-km/y	4,760,579 pers-km/y
Travel Time	185,663 veh-h/y	101,999 ped-h/y	353,901 pers-h/y
Cost	7,351,070 $/y	2,570,368 $/y	9,921,439 $/y
Fuel Consumption	509,571 L/y		
Carbon Dioxide	1,201,216 kg/y		

Figure 37 2017 WE 95th % Queue Ratios

Source Road Delay Solutions, 2017

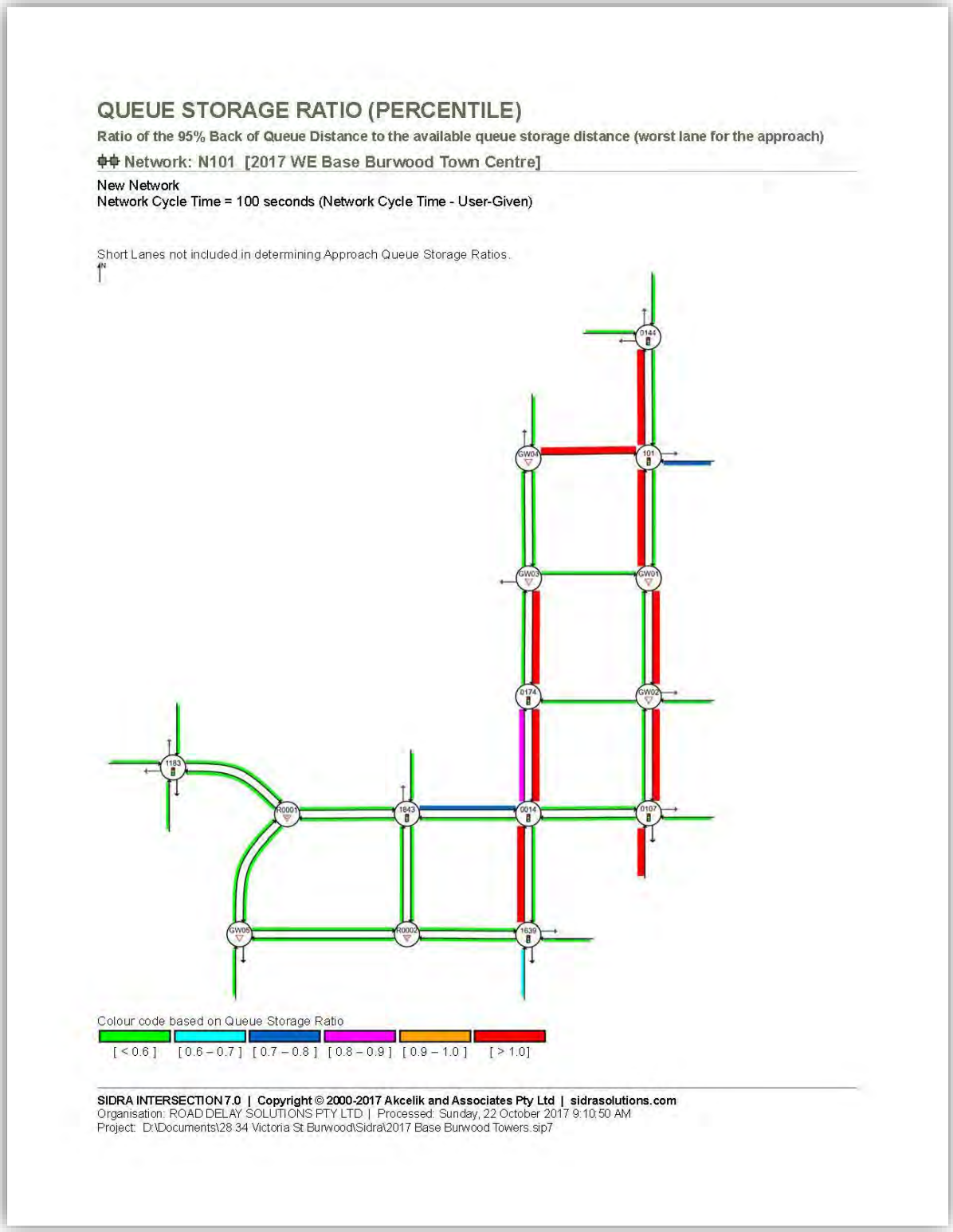
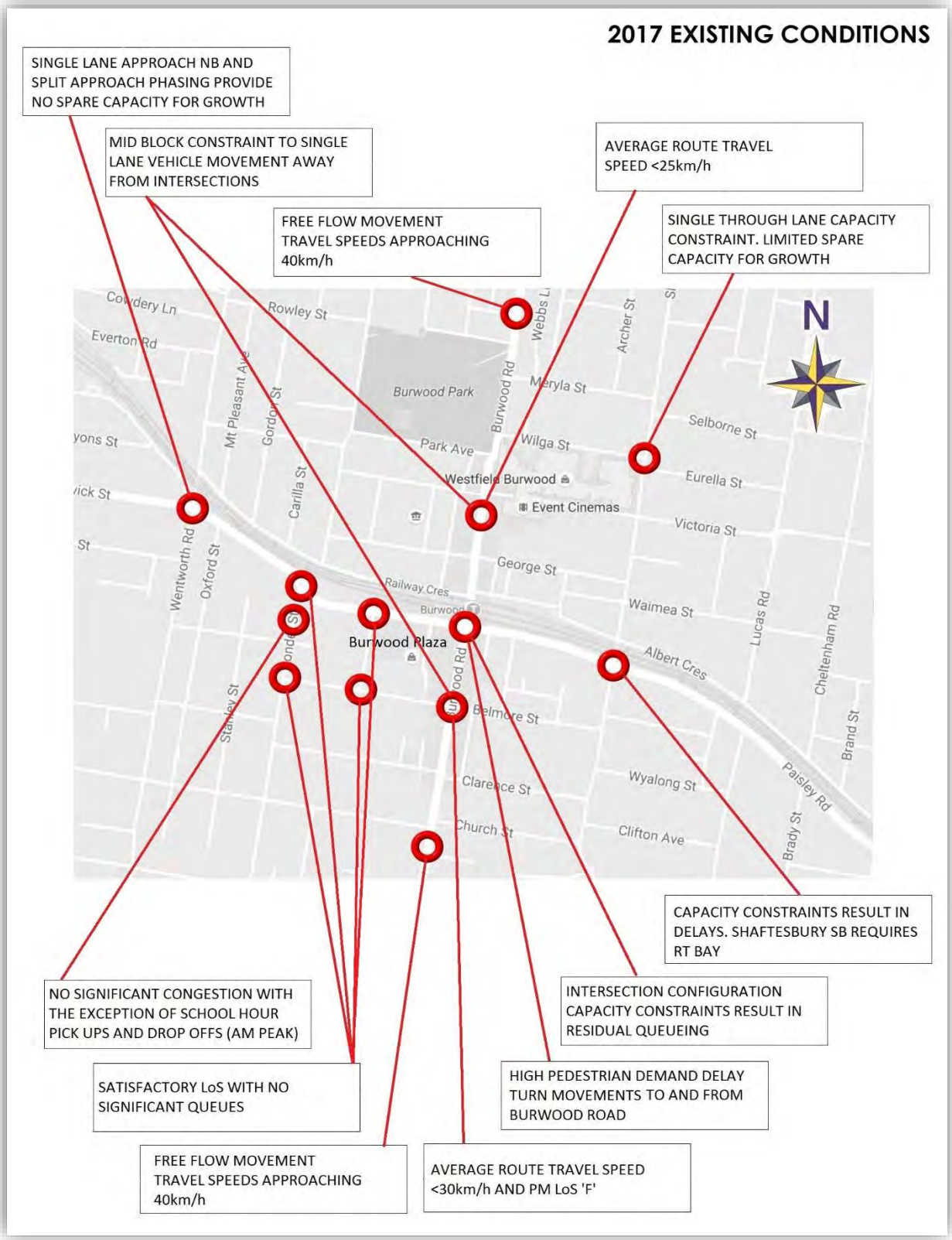


Figure 38 2017 Existing Conditions

Source Road Delay Solutions, 2017



6 FUTURE CONDITIONS

6.1 Planning Policies and Guidelines

This section contains a review of the strategic and statutory planning documents that will shape the Burwood Place Development. These include the Sydney Metropolitan Strategy and subregional planning documents, as well as the current local planning strategies, environmental planning instruments and guidelines, the *Local Environmental Plan* and relevant development control plans.

The focus here will be on the policies, strategic directions and development provisions that have direct implications in the development assessment and which influence the integration of land use, transport services and facilities in the future.

6.2 Policy Context

There are a number of strategic state policies which are relevant to future development in the Sydney metropolitan area. The policies include NSW 2021, A Plan for Growing Sydney and The NSW Long Term Transport Master Plan.

6.3 NSW 2021

NSW 2021 'Plan to Make NSW Number One' sets targets to increase the number of commuter trips made by public transport within various regions through the Metropolitan area, including…

- *80 per cent in the Sydney CBD,*
- *50 per cent in the Parramatta CBD,*
- *20 per cent in the Liverpool CBD, and*
- *25 per cent in the Penrith CBD.*

The plan targets are…

- *To improve road safety, reduce fatalities to 4.3 per 100,000 population by 2016,*
- *Double the mode share of bicycle trips made in the metropolitan area by 2016, and*
- *Increase the proportion of the population living within 30 minutes by public transport of a city or major centre in the metropolitan area.*

6.4 A Plan for Growing Sydney

A Plan for Growing Sydney provides a strategic plan to accommodate an additional 1.6 million people, 664,000 houses and 689,000 jobs.

The plan includes the following goals and actions...

Goal 1: A competitive economy with world class services and transport

Actions

- *grow a more internationally competitive Sydney CBD,*
- *grow Greater Parramatta – Sydney's second CBD,*
- *establish a new priority growth area – Greater Parramatta to the Olympic Peninsula,*
- *transform the productivity of western Sydney through growth and investment,*
- *enhance capacity at Sydney's gateways and freight networks,*
- *expand the Global Economic Corridor,*
- *grow strategic centres – providing more jobs closer to home,*
- *enhance linkages to regional NSW,*
- *support priority economic sectors,*
- *plan for education and health services to meet Sydney's growing needs, and*
- *deliver infrastructure.*

Goal 2: A city of housing choice, with homes that meet our needs and lifestyles

Actions

- *accelerate housing supply across Sydney,*
- *accelerate urban renewal across Sydney – providing homes closer to employment opportunities,*
- *improve housing choice to suit different needs and lifestyles, and*
- *deliver timely and well planned greenfield precincts and housing.*

Goal 3: A great place to live with communities that are strong, healthy and well balanced

Actions

- *revitalize existing suburbs,*
- *create a network of interlinked, multipurpose open and green spaces across Sydney,*
- *create built environments; and*
- *promote Sydney's heritage, arts and culture.*

Goal 4: A sustainable and resilient city that protects the natural environment and has a balanced approach to the use of land and resources

Actions

- *protect our natural environment and biodiversity,*
- *build Sydney's resilience to natural hazards, and*
- *manage the impacts of development on the environment.*

The Plan for Growing Sydney defines Burwood as a 'Strategic Centre', in the 'central subregion', highlighting its importance in the metropolitan area in terms of employment and future development.

The plan provides a number of priorities specifically relating to Burwood as follows...

- *work with council to provide capacity for additional mixed use development including offices, retail, services and housing, and*
- *investigate a potential light rail corridor from Parramatta to Strathfield/Burwood via Sydney Olympic Park.*

6.5 NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan has been developed, in association with A Plan for Growing Sydney and State Infrastructure Strategy, to support NSW 2021. The key measures identified are as follows...

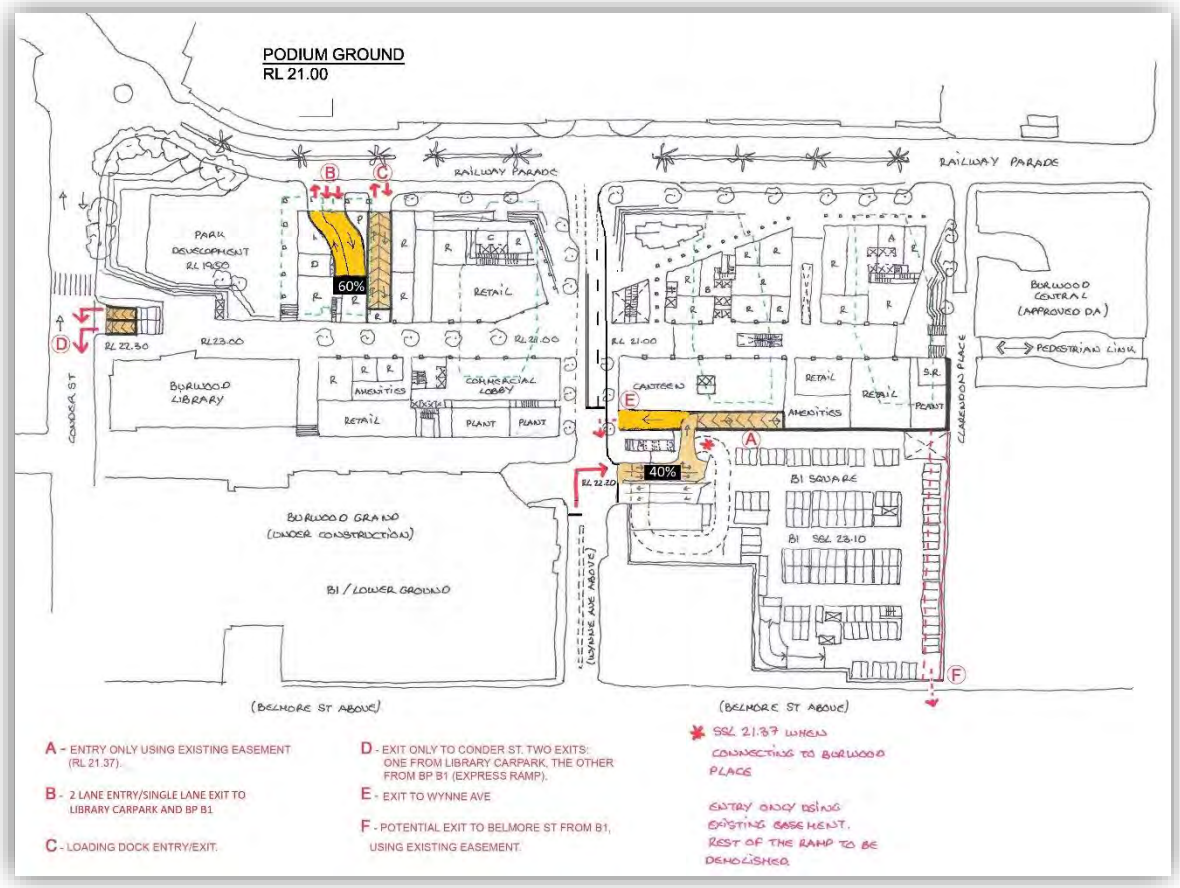
- *providing a fully integrated transport system,*
- *providing a modern railway system and increase capacity by 60 per cent,*
- *providing a modern light rail system in the CBD,*
- *providing a modern bus system to complement the rail networks,*
- *connect the motorway network, including WestConnex, F3/M2 link and F6,*
- *reduce congestion in the CBD, including removing the monorail, increasing light rail, improving pedestrian links, increasing ferry use, providing increased capacity on the rail system and improved walking and cycling infrastructure,*
- *support the growth of new economic centres including the north west and*
- *south west rail links, new roads in growth areas and new bus infrastructure;*
- *connect regional communities through major highway upgrades, and*
- *improved rail, bus and air services,*
- *improve freight efficiency and productivity,*
- *improve access to Sydney Airport and Port Botany,*
- *boost walking, cycling and its integration with public transport; and*
- *preserve future transport corridors.*

6.6 The Development Footprint

The planning proposal is to provide for...

- → *1,100 residential apartments,*
- → *100 Hotel styled serviced apartments,*
- → *27,502m² retail GFA (19,255m² GLFA) inclusive of supermarket GFA 4,200m² (2,900m² GLFA), and*
- → *15,429m² (12,350m² GLFA) of commercial floor space.*

Figure 39 The Development Footprint
Source Road Delay Solutions, 2018



The development proposes a reduction in the carriageway width to one (1) lane in each direction on a section of Wynne Avenue, some 25m south of Railway Parade for a distance of some approximately 30m, to permit the introduction of a cosmopolitan thouroughfare (*widened footway areas*) and reinforced pedestrian mobility and continuity at the podium level between the sites.

It is considered the proposed partial closure of Wynne Avenue will provide improved pedestrian amenity and function in a manner condusive with the anticipated pedestrian activity within the town centre.

The closure will permit the travel of vehicles both northbound and southbound while providing accessibility to the proposed entry/exit driveway on Wynne Avenue. In consultation with Council, a separate submission outlining the proposed configuration of Wynne Avenue is to be undertaken and submitted, prior to DA.

6.7 Development Access

Vehicular access to the site is currently under consideration from three (3) primary locations...

- → *Railway Parade servicing a maximum of 60% of development traffic, being general retail and Council Library Car Parking,*
- → *Wynne Avenue servicing the remaing 40% of development traffic, being residential, commercial and up to 10% of general retail, and*
- → *Egress onto Conder Street from both the Council Car Park and Basement B1*

The percentage use for each access point was an initial first step in defining dedicated access by use. The 60% retail entry adopted from Railway Parade was determined, through modelling, to be the maximum volume achievable at the site. While the 40% residential, commercial and some 10% retail entry was considered to be achievable and acceptable from Wynne Avenue.

There is also potential for the development, at Development Application stage, to reconfigure Wynne Avenue.

This could include a reduction in the carriageway width to one (1) lane in each direction on the section of Wynne Avenue for a distance of some 30m, from a point approximately 25m south of Railway Parade, to permit the introduction of a cosmopolitan thouroughfare (*widened footway areas*) and reinforced pedestrian mobility and continuity at the podium level, within the site.

The partial closure of Wynne Avenue will permit the travel of vehicles both northbound and southbound while maintaining accessibility to the proposed entry via the current easement from Wynne Avenue. This Wynne Avenue access will be controlled by the current traffic signals to Council's and Emerald Square car parks.

Access for resident, commercial, visitor and retail spaces is currently under consideration from both Railway Parade and Wynne Avenue.

The respective access destinations will be clearly defined on the surrounding road network via the use of signposting and on the internal ramp systems within the development's underground car park, connecting to the respective parking allocations.

The respective access destinations will be clearly defined on the surrounding road network via the use of signposting and on the internal ramp systems within the development's underground car park, connecting to the respective parking allocations.

Loading dock access is under consideration from Railway Parade via a dedicated driveway some 7 metres to the east of the passenger vehicle entry.

The loading dock is to provide for deliveries to the retail and commercial components, while also servicing garbage collection requirements.

The dock will cater for the use of 12.5 to 14.5m metre rigid trucks and lower order service vehicles to enter and leave the facility in a forward direction.

The preliminary allocation of traffic generation by access location are shown in the above figure and have yet to be accurately determined. These allocations, by access location, have been applied to the year 2026 development vehicle generation model and represent a '*worst case*' scenario.

The layout and internal machinations of the car park provisions and access locations are yet to be finalised, subject to the preparation of architectural drawings for DA application.

The passenger vehicle access points to the car park will be provided in accordance with the Australian Standard for Parking Facilities Part 1 Off-Street, AS 2890.1:2004.

The yet to be determined loading dock provisions will comply with *AS 2890.2 – 2002 Parking Facilities Part 2 Off-Street commercial vehicles*.

6.8 Parking Provisions

The parking provisions are to be finalised prior to DA submission. Currently, the locations, quantity and access conditions are yet to be determined, in consultation with key stakeholders.

The development will accord with Burwood City Council's DCP which includes the following parking requirements for development in centres…

Offices	*One (1) parking space per 400m² (for the first 400m² plus one space per 120m² thereafter,*
Retail	*One (1) space per 33m²,*

Residential *0.5 spaces per studio/bed sitter,*

One (1) space per one/two bedroom apartment,

1.5 spaces per three bedroom apartment; and

One (1) space per five dwellings for visitor parking.

By comparison, the *RMS guide* suggests the following parking requirements for high density residential in sub-regional centres and CBDs...

Sub-regional centres

0.6 spaces per one bedroom apartment,

0.9 spaces per two bedroom apartment,

1.4 spaces per three bedroom apartment, and

One (1) space per five apartments for visitors.

CBDs

0.4 spaces per one bedroom apartment,

0.7 spaces per two bedroom apartment,

1.2 spaces per three bedroom apartment, and

One (1) space per seven apartments for visitors.

Serviced Apartments

One (1) space per apartment, and

One (1) space per two (2) employees.

The appropriate parking rates will be provided at the development application stage, based on the above rates. Appropriate provisions for disabled and motor cycle parking will be included in the development.

6.9 Growth Forecasts

Investigations into the traffic impacts associated with the *Burwood Place* Planning Proposal have required the preparation of a mesoscopic, computer based, model.

The *Department of Planning* have set the areas defining the Burwood Town Centre as Travel Zones TZ 910, 913 and 915.

The future Year trip matrices, originally produced by the *BTS* in October 2014 and further revised in October 2016, have been developed from a 4 step travel model established on forecast

population and employment projections throughout the Metropolitan Area and assigned to a computer based transport network.

These trip tables form the basis for the *Netanal* future year trip demands and have been aligned with the *BTS* 2011 travel zone (TZ) system, through the employment of an equivalency table, prepared and provided by the *BTS*.

Generally, the *Netanal* vehicle trip distribution for the future year trip tables of the Sydney Statistical Division have been retained from the *BTS* trip matrices. However, known irregularities between the land use assumptions within the *BTS* matrices and available growth data, in particular *BTS* TZs 910, 913 and 915, make it necessary to disaggregate the zone structure to better reflect the future year demand generations associated with the Burwood Place development.

The following figure presents the interpreted population data employed in the modelled trip matrices taken from the *BTS* Travel Zone Explorer for TZs 910, 913 and 915…

- → *A residential population of 8,374 persons in year 2016 is anticipated to reach 11,714 by year 2026, being an increase of 3,340 persons,*
- → *Dwellings (homes and/or apartments) are set to reach 6,069 by 2026, an increase of 1,730 with an adopted occupancy rate of 1.93 persons, and*
- → *The current workforce of 4,353 is expected to reach 6,051 by year 2026.*

The *BTS* data has been compared with Council's approved and known developments which lie within the *BTS* Zones 910, 913 and 915. It has been considered that while still to be determined, the addition of growth associated with the Parramatta Road Urban Renewal Project on the southern side of Parramatta Road either side of Burwood Road is captured by the *BTS* projections. However the specific extent of the proposed Urban Renewal project and its associated traffic generation is yet to be determined.

After careful consideration and assessment it is considered that the *BTS* projections adequately encompass the approved and known development within the town centre, at this time.

The analysis also determined that the *BTS* forecast dwellings of 6,069 is in fact marginally higher than Council's current anticipated growth level achieving only 5,565 dwellings by year 2026. The *BTS* and Council growth levels are presented in the following figures.

Figure 40 Burwood Town Centre Adopted Growth Projections

Source BTS Zone Explorer, 2017

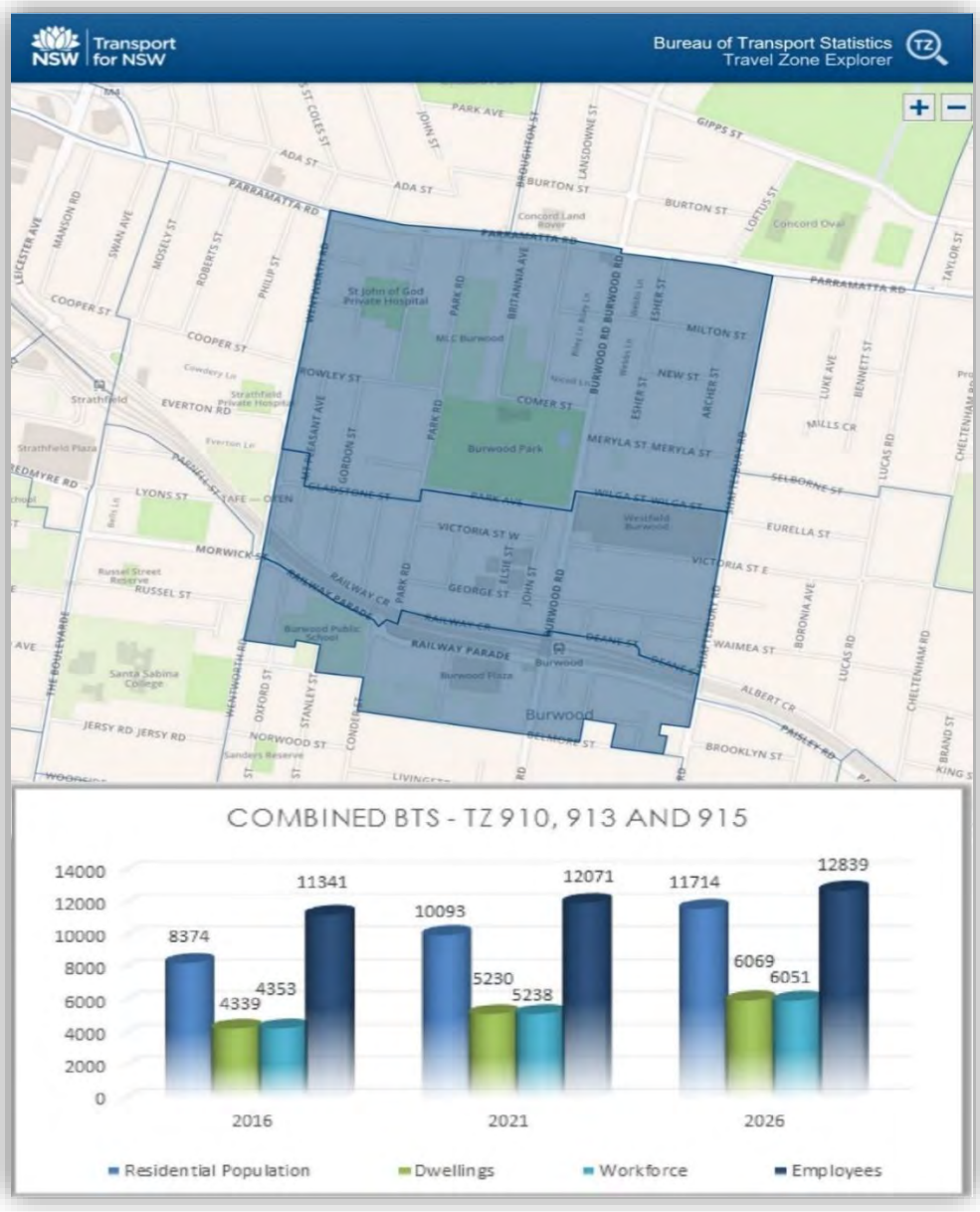


Figure 41 Burwood Council Approved and Planned Developments

Source Road Delay Solutions, 2018

CALCULATED VEHICLE GROWTH WITHIN BTS TZ 913 and 915 PLANNED DEVELOPMENT												
			Component				Generation Rate				Vehicle Generation	
Identifier BTS Zone	Address	Proposed Development	Residential Units	Retail GLFA *(70% of Site Area)*	Serviced Apartments	Commercial GLFA *(70% of Site Area)*	Residential	Retail	Serviced Apartments	Commercial	AM	PM
1 915	6 Railway Parade BURWOOD	Constructed 17 storey mixed residential flat building containing 47 residential units, 3 levels of commercial units, over 3 level of basement parking for 48 vehicles	BURWOOD CENTRAL EXISTING TRAFFIC GENERATION 2017									
2 910	48 Burwood Road BURWOOD	Construction of a 7 storey development comprising one ground floor commercial suite and twenty residential apartments over two levels of basement parking for 17 car parking spaces	20			252	0.19	0.125	0.4	0.016	8	8
3 910	11 - 13 Burwood Road BURWOOD	Construction of an 8 storey mixed use development containing commercial space, 37 residential apartments over 3 levels of basement parking for 53 vehicles	37			504	0.19	0.125	0.4	0.016	15	15
4 913	46 Park Road BURWOOD	Construction of a 5 storey residential flat building containing 14 units above basement parking	14				0.19	0.125	0.4	0.016	3	3
5 915	7 – 15 Conder Street, 2 – 10 Hornsey Street and 2 – 4 Stanley Street BURWOOD	Demolition and construction of Part 4 and 5 storey residential flat above basement parking	14				0.19	0.125	0.4	0.016	3	3
6 910	56 – 60 Burwood Road BURWOOD	Construction of 9 storey mixed use development containing 46 residential units and 1 ground floor retail suite above the basement parking	46	882			0.19	0.125	0.4	0.016	119	119
7 913	1 – 3 Gloucester Avenue and 42 – 44 Park Road BURWOOD	Construction of a 4 storey residential flat building comprising of 129 units with 2 levels of basement parking	129				0.19	0.125	0.4	0.016	25	25
8 910	35 Burwood Road BURWOOD	Construction of a 9 storey mixed use development containing ground floor commercial suites and 22 residential units above basement parking	22			420	0.19	0.125	0.4	0.016	11	11
9 913	28-34 Victoria St BURWOOD	Construction of a 33 storey mixed use building comprising 436 residential units, 3,200 retail and 4,200 commercial	436	3200		4200	0.19	0.059	0.059	0.016	339	339
10 910	32 Burwood Road BURWOOD	Construction of a 6 storey mixed use development containing ground floor commercial suites and 22 residential units above basement parking	22			252	0.19	0.125	0.4	0.016	8	8
11 913	7 Gloucester Avenue and 48 – 50 Park Road BURWOOD	Construction of a 5 storey residential flat building containing 42 units above basement parking	42			420	0.19	0.125	0.4	0.016	15	15
12 915	121 – 133 Burwood Road and 38 – 40 Railway Parade BURWOOD	Construction of a 20 storey mixed - use development consisting of 3 levels of retail suites, 1 level of restaurant, 7 levels containing 56 serviced apartments, 9 levels containing 68 residential apartments above basement parking	68	4200	56		0.19	0.125	0.4	0.016	560	560
13 910	18 – 20 Meryla Street BURWOOD	Construction of a 5 storey multi residential flat building containing 27 residential units, 3 commercial units and over 2 levels of basement parking for 33 vehicles	27			630	0.19	0.125	0.4	0.016	15	15
14 910	2A – 8 Burwood Road BURWOOD	Construction of a 9 storey residential flat building containing 50 residential units, over 2 level of basement parking for 67 vehicles	50				0.19	0.125	0.4	0.016	10	10
15 910	27 – 29 Burwood Road BURWOOD	Construction of a 9 storey mixed use development consisting of 46 residential units, 4 commercial premise units and 2 levels of basement car parking	46			525	0.19	0.125	0.4	0.016	17	17
16 913	2 -14 Elsie Street BURWOOD	Retention of 7 storeys commercial building and construction of 8 storey mixed use development containg 64 units and 2 reatil units above basement parking	64	945			0.19	0.125	0.4	0.016	130	130
17 915	Burwood Place	Construction of 3 towers of residential units, retail and commercial floor space above basement car parking	1,071	19,255	100	12,350	0.19	0.125	0.4	0.016	2848	2848
18 913	9 - 15 Deane Street and 18 - 20 George Street BURWOOD	Construction of 3 storey residential flat building above basement parking	12				0.19	0.125	0.4	0.016	2	2
		TOTALS	2120	28482	156	19553					4127	4127
		BTS TZ 910	270	0	0	2583					8246	8246
		BTS TZ 913	697	4145	0	4620					489	489
		BTS TZ 915	1,153	23,455	156	12,875					563	563

1. Retail and commercial GLFA has been calculated as 70% of the total site area.

6.10 Traffic Generation

All projected traffic generation rates applied to the developments within the town centre were based on the industry standard *RMS Guide to Traffic Generating Developments*.

Based on the RMS's *Technical Direction TDT 2013/04a* entitled '*Guide to Traffic Generating Developments Updated Traffic Surveys*', hereby referred to as the '*guide*', the Plaza development will generate 9,821 vehicle trips daily, with 3,144 vehicle trips, including heavy vehicles, occurring during the morning and evening commuter peak periods, combined.

The *RMS Technical Direction* outlines the generation rate for the high density residential form, per apartment, commercial and retail activities. The following presents the applied generation rates adopted for the assessment of the road network.

While the average annual growth in vehicular traffic throughout the Metropolitan area is in the order of 1.5%-1.7% the current average annual growth on Burwood Road is reported as -0.9% across the combined AM and PM peak commuter periods. The AM peak reports an average growth of 0.3% per annum while the PM peak is reported as -1.8%.

While the applied annual growth rate in traffic of 1.5% to 1.7% throughout the Metropolitan area within the models is higher than that currently reported on Burwood Road, examination of the competing parallel routes of Shaftesbury Road and Wentworth Road, suggest a significant volume of through traffic and vehicles accessing the town centre utilise these corridors.

The applied annual growth rate is considered to be a conservatively high estimation within the study area given that the town centre is already well established, with Burwood Road operating near or at capacity during the commuter peak periods. Expectations are that with no change to the road network the reported growth on Burwood Road from the year 2026 '*Do Nothing*' model vehicular growth within the study area will be low.

Table 6 *Proposed Vehicle Generation*

Source *Road Delay Solutions, 2018*

BURWOOD PLACE VEHICLE GENERATION TABLE															
Development Component	Area (Units &/or GLFA m^2)	Area (Units &/or GFA m^2)	Daily RMS Trip Rate	AM Peak Hour GLFA RMS Trip Rate/m^2	PM Peak Hour GLFA RMS Trip Rate/m^2	PM Peak Hour GLFA RMS Trip Rate/m^2	AM Peak Hour Generation (vph)	PM Peak Hour Generation (vph)	WE Peak Hour Generation (vph)	AM Outbound Trips (vph)	AM Inbound Trips (vph)	PM Outbound Trips (vph)	PM Inbound Trips (vph)	WE Outbound Trips (vph)	WE Inbound Trips (vph)
Residential Apartments	1,100	1,071	1.52	0.19	0.15	0.1	209	165	110	167	42	33	132	61	50
Serviced Apartments#	100	100	3	0.4	0.4	0.4	40	40	20	32	8	8	32	16	4
Retail Specialty Shops*	16,855	23,302	0.3403	0.059	0.059	0.075	994	994	1264	448	547	547	448	695	569
Supermarket*	3,100	4,200	0.3403	0.059	0.059	0.075	183	183	233	82	101	101	82	128	105
Commercial	12,350	15,429	0.11	0.016	0.012	0.001	198	148	12	30	168	126	22	7	5
TOTAL			9,821				1624	1531	1639	759	865	815	716	907	732

**The Supermarket and Specialty Shops Generation rate is based on RMS Technical Direction TDT 2013/04a for the highest weekday generation - 5.9vph/100m2 of GLFA.*

The retail GLFA excludes common areas such as walkways, garbage storage, unoccupied lobby areas and the shared loading dock provisions.

 # The hotel style serviced apartments have adopted the casual accommodation vehicle generation rate prescribed by the RMS of 0.4 trips per apartment during the peak periods given the proximity to Burwood Railway Station.

6.11 Traffic Distribution

The traffic distribution through the town centre has been drawn from numerous sources.

Residential and commercial land use distributions have been based on the applied year 2026 *BTS* trip matrices, published in 2014 and revised in October 2016.

The retail distribution has been determined by a catchment analysis of simillar operations.

To determine and apply the distribution of traffic generated by the proposed supermarket, within the model, former analysies of supermarket operations for the Gladesville Shopping Village and Warriewood Square were undertaken by *Road Delay Solutions* in the first quarter of 2016.

The retail distribution pattern was determined by a simple survey of 126 patrons at each surveyed complex, entering by vehicle into the carparks, and observed heading to the respective supermarkets. These patrons were asked to roughly estimated the distance they had travelled or their origin postcode. The survey did not include pedestrian foot traffic.

These investigations revealed that patrons to both centres were generally attracted from a radial catchment not exceeding 5 kilometres.

It was found that the supermarkets generally attracted some 72% of patrons from within a 1.5 kilometre radius of the site, a further 19% within 2kms and with the majority of the remaining 8%, some 3.5 - 4kms.

This particular distribution pattern has been applied within the trip matrices applied to the future year 2026 model. The distribution of traffic was proportionately applied to the percentage of residential lots within adjoining catchments.

It was found that the current 2016 matrices reflected a similar trip distribution pattern with the exception of some 10% arriving from an origin some 5.5km away.

An average of some 25% of patrons surveyed commented that they frequently utilised competing supermarkets and that each respective surveyed supermarket was not necessarily their sole source of groceries.

6.12 Future Year Models

The future year 2026 models were run against four different infrastructure scenarios to understand and compare the impacts associated with the Burwood Place development site and Council's proposed Section 94 infrastructure...

- *2017 Base Burwood Place Model – The 2017 road network and trip matrices impacted by the Burwood Place development only,*
- *2026 'Do Nothing' - The future growth run on the current 2016 road network,*
- *2026 Section 94 Model – The developed 2026 road network including the Section 94 infrastructure improvements with the future year 2026 traffic demands, excluding the Burwood Place development traffic, and*
- *2026 Development Model – The 2026 Section 94 road network including proposed infrastructure and traffic generation from the Burwood Place development.*

Three (3) levels of road network and intersection performance have been undertaken for this project...

- *Network,*
- *Route, and*
- *Intersection.*

Network performance assess the operation of all modelled intersections and their interaction.

Route performance which focuses on Burwood Road and Shaftesbury Avenue.

Intersection performance is reported from the *SIDRA* network models and reports the operation of each individual intersection.

6.13 2017 Base Burwood Place Model

(17AMBPD.PLT/17PMBPD.PLT/17AMWEPB.PLT)

The 2017 base Burwood Place Development model is based upon the 2017 road network with the applied 2017 trip matrices, inclusive of the Burwood Place development traffic generations.

The model was developed to provide confidence in determining which infrastructure is required to satisfy the needs of the proposed Burwood Place.

The uplift from the existing Burwood Plaza can be defined as follows.

Table 7 Burwood Place Development Pedestrian Uplift

Source Road Delay Solutions, 2018

Component	Existing	Proposed	Uplift
Jobs (direct + indirect)	386	3,145 persons	2,759 persons
Direct Jobs	319	2,145 persons	1,826 persons
Residential	Nil	1,100 lots	1,100 lots
Population	Nil	2123 persons	2,123 persons
Serviced Apartments	Nil	100 lots	100 lots
Poulation	Nil	160 persons	160 persons
Public Transpor (combined)	216	1,762 persons	1,546 persons
Bus	15	126 persons	111 persons
Train	201	1,636 persons	1,435 persons
Pedestrian Activity (combined)	386	3,689 persons	3,303 persons

The model indicates that the traffic volume increases on Wynne Avenue, Belmore Street, Conder Street and Railway Parade, as a consequence of the development, do not alone warrant the upgrade to traffic signals of the Railway Parade and Belmore Street roundabouts.

It can be argued that the pedestrian activity uplift associated with the neighbouring developments will require improved pedestrian mobility at the key intersections of Railway Parade and Conder Street, Conder Street and Belmore Street and Belmore Street and Wynne Avenue. Each intersection has been identified in the Section 94 plan for upgrade to signalisation. The timing of signalisation is subject to the level of growth and the need for improved pedestrian safety. Therefore, to ensure adequate pedestrian mobility, signalisation of the aforementioned intersections should be completed prior to the occupation of Stage 1 of the Burwood Place development.

Figure 42 2017 AM Burwood Place Development Base

Source Road Delay Solutions, 2018

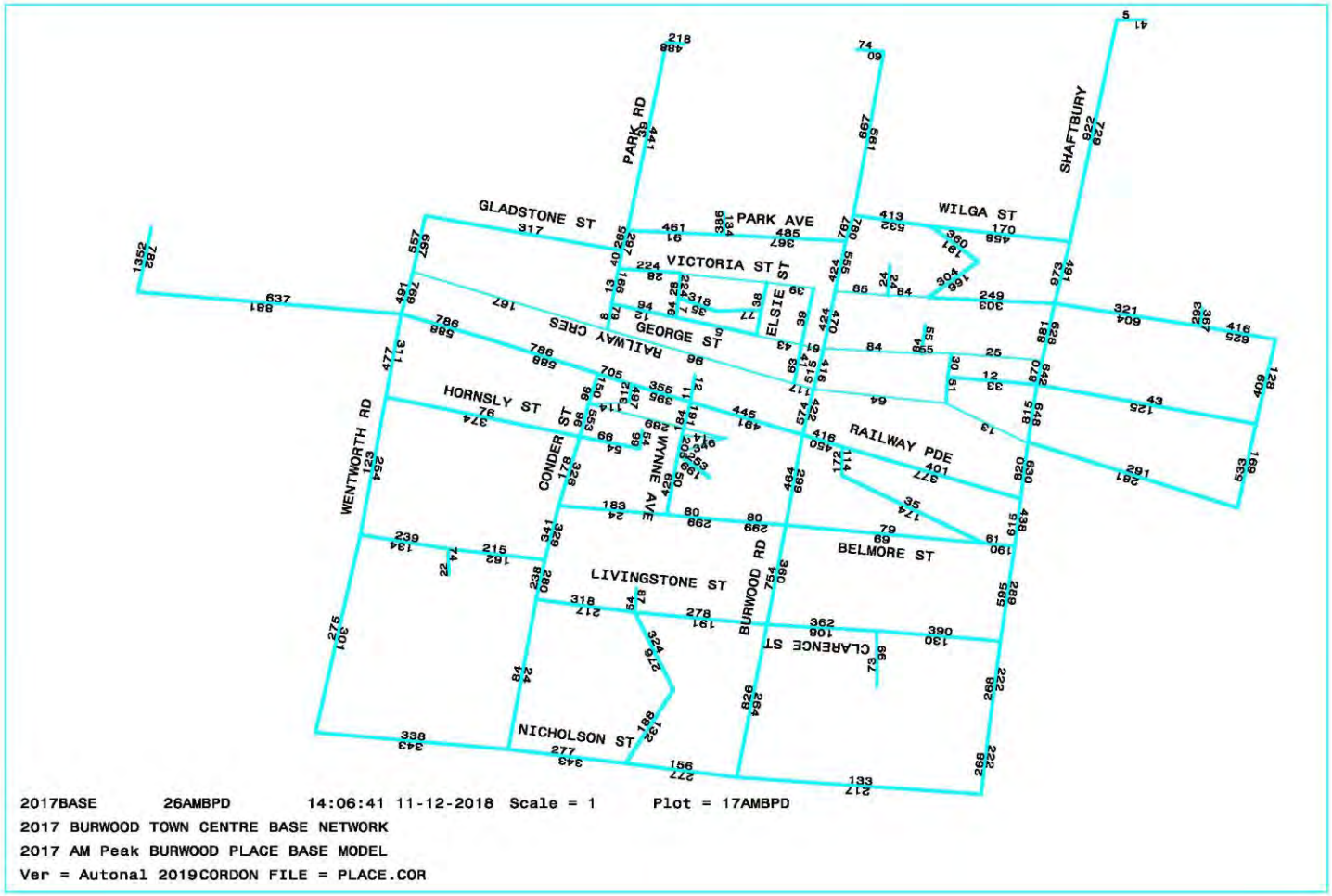


Figure 43 2017 PM Burwood Place Development Base

Source Road Delay Solutions, 2018

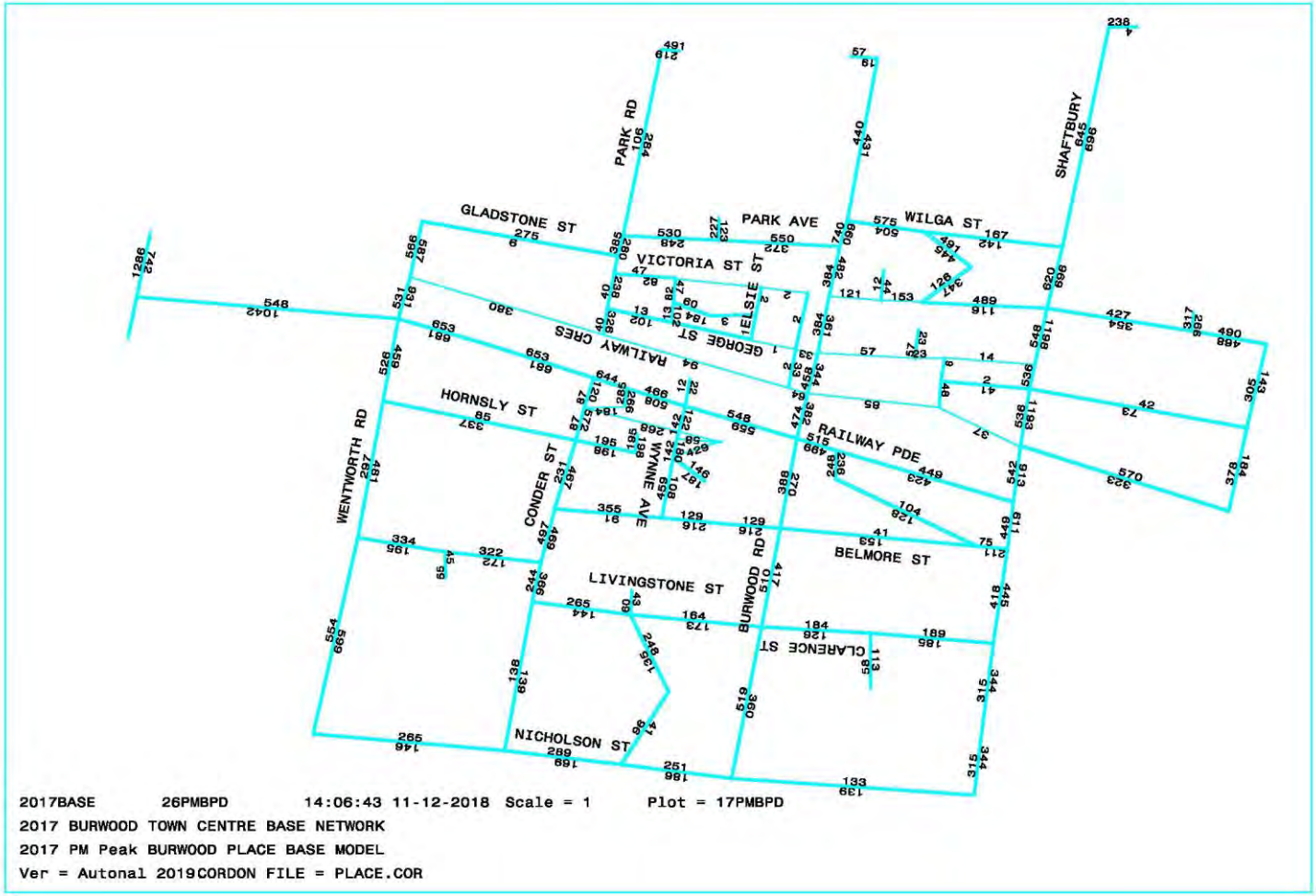
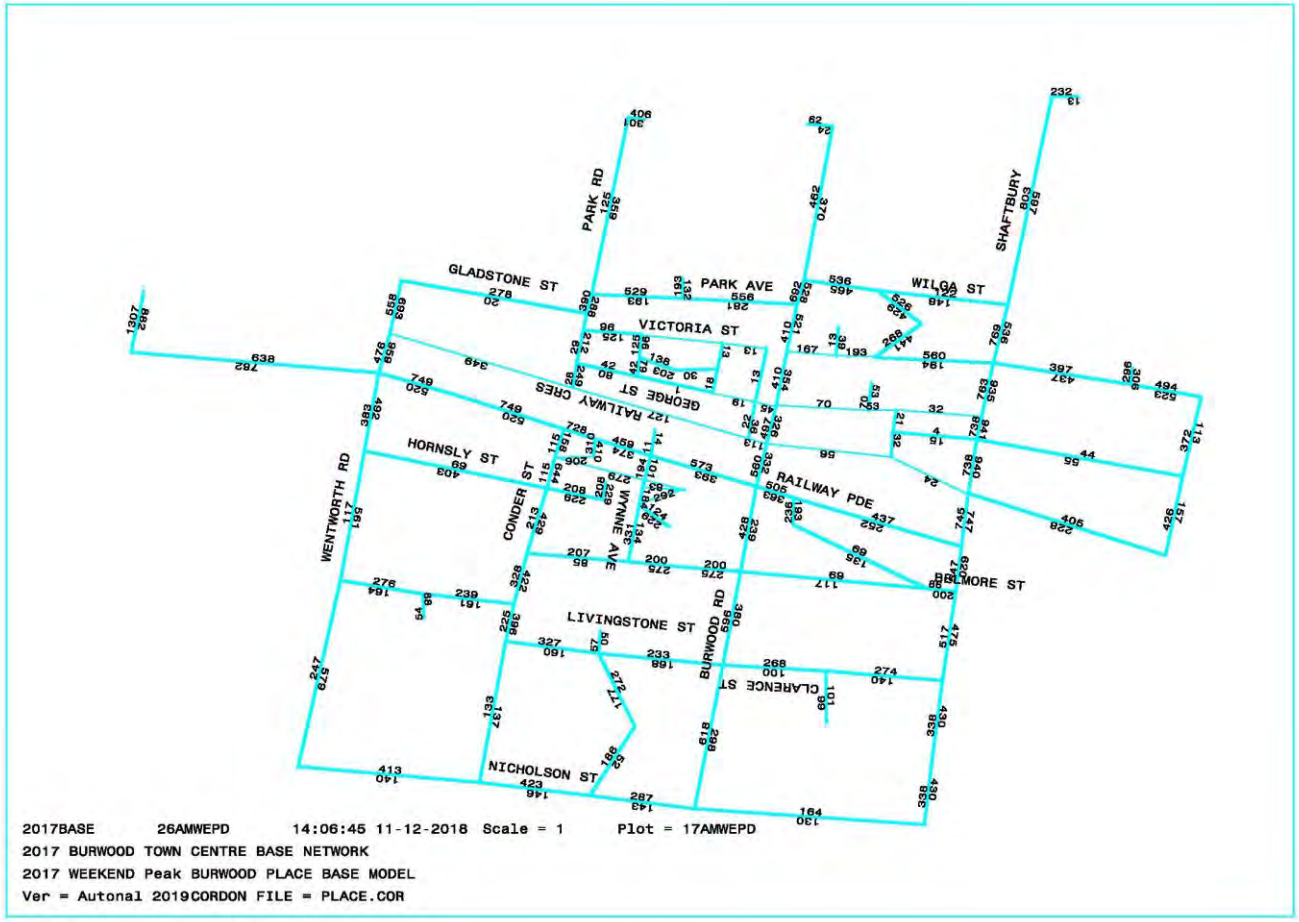


Figure 44 *2017 WE Burwood Place Development Base*

Source *Road Delay Solutions, 2018*



6.14A 2026 Base Year Model

(26AMBPB.PLT/26PMBPB.PLT/26AMWEPB.PLT)

Year 2026 was nominated as the future assessment year which is conventional practice for this form of mixed use development. The year represents a practical timeframe within which some confidence in the understanding of likely development levels and prevailing traffic patterns can be made.

The future year 2026 model was developed to understand the likely traffic impacts the general metropolitan growth, and any other potential Burwood town centre developments, would have on the traffic network.

Year 2026 is a typical planning horizon based upon 15 years since the observed census data in 2011.

The base case or hereafter termed the '*Do Nothing*' traffic model was developed with the 2026 trip matrices assigned to the 2017 road network with no infrastructure improvements or mitigation measures employed.

With the *BTS* housing and employement growth rates applied to the modelled 2026 trip matrices, the reported vehicle growth projections, within the town centre, are presented in the following table. By comparison, the Metropolitan arterial road network screen lines, including Parramatta Road and the Hume Highway, report an average growth of some 13.8% to year 2026.

Table 8 Projected 10 Year Vehicle Growth
Source Road Delay Solutions, 2017

AVERAGE PROJECTED VEHICLE GROWTH TO YEAR 2026			
Road	AM PEAK	PM PEAK	WEEKEND PEAK
Burwood Road	7.8%	7.6%	8.7%
Shaftesbury Avenue	16.1%	12.1%	8.7%
Wentworth Road	11.0%	12.1%	8.5%

The road network operation and Burwood Road route operation are both reported as LoS 'E' The reported growth on Shaftesbury Road and Wentworth Road is greater than that on Burwood Road and suggests that the congested state of Burwood Road will be unattractive to motorists until such time as capacity constraints can be reduced or eliminated.

It is apparent that with the anticipated metropolitan growth, Burwood Road will continue to operate, at a LoS 'E'. Anecdotally, it can be supposed that Burwood Road is operating at or near its theoretical capacity and will allow for no further growth in vehichular traffic while the competing parallel routes of Shaftesbury Road and Wentworth Road remain a viable options.

It is considered that the level of congestion reported on Burwood Road is acceptable as it reduces the speed of vehicles within a highly pedestrianised town centre while reducing the attractiveness of the route to through traffic. Invariably, reducing congestion on Burwood Road would likely increase vehicle speeds and may give rise to any potential incident severity. Furthermore, all evidence would suggest that any treatment to reduce traffic on Burwood Road would see a proportionate and corresponding rise in traffic on Shaftesbury Road and Wentworth Road.

Table 9 *Burwood Town Centre Network and Route Operational Performance*

Source *Road Delay Solutions, 2018*

SIDRA NETWORK AND ROUTE PERFORMANCE															
	2016 Existing			2017 Base Burwood Place			2026 'Do Nothing' Base			2026 'With Section 94'			2026 Full Plaza Development		
	AM	PM	WE	AM	PM	WE	AM	PM	WE	AM	PM	WE	AM	PM	WE
NETWORK PERFORMANCE - BURWOOD TOWN CENTRE ROAD NETWORK															
LOS	D	D	D	D	D	D	D	D	D	E	D	E	E	D	D
AVD (sec)	19	17.5	14.2	16	15.6	16.9	18.6	16.9	19	24.7	21.7	27.3	29.4	22.5	20.3
DS	0.899	1.004	0.691	0.641	0.701	0.9	1.165	0.676	0.911	0.904	0.927	0.96	1.135	0.906	0.894
ROUTE PERFORMANCE - BURWOOD ROAD NORTHBOUND															
LOS	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
AVD (sec)	18.8	19.5	11	20.7	18.1	26.5	16.3	15.7	24.9	14.3	15.4	23.6	29.4	26.3	25.3
DS	0.888	0.863	0.691	0.612	0.701	0.9	0.651	0.64	0.911	0.757	0.64	0.898	1.1	0.899	0.893
ROUTE PERFORMANCE - BURWOOD ROAD SOUTHBOUND															
LOS	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
AVD (sec)	11.6	8.4	11	13	17.7	22.6	12.6	17.7	22	11.1	17.4	20.2	26.8	27.3	22.4
DS	0.779	0.763	0.691	0.618	0.681	0.625	1.165	0.676	0.799	0.58	0.863	0.762	0.894	0.766	0.844

Table 10 Burwood Town Centre Intersection Operational Performance

Source Road Delay Solutions, 2018

BURWOOD TOWN CENTRE SIDRA NETWORK INTERSECTION PERFORMANCE												
	2017 Existing			2026 'Do Nothing' Base			2026 'With Section 94'			2026 Full Development		
	AM	PM	WE	AM	PM	WE	AM	PM	WE	AM	PM	WE
Burwood Road and Victoria Street East												
DS	0.156	0.182	0.165	0.158	0.275	0.231	0.171	0.206	0.186	0.44	0.752	0.525
AVD *(sec)*	1.2	1.6	1.5	1.1	1.9	1.7	1.2	1.5	1.3	11.4	15.7	11.8
LOS	A	A	A	A	A	A	A	A	A	A	B	A
Burwood Road, Deane Street and Railway Crescent												
DS	0.881	0.711	0.723	0.288	0.772	0.755	0.671	0.72	0.819	0.871	0.731	0.883
AVD *(sec)*	19.6	14	13.9	2.4	14.7	14.1	14.2	14.3	16.3	14.2	14.1	19.8
LOS	B	A	A	A	B	B	A	B	B	A	B	B
Burwood Road and Railway Parade												
DS	0.861	0.798	0.798	0.855	0.882	0.869	0.772	0.831	0.71	0.924	0.986	0.896
AVD *(sec)*	36.3	25.5	25.5	27.4	36.3	31.2	20.8	24.9	20.3	34.2	54.6	33.3
LOS	C	B	B	B	C	C	B	B	B	C	D	C
Burwood Road and Belmore Street												
DS	1.177	0.666	0.856	0.799	0.791	0.73	1.07	0.709	0.895	0.918	0.824	0.692
AVD *(sec)*	72.3	16.4	21.1	18.9	21.5	20.4	45.7	19.9	36.1	25.5	21.9	20.8
LOS	F	B	B	B	B	B	D	B	C	B	B	B
Shaftesbury Road and Wilga Avenue												
DS	0.639	0.871	0.794	1.157	0.857	0.898	0.981	0.864	0.878	1.039	0.945	0.995
AVD *(sec)*	16.5	21.3	19.6	123	21.4	32	44.2	24.7	29.7	55.8	44.5	43.7
LOS	B	B	B	F	B	C	D	B	C	D	D	D
Shaftesbury Road and Victoria Street												
DS	0.892	0.763	0.728	0.824	0.791	0.842	0.873	0.845	0.845	0.907	0.903	0.867
AVD *(sec)*	45.2	22.4	48.8	26.4	22.1	44.2	31.9	40.8	41.9	48.7	46.4	32.5
LOS	B	B	D	B	B	D	C	C	C	D	D	C
Shaftesbury Road and George Street												
DS	0.182	0.28	0.415	0.196	0.84	0.793	0.623	1.008	1.689	0.668	0.838	0.736
AVD *(sec)*	1	1.3	1.9	0.4	3.8	3.7	2.1	6.8	28	8.8	13.4	10.5
LOS	A	A	A	A	A	A	A	A	B	A	A	A
Shaftesbury Road, Railway Parade and Paisley Street												
DS	0.91	0.84	0.84	0.829	0.856	0.762	0.853	0.854	0.854	0.925	0.876	0.852
AVD *(sec)*	44.4	41.9	37.7	34.1	45.5	26.6	29.2	39.8	31.6	49.1	41.6	41.6
LOS	D	C	C	C	D	B	C	C	C	D	C	C
Wentworth Road, Railway Parade and Morwick Street												
DS	0.879	0.975	0.84	0.796	0.975	0.807	0.911	1.121	1.129	0.911	1.174	0.919
AVD *(sec)*	43.9	61.4	37.7	33	61.4	37.8	49.8	139.1	127.7	49.8	172.2	57.8
LOS	D	E	C	C	E	C	D	F	F	D	F	D
Burwood Road and George Street												
DS	0.196	0.164	0.17	0.196	0.194	0.19	0.167	0.172	0.208	0.167	0.18	0.208
AVD *(sec)*	0.7	0.7	1	0.4	0.7	0.9	1.3	1.1	1.3	1.3	1.1	1.3
LOS	A	A	A	A	A	A	A	A	A	A	A	A
Railway Parade and Wynne Avenue												
DS	0.533	0.477	0.613	0.508	0.488	0.338	0.794	0.718	0.431	0.728	0.889	0.585
AVD *(sec)*	19.2	18.4	18.7	18.6	18.6	17.2	22.1	22.2	18.6	23.7	46.7	19.7
LOS	B	B	B	B	B	B	B	B	B	B	D	B
Railway Parade and Conder Street												
DS	0.569	0.513	0.499	0.533	0.618	0.42	0.518	0.555	0.268	0.543	0.557	0.395
AVD *(sec)*	7.2	6.6	7.2	7.6	8.4	6.7	16.8	15.3	14.7	17.8	13.9	14.1
LOS	A	A	A	A	A	A	B	B	B	B	A	A
Belmore Street and Wynne Avenue												
DS	0.202	0.259	0.291	0.143	0.231	0.279	0.717	0.618	0.554	0.489	0.654	0.547
AVD *(sec)*	5.6	5.6	5.6	5.7	6.4	6.2	19.5	15.8	13	13.1	18.1	15.1
LOS	A	A	A	A	A	A	B	B	A	A	B	B
Belmore Street and Conder Street												
DS	0.24	0.202	0.24	0.181	0.195	0.238	0.654	0.777	0.344	0.442	0.451	0.661
AVD *(sec)*	4.3	3.5	3.8	3.3	3.6	4.1	16.5	17	15.4	14.7	16.1	16.7
LOS	A	A	A	A	A	A	B	B	B	B	B	B
Railway Parade and Development Access												
DS										0.549	0.952	0.591
AVD *(sec)*										4.8	9.7	4.3
LOS										A	A	A
Wynne Avenue and Development Access												
DS										0.566	0.541	0.522
AVD *(sec)*										18.6	18.9	17.7
LOS										B	B	B

Figure 45 ***2026 AM 'Do Nothing' Traffic Projections***

Source *Road Delay Solutions, 2017*

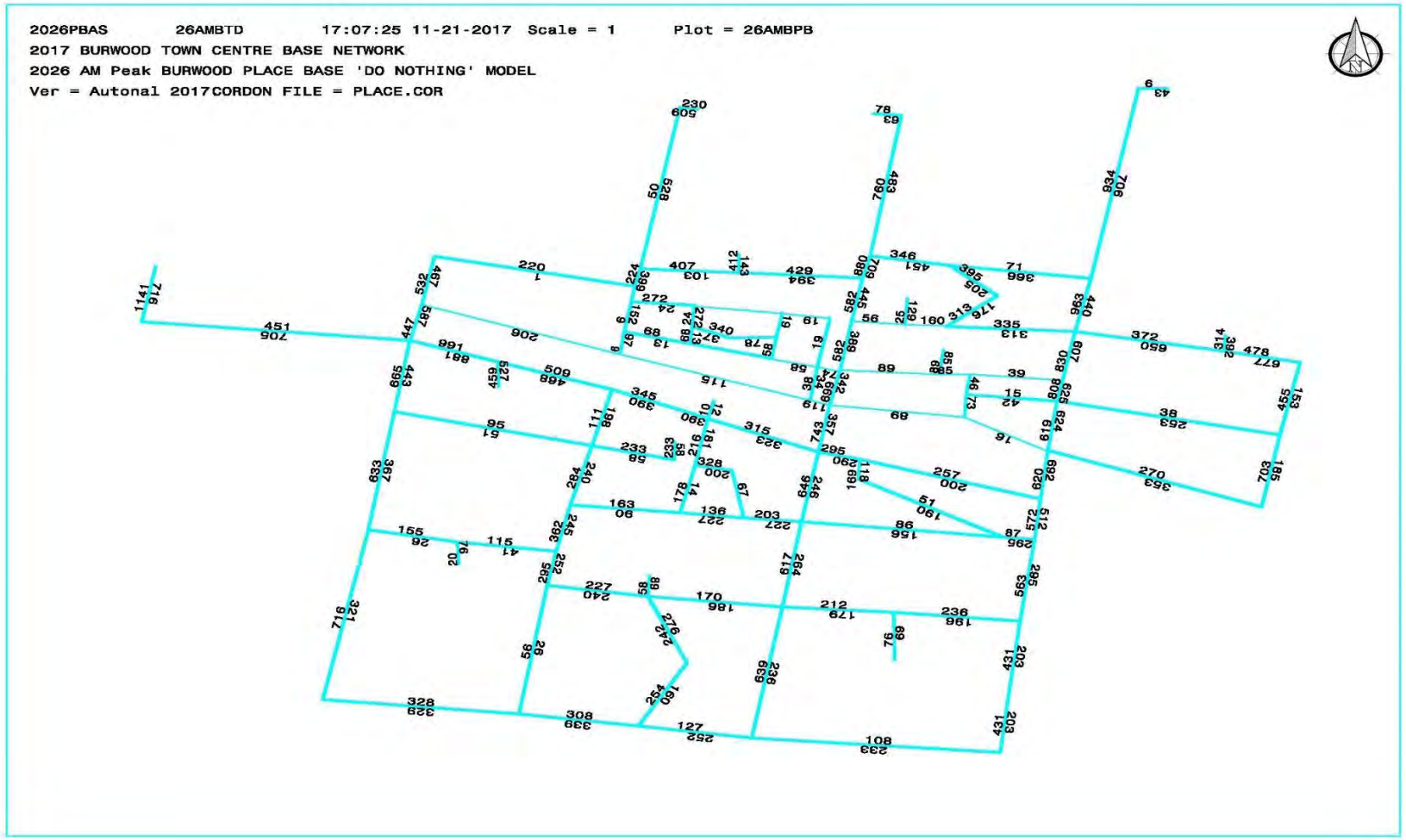


Figure 46 ***2026 PM 'Do Nothing' Traffic Projections***

Source *Road Delay Solutions, 2017*

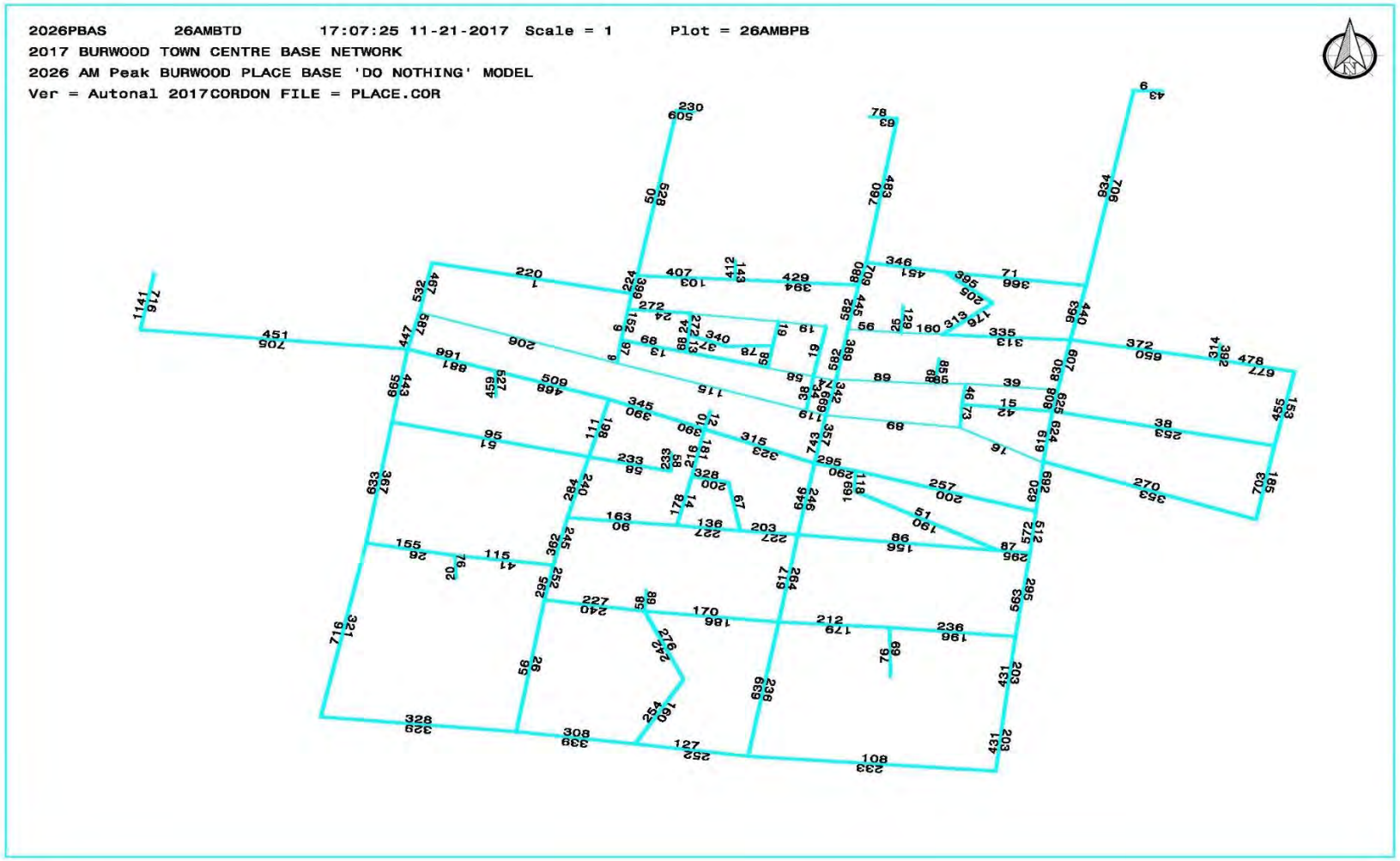


Figure 47 ***2026 WE 'Do Nothing' Traffic Projections***

Source *Road Delay Solutions, 2017*

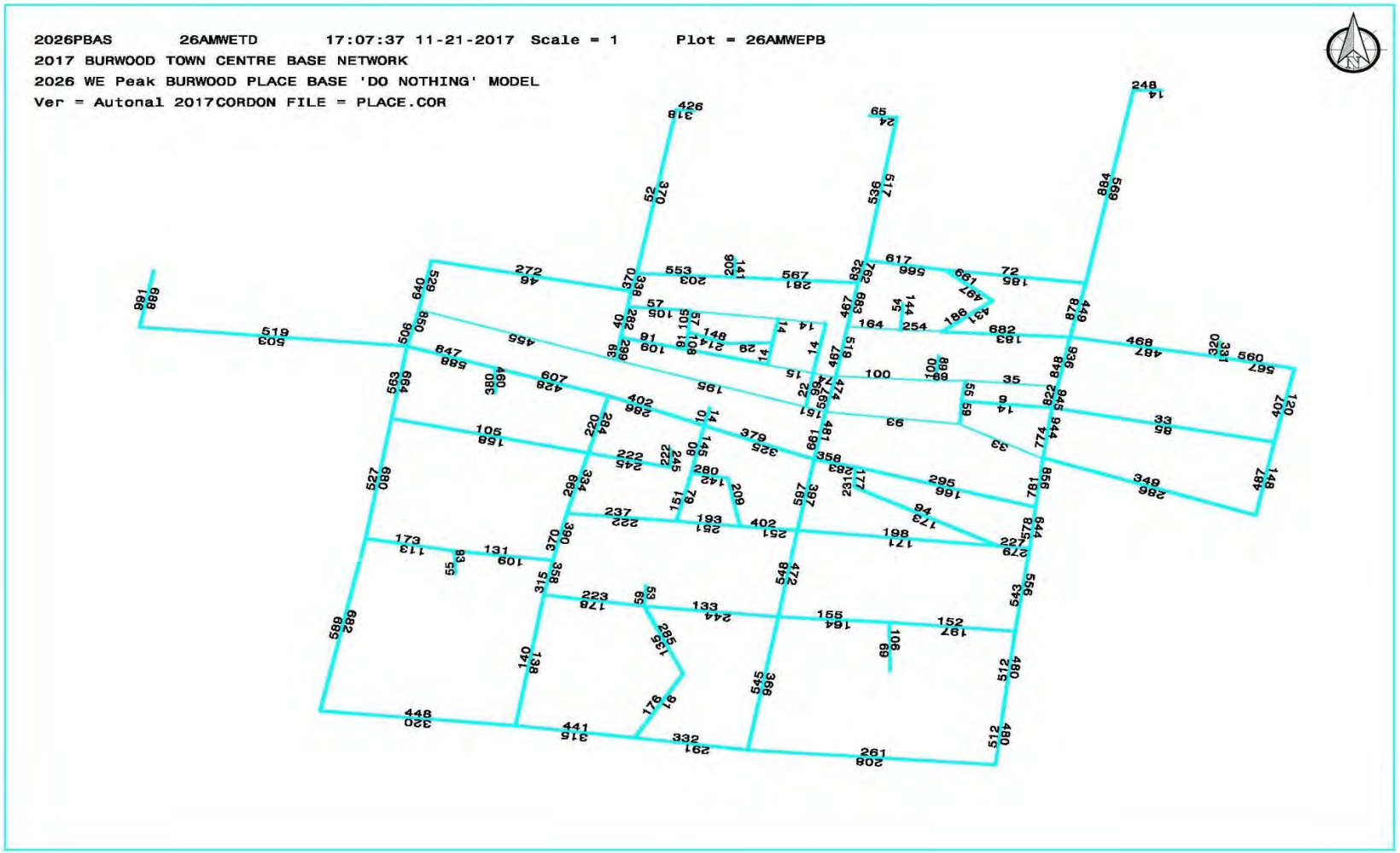


Figure 48 *2026* ***SIDRA 'Do Nothing' Modelled Road Network***

Source *Sidra/Road Delay Solutions, 2017*

SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
0107	NA	2026 AM Do Nothing Shaftesbury Rd, Railway Pde and Paisley St
0144	NA	2026 AM Do Nothing Shaftesbury Rd and Wilga St
0784	NA	2026 AM Do Nothing Shaftesbury Road and Victoria Street
GW01	NA	2026 AM Do Nothing Shaftesbury Rd and George St
GW02	NA	2026 AM Do Nothing Shaftesbury Rd and Deane St
GW04	NA	2026 AM Do Nothing Burwood Rd and Victoria St
GW03	NA	2026 AM Do Nothing Burwood Rd and George St
0174	NA	2026 AM Do Nothing Burwood Rd and Deane St
0014	NA	2026 AM Do Nothing Burwood Rd and Railway Pde
1639	NA	2026 AM Do Nothing Burwood Rd and Belmore St
1843	NA	2026 AM Do Nothing Railway Pde and Wynne Ave
R0001	NA	2026 AM Do Nothing Railway Pde and Conder St
R0002	NA	2026 AM Do Nothing Belmore St and Wynne Ave
GW05	NA	2026 AM Do Nothing Belmore St and Conder St
1183	NA	2026 AM Do Nothing Wentworth Rd, Railway Pde and Morwick St

Figure 49 *2026* ***SIDRA 'Do Nothing' AM Peak Network Report***

Source *Sidra/Road Delay Solutions, 2017*

NETWORK SUMMARY

Network: N101 [2026 AM Base Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	2.39			
Speed Efficiency	0.31			
Congestion Coefficient	3.18			
Travel Speed (Average)	18.9 km/h		2.5 km/h	14.6 km/h
Travel Distance (Total)	6953.3 veh-km/h		466.5 ped-km/h	10251.6 pers-km/h
Travel Time (Total)	368.2 veh-h/h		187.8 ped-h/h	701.0 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	21655 veh/h		13777 ped/h	35237 pers/h
Arrival Flows (Total for all Sites)	21615 veh/h		13777 ped/h	35189 pers/h
Demand Flows (Entry Total)	6094 veh/h			
Midblock Inflows (Total)	1594 veh/h			
Midblock Outflows (Total)	-1746 veh/h			
Percent Heavy Vehicles (Demand)	3.7 %			
Percent Heavy Vehicles (Arrival)	3.7 %			
Degree of Saturation	1.152			
Control Delay (Total)	226.86 veh-h/h		88.17 ped-h/h	399.15 pers-h/h
Control Delay (Average)	37.8 sec		23.0 sec	40.8 sec
Control Delay (Worst Lane)	191.1 sec			
Control Delay (Worst Movement)	191.1 sec		44.8 sec	191.1 sec
Geometric Delay (Average)	1.7 sec			
Stop-Line Delay (Average)	36.1 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	15540 veh/h		10456 ped/h	33980 pers/h
Effective Stop Rate	0.72 per veh	2.2 per km	0.76 per ped	0.97 per pers
Proportion Queued	0.60		0.76	0.89
Performance Index	1302.5		245.9	1548.5
Cost (Total)	15164.80 $/h	2.18 $/km	4733.64 $/h	19898.44 $/h
Fuel Consumption (Total)	1062.2 L/h	152.8 mL/km		
Fuel Economy	15.3 L/100km			
Carbon Dioxide (Total)	2506.2 kg/h	360.4 g/km		
Hydrocarbons (Total)	0.258 kg/h	0.037 g/km		
Carbon Monoxide (Total)	2.186 kg/h	0.314 g/km		
NOx (Total)	2.532 kg/h	0.364 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 205.7 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	10,394,270 veh/y	6,612,885 ped/y	16,913,810 pers/y
Delay	108,894 veh-h/y	42,320 ped-h/y	191,592 pers-h/y
Effective Stops	7,458,992 veh/y	5,018,665 ped/y	16,310,160 pers/y
Travel Distance	3,337,566 veh-km/y	223,913 ped-km/y	4,920,749 pers-km/y
Travel Time	176,713 veh-h/y	90,165 ped-h/y	336,485 pers-h/y
Cost	7,279,103 $/y	2,272,147 $/y	9,551,250 $/y
Fuel Consumption	509,853 L/y		
Carbon Dioxide	1,202,954 kg/y		

*Figure 50 2026 **AM 'Do Nothing' 95**th Percentile Queue Ratios*

Source Road Delay Solutions, 2017

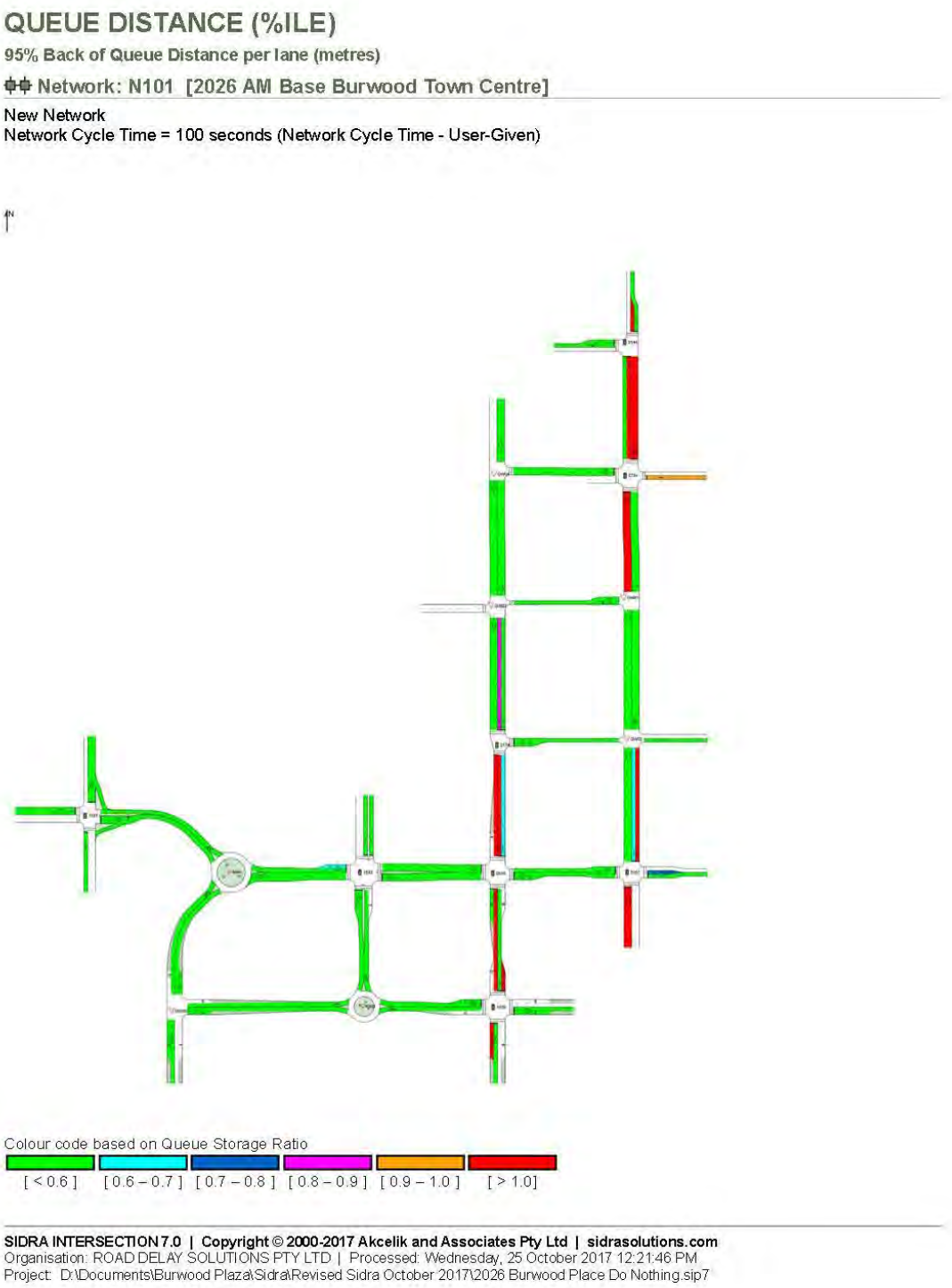


Figure 51 *2026* ***SIDRA 'Do Nothing' PM Peak Network Report***

Source *Sidra/Road Delay Solutions, 2017*

NETWORK SUMMARY

Network: N101 [2026 PM Base Burwood Town Centre]

New Network
Network Cycle Time = 110 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	2.40			
Speed Efficiency	0.32			
Congestion Coefficient	3.16			
Travel Speed (Average)	19.0 km/h		2.3 km/h	14.7 km/h
Travel Distance (Total)	8299.2 veh-km/h		479.9 ped-km/h	11914.1 pers-km/h
Travel Time (Total)	437.6 veh-h/h		211.0 ped-h/h	811.2 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	26394 veh/h		14157 ped/h	41528 pers/h
Arrival Flows (Total for all Sites)	26281 veh/h		14157 ped/h	41393 pers/h
Demand Flows (Entry Total)	6332 veh/h			
Midblock Inflows (Total)	2044 veh/h			
Midblock Outflows (Total)	-1477 veh/h			
Percent Heavy Vehicles (Demand)	3.0 %			
Percent Heavy Vehicles (Arrival)	3.0 %			
Degree of Saturation	1.258			
Control Delay (Total)	272.07 veh-h/h		108.47 ped-h/h	476.62 pers-h/h
Control Delay (Average)	37.3 sec		27.6 sec	41.5 sec
Control Delay (Worst Lane)	291.2 sec			
Control Delay (Worst Movement)	291.2 sec		49.9 sec	291.2 sec
Geometric Delay (Average)	1.6 sec			
Stop-Line Delay (Average)	35.6 sec			
Queue Storage Ratio (Worst Lane)	1.10			
Total Effective Stops	18040 veh/h		9891 ped/h	35775 pers/h
Effective Stop Rate	0.69 per veh	2.2 per km	0.70 per ped	0.86 per pers
Proportion Queued	0.60		0.70	0.81
Performance Index	1753.4		266.0	2019.3
Cost (Total)	17552.91 $/h	2.12 $/km	5317.36 $/h	22870.26 $/h
Fuel Consumption (Total)	1239.8 L/h	149.4 mL/km		
Fuel Economy	14.9 L/100km			
Carbon Dioxide (Total)	2922.4 kg/h	352.1 g/km		
Hydrocarbons (Total)	0.299 kg/h	0.036 g/km		
Carbon Monoxide (Total)	2.540 kg/h	0.306 g/km		
NOx (Total)	2.521 kg/h	0.304 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 32.2 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	12,668,970 veh/y	6,795,285 ped/y	19,933,280 pers/y
Delay	130,595 veh-h/y	52,066 ped-h/y	228,780 pers-h/y
Effective Stops	8,659,202 veh/y	4,747,534 ped/y	17,172,180 pers/y
Travel Distance	3,983,593 veh-km/y	230,334 ped-km/y	5,718,755 pers-km/y
Travel Time	210,038 veh-h/y	101,283 ped-h/y	389,365 pers-h/y
Cost	8,425,396 $/y	2,552,331 $/y	10,977,730 $/y
Fuel Consumption	595,116 L/y		
Carbon Dioxide	1,402,765 kg/y		

*Figure 52 2026 **PM 'Do Nothing' 95**th Percentile Queue Ratios*

Source Road Delay Solutions, 2017

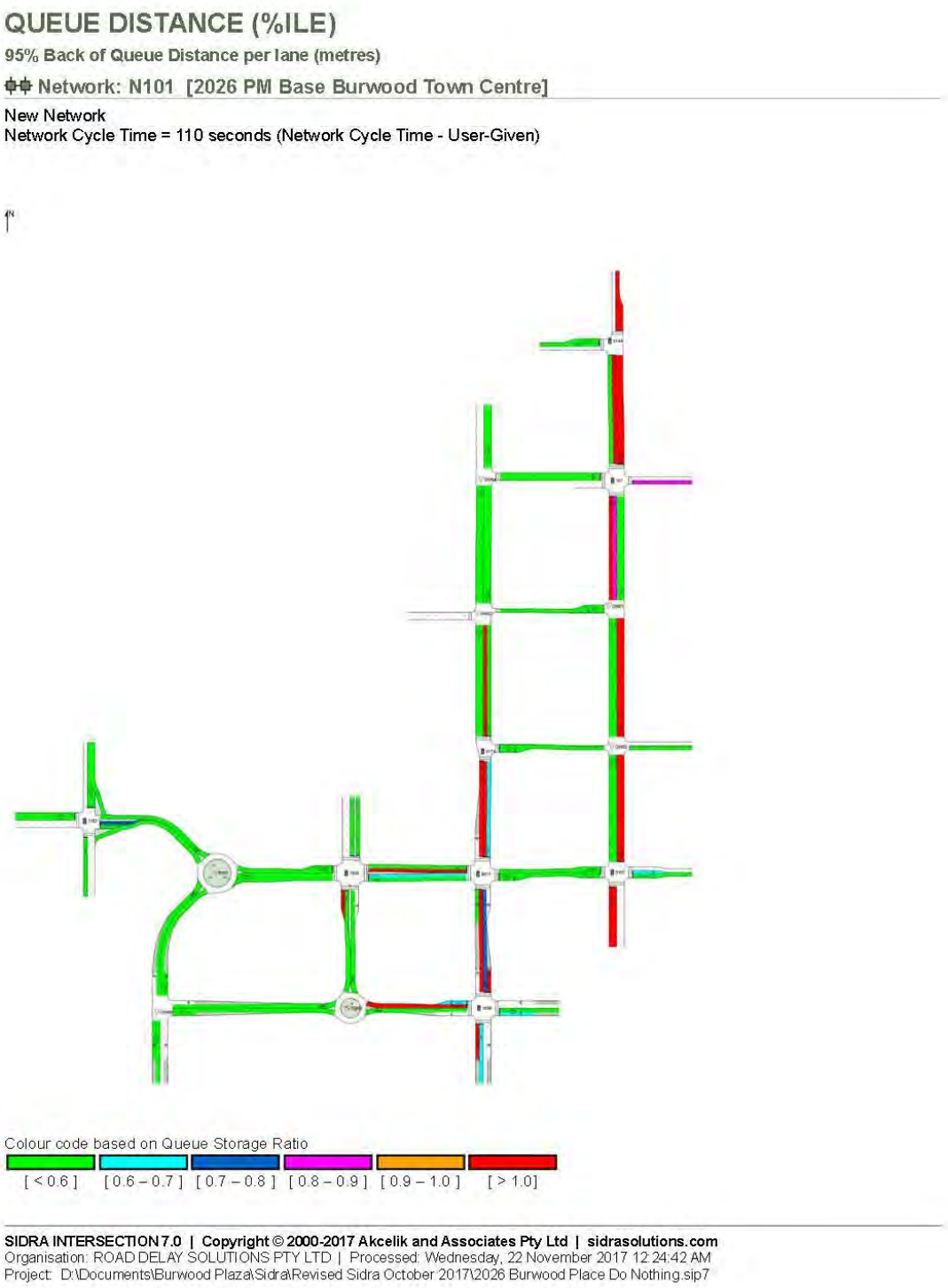


Figure 53 *2026* ***SIDRA 'Do Nothing' WE Peak Network Report***

Source *Sidra/Road Delay Solutions, 2017*

NETWORK SUMMARY

Network: N101 [2026 WE Base Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	2.72			
Speed Efficiency	0.34			
Congestion Coefficient	2.90			
Travel Speed (Average)	20.7 km/h		2.3 km/h	15.6 km/h
Travel Distance (Total)	7295.2 veh-km/h		468.6 ped-km/h	10697.0 pers-km/h
Travel Time (Total)	352.7 veh-h/h		201.7 ped-h/h	686.8 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	23824 veh/h		13836 ped/h	38376 pers/h
Arrival Flows (Total for all Sites)	23725 veh/h		13836 ped/h	38256 pers/h
Demand Flows (Entry Total)	5945 veh/h			
Midblock Inflows (Total)	1812 veh/h			
Midblock Outflows (Total)	-1286 veh/h			
Percent Heavy Vehicles (Demand)	3.2 %			
Percent Heavy Vehicles (Arrival)	3.2 %			
Degree of Saturation	1.303			
Control Delay (Total)	209.16 veh-h/h		101.61 ped-h/h	380.31 pers-h/h
Control Delay (Average)	31.7 sec		26.4 sec	35.8 sec
Control Delay (Worst Lane)	327.5 sec			
Control Delay (Worst Movement)	327.5 sec		44.8 sec	327.5 sec
Geometric Delay (Average)	1.7 sec			
Stop-Line Delay (Average)	30.0 sec			
Queue Storage Ratio (Worst Lane)	1.23			
Total Effective Stops	14608 veh/h		9970 ped/h	30989 pers/h
Effective Stop Rate	0.62 per veh	2.0 per km	0.72 per ped	0.81 per pers
Proportion Queued	0.55		0.72	0.77
Performance Index	1296.1		257.1	1553.2
Cost (Total)	14203.93 $/h	1.95 $/km	5083.53 $/h	19287.46 $/h
Fuel Consumption (Total)	1053.6 L/h	144.4 mL/km		
Fuel Economy	14.4 L/100km			
Carbon Dioxide (Total)	2484.0 kg/h	340.5 g/km		
Hydrocarbons (Total)	0.253 kg/h	0.035 g/km		
Carbon Monoxide (Total)	2.244 kg/h	0.308 g/km		
NOx (Total)	2.128 kg/h	0.292 g/km		

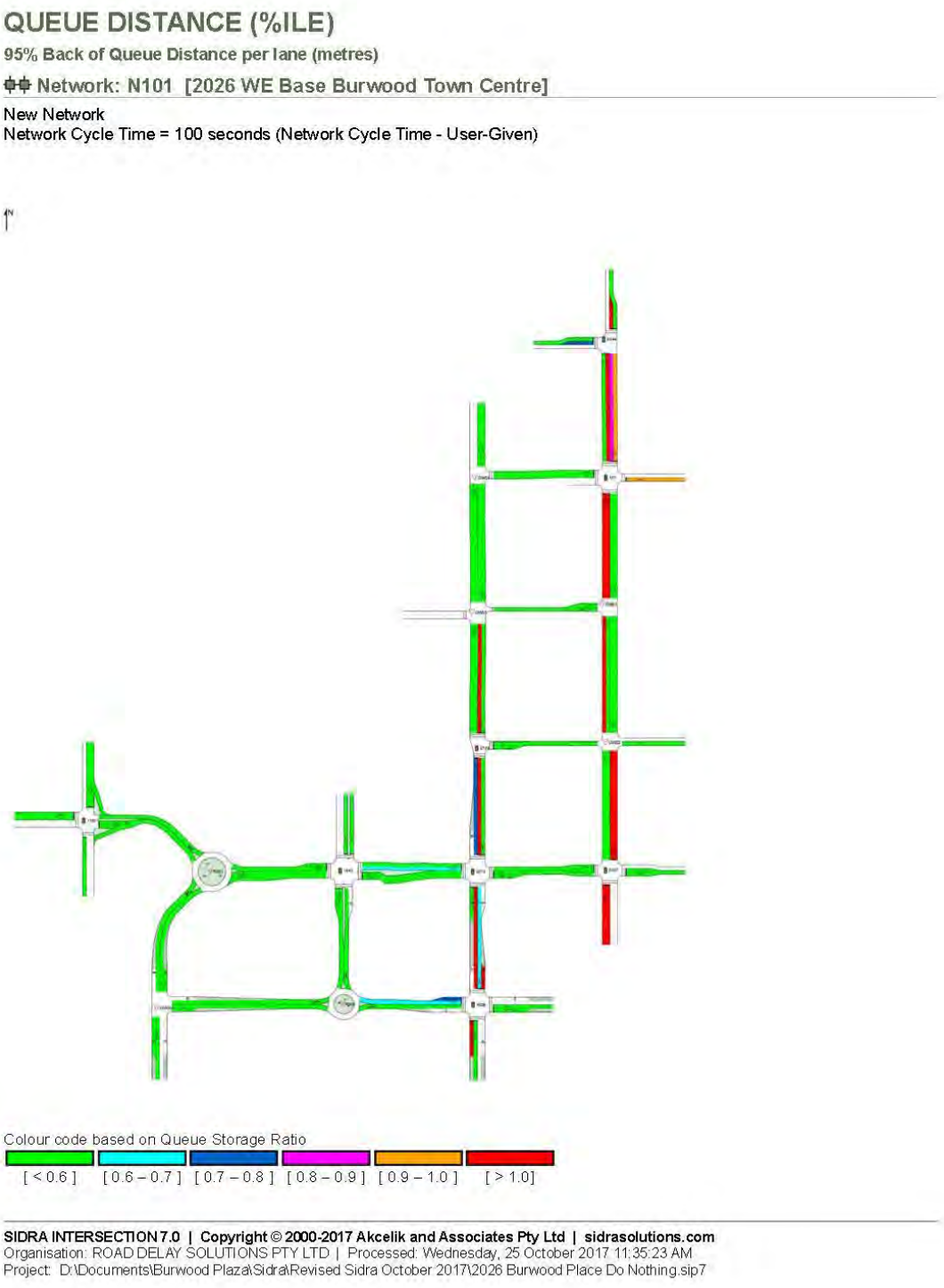
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 390.0 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	11,435,620 veh/y	6,641,179 ped/y	18,420,710 pers/y
Delay	100,399 veh-h/y	48,772 ped-h/y	182,551 pers-h/y
Effective Stops	7,011,819 veh/y	4,785,548 ped/y	14,874,650 pers/y
Travel Distance	3,501,686 veh-km/y	224,909 ped-km/y	5,134,539 pers-km/y
Travel Time	169,315 veh-h/y	96,829 ped-h/y	329,659 pers-h/y
Cost	6,817,887 $/y	2,440,092 $/y	9,257,978 $/y
Fuel Consumption	505,743 L/y		
Carbon Dioxide	1,192,316 kg/y		

*Figure 54 2026 **WE 'Do Nothing' 95**th Percentile Queue Ratios*

Source Road Delay Solutions, 2017



6.14 2026 Section 94 Infrastructure Model

(2026AMS94.PLT/2026PMS94.PLT/26AMWE94.PLT)

The second scenario model of the Year 2026 was prepared inclusive of...

- *The BTS growth rates,*
- *Stage 1 of the West Connex project (M4 East – Homebush Bay Drive to Pomeroy Street/Tunnelled Pomeroy Street to City West Link Road), which is scheduled for opening in 2019, and*
- *Burwood Council's Section 94 Infrastructure Plan.*

Figure 55 Westconnex Stage 1 M4 East – M4 to City West Link Road
Source http://www.westconnex.com.au, 2016

The Section 94 infrastructure plan and anticipated implementation dates include...

- *Future signalised right turn movement from Burwood Road, southbound, into Belmore Street, westbound, (2016-2018),*
- *Upgrade to the signalised intersection at Burwood Road and Railway Parade, (2016-2018),*
- *New traffic signals at the intersection of Railway Parade and Conder Street, (2016-2018),*
- *Widening of Railway Parade east of Burwood Road (2024-2027),*
- *New mid-block traffic signals in Wynne Avenue (2012-2015),*
- *New traffic signals at Belmore Street and Wynne Avenue (2012-2015),*
- *New traffic signals at Belmore Street and Conder Street (2012-2015),*
- *Widening of Railway Parade adjacent to Burwood Place (after 2035),*
- *Streetscape upgrades in Belmore Street, Conder Street, Wynne Avenue (2012 - after 2020), and*
- *Shared zones in Conder Street and Clarendon Place (2016-2018).*

The intention of this model is to adopt the Section 94 infrastructure measures, as proposed by Council, and report the road network operation under the demands of year 2026 growth.

Figure 56 Section 94 Infrastructure Plan

Source Burwood Council, 2017

The 2026 Section 94 model does not assess each measure proposed under the Council plan but adopts the proposed improvements and excludes any and all traffic generation associated with the Burwood Place development.

It has been reported from the modelling that with the introduction of the Section 94 improvements, the operational performance of Burwood Road, both northbound and southbound will operate at a LoS 'E', further consolidating the view that Burwood Road is operating at capacity and the competing parallel routes of Wentworth Road and Shaftesbury Road remain viable alternative paths into and out of the town centre with motorists utilising side street entry to the centre and access to the available parking provisions.

The Section 94 Infrastructure Plan outlines provision for modification to the Burwood Road intersection with Railway Parade. After dicussions with Council it is intended to retain the current movement conditions including the right turn from Burwood Road, southbound, into Railway Parade under the plan.

There is some discrepancy over the intersection of Burwood Road and Belmore Street. An *RMS* traffic signal design layout depicts a future dedicated, right turn movement, southbound, in Burwood Road, replacing the current filterd right turn movement for all vehicles,

Under the Section 94 Infrastructure Plan the introduction of traffic signals in Belmore Street at Wynne Avenue and Conder Street and the further introduction of traffic signals at Railway Parade and Conder Street create a circulatory route around the development site which meets the needs of both motorists and pedestrians. The introduction of signalised pedestrian crossings at the new signal sites will improve community mobility and safety.

Modelling supports Council's view thatr the Burwood Road intersection with Railway Parade and also with Belmore Street, should be retained in their current form as no significant improvement is reported with the relocation of the right turn movement, southbound, in Burwood Road from Railway Parade to Belmore Street, as reported in the body of this document.

Sensitivity Model (2026AMS94S.PLT/2026PMS94S.PLT)

An alternate, sensitivity, model was also run banning completely, the right turn movement from Burwood Road, southbound, at Railway Parade. This ban included buses.

This model was run appreciating that some buses currently perform a U-Turn manoeuvre at the Railway Parade intersection with Conder Street at the existing roundabout, then proceed to a lay over in Railway Parade adjacent to Burwood Central. While buses may perform the same U-Turn movement at the intersection once signalised and with the installation of a dedicated bus only

movement, it was considered that if buses were directed to Belmore Street to perform the righ turn movement to the west they would be able to travel in a circulatory route via Belmore Street, right into Conder Street and a further right Into Railway Parade.

This particular sensitivity model did report that the Burwood Road southbound route would improve during the morning AM peak to a LoS 'D' in comparison to the LoS 'E' reported in the Section 94 model. During the PM peak the modelled 18 bus movements turning right at Railway Parade resulted in a consistant LoS 'E'. However, the circulatory route, via Belmore Street, is considered to pose issues with the turning path into Conder Street and pedestrian movements in the vicinity of Burwood Public School.

The network model did indicate that if the right turn movement for all vehicles was banned, southbound on Burwood Road at Railway Parade and a corresponding right turn phase introduced from Burwood Road into Belmore Street, significant queuing and delay would result on Burwood Road between Railway Parade and Belmore Street.

The model indicated that with the presence of on street parking and the narrow road carriageway at the Belmore Street intersection, contributed to increasing vehicle delays during the PM peak period and did not provide any significant improvement in the road network operation. Effectively, the sensitivity model reported the vehicle delays, which were reported at the Railway Parade intersection, with retention of the right turn movement for all vehicles, simply relocated to the Belmore Street intersection.

Given the outcome of the sensitivity model it was concluded that…

- → *All vehicles be allowed to turn right from Burwood Road, southbound, into Railway Parade via the current dedicated 'B' phase right turn,*
- → *The modest improvement in performance reported during the morning peak was not significant enough to impose the Belmore Street circulatory route on buses, and*
- → *The right turn movement from Burwood Road, southbound, at Belmore Street be retained as a filter movement only.*

The modelling has evidenced that the outcome of the S94 infrastructure improvements adequately manage the planned future growth, of which the Burwood Place development is one. This was the intention of the S94 plan and the modelling does not indicate to the contrary. The S94 plan appears to have been carefully constructed and capable of sustaining the level of development for which it was intended at an operational level comparable with the current state.

Following discussions with Council, it is Holdmark's intention to consult fully with Council early in the DA design stage all aspects of the road network operation and access provisions in an attempt to achieve the optimum and sustainable outcomes for both community and development.

Figure 57 2026 AM Section 94 Traffic Projections

Source Road Delay Solutions, 2017

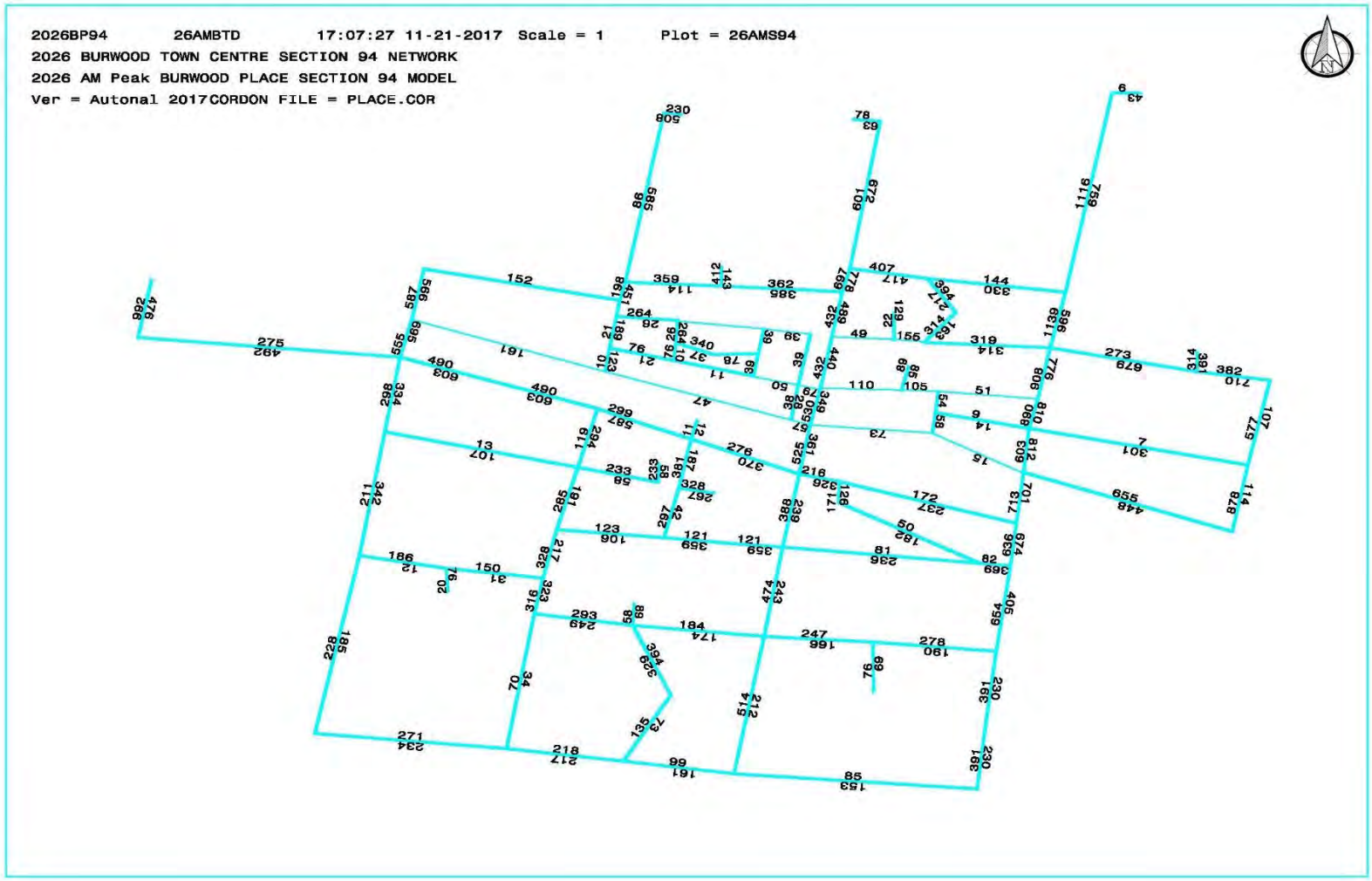


Figure 58 2026 PM Section 94 Traffic Projections

Source Road Delay Solutions, 2017

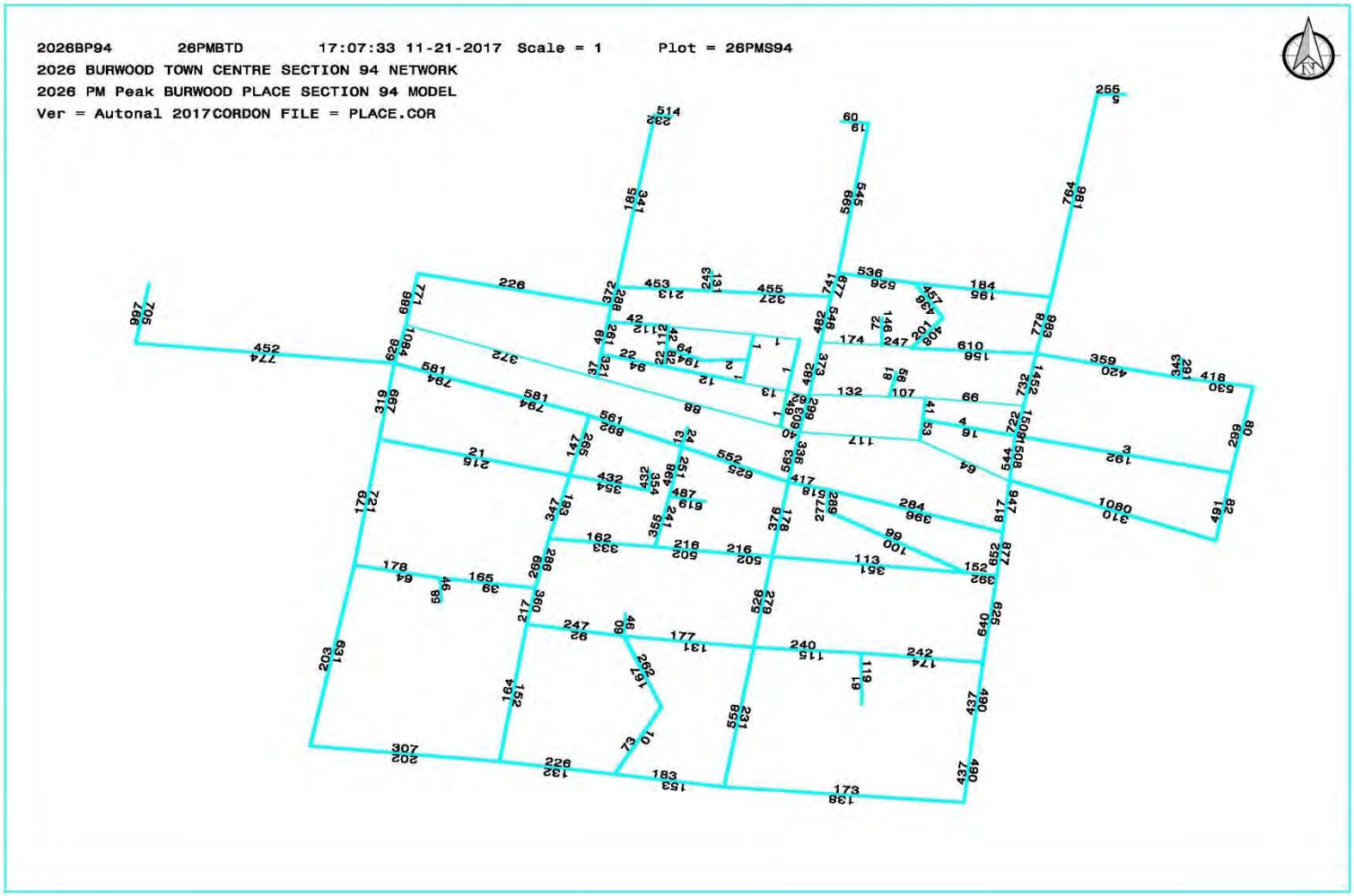


Figure 59 *2026 WE Section 94 Traffic Projections*

Source *Road Delay Solutions, 2016*

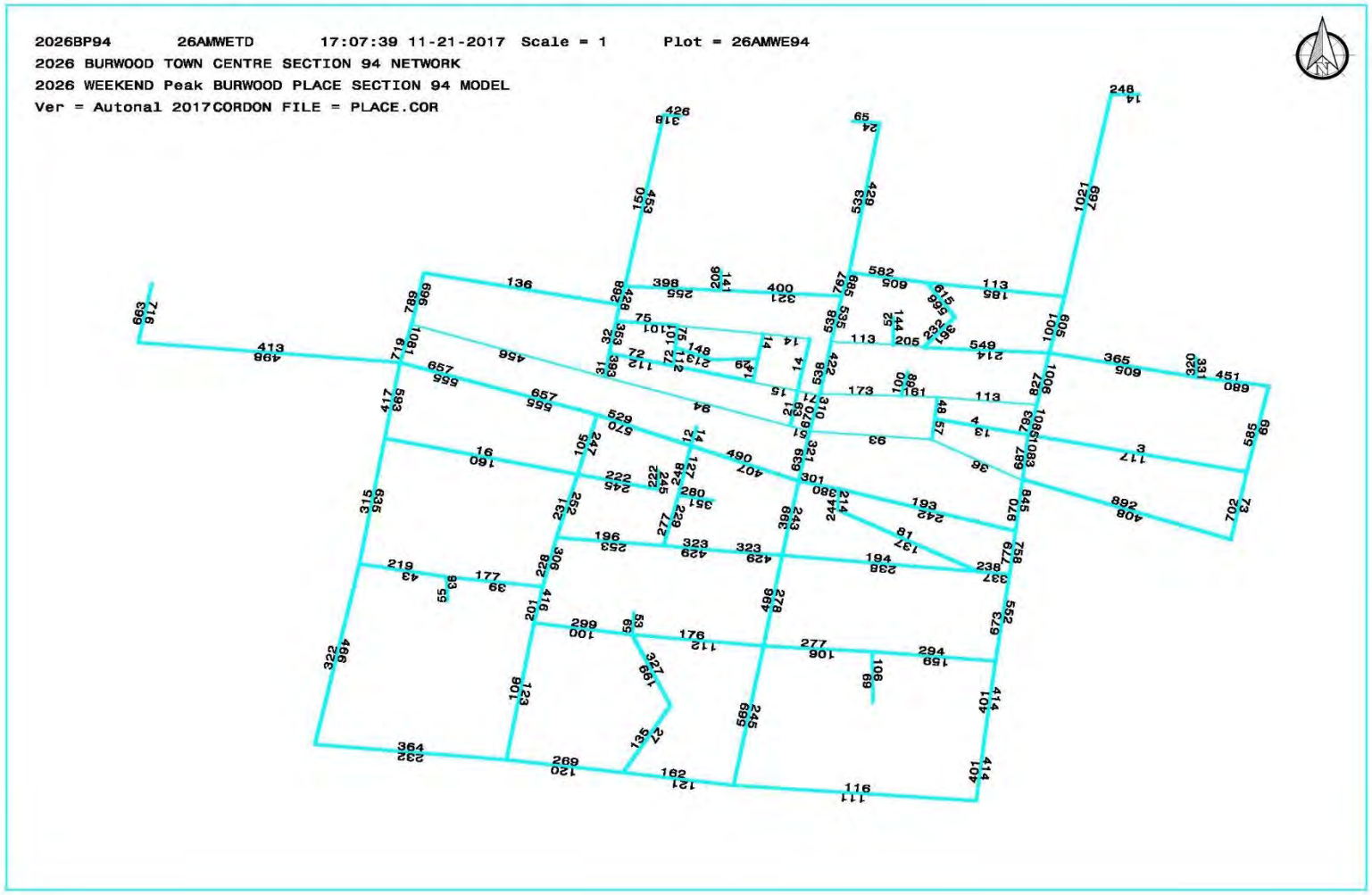


Figure 60 2026 SIDRA Section 94 Modelled Road Network

Source Sidra/Road Delay Solutions, 2017

SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
0107	NA	2026 WE S94 Shaftesbury Rd, Railway Pde and Paisley St
0144	NA	2026 WE S94 Shaftesbury Rd and Wilga St
101	NA	2026 WE S94 Shaftesbury Road and Victoria Street
GW01	NA	2026 WE S94 Shaftesbury Rd and George St
GW02	NA	2026 WE S94 Shaftesbury Rd and Deane St
GW04	NA	2026 WE S94 Burwood Rd and Victoria St
GW03	NA	2026 WE S94 Burwood Rd and George St
0174	NA	2026 WE S94 Burwood Rd and Deane St
0014	NA	2026 WE S94 Burwood Rd and Railway Pde
1639	NA	2026 WE S94 Burwood Rd and Belmore St
1843	NA	2026 WE S94 Railway Pde and Wynne Ave
TCS001	NA	2026 WE S94 Railway Pde and Conder St
TCS002	NA	2026 WE S94 Belmore St and Wynne Ave
TCS003	NA	2026 WE S94 Belmore St and Conder St
1183	NA	2026 WE S94 Wentworth Rd, Railway Pde and Morwick St

Figure 61 2026 SIDRA Section 94 AM Peak Network Report

Source Sidra/Road Delay Solutions, 2017

NETWORK SUMMARY

Network: N101 [2026 AM S94 Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	2.97			
Speed Efficiency	0.37			
Congestion Coefficient	2.72			
Travel Speed (Average)	22.0 km/h		2.5 km/h	16.3 km/h
Travel Distance (Total)	7504.9 veh-km/h		490.1 ped-km/h	10833.2 pers-km/h
Travel Time (Total)	340.8 veh-h/h		199.6 ped-h/h	665.6 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	23641 veh/h		14459 ped/h	37106 pers/h
Arrival Flows (Total for all Sites)	23627 veh/h		14459 ped/h	37086 pers/h
Demand Flows (Entry Total)	6458 veh/h			
Midblock Inflows (Total)	3090 veh/h			
Midblock Outflows (Total)	-2679 veh/h			
Percent Heavy Vehicles (Demand)	3.3 %			
Percent Heavy Vehicles (Arrival)	3.3 %			
Degree of Saturation	1.499			
Control Delay (Total)	191.63 veh-h/h		94.90 ped-h/h	351.75 pers-h/h
Control Delay (Average)	29.2 sec		23.6 sec	34.1 sec
Control Delay (Worst Lane)	497.9 sec			
Control Delay (Worst Movement)	497.9 sec		45.2 sec	497.9 sec
Geometric Delay (Average)	1.6 sec			
Stop-Line Delay (Average)	27.6 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	16273 veh/h		11546 ped/h	35067 pers/h
Effective Stop Rate	0.69 per veh	2.2 per km	0.80 per ped	0.95 per pers
Proportion Queued	0.65		0.80	0.93
Performance Index	1318.9		263.8	1582.6
Cost (Total)	13768.67 $/h	1.83 $/km	5030.80 $/h	18799.47 $/h
Fuel Consumption (Total)	1065.7 L/h	142.0 mL/km		
Fuel Economy	14.2 L/100km			
Carbon Dioxide (Total)	2514.6 kg/h	335.1 g/km		
Hydrocarbons (Total)	0.252 kg/h	0.034 g/km		
Carbon Monoxide (Total)	2.259 kg/h	0.301 g/km		
NOx (Total)	2.647 kg/h	0.353 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 213.6 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	11,347,820 veh/y	6,940,334 ped/y	17,811,100 pers/y
Delay	91,983 veh-h/y	45,554 ped-h/y	168,842 pers-h/y
Effective Stops	7,811,231 veh/y	5,542,279 ped/y	16,832,350 pers/y
Travel Distance	3,602,348 veh-km/y	235,269 ped-km/y	5,199,936 pers-km/y
Travel Time	163,562 veh-h/y	95,825 ped-h/y	319,510 pers-h/y
Cost	6,608,961 $/y	2,414,785 $/y	9,023,746 $/y
Fuel Consumption	511,554 L/y		
Carbon Dioxide	1,207,011 kg/y		

Figure 62 2026 SIDRA Section 94 AM Peak 95th % Queues

Source Sidra/Road Delay Solutions, 2017

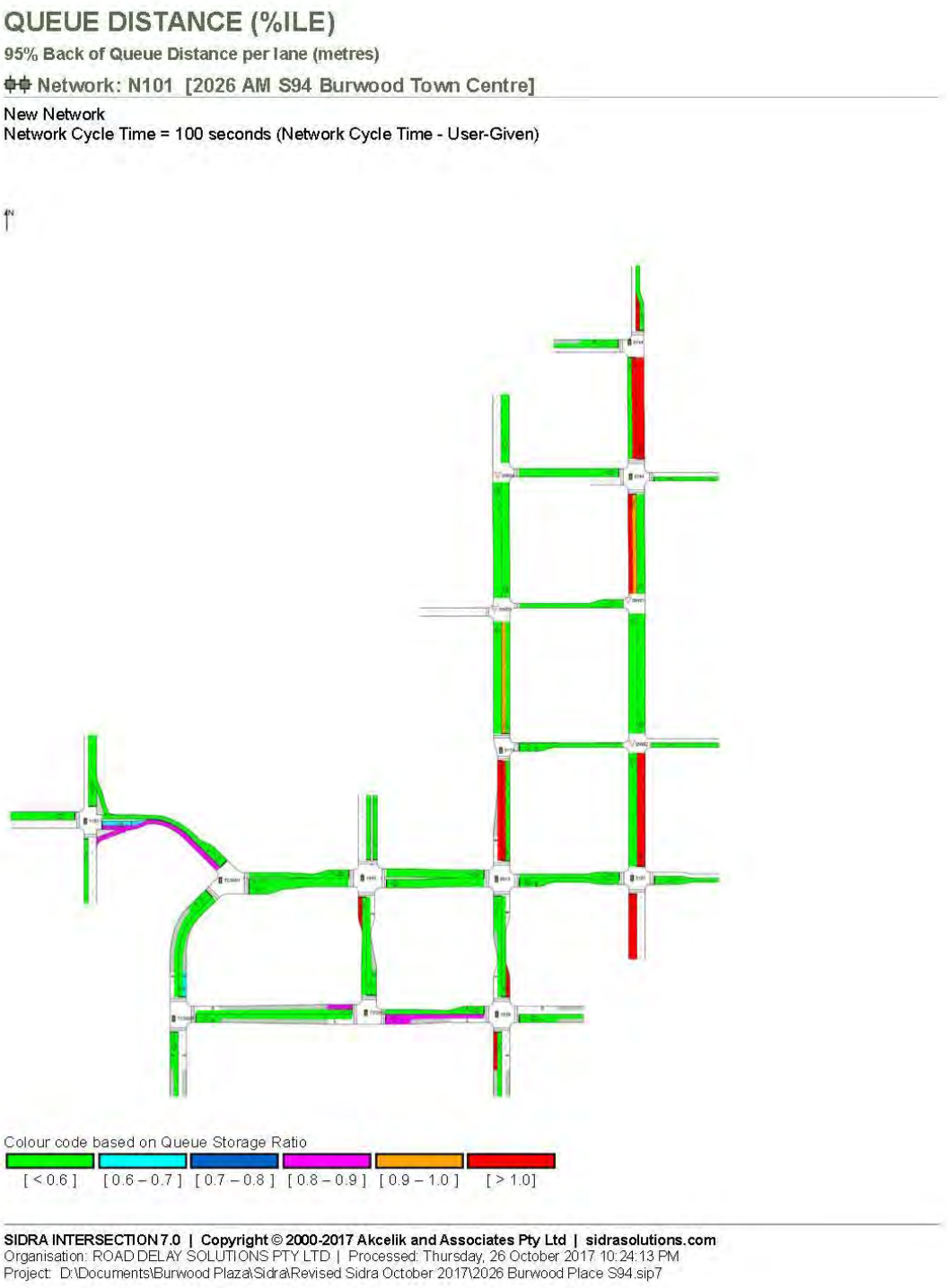


Figure 63 2026 SIDRA Section 94 PM Peak Network Report

Source Sidra/Road Delay Solutions, 2017

NETWORK SUMMARY

Network: N101 [2026 PM S94 Burwood Town Centre]

New Network
Network Cycle Time = 110 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS F			
Travel Time Index	1.57			
Speed Efficiency	0.24			
Congestion Coefficient	4.14			
Travel Speed (Average)	14.5 km/h		2.3 km/h	12.1 km/h
Travel Distance (Total)	8469.5 veh-km/h		503.9 ped-km/h	11950.4 pers-km/h
Travel Time (Total)	584.7 veh-h/h		223.5 ped-h/h	989.9 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	25522 veh/h		14839 ped/h	38735 pers/h
Arrival Flows (Total for all Sites)	25008 veh/h		14839 ped/h	38085 pers/h
Demand Flows (Entry Total)	6969 veh/h			
Midblock Inflows (Total)	3292 veh/h			
Midblock Outflows (Total)	-3122 veh/h			
Percent Heavy Vehicles (Demand)	2.6 %			
Percent Heavy Vehicles (Arrival)	2.6 %			
Degree of Saturation	1.453			
Control Delay (Total)	403.96 veh-h/h		115.87 ped-h/h	635.81 pers-h/h
Control Delay (Average)	58.2 sec		28.1 sec	60.1 sec
Control Delay (Worst Lane)	462.1 sec			
Control Delay (Worst Movement)	462.1 sec		49.5 sec	462.1 sec
Geometric Delay (Average)	1.5 sec			
Stop-Line Delay (Average)	56.7 sec			
Queue Storage Ratio (Worst Lane)	1.57			
Total Effective Stops	20708 veh/h		10587 ped/h	39096 pers/h
Effective Stop Rate	0.83 per veh	2.4 per km	0.71 per ped	1.03 per pers
Proportion Queued	0.69		0.71	0.93
Performance Index	2043.1		282.4	2325.5
Cost (Total)	22213.14 $/h	2.62 $/km	5633.20 $/h	27846.34 $/h
Fuel Consumption (Total)	1460.8 L/h	172.6 mL/km		
Fuel Economy	17.2 L/100km			
Carbon Dioxide (Total)	3441.3 kg/h	406.3 g/km		
Hydrocarbons (Total)	0.361 kg/h	0.043 g/km		
Carbon Monoxide (Total)	2.911 kg/h	0.344 g/km		
NOx (Total)	2.514 kg/h	0.297 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 255.3 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	12,250,530 veh/y	7,122,734 ped/y	18,592,970 pers/y
Delay	193,902 veh-h/y	55,615 ped-h/y	305,191 pers-h/y
Effective Stops	9,939,823 veh/y	5,081,797 ped/y	18,765,900 pers/y
Travel Distance	4,065,369 veh-km/y	241,880 ped-km/y	5,736,201 pers-km/y
Travel Time	280,652 veh-h/y	107,299 ped-h/y	475,172 pers-h/y
Cost	10,662,310 $/y	2,703,936 $/y	13,366,240 $/y
Fuel Consumption	701,192 L/y		
Carbon Dioxide	1,651,814 kg/y		

Figure 64 2026 SIDRA Section 94 PM Peak 95th % Queues

Source Sidra/Road Delay Solutions, 2017

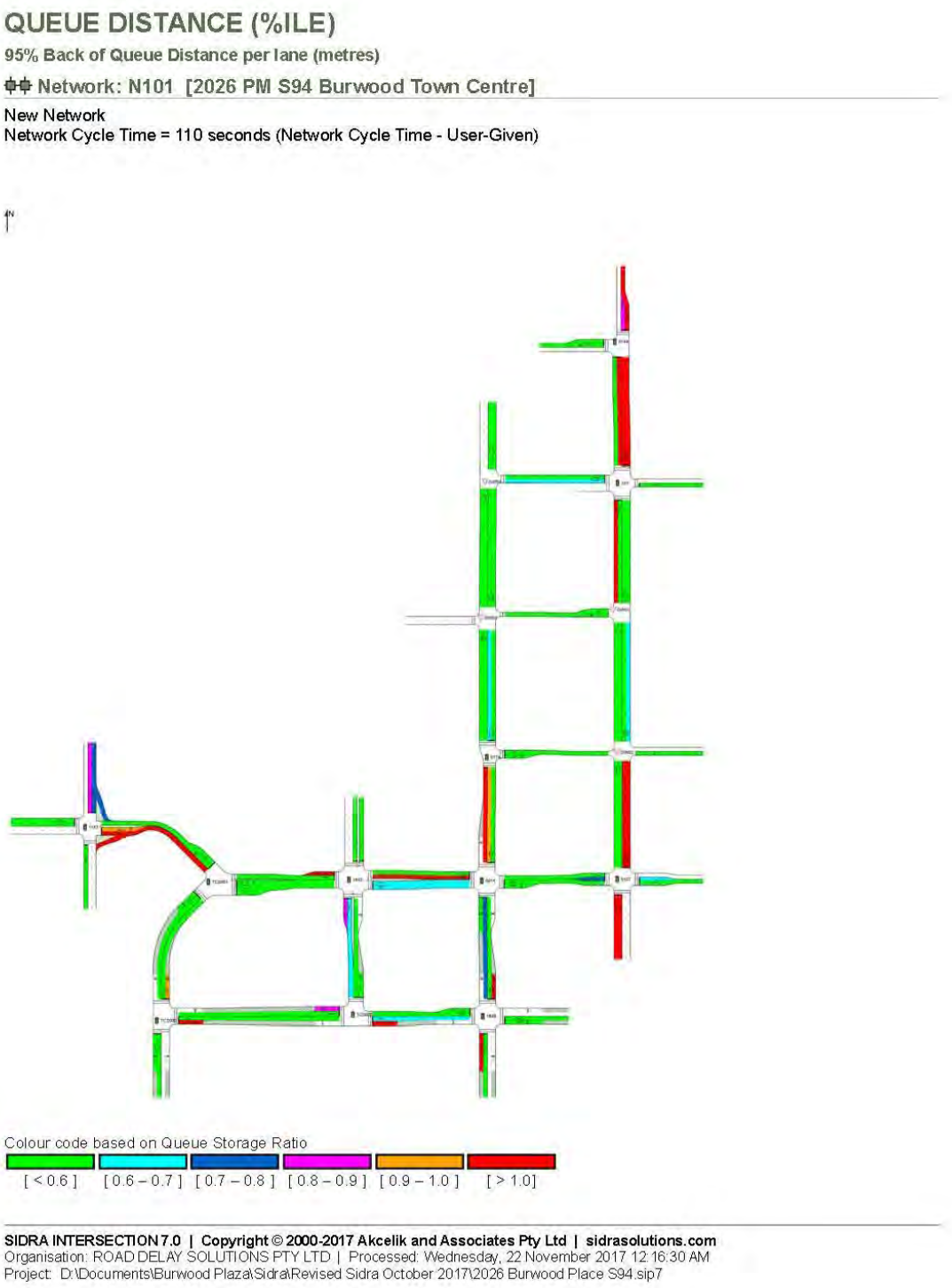


Figure 65 2026 SIDRA Section 94 WE Peak Network Report

Source Sidra/Road Delay Solutions, 2017

NETWORK SUMMARY

Network: N101 [2026 WE S94 Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS F			
Travel Time Index	2.02			
Speed Efficiency	0.28			
Congestion Coefficient	3.55			
Travel Speed (Average)	16.9 km/h		2.3 km/h	13.3 km/h
Travel Distance (Total)	7542.8 veh-km/h		492.6 ped-km/h	10910.3 pers-km/h
Travel Time (Total)	445.7 veh-h/h		217.7 ped-h/h	820.9 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	23932 veh/h		14518 ped/h	37742 pers/h
Arrival Flows (Total for all Sites)	23811 veh/h		14518 ped/h	37666 pers/h
Demand Flows (Entry Total)	6443 veh/h			
Midblock Inflows (Total)	3063 veh/h			
Midblock Outflows (Total)	-2578 veh/h			
Percent Heavy Vehicles (Demand)	2.9 %			
Percent Heavy Vehicles (Arrival)	2.9 %			
Degree of Saturation	1.465			
Control Delay (Total)	293.09 veh-h/h		112.42 ped-h/h	500.31 pers-h/h
Control Delay (Average)	44.3 sec		27.9 sec	47.9 sec
Control Delay (Worst Lane)	511.3 sec			
Control Delay (Worst Movement)	511.3 sec		44.4 sec	511.3 sec
Geometric Delay (Average)	1.5 sec			
Stop-Line Delay (Average)	42.8 sec			
Queue Storage Ratio (Worst Lane)	2.35			
Total Effective Stops	18011 veh/h		10816 ped/h	36570 pers/h
Effective Stop Rate	0.76 per veh	2.4 per km	0.75 per ped	0.97 per pers
Proportion Queued	0.65		0.75	0.90
Performance Index	1673.6		277.8	1951.3
Cost (Total)	17577.75 $/h	2.33 $/km	5485.48 $/h	23063.23 $/h
Fuel Consumption (Total)	1210.1 L/h	160.4 mL/km		
Fuel Economy	16.0 L/100km			
Carbon Dioxide (Total)	2852.1 kg/h	378.1 g/km		
Hydrocarbons (Total)	0.298 kg/h	0.040 g/km		
Carbon Monoxide (Total)	2.497 kg/h	0.331 g/km		
NOx (Total)	2.280 kg/h	0.302 g/km		

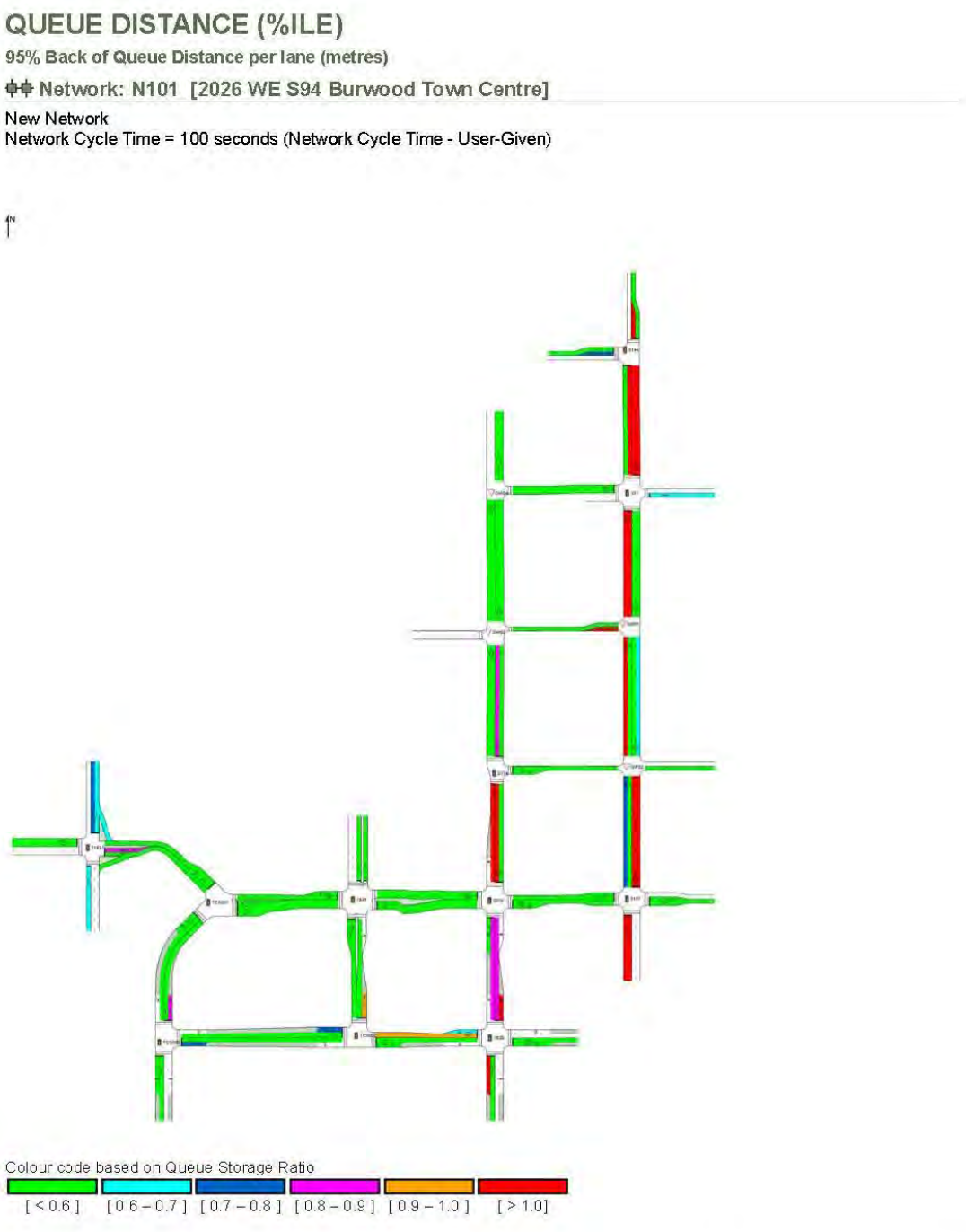
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 39.5 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	11,487,550 veh/y	6,968,629 ped/y	18,116,390 pers/y
Delay	140,685 veh-h/y	53,961 ped-h/y	240,147 pers-h/y
Effective Stops	8,645,348 veh/y	5,191,856 ped/y	17,553,560 pers/y
Travel Distance	3,620,528 veh-km/y	236,456 ped-km/y	5,236,923 pers-km/y
Travel Time	213,941 veh-h/y	104,485 ped-h/y	394,019 pers-h/y
Cost	8,437,321 $/y	2,633,031 $/y	11,070,350 $/y
Fuel Consumption	580,857 L/y		
Carbon Dioxide	1,368,986 kg/y		

Figure 66 2026 SIDRA Section 94 WE Peak 95th % Queues

Source Sidra/Road Delay Solutions, 2017



6.15 2026 Plaza Development Model

(2026AMDV2.PLT/2026PMDV2.PLT/26AMWED2.PLT)

The third scenario model of the Year 2026 includes the impacts of the Burwood Place Development.

The development model was specifically constructed to shape the necessary mitigation treatments to sustain the planned growth levels within and immediate Burwood Town Centre surrounds. The model addresses the following objectives…

- *The minimisation of impacts from development generated traffic on Burwood Road and local streets,*
- *The optimisation of traffic operations on Burwood Road during the commuter peak periods within the current road reserve constraints,*
- *To maintain and/or improve pedestrian mobility and safety within the study area, and*
- *Realise a traffic management outcome which retains a level of amenity while allowing further development necessary for economic growth within the retail and commercial sectors within the town centre.*

The major input parameters incorporated in the 2026 Plaza Development model, comprise…

- *The introduction of committed road network infrastructure improvements outlined in Burwood Council's Section 94 Plan,*
- *Trip matrices for the AM, PM and WE peak periods encapsulating the planned growth levels to year 2026, as defined by the BTS, within the Metropolitan Area, and the BTS TZ 910, 913 and 915,*
- *The introduction of traffic generation associated with the Burwood Place development, via the proposed access locations on Railway Parade, Belmore Street and Wynne Avenue, and*
- *A general 3% increase in pedestrian traffic associated with the population growth within the Burwood town centre.*

To achieve the objectives of this assessment, it was necessary to consider a number of treatments, including several from the Section 94 Infrastructure Plan, which will meet the amenity and capacity objectives associated with the Plaza development.

Figure 67 2026 Plaza Development Model – Road Network Treatment Options

Source Road Delay Solutions, 2018

Identifier	Proposed Road Network Component	Priority in Relation to Plaza Development	Reasoning
1	Widening of pedestrian crossings to 5m at select locations	Low	To increase the pedestrian capacity and attempt to reduce the incidence of demand for the pedestrian 'WALK' during each cycle.
2	Retention of right turn for all vehicles, SB on Burwood Road at Railway Parade	High	Afford buses access to the stops in Railway Parade on the northern side of Burwood Plaza.
4	Introduction of a pedestrian 'scramble' phase	High	A pedestrian 'scramble' phase will reduce the impacts of pedestrian movements on the SB left turn movement in Burwood Road.
5	Retention of current intersection configuration and phasing on Burwood Road at Belmore Street	Medium	Retention of the RT movement for all vehicle classes at Railway Parade negates the need for a dedicated RT phase from Burwood Road, SB, in Burwood Road.
6	Introduction of a partial closure of Wynne Avenue, south of Railway Parade	Low	The partial closure, or narrowing, of Wynne Avenue is proposed to consolidate continuity and pedestrian mobility at the podium level, between the two Burwood Plaza development sites.
7	Introduction of priority sign controlled development access in Railway Parade	High	Required to provide access to the Burwood Plaza development. No RT from development site onto Railway Parade to be permitted.
8	Introduction of traffic signal controlled development access in Wynne Avenue	High	Required to provide access to the Burwood Plaza development and manage the movement of pedestrian across the driveway and Wynne Avenue. Possible loading dock access to also be considered prior to DA.
9	Introduction of priority sign controlled development access in Belmore Street	High	Necessary to provide access to the development.
9	Signalisation of the Railway Parade intersection with Conder Street	High	Signalisation will formalise pedestrian movements, efficiently manage traffic movements and allow buses to perform a 'U' turn movement to access the bus layover on the northern side of Railway Parade, adjacent to Burwood Central.
10	Signalisation of Burwood Road intersection at Victoria Street East. Buses Only RT movement from Burwood Road NB	Low	Necessary to formalise both bus and pedestrian movements. Intended to reduce the incidence of 'J' walking across Burwood Road.
11	Traffic signalisation of the Belmore Street intersection with Conder Street	High	Treatment will effectively manage vehicle and pedestrian movements.
12	Traffic signalisation of the Belmore Street intersection with Wynne Avenue	High	Treatment will effectively manage vehicle and pedestrian movements.
13	`Increased capacity at the intersection of Shaftesbury Road and Wilga Street by developing and introducing... ** A shared through and left turn lane NB in Shaftesbury Road,* ** A corresponding 80m kerbside departure lane, and* ** An 80m long RT bay SB in Shafesbury Road.*	Low	The Wilga Street intersection currently has capacity constraints with only a single lane NB on Shaftesbury Road limiting the potential growth of traffic with development. Widening is necessary to sustain the Towers and Burwood RSL developments.
14	Introduction of traffic signals at Shaftesbury Road and George Street.	Low	Right turn delays from George Street onto Shaftesbury Road require the signalisation of the site. Improved pedestrian access to the proposed retail component of the development by local patrons.

Burwood Plaza currently generates some 840 vehicle trips per hour during the one (1) hour morning and evening commuter peak periods. With the proposed mixed use development the subsequent, calculated ,vehicle generation is 1,624vph during the morning AM peak and 1,531vph during the PM.

The development vehicle generation has been applied to the year 2026 trip matrices. The operational modelling reports a LoS 'E' for the morning, evening and weekend peak periods.

Detailed assessment of each key intersection and the town centre route was undertaken to determine the impact on average vehicle delay, level of service and the resultant queue lengths.

The mesoscopic modelling indicates that with the addition of the Burwood Place traffic generation, Burwood Road traffic volumes do not rise significantly. However, traffic vehicle volume increases do occur on Shaftesbury Road and Wentworth Road.

The model results would suggest that residents of the proposed Plaza development will opt for the less congested alternate, parallel, routes to avoid congestion and reduce travel times to their elected destinations, should they be outside the cordon of the town centre. This was evident from select link analysis of the development traffic generation movements.

The growth reported on Burwood Road is consistent with that reported between the years 2000 and 2016.

6.16 Widening of Pedestrian Crossings

Consideration has been given to widening of the marked foot crossings on Burwood Road at…

- *Victoria Road East,*
- *Dean Street,*
- *Railway Parade, and*
- *Belmore Street.*

The measure will increase pedestrian '***throughput***', reduce pedestrian delays and may reduce the incidence of the pedestrian '***walk phase***' being called each cycle of the traffic signals throughout the day.

Widening of the crossings will also improve pedestrian mobility within the confines of the marked crossings and may reduce the incidence of 'J' walking.

Modelling of the widened crossings was undertaken and found to reduce pedestrian delays by up to 20 seconds per person per cycle of the traffic lights.

This action may be undertaken when each signal site undergoes reconstruction.

6.17 Burwood Road and Railway Parade

A number of options have been considered and modelled for this site. The signalised intersection is currently operating a dedicated right turn phase, from the central shared lane, on Burwood Road northbound into Railway Parade, modelling indicated no significant improvement in the network operation would result from banning the movement ot all vehicles, with the exception of buses.

Reloction of the right turn phase from Railway Parade to Belmore Street yielded no significant benefit. The action reported significant increases in vehicle delay and queues for southbound motorists between Belmore Street and Railway Parade.

The pedestrian demand at the intersection is high and causes delay to turn movements. To eliminate this delay a '*scramble*' pedestrian phase has been analysed. By introducing the signle walk phase all left turn movements are no longer held by the movement of pedestrians. The '*scramble'* phase is introduced as the last phase of the cycle and has been timed to coincide with the longest perpendicular walk through the intersection.

Introduction of a *scramble* crossing phase at the intersection of Burwood Road and Railway Parade, will improve vehicle flow by eliminating delays to the left turn movements within the intersection. Currently red roundel and red arrow protection is afforded pedestrians at each of the left turn movements. A scramble phase eliminates this hold on left turn vehicles and allows them to clear upon display of the respective green signal, without restriction.

With the Burwood railway station only 170m from the Plaza site, the scramble walk will afford pedestrians improved connectivity and a shorter walk time.

The retention of the right turn movement and introduction of the scramble walk phase, the signals report LoS 'D' during the week day commuter peak periods and LoS 'C' during the weekend peak.

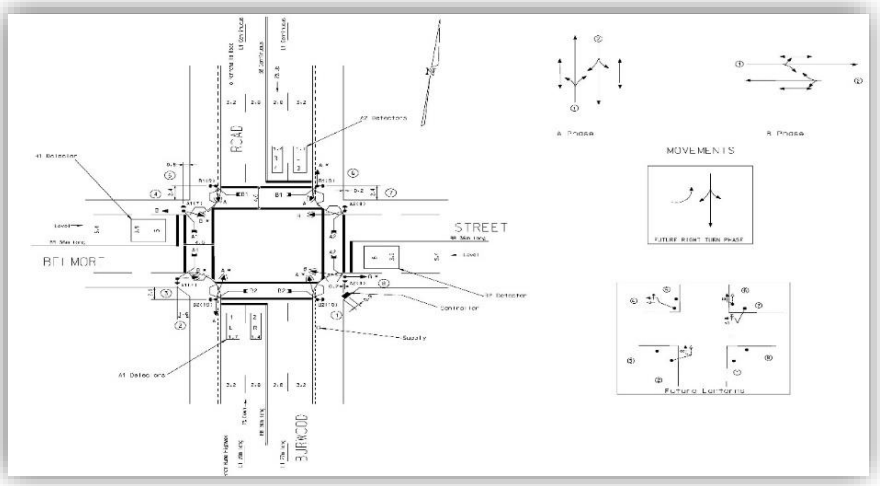
6.18 Burwood Road and Belmore Street

With the retention of the right turn movement for all vehicles, southbound in Burwood Road at Railway Parade, route modelling indicates that the Belmore Street intersection performs best if retained in its current state.

The *RMS* have indicated future plans to introduce a dedicated right turn phase from Burwood Road, southbound, into Belmore Street. Modelling shows that the introduction of an additional phase in the cycle will cause queueing and increase vehicle delays in Burwood Road.

Figure 68 Future Right Turn Treatment at Belmore Street

Source Extract RMS Traffic Signal Design, 2016



6.19 Wynne Avenue Partial Closure

A partial closure, or narrowing, of Wynne Avenue is proposed to consolidate continuity and pedestrian mobility at the podium level, between the two Burwood Place development sites. The partial closure is to take the form of widened footway provisions and the restriction of one (1) trafficable lane each way in Wynne Avenue, some 25m south of Railway Parade, for a distance of approximately 30m.

A sensitivity model was built with the section of Wynne Avenue, immediately south of Railway Parade, restricted to one (1) lane in each direction with a regulated speed of 20km/hr.

The following figures depict the numerical volume difference between the development model with the partial closure of Wynne Avenue (26AMDV2.PLT, 26PMDV2.PLT, 26AMWED2.PLT) minus the Wynne Avenue sensitivity model which retained Wynne Avenue open to all traffic with the introduction of traffic generation associated with the Burwood Place Development in 2026 (26AMDM.PLT/26PMDM.PLT/26AMWEDM.PLT). The difference plots clearly show the change in traffic volumes with the partial closure of Wynne Avenue.

Traffic volumes and traffic patterns on Burwood Road remain relatively constant, while inherently, any increases occur in close proximity to Wynne Avenue and on Railway Parade, Conder Street and Belmore Street.

Sidra network modelling of Conder Street with both the Belmore Street and Railway Parade intersections and the Belmore Street and Wynne Avenue intersection do not indicate any significant deterioration with the changed travel patterns associated with the Wynne Avenue partial closure.

The following plots depict the difference in traffic volumes with the introduction of a single trafficable lane in each direction and no change in regulated speed on Wynne Avenue between Railway Parade and the signalised Council Car Park access.

A number of models were run reflecting a reduced speed limit on Wynne Avenue. The impacts of this were more significant with an average reduction of some 35vph in each direction for each 10km/h speed reduction, through the proposed partial closure. It was also found that a speed reduction will impact travel patterns along Burwood Road, Wentworth Road and Shaftesbury Avenue.

Further investigation is required into the operation of a partial closure of Wynne Avenue. For the purposes of the Planning Proposal modelling, all movements are permitted at the signalised intersection of Wynne Avenue with Railway Parade, maintaining connection with the Burwood Central access.

These investigations will be undertaken in consultation with Council, the RMS and any identified stakeholders during the DA design phase.

Figure 69 2026 AM Peak Wynne Avenue Difference Plot

Source Road Delay Solutions, 2018

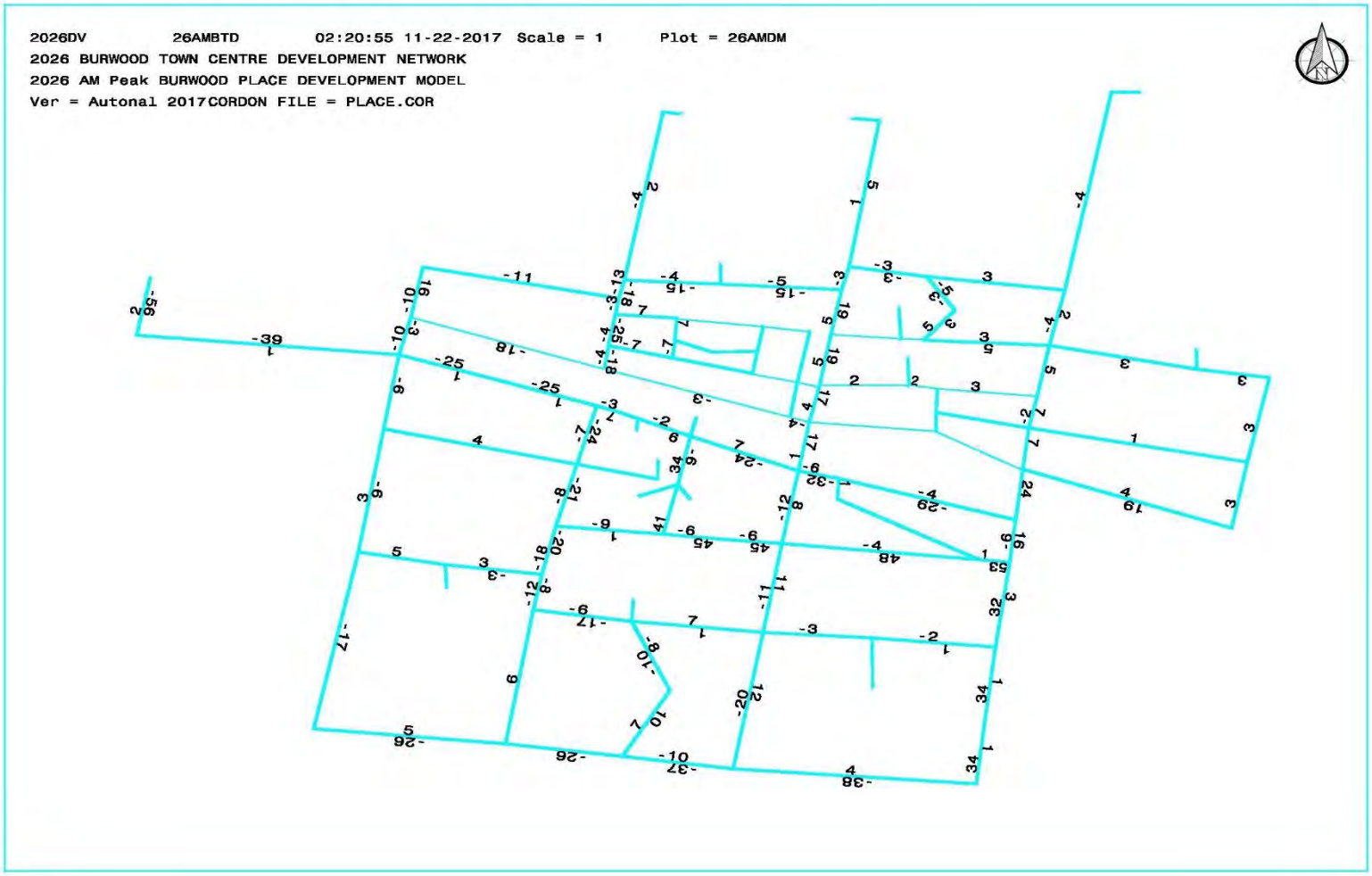


Figure 70 2026 PM Peak Wynne Avenue Difference Plot

Source Road Delay Solutions, 2018

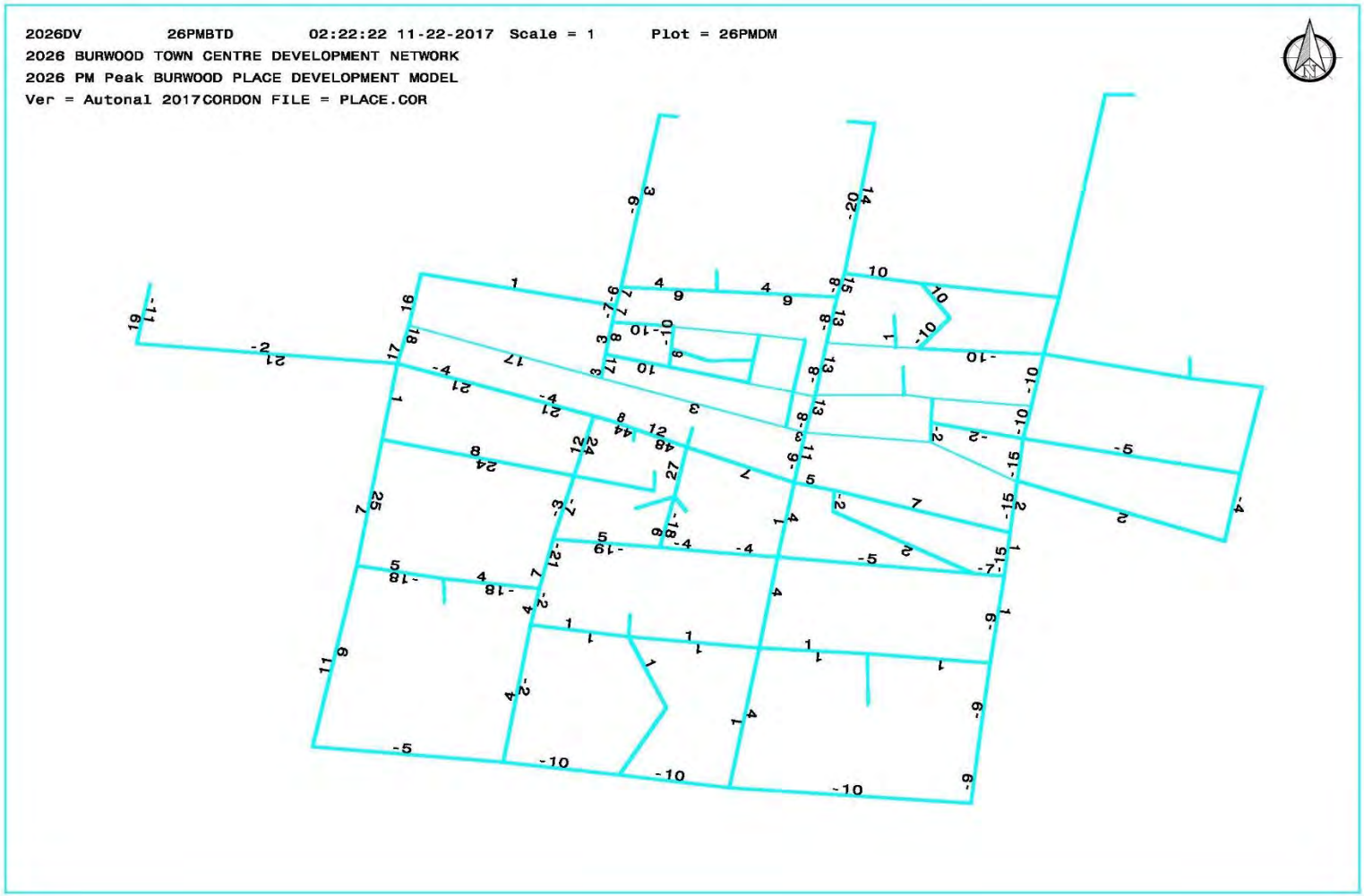
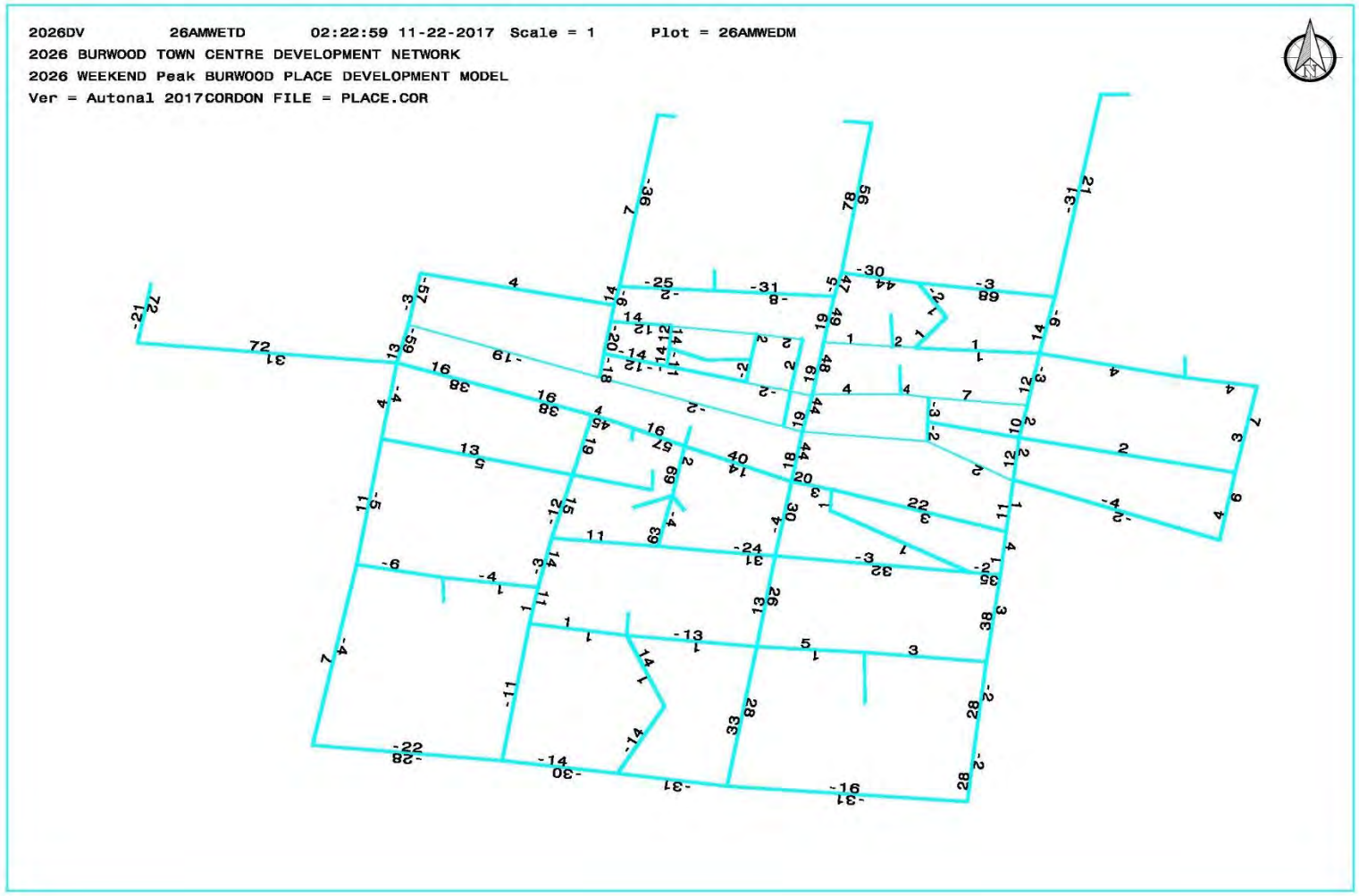


Figure 71 2026 WE Peak Wynne Avenue Difference Plot

Source Road Delay Solutions, 2018



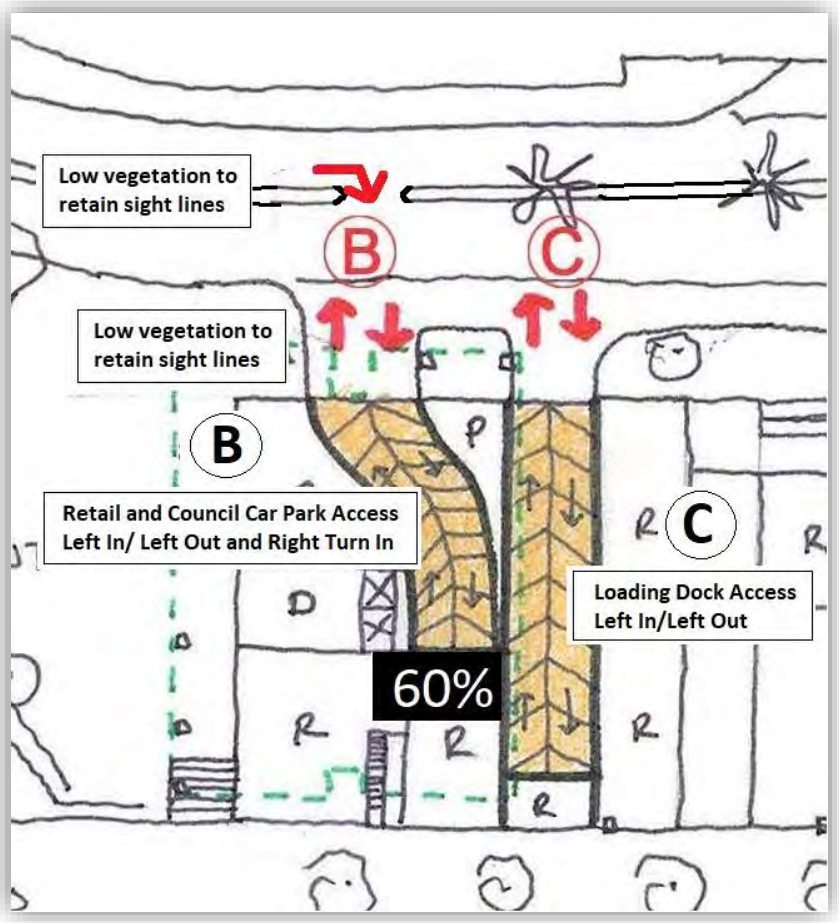
6.20 Railway Parade Access

The modelled access locations on Railway Parade and Wynne Avenue are subject to on going discussions between the proponent, Council and key stakeholders.

For the purpose of the Planning Proposal, the access locations have been tentatively located to service the two sites. Details of their design and final proposed locations are to be considered during the DA design stage.

The proposed sign controlled access on Railway Parade has been found to operate at a good LoS 'A' for all peak periods. The intersection is proposed to incorporate…

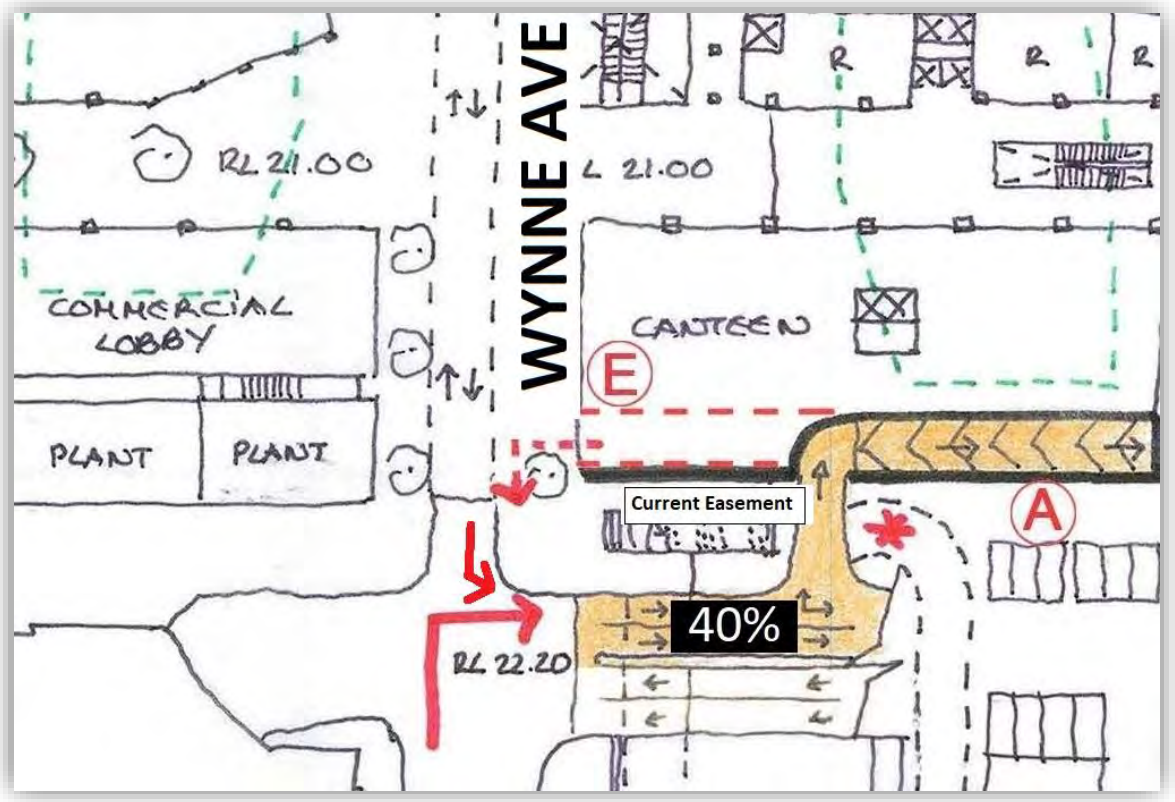
- *Sign priority control,*
- *Adjacent western and eastern entry points, separated by some 2 metres…*
  - *With the Western most access designated for residential, commercial, visitor and retail activity uses, and*
  - *An Eastern driveway access to the below ground level loading docks catering for left in/left out movements only.*
- *Modification of the central median in Railway Parade to allow for a single lane right turn movement from Railway Parade, eastbound, into the residential, commercial, visitor and retail activities,*
- *Permit entry to Council's library car park,*
- *Location a minimum of 60m east from the Conder Street intersection,*
- *Clearly identified multiple lane entry for the differing uses within the site,*
- *Employment of a right turn ban from Railway Parade into the eastern loading dock access, and*
- *Employment of a right turn ban from both the western and eastern driveways onto Railway Parade.*



The access has been modelled, at this time, to cater for a maximum 60% of the development's retail traffic generation, representing the *worst case scenario*, and to be located a minimum of 60m, east from Conder Street, to provide satisfactory sight distance and queueing capacity.

The final configuration, traffic composition and location will be determined during the DA design stage in consultation with Council and any key stakeholders.

6.21 Wynne Avenue Entry



Discussions are currently underway as to the viability of a possible entry utilising the current easement to the development from Wynne Avenue. Modelling reports a LoS 'B' at the location when servicing some 40% of the Place development's traffic generation.

In conjunction with the possible partial closure of Wynne Avenue, it is anticipated that the access will be reinforced by a low speed environment and reduced severity of any potential pedestrian vehichular conflicts.

6.22 Current Belmore Street Access

Historically recognised as an access location to the former Burwood Plaza, the right of carriageway (easement) is to be considered as to the viability of an egress for the future Burwood Place and will be determined prior to DA submission.

6.23 Railway Parade and Conder Street

The introduction of traffic signal control is proposed under Counci'ls Section 94 Infrastructure Plan.

The signalisation of the site will formalise pedestrian movements and effectively manage the increasing vehicle activity. The future signalised pedestrian crossings at the site should be designed 5m wide to increase the throughput and reduce the delay of pedestrians per phase.

Of critical note when introducing traffic signals at the site is the inclusion of a 'U' turn provision for buses only in Railway Parade, westbound. Current bus lay over provisions on the northern side of Railway Parade, adjacent to Burwood Central, necessitate the need for a 'U' turn facility for buses only. Modelling of the site has reported a satisfactory LoS while incorporating a 'U' turn movement occurring prior to 'A' phase. The movement is to be controlled by use of an exclusive 20m long bus lane and bus lantern display.

6.24 Burwood Road and Victoria Street East

TfNSW has formerly requested consideration of traffic signalisation of the Burwood Road intersection with Victoria Street East to facilitate the right turn movement northbound for buses only to enable access to bus layover provisions in Victoria Street East, adjacent to Westfields.

Bus priority and a 'B' signal lantern display is proposed at the Burwood Road intersection with Victoria Street East. The bus movement is proposed to occur during the intergreen period prior to 'A' phase.

The proposal considers the introduction of through and right turn movements by buses only from the kerb side lane during the peak periods 6 to 10am and 3 to 7pm, Monday to Friday. This measure will eliminate the need for buses to merge from the kerb side lane to the centre lane prior to turning right into Victoria Street reducing the incidence of delay to the central through lane traffic.

The design of the site should incorporate 5m wide signalised pedestrian crossings to increase throughput and reduce delays per phase.

The area around the site has been identified as a known 'J' walking location and with the introduction of traffic signals, and the incorporation of controlled pedestrian crossings, pedestrian amenity and safety will be improved.

The site reports a LoS 'A' during the AM and weekend peak periods while 'B' during the PM weekday commuter peak period. The recommended intersection also reports satisfactory DS levels and effective spare capacity for further growth.

6.25 Belmore Street and Conder Street

The introduction of traffic signal control at the site is proposed under Counci'ls Section 94 Infrastructure Plan.

The signals will provide improved management and formalisation of vehicle movements and pedestrian demands.

The site reports a LoS 'B' during each of the modelled peak hour periods.

6.26 Belmore Street and Wynne Avenue

The introduction of traffic signal control at the site is proposed under Counci'ls Section 94 Infrastructure Plan.

Once again, the introduction of traffic signals will provide improved management and formalisation of vehicle movements and pedestrian demands.

Figure 72 2026 AM Peak Plaza Development Model

Source Road Delay Solutions, 2018

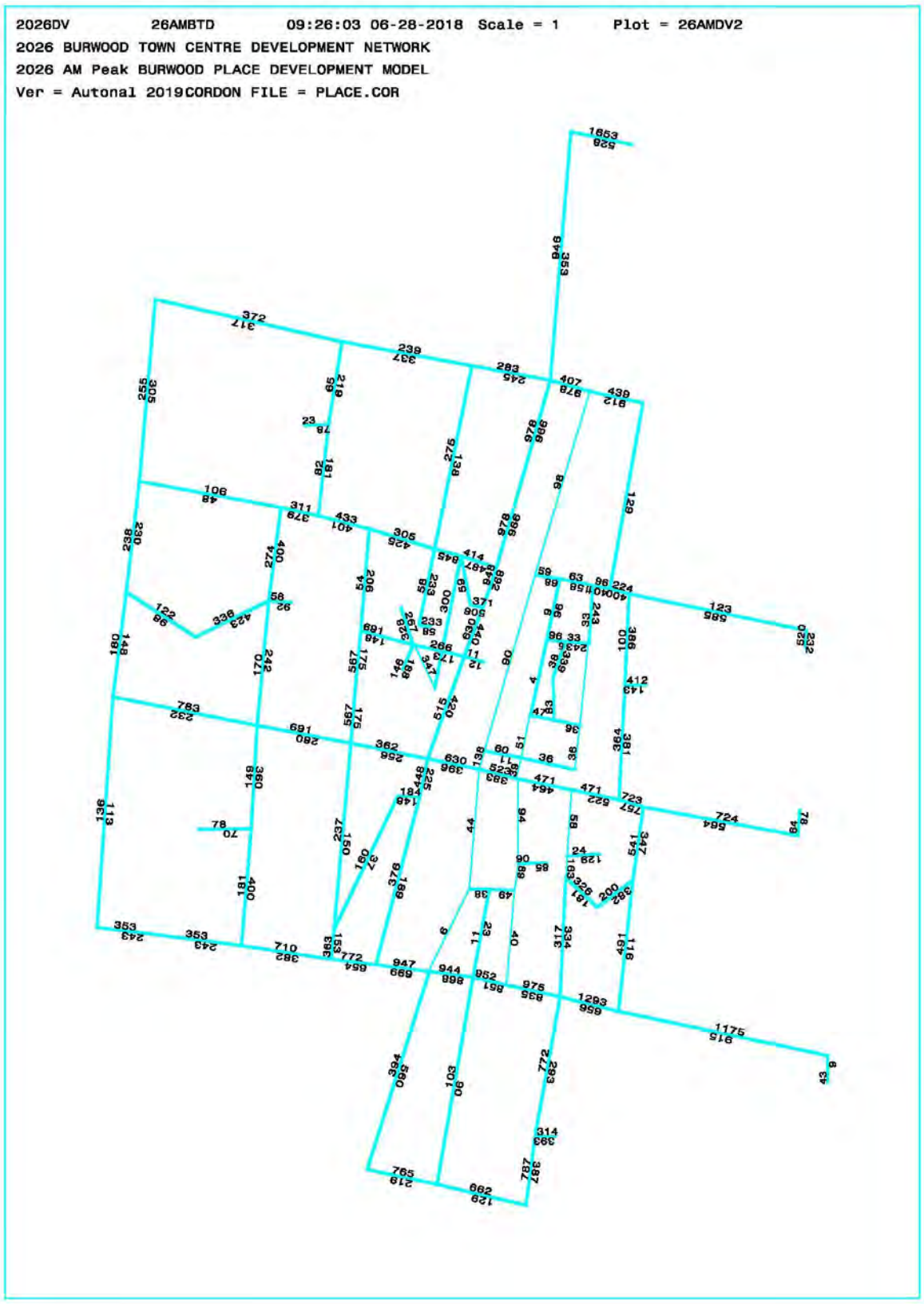


Figure 73 2026 PM Peak Plaza Development Model

Source Road Delay Solutions, 2018

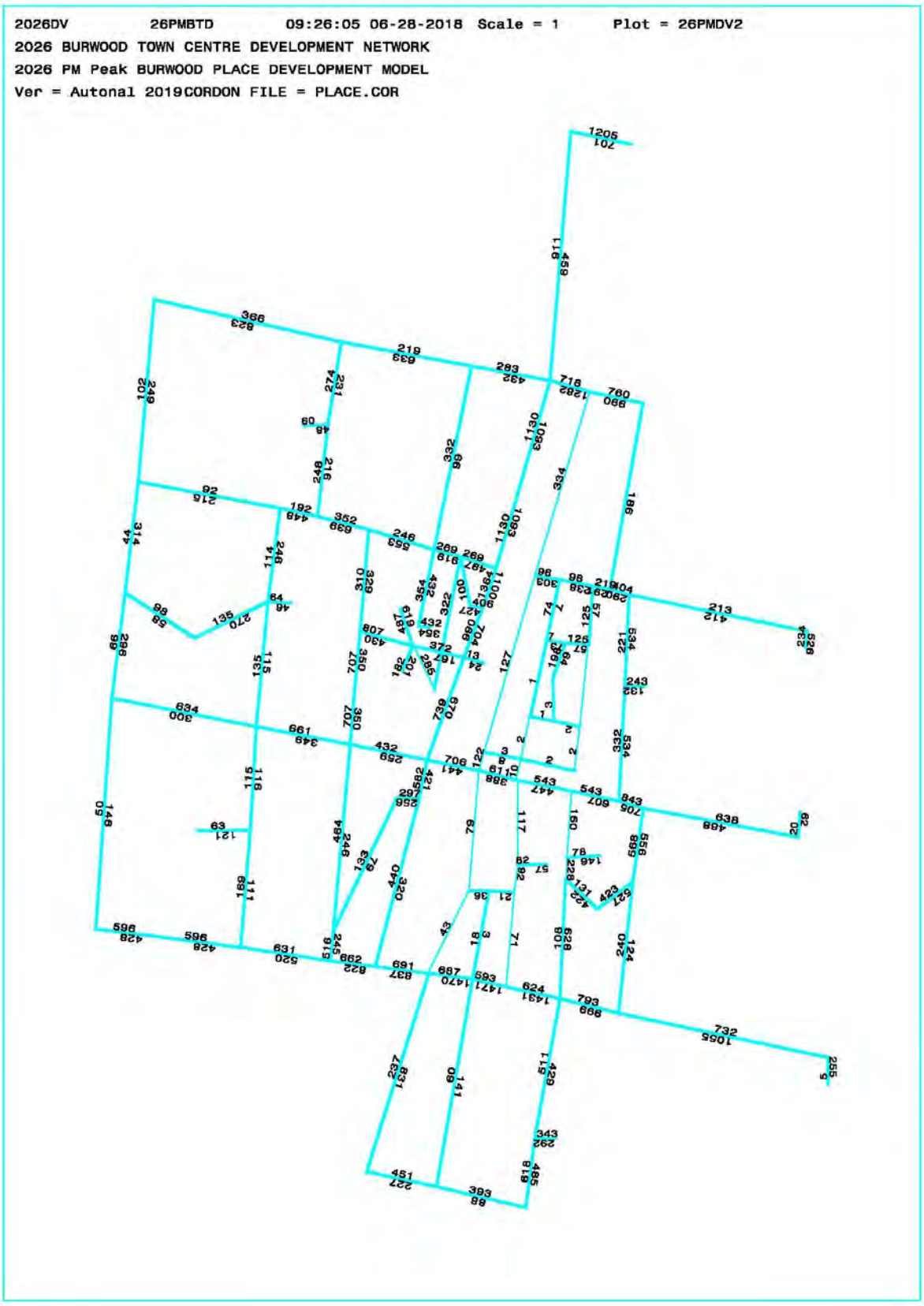


Figure 74 2026 WE Peak Plaza Development Model

Source Road Delay Solutions, 2018

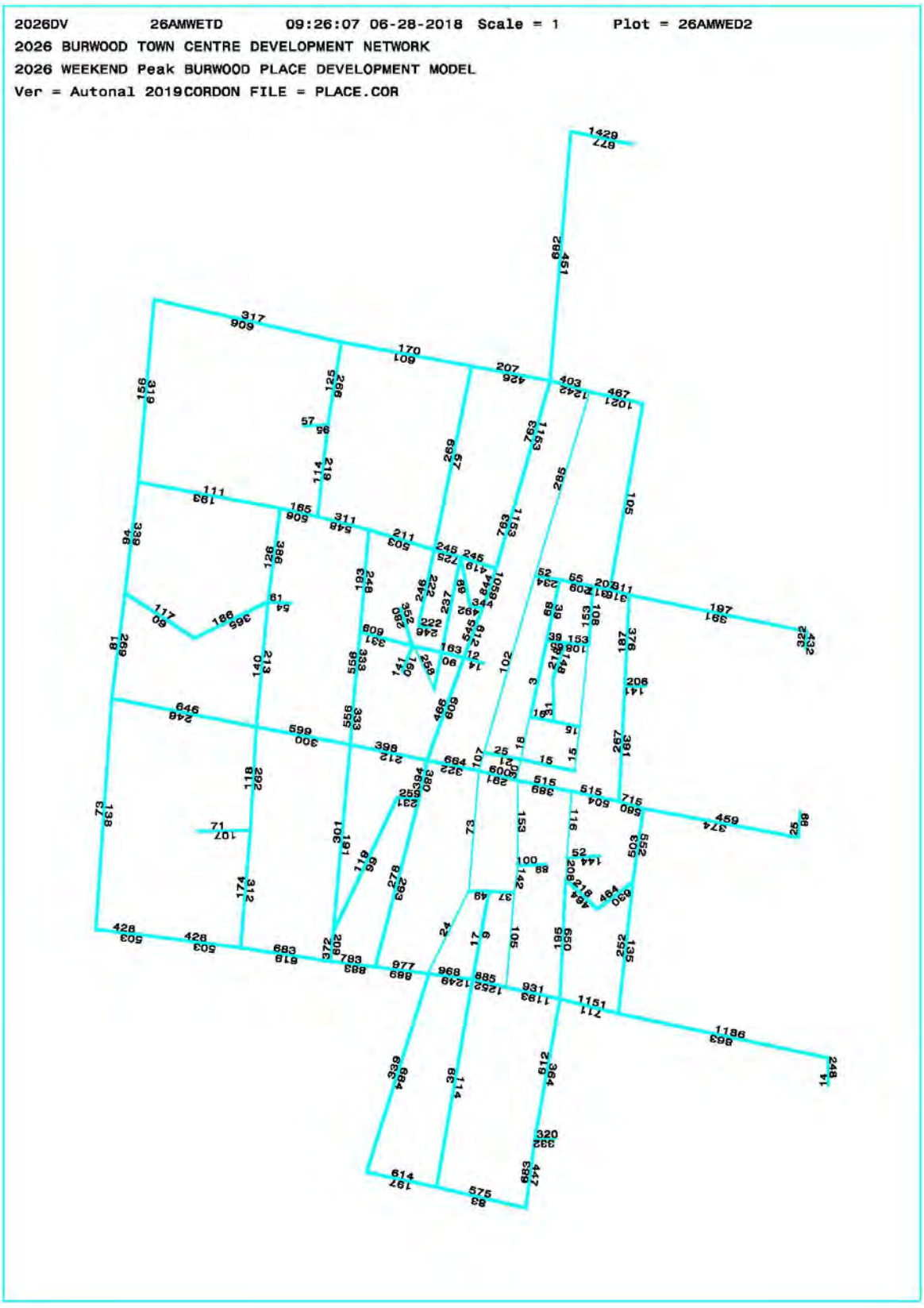
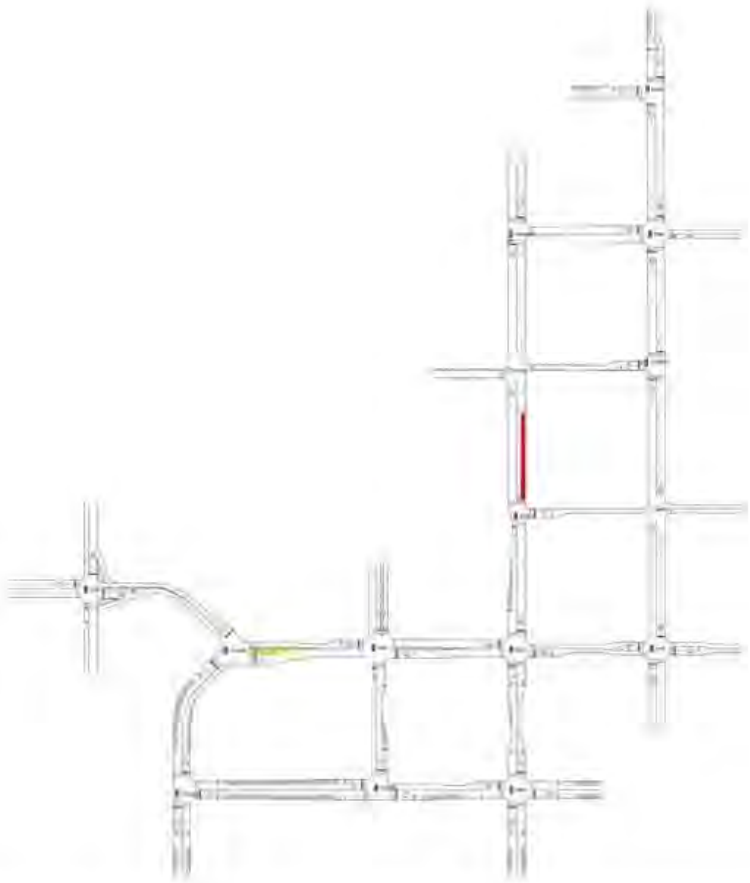


Figure 75 2026 SIDRA Development Model Road Network

Source Sidra/Road Delay Solutions, 2018



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
0107	NA	2026 AM Shaftesbury Rd, Railway Pde and Paisley St
0144	NA	2026 AM Shaftesbury Rd and Wilga St UPGRADED
0784	NA	2026 AM Shaftesbury Road and Victoria Street
TCS007	NA	2026 AM Shaftesbury Rd and George St - Conversion
GW02	NA	2026 AM Shaftesbury Rd and Deane St
TCS0008	NA	2026 AM Burwood Rd and Victoria St - Conversion
GW03	NA	2026 AM Burwood Rd and George St
0174	NA	2026 AM S94 Burwood Rd and Deane St
0014	NA	2026 AM S94 Burwood Rd and Railway Pde
1639	NA	2026 AM S94 Burwood Rd and Belmore St
1843	NA	2026 AM S94 Railway Pde and Wynne Ave
TCS001	NA	2026 AM S94 Railway Pde and Conder St
TCS002	NA	2026 AM S94 Belmore St and Wynne Ave
TCS003	NA	2026 AM S94 Belmore St and Conder St
1183	NA	2026 AM S94 Wentworth Rd, Railway Pde and Morwick St

Figure 76 2026 SIDRA Development Model AM Peak Network Report

Source Sidra/Road Delay Solutions, 2018

NETWORK SUMMARY

Network: N101 [2026 AM Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS F			
Travel Time Index	1.97			
Speed Efficiency	0.28			
Congestion Coefficient	3.61			
Travel Speed (Average)	16.6 km/h		2.3 km/h	13.0 km/h
Travel Distance (Total)	7820.9 veh-km/h		539.3 ped-km/h	11348.5 pers-km/h
Travel Time (Total)	470.2 veh-h/h		233.5 ped-h/h	874.1 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	24634 veh/h		16009 ped/h	38763 pers/h
Arrival Flows (Total for all Sites)	24478 veh/h		16009 ped/h	38570 pers/h
Demand Flows (Entry Total)	6618 veh/h			
Midblock Inflows (Total)	2756 veh/h			
Midblock Outflows (Total)	-2026 veh/h			
Percent Heavy Vehicles (Demand)	3.1 %			
Percent Heavy Vehicles (Arrival)	3.1 %			
Degree of Saturation	1.501			
Control Delay (Total)	311.37 veh-h/h		118.25 ped-h/h	535.61 pers-h/h
Control Delay (Average)	45.8 sec		26.6 sec	50.0 sec
Control Delay (Worst Lane)	499.6 sec			
Control Delay (Worst Movement)	499.6 sec		45.2 sec	499.6 sec
Geometric Delay (Average)	1.5 sec			
Stop-Line Delay (Average)	44.3 sec			
Queue Storage Ratio (Worst Lane)	1.53			
Total Effective Stops	20417 veh/h		12762 ped/h	42558 pers/h
Effective Stop Rate	0.83 per veh	2.6 per km	0.80 per ped	1.10 per pers
Proportion Queued	0.73		0.80	1.02
Performance Index	1778.4		304.4	2082.8
Cost (Total)	18822.20 $/h	2.41 $/km	5883.92 $/h	24706.13 $/h
Fuel Consumption (Total)	1283.9 L/h	164.2 mL/km		
Fuel Economy	16.4 L/100km			
Carbon Dioxide (Total)	3027.6 kg/h	387.1 g/km		
Hydrocarbons (Total)	0.318 kg/h	0.041 g/km		
Carbon Monoxide (Total)	2.619 kg/h	0.335 g/km		
NOx (Total)	2.780 kg/h	0.355 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 21.5 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	11,824,360 veh/y	7,684,081 ped/y	18,606,240 pers/y
Delay	149,456 veh-h/y	56,759 ped-h/y	257,093 pers-h/y
Effective Stops	9,800,342 veh/y	6,125,518 ped/y	20,427,610 pers/y
Travel Distance	3,754,023 veh-km/y	258,877 ped-km/y	5,447,254 pers-km/y
Travel Time	225,676 veh-h/y	112,075 ped-h/y	419,577 pers-h/y
Cost	9,034,657 $/y	2,824,284 $/y	11,858,940 $/y
Fuel Consumption	616,285 L/y		
Carbon Dioxide	1,453,271 kg/y		

Figure 77 2026 SIDRA Development Model AM Peak 95th % Queues

Source Sidra/Road Delay Solutions, 2018

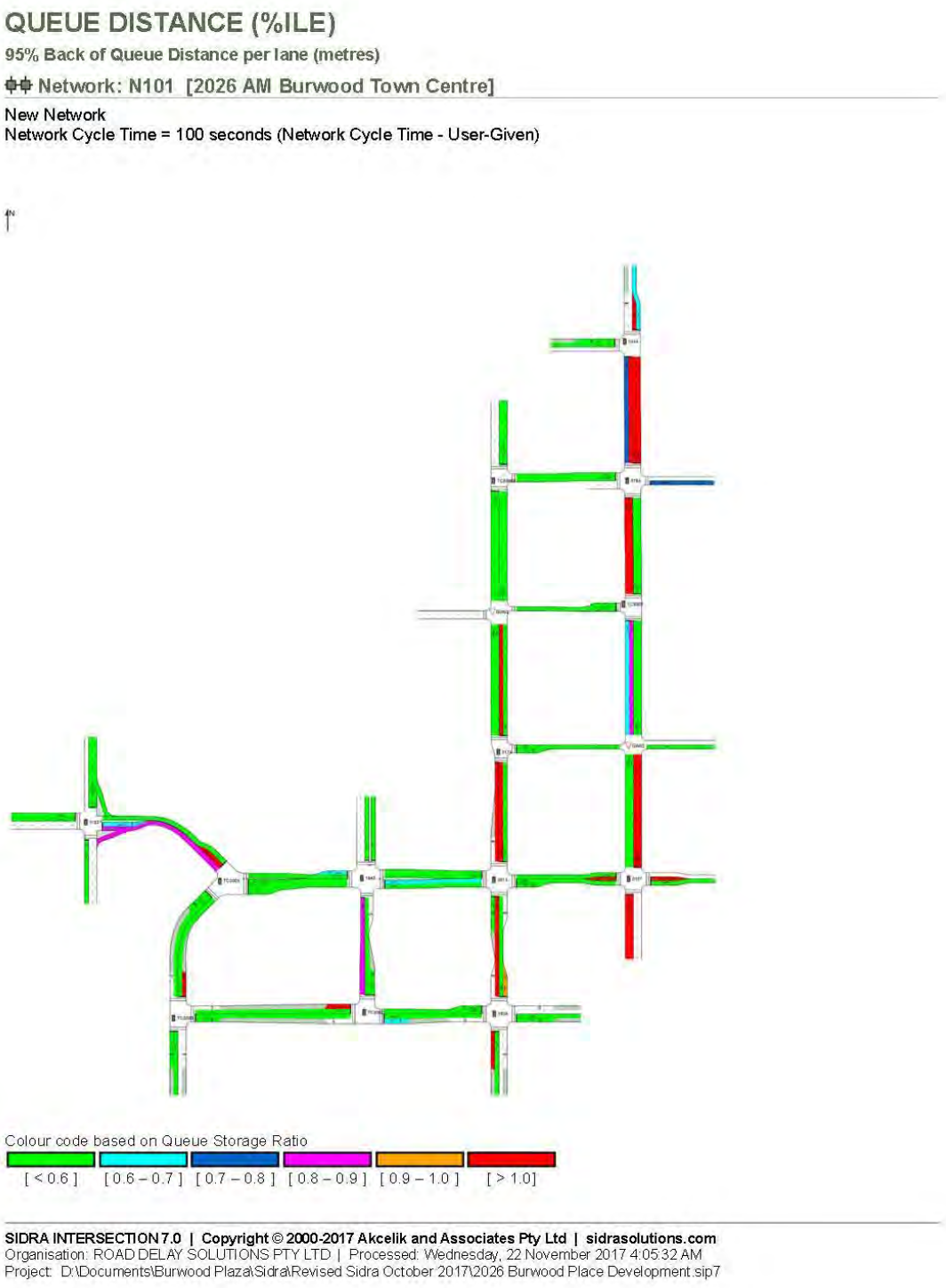


Figure 78 2026 SIDRA Development Model PM Peak Network Report

Source Sidra/Road Delay Solutions, 2018

NETWORK SUMMARY

Network: N101 [2026 PM Burwood Town Centre]

New Network
Network Cycle Time = 110 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS F			
Travel Time Index	0.67			
Speed Efficiency	0.16			
Congestion Coefficient	6.24			
Travel Speed (Average)	9.6 km/h		2.0 km/h	8.6 km/h
Travel Distance (Total)	8849.7 veh-km/h		585.2 ped-km/h	12764.5 pers-km/h
Travel Time (Total)	919.9 veh-h/h		289.1 ped-h/h	1476.9 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	28938 veh/h		17358 ped/h	45195 pers/h
Arrival Flows (Total for all Sites)	27837 veh/h		17358 ped/h	43766 pers/h
Demand Flows (Entry Total)	7248 veh/h			
Midblock Inflows (Total)	3825 veh/h			
Midblock Outflows (Total)	-3202 veh/h			
Percent Heavy Vehicles (Demand)	3.0 %			
Percent Heavy Vehicles (Arrival)	3.1 %			
Degree of Saturation	4.072			
Control Delay (Total)	724.19 veh-h/h		164.07 ped-h/h	1080.39 pers-h/h
Control Delay (Average)	93.7 sec		34.0 sec	88.9 sec
Control Delay (Worst Lane)	2797.5 sec			
Control Delay (Worst Movement)	2798.8 sec		51.9 sec	2798.8 sec
Geometric Delay (Average)	1.4 sec			
Stop-Line Delay (Average)	92.3 sec			
Queue Storage Ratio (Worst Lane)	1.44			
Total Effective Stops	24723 veh/h		13350 ped/h	47682 pers/h
Effective Stop Rate	0.89 per veh	2.8 per km	0.77 per ped	1.09 per pers
Proportion Queued	0.70		0.77	0.98
Performance Index	2830.2		363.3	3193.5
Cost (Total)	34028.54 $/h	3.85 $/km	7285.59 $/h	41314.13 $/h
Fuel Consumption (Total)	1947.2 L/h	220.0 mL/km		
Fuel Economy	22.0 L/100km			
Carbon Dioxide (Total)	4587.2 kg/h	518.3 g/km		
Hydrocarbons (Total)	0.503 kg/h	0.057 g/km		
Carbon Monoxide (Total)	3.691 kg/h	0.417 g/km		
NOx (Total)	3.299 kg/h	0.373 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 41.0 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	13,890,270 veh/y	8,331,829 ped/y	21,693,820 pers/y
Delay	347,612 veh-h/y	78,752 ped-h/y	518,589 pers-h/y
Effective Stops	11,866,880 veh/y	6,408,216 ped/y	22,887,460 pers/y
Travel Distance	4,247,870 veh-km/y	280,901 ped-km/y	6,126,979 pers-km/y
Travel Time	441,529 veh-h/y	138,773 ped-h/y	708,891 pers-h/y
Cost	16,333,700 $/y	3,497,084 $/y	19,830,780 $/y
Fuel Consumption	934,640 L/y		
Carbon Dioxide	2,201,877 kg/y		

Figure 79 2026 SIDRA Development Model PM Peak 95th % Queues

Source Sidra/Road Delay Solutions, 2018

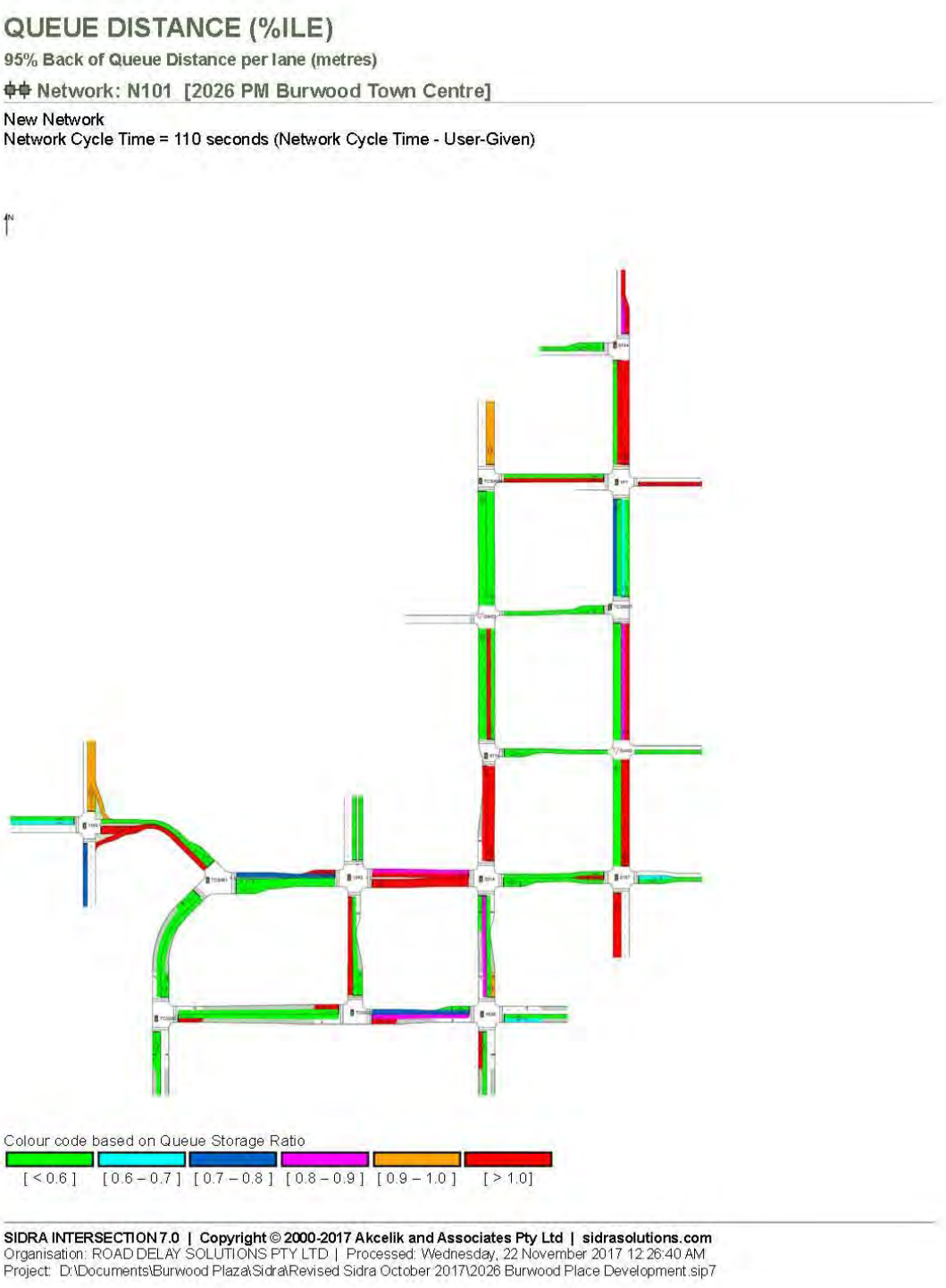


Figure 80 2026 SIDRA Development Model WE Peak Network Report

Source Sidra/Road Delay Solutions, 2018

NETWORK SUMMARY

Network: N101 [2026 WE Burwood Town Centre]

New Network
Network Cycle Time = 100 seconds (Network Cycle Time - User-Given)

Network Performance - Hourly Values

Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	2.36			
Speed Efficiency	0.31			
Congestion Coefficient	3.20			
Travel Speed (Average)	18.7 km/h		2.1 km/h	13.6 km/h
Travel Distance (Total)	7773.7 veh-km/h		545.0 ped-km/h	11229.2 pers-km/h
Travel Time (Total)	415.2 veh-h/h		258.2 ped-h/h	824.6 pers-h/h
Desired Speed	60.0 km/h			
Demand Flows (Total for all Sites)	25226 veh/h		16166 ped/h	39771 pers/h
Arrival Flows (Total for all Sites)	25024 veh/h		16166 ped/h	39521 pers/h
Demand Flows (Entry Total)	7042 veh/h			
Midblock Inflows (Total)	2630 veh/h			
Midblock Outflows (Total)	-2893 veh/h			
Percent Heavy Vehicles (Demand)	2.9 %			
Percent Heavy Vehicles (Arrival)	3.0 %			
Degree of Saturation	1.382			
Control Delay (Total)	259.65 veh-h/h		141.77 ped-h/h	489.25 pers-h/h
Control Delay (Average)	37.4 sec		31.6 sec	44.6 sec
Control Delay (Worst Lane)	398.2 sec			
Control Delay (Worst Movement)	398.2 sec		44.6 sec	398.2 sec
Geometric Delay (Average)	1.5 sec			
Stop-Line Delay (Average)	35.8 sec			
Queue Storage Ratio (Worst Lane)	1.44			
Total Effective Stops	18198 veh/h		12786 ped/h	38422 pers/h
Effective Stop Rate	0.73 per veh	2.3 per km	0.79 per ped	0.97 per pers
Proportion Queued	0.68		0.79	0.95
Performance Index	1608.0		329.3	1937.2
Cost (Total)	16734.98 $/h	2.15 $/km	6507.43 $/h	23242.41 $/h
Fuel Consumption (Total)	1193.1 L/h	153.5 mL/km		
Fuel Economy	15.3 L/100km			
Carbon Dioxide (Total)	2812.1 kg/h	361.7 g/km		
Hydrocarbons (Total)	0.289 kg/h	0.037 g/km		
Carbon Monoxide (Total)	2.442 kg/h	0.314 g/km		
NOx (Total)	2.359 kg/h	0.303 g/km		

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 19.1 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New South Wales.

Network Performance - Annual Values

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total for all Sites)	12,108,280 veh/y	7,759,871 ped/y	19,090,140 pers/y
Delay	124,632 veh-h/y	68,050 ped-h/y	234,842 pers-h/y
Effective Stops	8,735,273 veh/y	6,137,135 ped/y	18,442,690 pers/y
Travel Distance	3,731,381 veh-km/y	261,618 ped-km/y	5,389,996 pers-km/y
Travel Time	199,275 veh-h/y	123,951 ped-h/y	395,824 pers-h/y
Cost	8,032,791 $/y	3,123,568 $/y	11,156,360 $/y
Fuel Consumption	572,671 L/y		
Carbon Dioxide	1,349,793 kg/y		

Figure 81 2026 SIDRA Development Model WE Peak 95th % Queues

Source Sidra/Road Delay Solutions, 2018

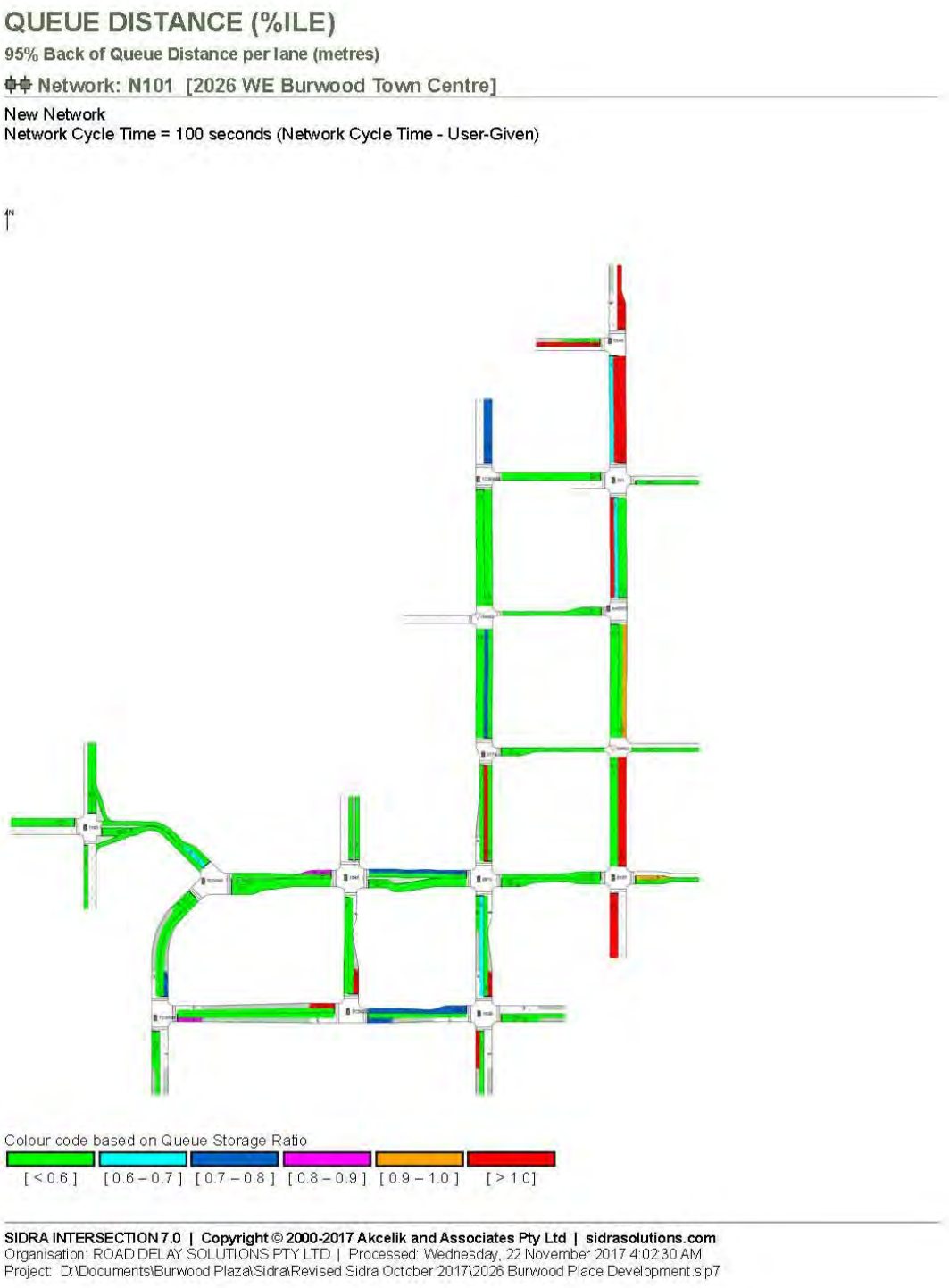


Table 11 Modelled Vehicle Projections

Source Road Delay Solutions, 2018

MESOSCOPIC MODEL HOURLY TRAFFIC VOLUME PROJECTIONS																					
	Model																				
Road Link	17AM4	26AMBT	Variance 2026 Base Model minus Existing	26AMS94B	Variance 2026 S94 Model minus Existing	26AMDV2	Variance 2026 Towers Model minus Existing	17PM3	26PMBT	Variance 2026 Base Model minus Existing	26PMS94B	Variance 2026 S94 Model minus Existing	26PMDV2	Variance 2026 Towers Model minus Existing	17AMWE6	26AMWEB	Variance 2026 Base Model minus Existing	26AMWES B	Variance 2026 S94 Model minus Existing	26AMWED2	Variance 2026 Towers Model minus Existing
BURWOOD RD SB N WILGA ST	562	655	93	717	62	564	2	452	609	157	442	-10	488	36	371	627	256	429	58	374	3
WILGA ST EB	386	327	-59	404	77	347	-39	541	474	-67	516	-25	556	15	581	646	65	567	-14	552	-29
WILGA ST WB	501	479	-22	583	104	541	40	472	564	92	509	37	568	96	489	511	22	564	75	503	14
PARK AVE EB	460	482	22	411	-71	381	-79	507	507	0	490	-17	534	27	536	604	68	403	-133	391	-145
PARK AVE WB	359	415	56	398	-17	364	5	349	297	-52	343	-6	332	-17	298	264	-34	311	13	267	-31
BURWOOD RD NB S PARK AVE	487	519	32	419	-100	471	-16	486	602	116	464	-22	543	57	423	497	74	550	127	515	92
BURWOOD RD SB S PARK AVE	540	613	73	529	-84	522	-18	502	762	260	457	-45	607	105	496	778	282	515	19	504	8
BURWOOD RD SB N GEORGE ST	471	538	67	482	-56	464	-7	389	575	186	335	-54	447	58	346	651	305	417	71	389	43
GEORGE ST EB	84	244	160	212	-32	334	250	58	592	534	488	430	628	570	71	611	540	461	390	650	579
GEORGE ST WB W BURWOOD RD	140	98	-42	68	-30	39	-101	179	53	-126	43	-136	10	-169	106	58	-48	71	-35	30	-76
RAILWAY CRES WB	93	132	39	54	-78	138	45	56	193	137	42	-14	122	66	73	165	92	51	-22	107	34
DEANE ST WB	173	77	-96	67	-10	44	-129	216	106	-110	72	-144	79	-137	137	71	-66	86	-51	73	-64
BURWOOD RD NB N RAILWAY PDE	588	692	104	513	-179	630	42	569	826	257	545	-24	706	137	523	697	174	644	121	664	141
RAILWAY PDE EB W BURWOOD RD	428	469	41	408	-61	396	-32	395	596	201	282	-113	441	46	334	623	289	326	-8	322	-12
RAILWAY PDE WB E BURWOOD RD	415	334	-81	379	45	448	33	416	299	-117	474	58	582	166	448	313	-135	343	-105	394	-54
RAILWAY PDE EB E BURWOOD RD	341	390	49	291	-99	225	-116	411	451	40	566	155	421	10	400	435	35	362	-38	380	-20
BURWOOD RD NB S RAILWAY PDE	509	511	2	382	-129	362	-147	446	555	109	362	-84	432	-14	484	585	101	354	-130	398	-86
BURWOOD RD SB S RAILWAY PDE	311	308	-3	261	-47	256	-55	312	414	102	194	-118	259	-53	274	404	130	241	-33	212	-62
BURWOOD CENTRAL NB	11	10	-1	11	1	11	0	12	11	-1	13	1	13	1	11	10	-1	12	1	12	1
BURWOOD CENTRAL SB	12	12	0	12	0	12	0	22	24	2	24	2	24	2	13	14	1	14	1	14	1
RAILWAY PDE EB W WYNNE AVE	369	397	28	352	-45	440	71	472	476	4	831	359	704	232	473	434	-39	584	111	612	139
RAILWAY PDE WB W WYNNE AVE	480	388	-92	870	482	630	150	607	496	-111	910	303	990	383	463	455	-8	549	86	545	82
RAILWAY PDE EB W CONDER ST	507	689	182	361	-328	996	489	516	1188	672	638	122	1093	577	573	855	282	657	84	1153	580
RAILWAY PDE WB W CONDER ST	476	997	521	986	-11	978	502	584	699	115	1041	457	1130	546	436	606	170	528	92	763	327
CONDER ST NB	239	299	60	502	203	305	66	217	221	4	376	159	246	29	202	221	19	227	25	211	9
CONDER ST SB	212	213	1	223	10	487	275	102	294	192	353	251	497	395	183	207	24	249	66	419	236
BELMORE ST EB W BURWOOD RD	231	171	-60	162	-9	175	-56	333	464	131	498	165	350	17	403	466	63	382	-21	333	-70
BELMORE ST WB W BURWOOD RD	178	331	153	718	387	567	389	206	317	111	477	271	707	501	181	308	127	466	285	556	375
BELMORE ST WB E BURWOOD RD	138	218	80	286	68	237	99	183	241	58	326	143	464	281	144	212	68	265	121	301	157
BELMORE ST EB E BURWOOD RD	132	140	8	138	-2	150	18	160	190	30	117	-43	246	86	201	196	-5	239	38	191	-10
WYNNE AVE NB N BELMORE RD	128	401	273	777	376	266	138	132	485	353	712	580	372	240	117	259	142	359	242	163	46
WYNNE AVE SB N BELMORE RD	182	337	155	364	27	173	-9	168	238	70	457	289	167	-1	147	227	80	171	24	90	-57
CONDER ST NB S BELMORE ST	338	356	18	518	162	433	95	193	339	146	378	185	352	159	259	326	67	237	-22	311	52
CONDER ST SB N BELMORE ST	159	297	138	190	-107	425	266	228	221	-7	162	-66	553	325	231	295	64	222	-9	503	272
BELMORE ST WB E CONDER ST	90	93	3	111	18	54	-36	228	299	71	273	45	310	82	171	245	74	232	61	193	22
BELMORE ST EB E CONDER ST	197	122	-75	94	-28	206	9	146	259	113	115	-31	329	183	245	257	12	159	-86	248	3
WENTWORTH NB S RAILWAY	223	781	558	339	-442	283	60	376	444	68	319	-57	283	-93	228	220	-8	415	187	207	-21
WENTWORTH SB S RAILWAY	337	513	176	467	-46	245	-92	529	853	324	662	133	432	-97	516	390	-126	576	60	426	-90
RAILWAY WB E WENTWORTH	478	1511	1033	986	-525	978	500	598	1032	434	1041	443	1130	532	440	610	170	528	88	763	323
RAILWAY EB E WENTWORTH	516	1288	772	361	-927	996	480	517	1367	850	638	121	1093	576	581	863	282	657	76	1153	572
WENTWORTH SB N RAILWAY	643	793	150	747	-46	978	335	1002	1315	313	1066	64	1282	280	851	1056	205	1075	224	1242	391
MORWICK EB W WENTWORTH	596	515	-81	257	-258	353	-243	517	687	170	548	31	459	-58	640	618	-22	396	-244	451	-189
SHAFTESBURY NB S RAILWAY	635	656	21	729	73	772	137	613	629	16	597	-16	662	49	689	674	-15	848	159	783	94
SHAFTESBURY SB S RAILWAY	541	546	5	603	57	654	113	593	700	107	758	165	822	229	612	688	76	787	175	883	271
PAISLEY EB E SHAFTESBURY	380	355	-25	137	-218	161	-219	443	758	315	180	-263	221	-222	346	370	24	85	-261	157	-189
PAISLEY WB E SHAFTESBURY	564	104	-460	295	191	479	-85	432	74	-358	301	-131	355	-77	440	89	-351	208	-232	331	-109
SHAFTESBURY NB N RAILWAY	797	766	-31	889	123	947	150	766	738	-28	851	85	691	-75	829	831	2	1094	265	977	148
SHAFTESBURY SB N RAILWAY	521	820	299	662	-158	699	178	769	1294	525	801	32	837	68	641	956	315	862	221	889	248
RAILWAY WB W SHAFTESBURY	327	250	-77	305	55	376	49	342	183	-159	343	1	440	98	313	197	-116	206	-107	278	-35
SHAFTESBURY SB N WILGA	682	703	21	798	95	915	233	906	846	-60	963	57	1055	149	569	492	-77	690	121	863	294
WILGA EB W SHAFTESBURY	146	68	-78	130	62	116	-30	146	109	-37	140	-6	124	-22	119	87	-32	115	-4	135	16
SHAFTESBURY NB S WILGA	917	920	3	1071	151	1293	376	638	753	115	784	146	793	155	718	801	83	918	200	1151	433
SHAFTESBURY SB N VICTORIA	464	445	-19	622	177	656	192	917	777	-140	943	26	999	82	536	440	-96	633	97	711	175
VICTORIA WB E SHAFTESBURY	540	668	128	624	-44	772	232	324	465	141	405	81	511	187	324	494	170	518	194	612	288
SHAFTESBURY NB S VICTORIA	831	924	93	1010	86	975	144	594	714	120	742	148	624	30	757	888	131	895	138	931	174
VICTORIA EB W SHAFTESBURY	241	244	3	212	-32	334	93	524	592	68	488	-36	628	104	528	611	83	461	-67	650	122

LOADING DOCK MANAGEMENT PLAN

Prior to submission of the DA a concise Loading Dock Management Plan (LDMP) will be prepared and presented addressing the location, responsibilities and machinations of the dock, and its operators, outlining mitigation treatment(s), as required, to minimise the impact on the surrounding road network and its users.

SUSTAINABLE TRAVEL PLAN

Prior to submission of the DA a concise Sustainable Travel Plan will be prepared and presented addressing the opportunities for a reduction in private and commercial vehicle usage.

CONCLUSION

Road Delay Solutions has been engaged by *Holdmark Property NSW Pty Ltd* to undertake the preparation of a Traffic Impact Assessment in support of the Planning Proposal for a mixed use development at 42-50 and 52-60 Railway Parade, Burwood, commonly known as '*Burwood Plaza*'.

Burwood is a dynamic LGA with the town centre constantly growing with planned residential, retail and commercial developments, some well into their construction phases. The Burwood Plaza redevelopment is just one of these.

Extensive mesoscopic and operational modelling has reported that vehicular growth, particularly along Burwood Road is relatively static and any further growth is shared with the competing routes of Shaftesbury Road and Wentworth Road. Shaftesbury Road, in particular, provides a viable through traffic avenue between the Hume Highway to the south and Great Western Highway to the north, which removes pressure from Burwood Road.

This report has critically analysed the impacts of the Burwood Place development on the Burwood Town Centre road network and concluded that the impacts of traffic generation, both vehicular and pedestrian, is benign on a network of roads which currently operate at capacity.

The impacts of growth throughout the centre, not only that of the Burwood Place site, indicate that future traffic is able to mesh with the current travel patterns indicating a degree of '*elasticity*' which can be supported until such time as capacity constraints prevent use of the road network bordering the town centre.

This assessment has concluded that, once the proposed infrastructure outlined in Council's Section 94 Contributions Plan has been implemented, any impacts of traffic generation, both vehicular and pedestrian, is benign on the town centre's road network.

A number of measures (in conjunction and additional to the infrastructure outlined in Council's S94 Plan) have been identified and assessed in unison to sustain the movement of traffic within the town centre and support the planned level of growth anticipated with the Burwood Place development to year 2026. These works include…

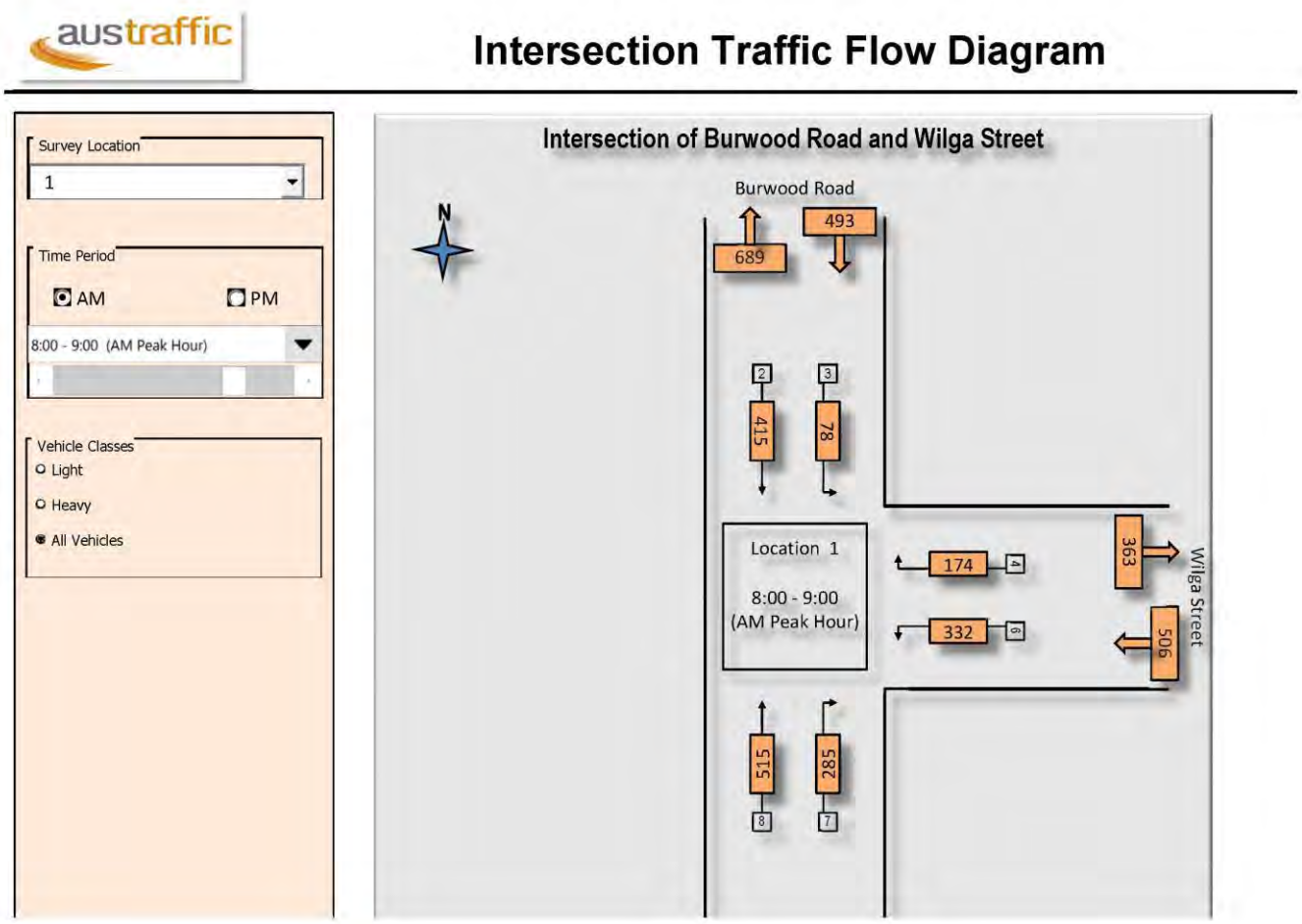
- → *Widening of existing signalised foot crossings along Burwood Road between Wilga Street and Belmore Street to 5m,*
- → *General retention of the current traffic signal operations at the Burwood Road intersections with Railway Parade (including retention of the right turn movement for all vehicles southbound turning into Railway Parade) and Belmore Street,*
- → *The introduction of a 'scramble' phase pedestrian crossing at the Burwood Road intersection with Railway Parade,*
- → *Introduction of a partial closure of Wynne Avenue to accommodate a single trafficable lane in each direction, some 25m south of Railway Parade for a distance of approximately 30m,*
- → *The introduction of site specific access from Railway Parade and Wynne Avenue,*
- → *The introduction of an exit only onto Conder Street from Burwood Place and Council's library car parks,*
- → *Widening of Shaftesbury Road to provide two (2) through lanes in each direction at the Wilga Street intersection,*
- → *The introduction of traffic signal control at the intersections of…*
    - o *Railway Parade and Conder Street,*
    - o *Belmore Street and Wynne Avenue,*
    - o *Belmore Street and Conder Street,*
    - o *Burwood Road and Victoria Street East, and*
    - o *Shaftesbury Road and George Street.*

In conclusion, with the introduction of the aforementioned measures, the impact of traffic generation associated with the Burwood Place development will be effectively managed while reducing the impedence to pedestrian movement.

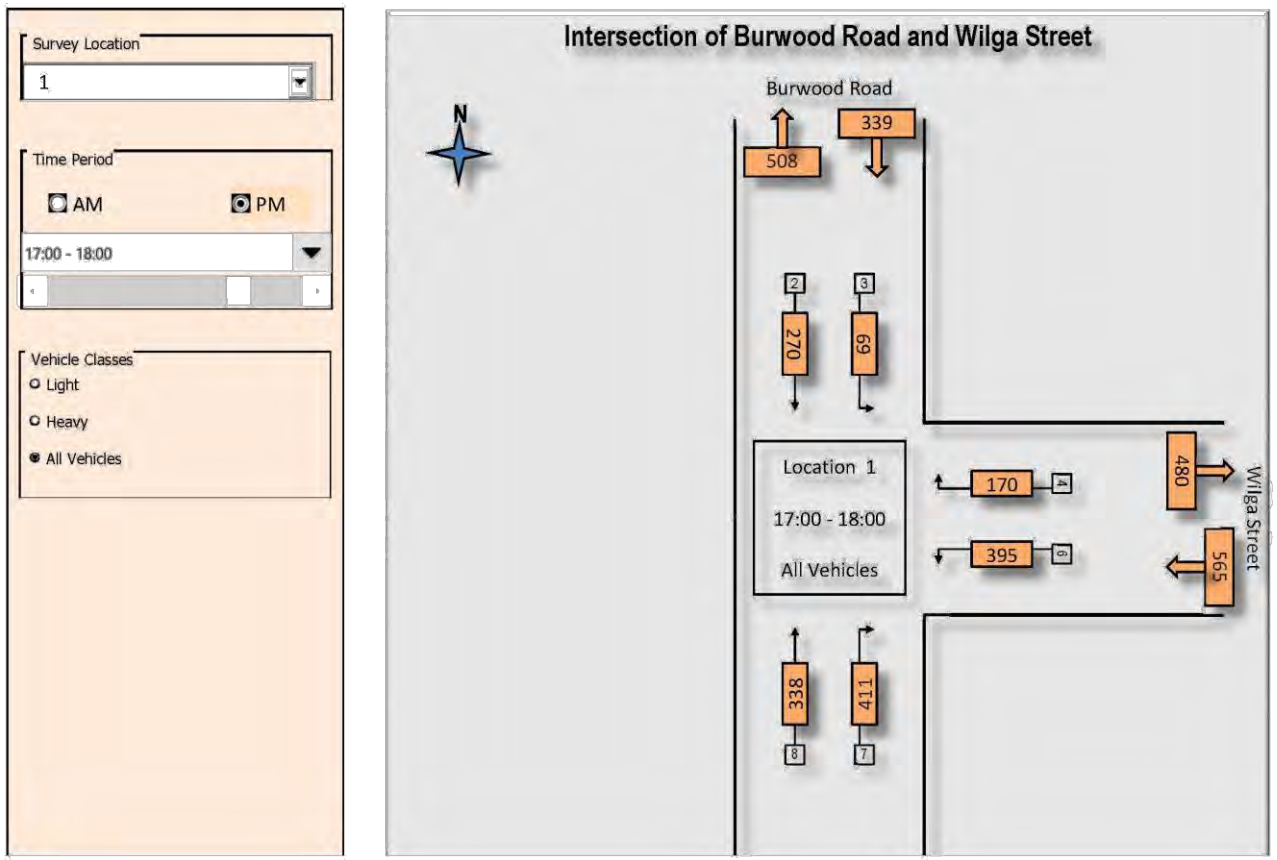
It is recommended that the traffic measures outlined be implemented over the coming five (5) years to retain the current service and amenity levels with the anticipated growth within the Burwood Town Centre.

APPENDIX A – TRAFFIC COUNT FIELD DATA

(A full copy of the traffic data is available on USB Flash Drive from Road Delay Solutions)



Intersection Traffic Flow Diagram



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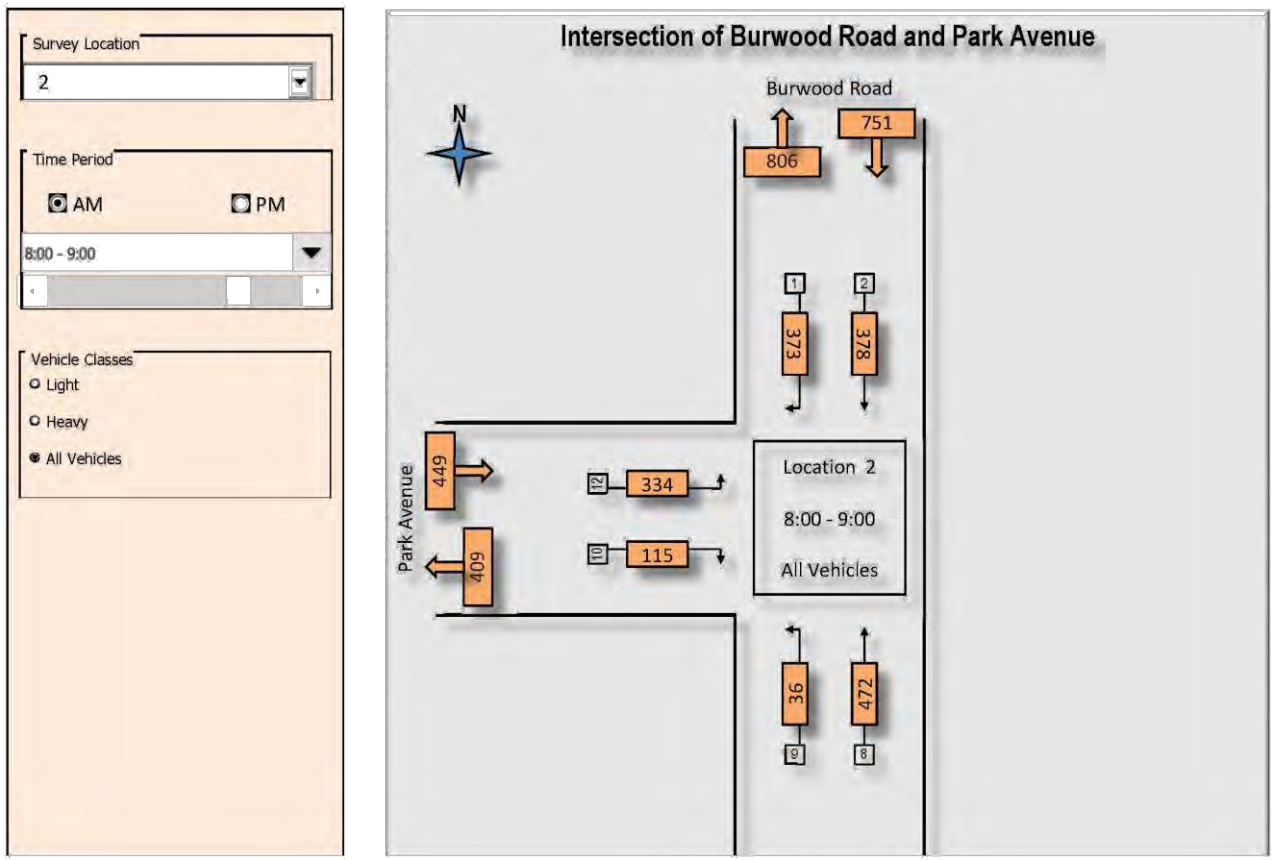

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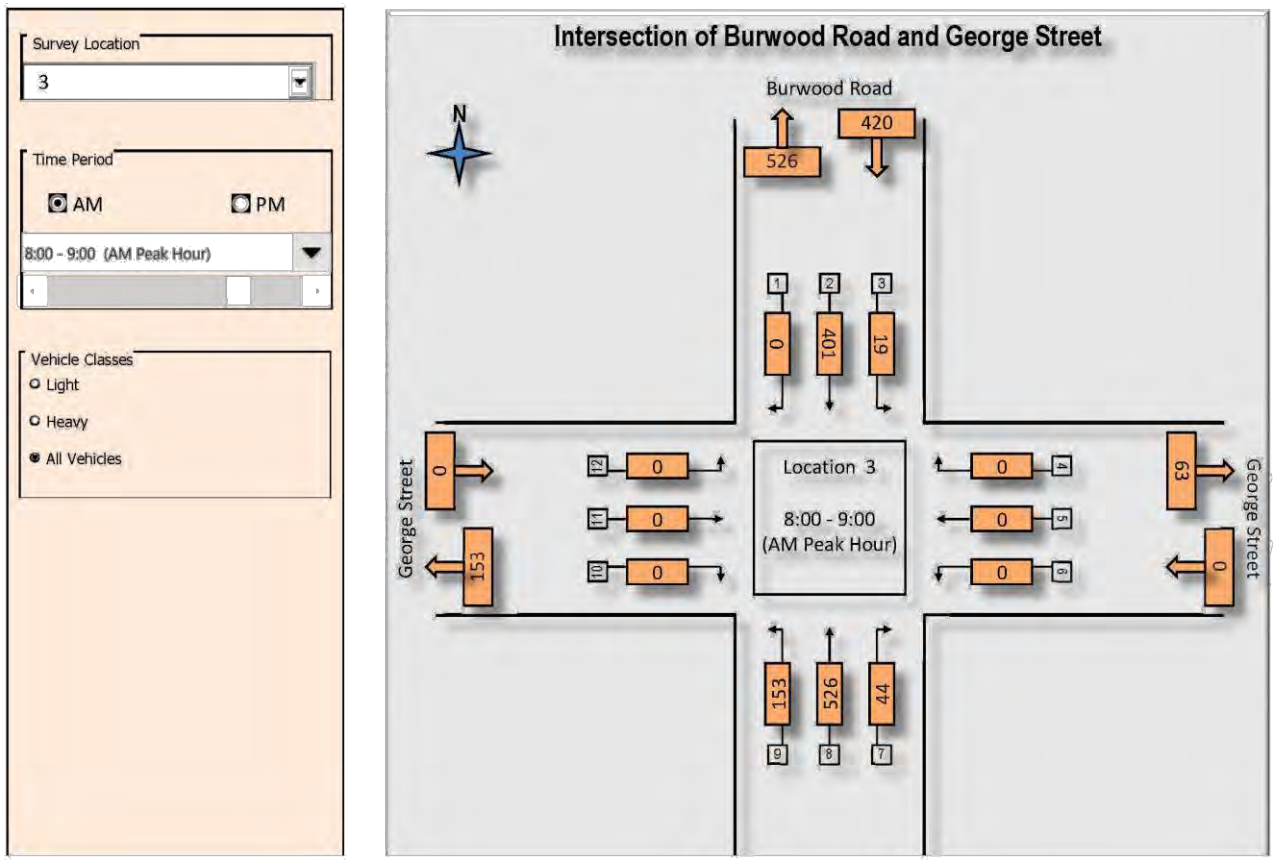

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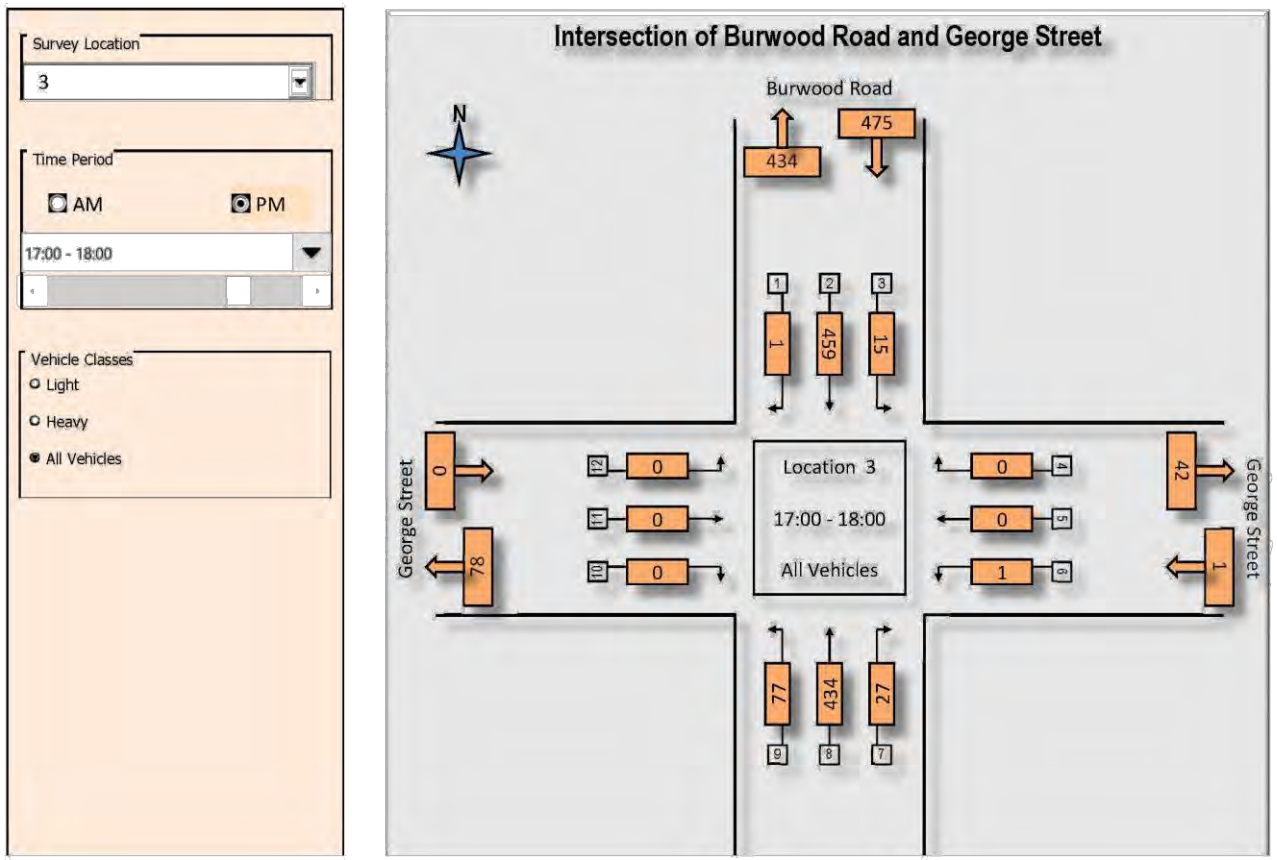

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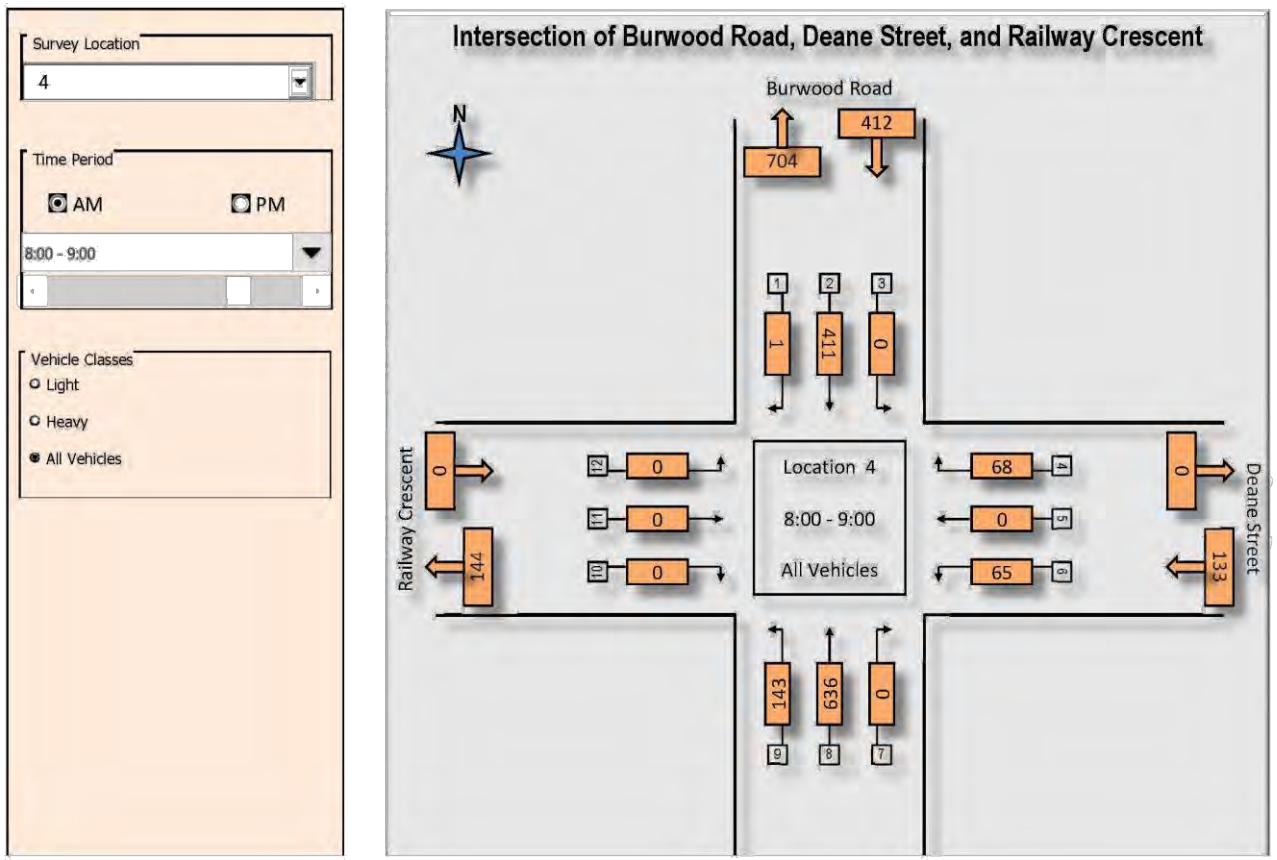

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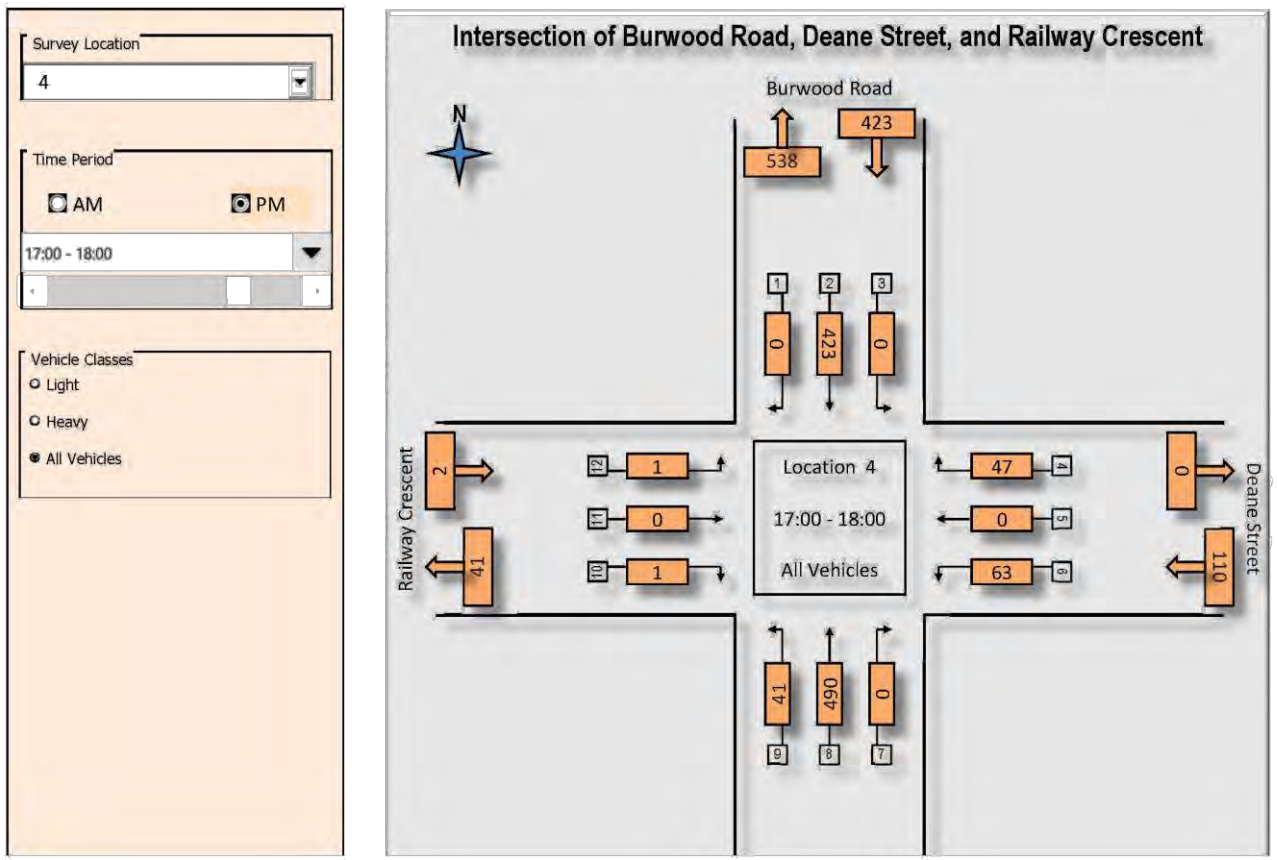

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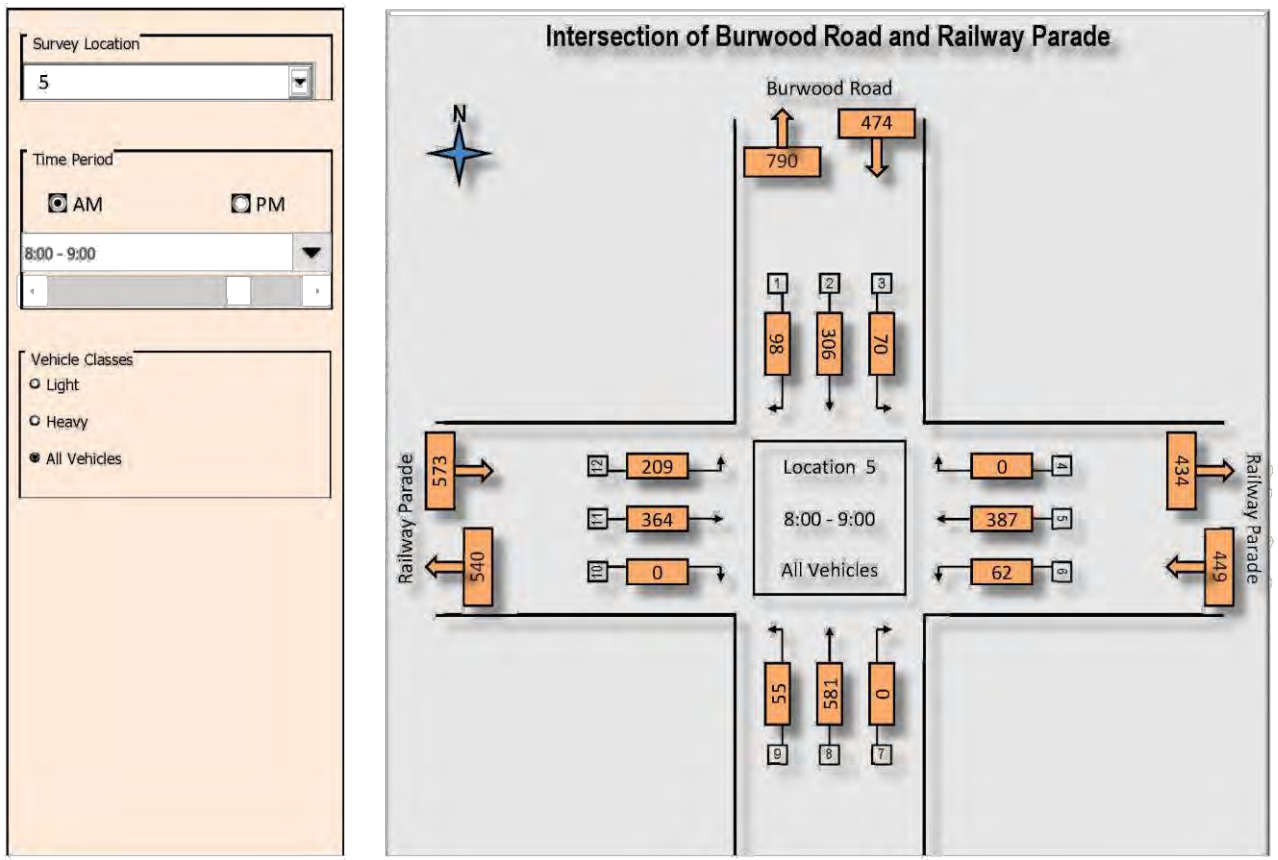

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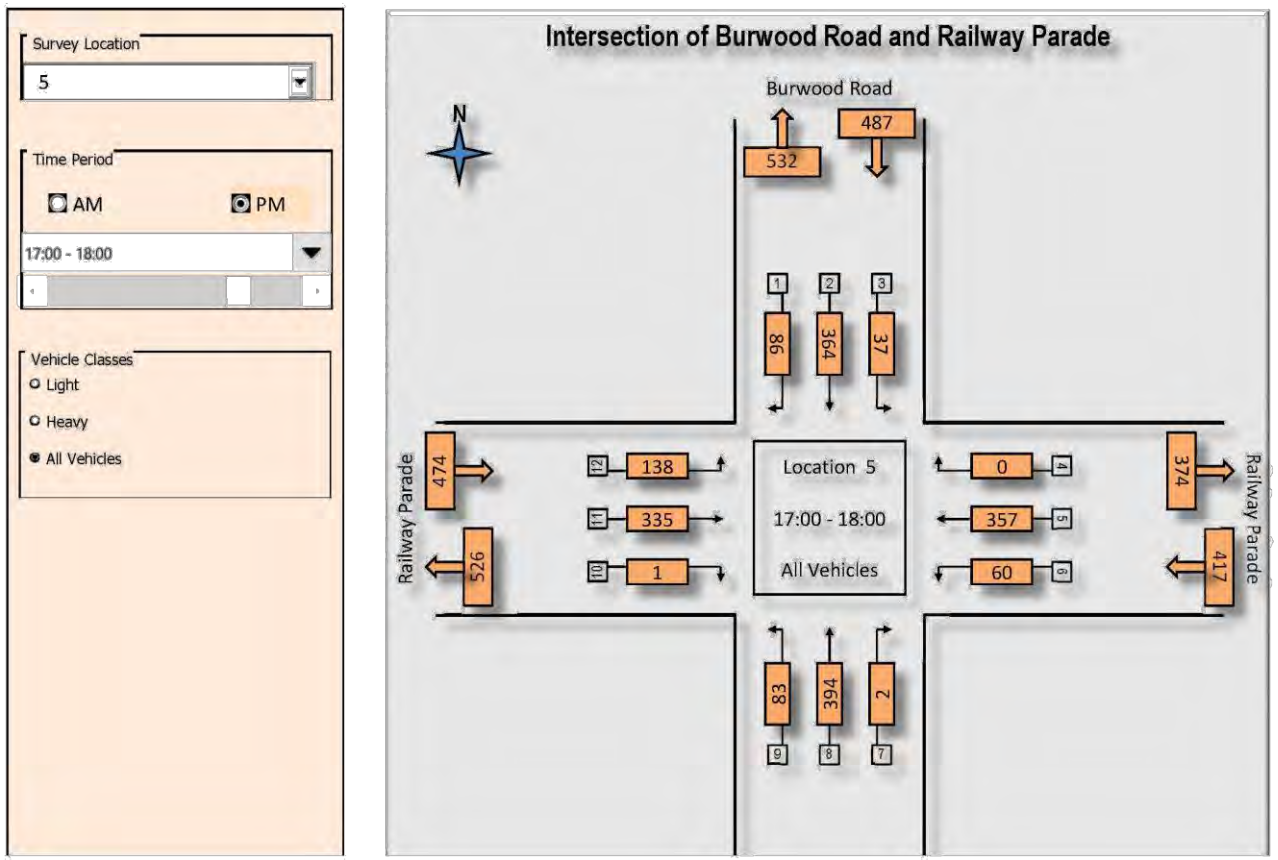

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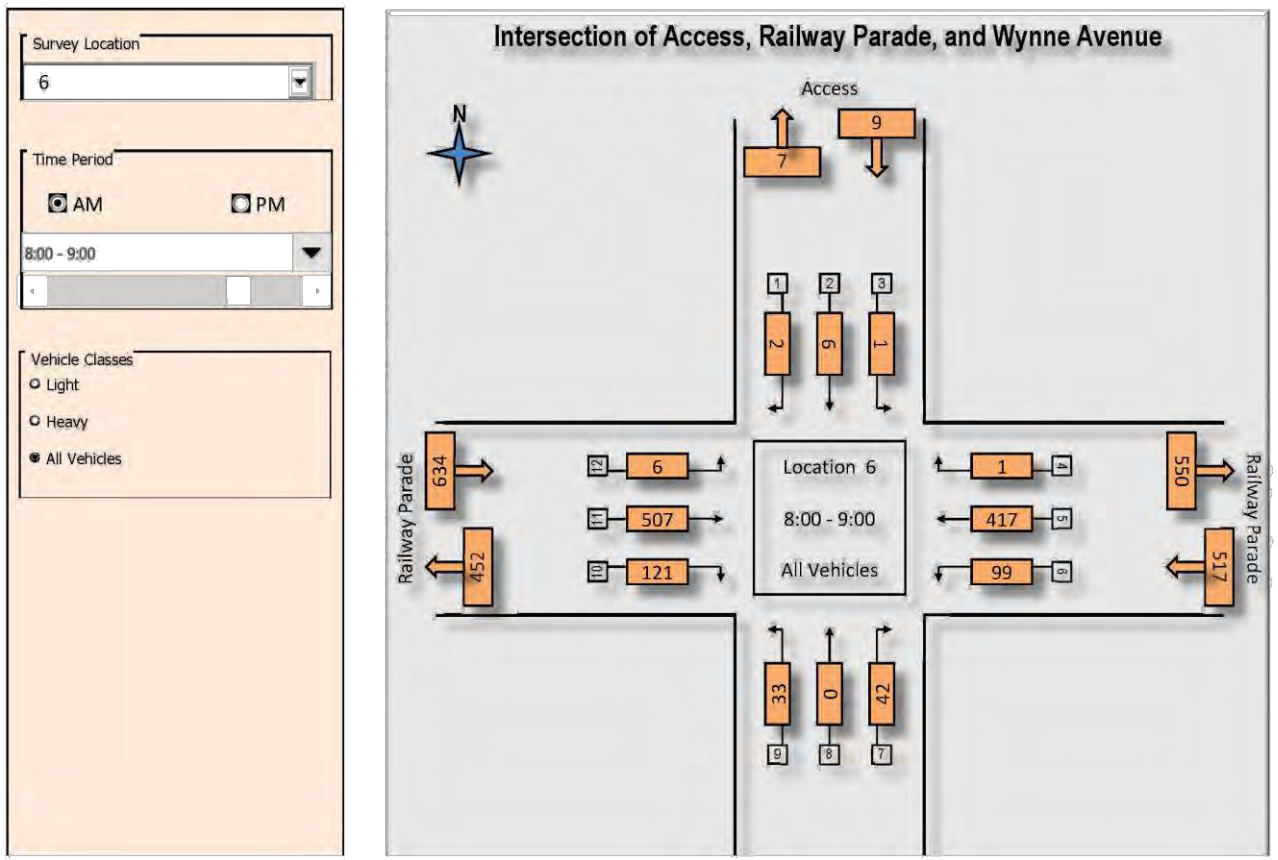

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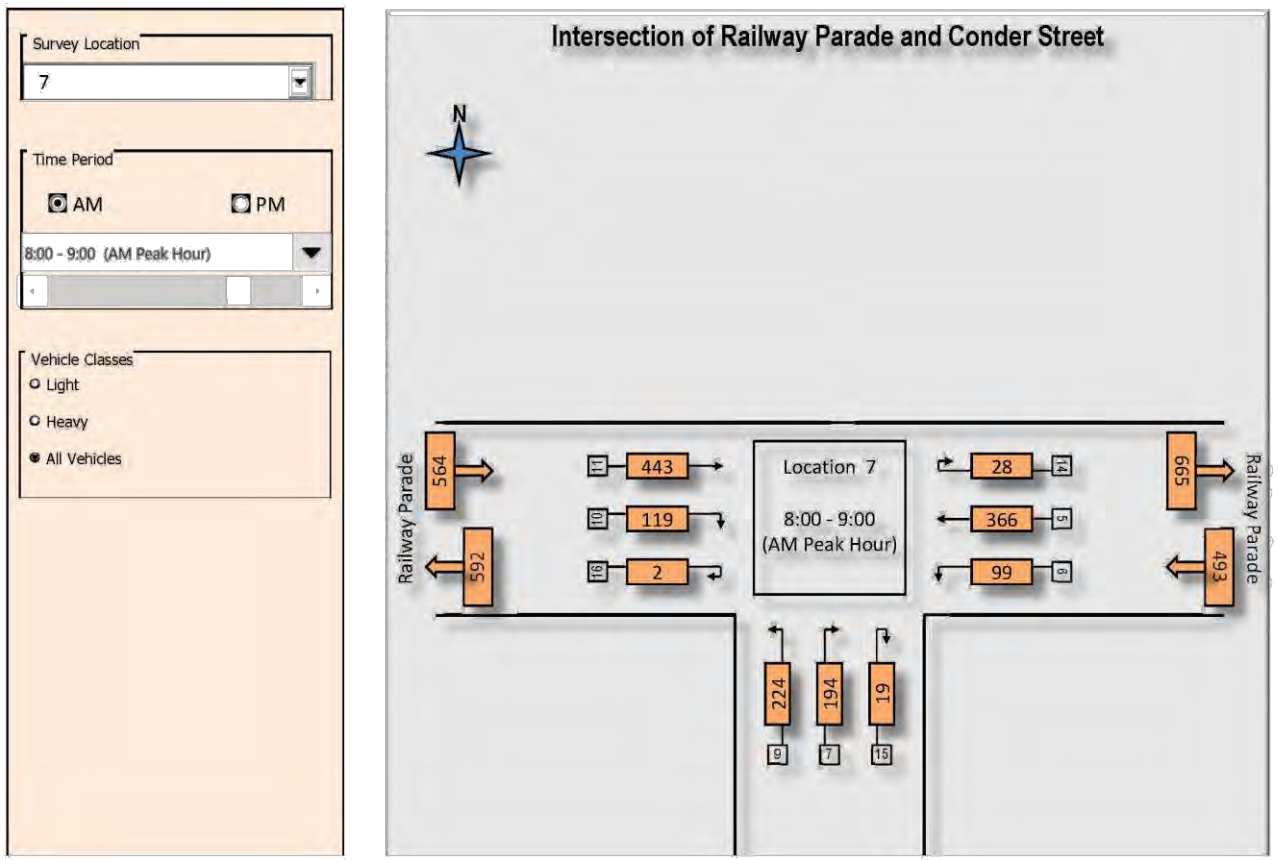

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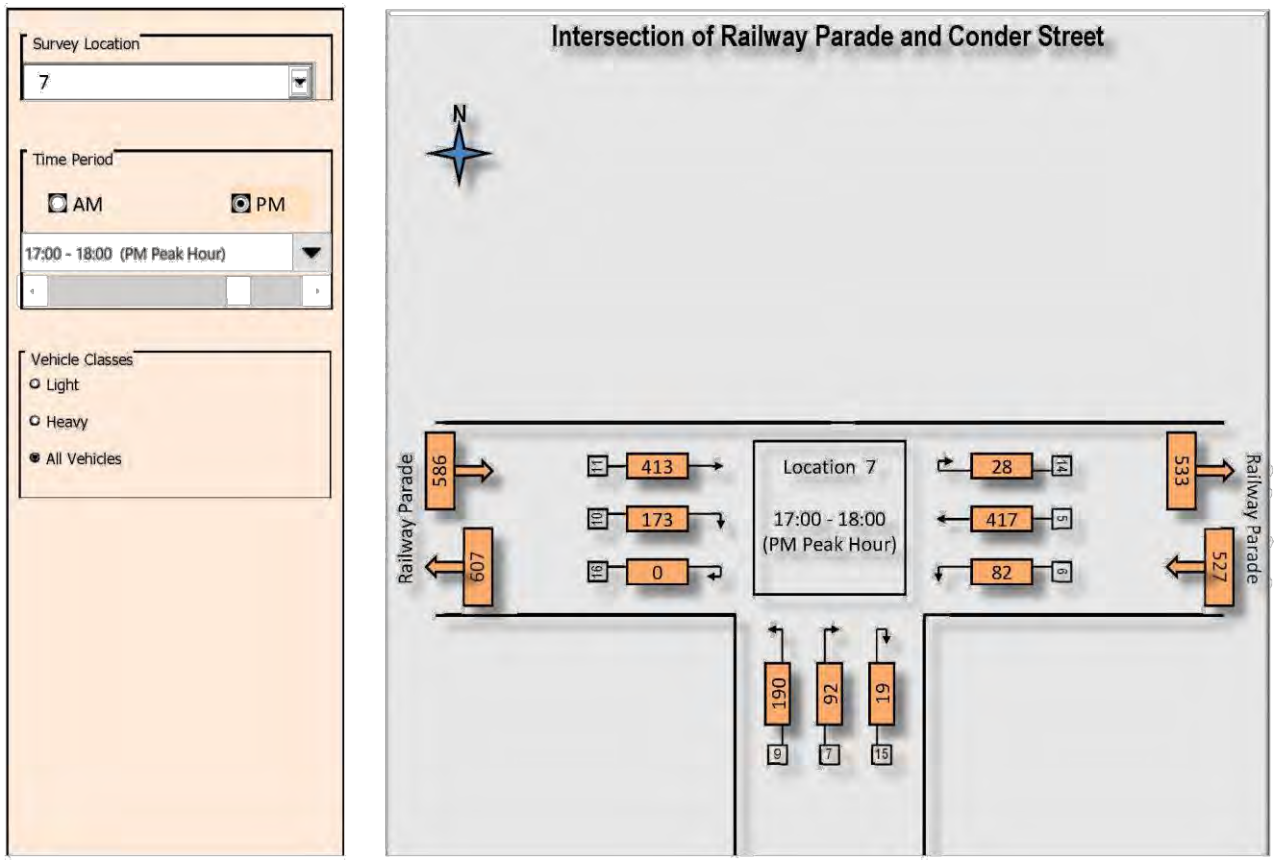

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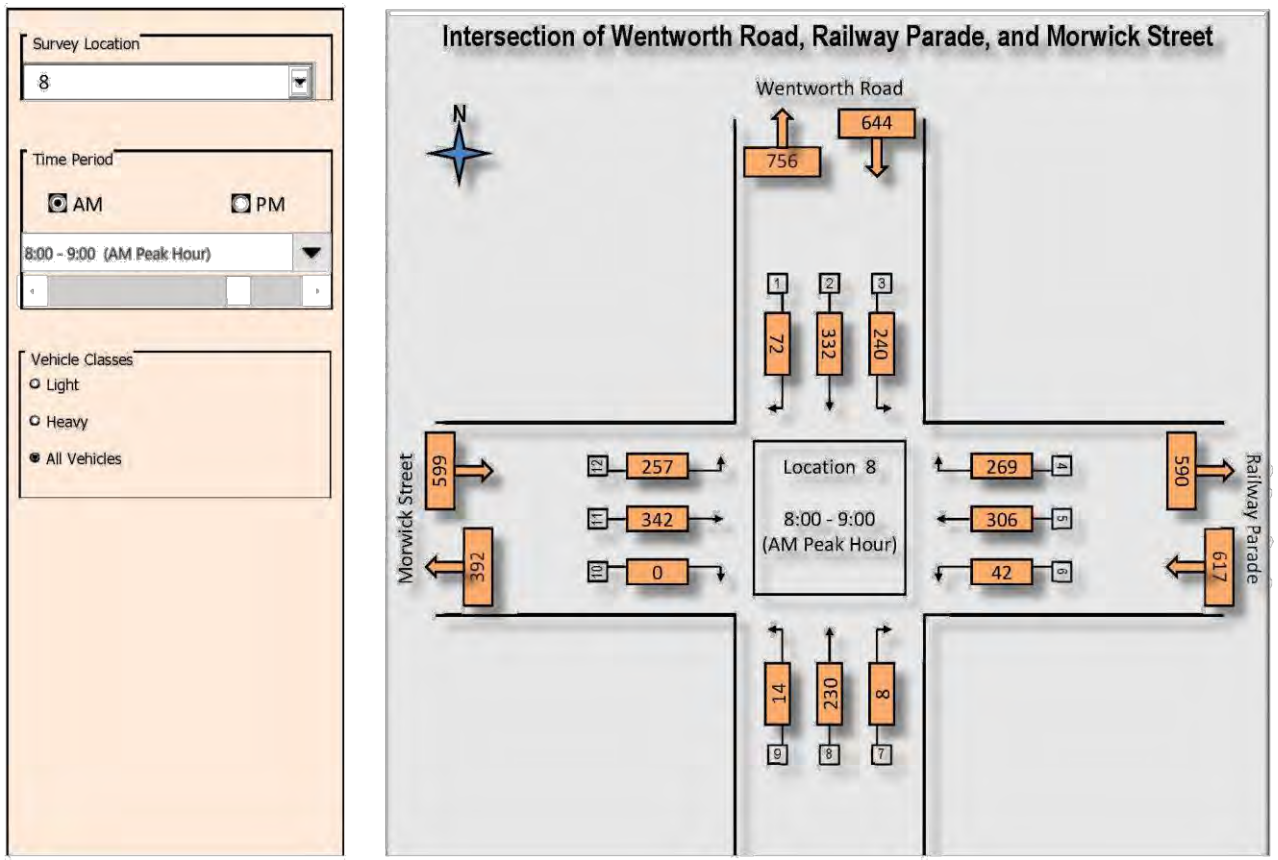

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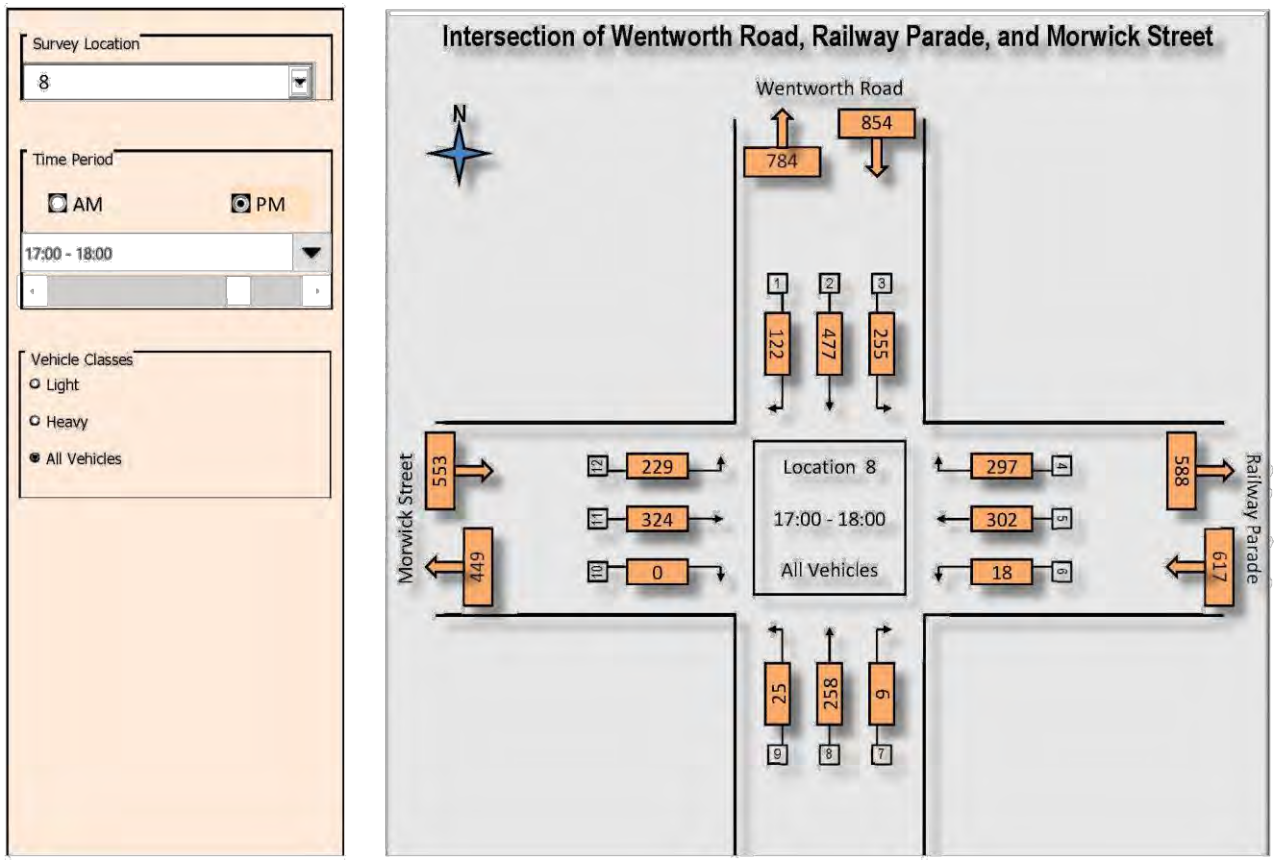

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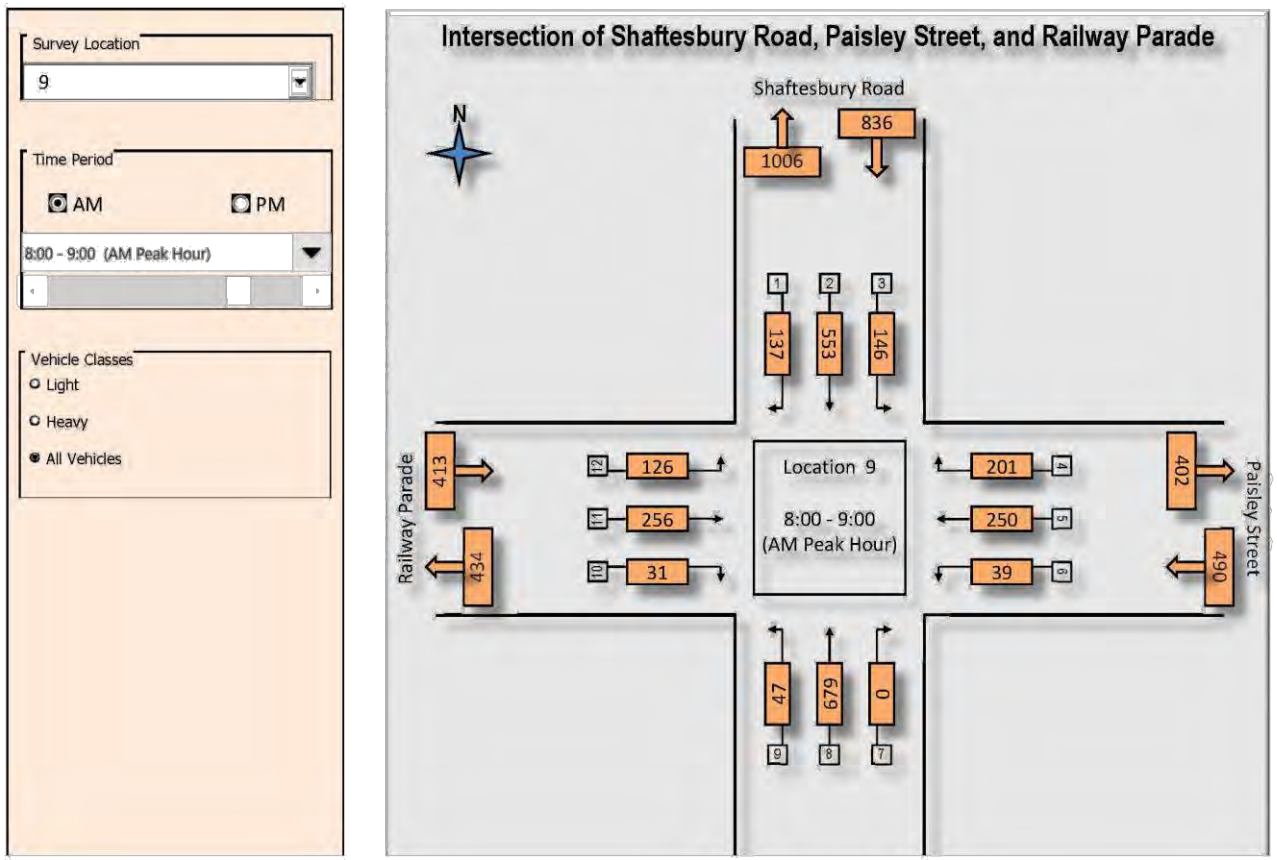

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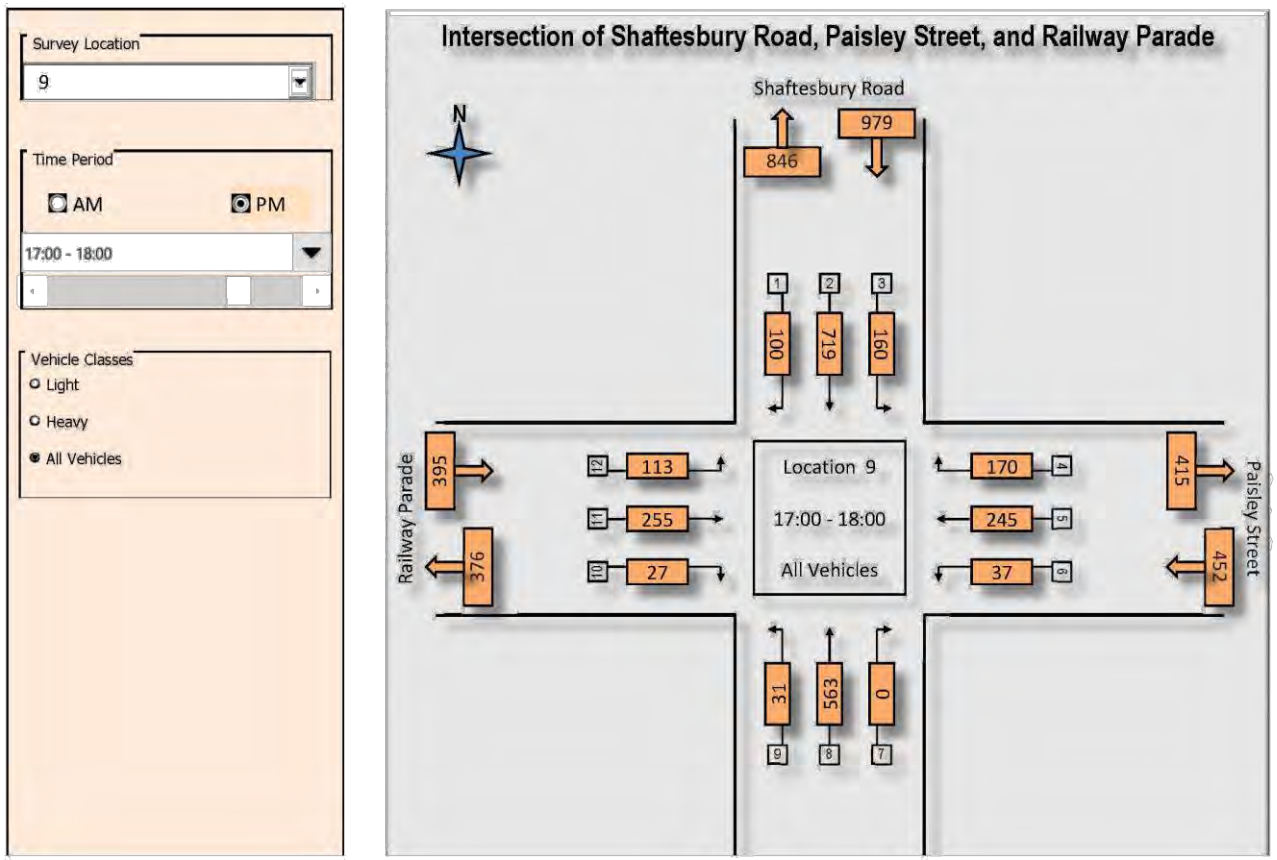

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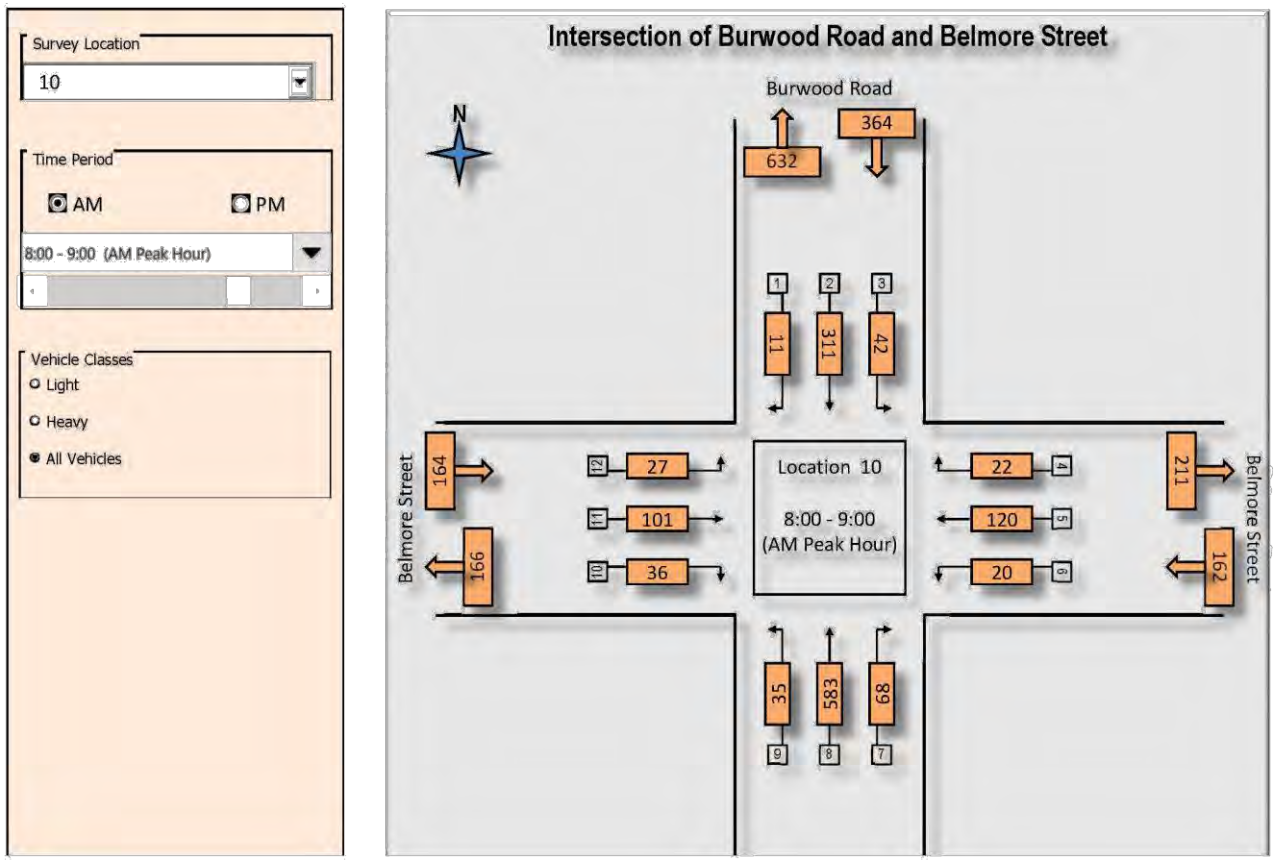

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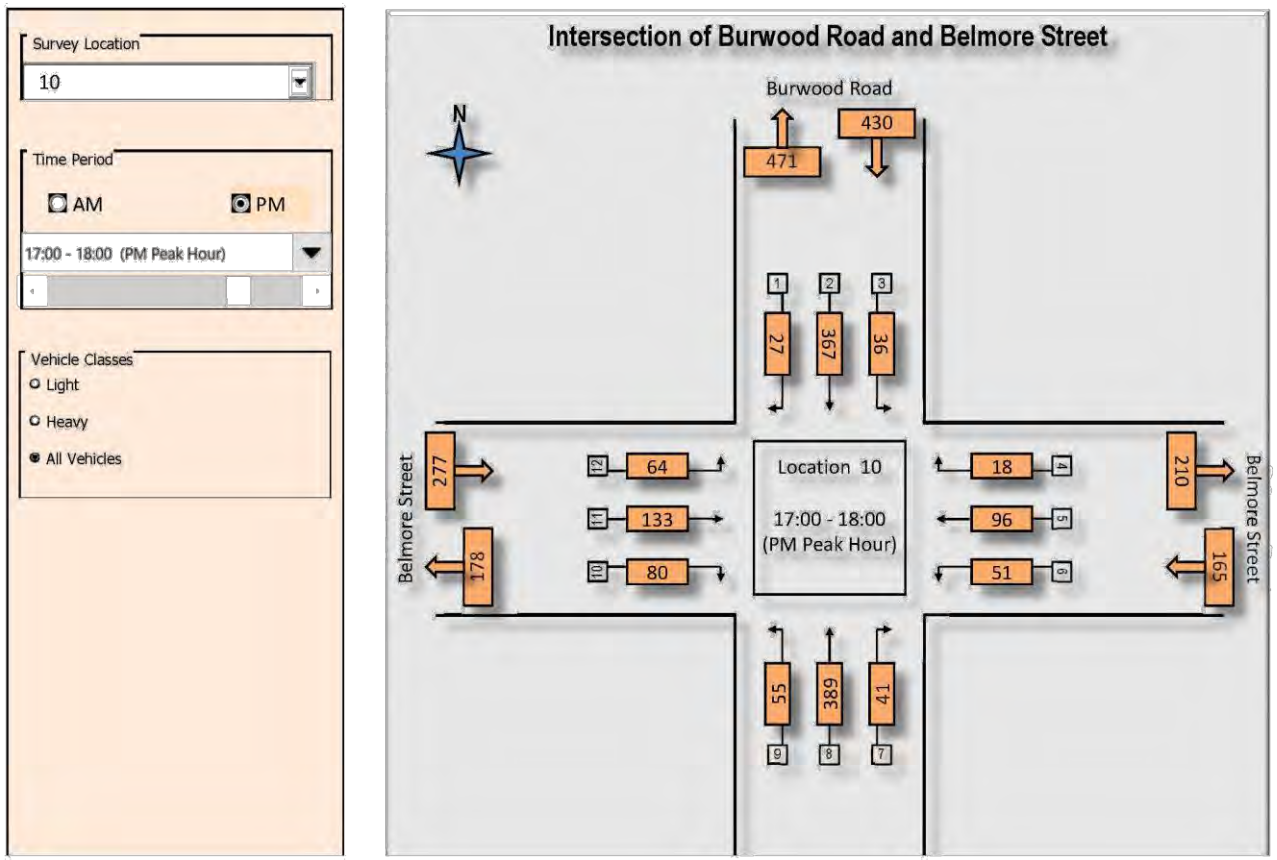

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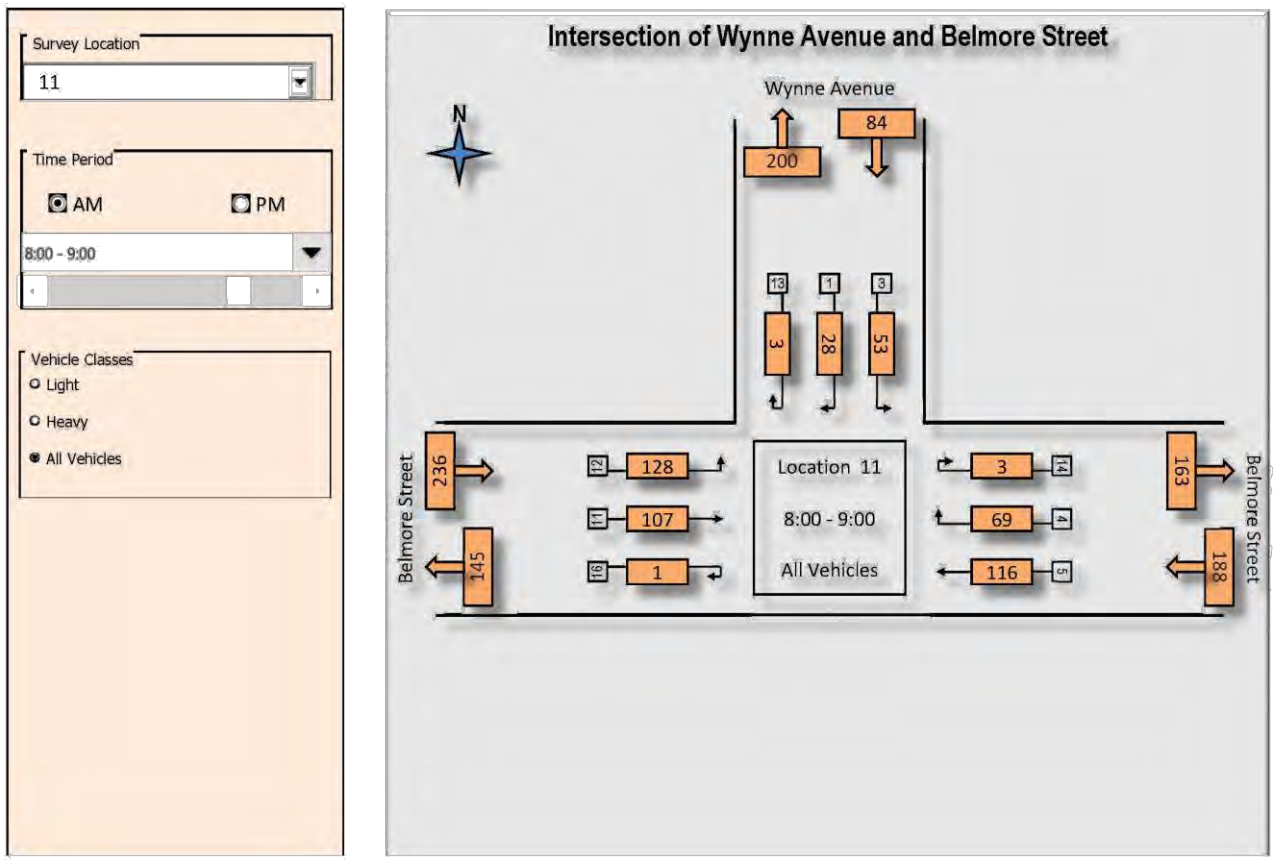

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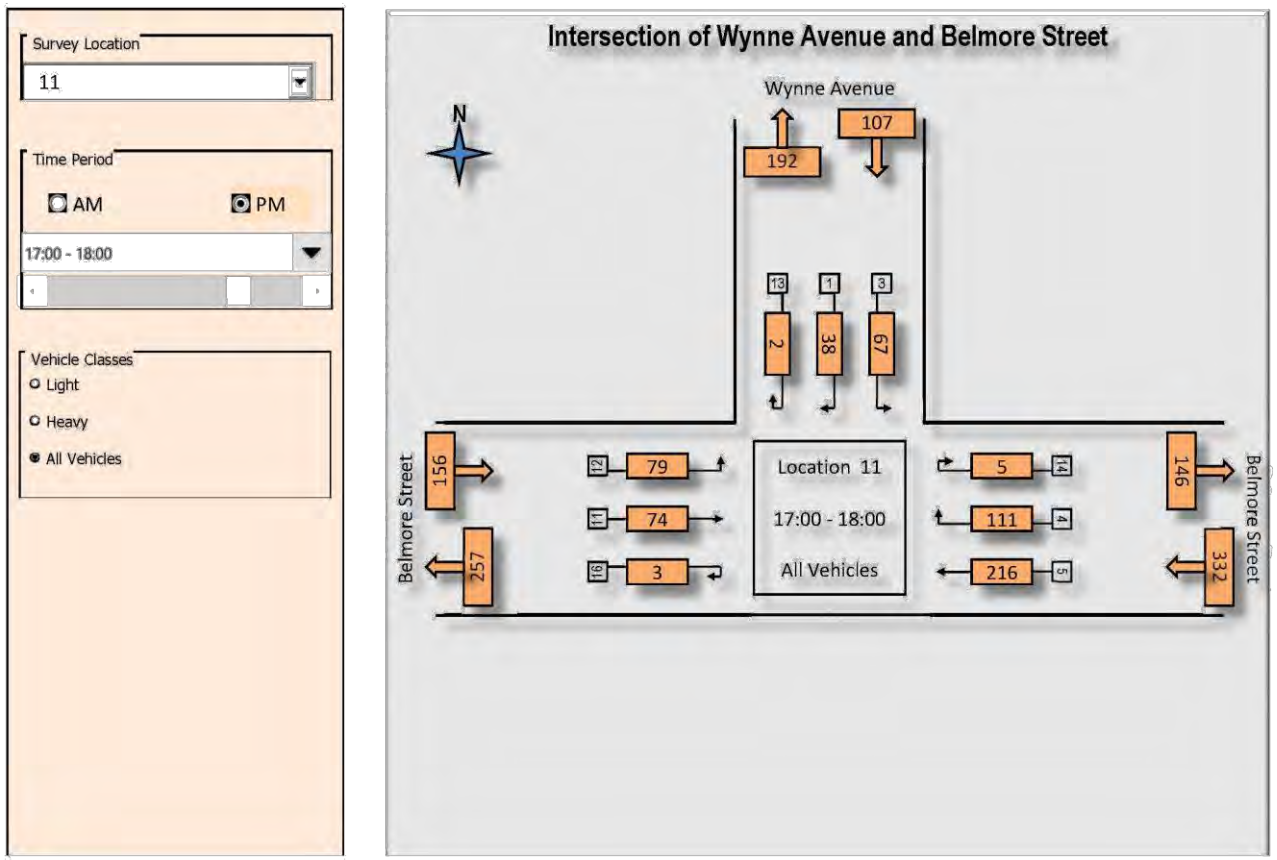

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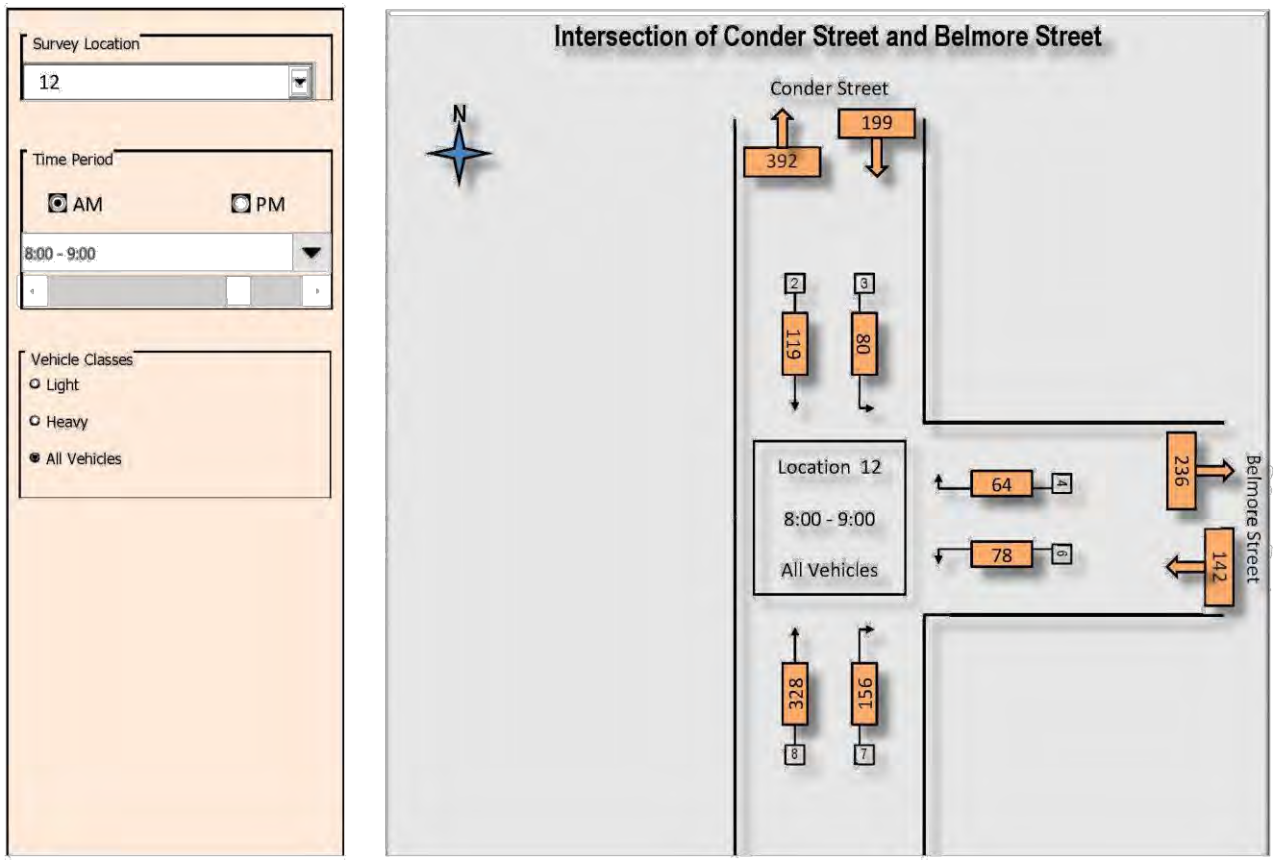

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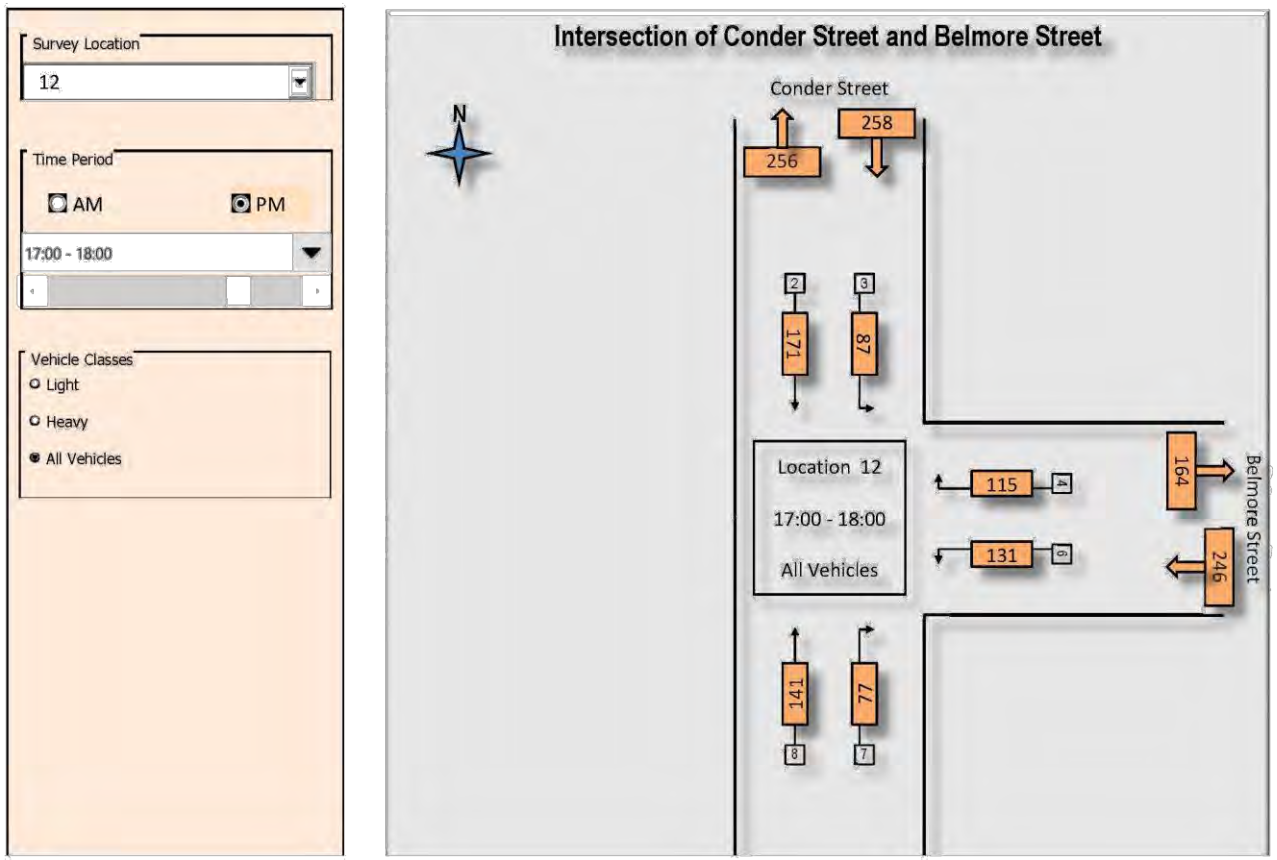
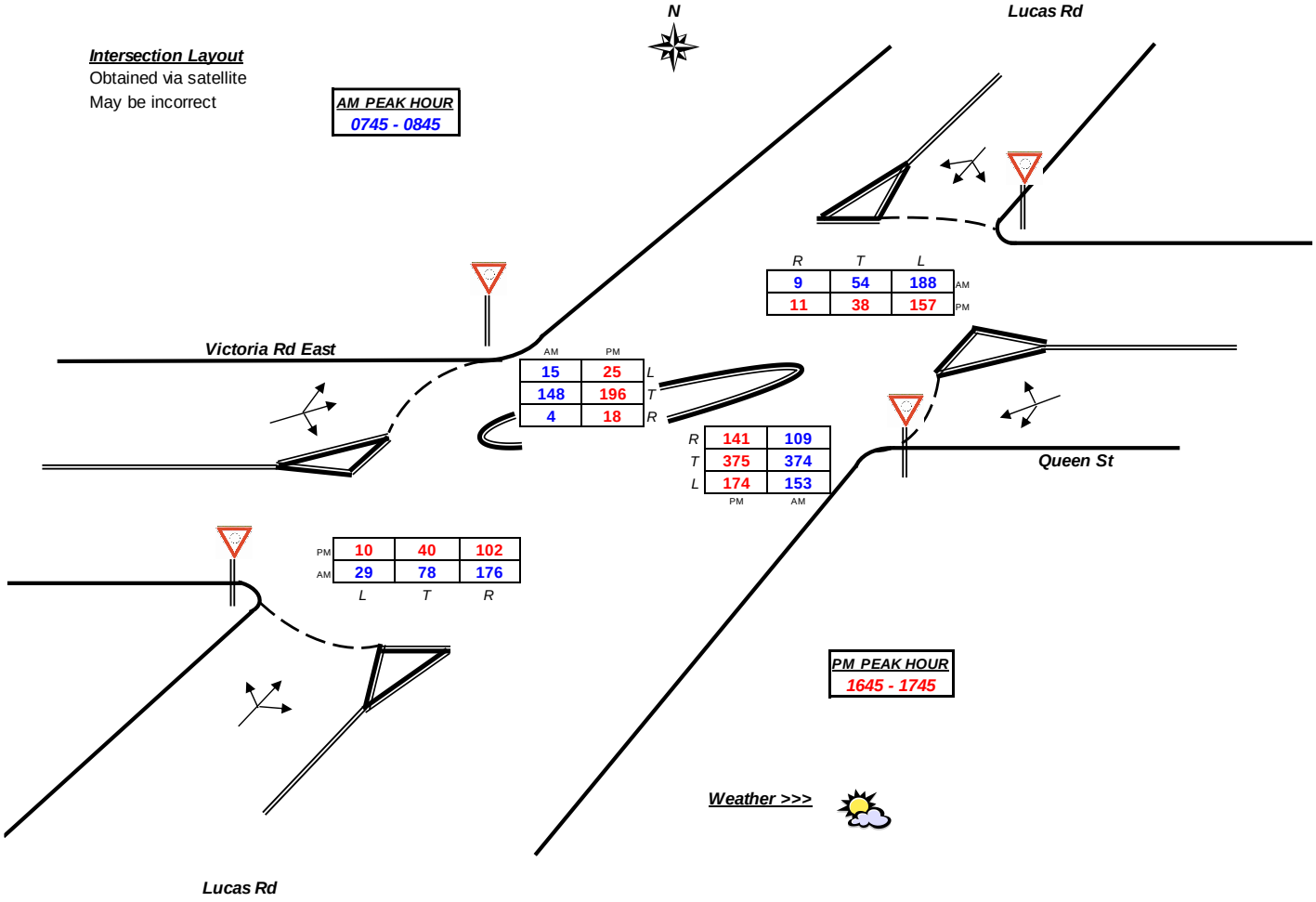


R.O.A.R. DATA
Reliable, Original & Authentic Results
Ph.88196847, Mob.0418-239019

Client : Road Delay Solutions
Job No/Name : 6510 BURWOOD Town Centre Counts
Day/Date : Thursday 20th July 23017

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0745 - 0845



R.O.A.R. DATA

Reliable, Original & Authentic Results

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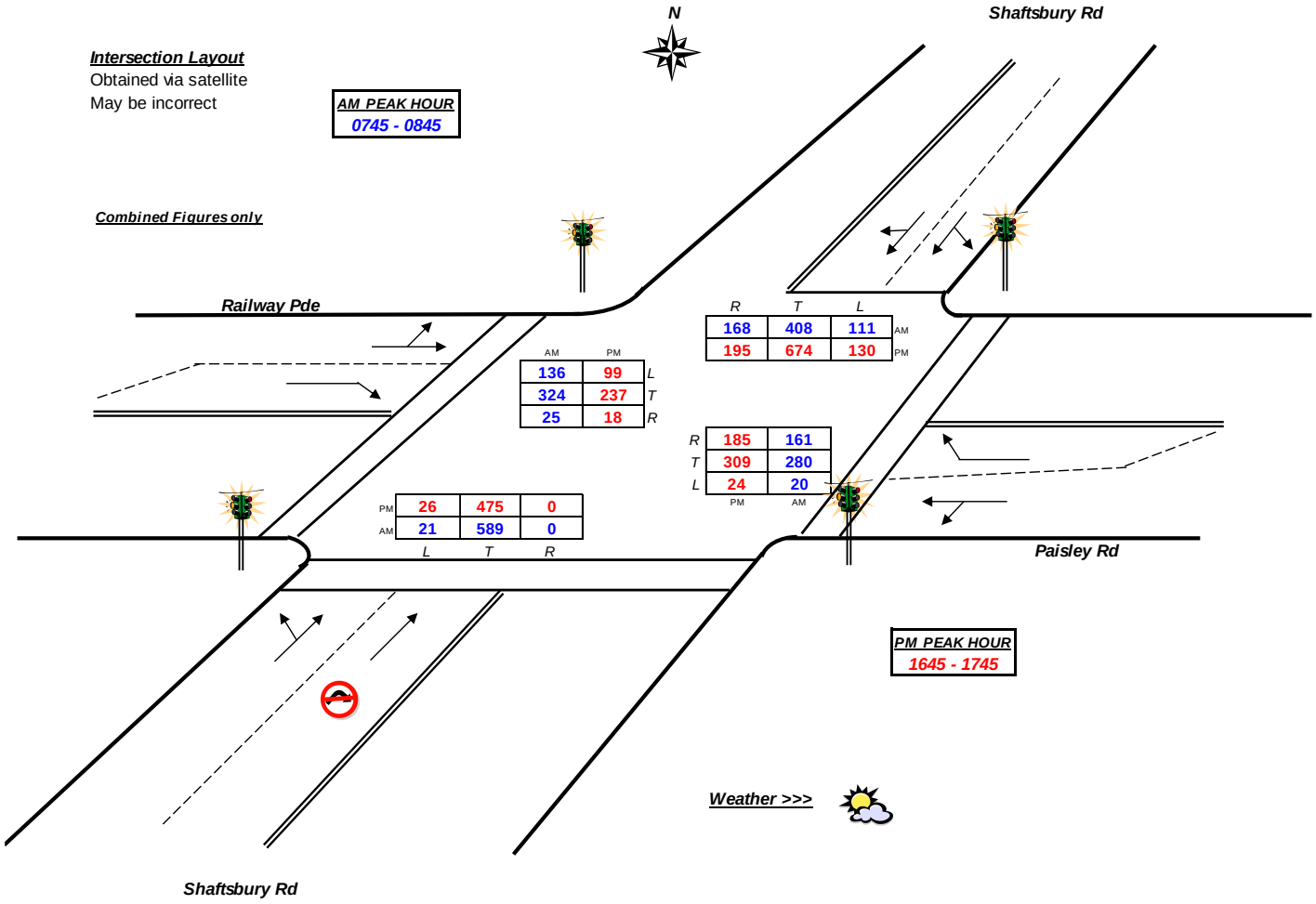
Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0745 - 0845

Combined Figures only



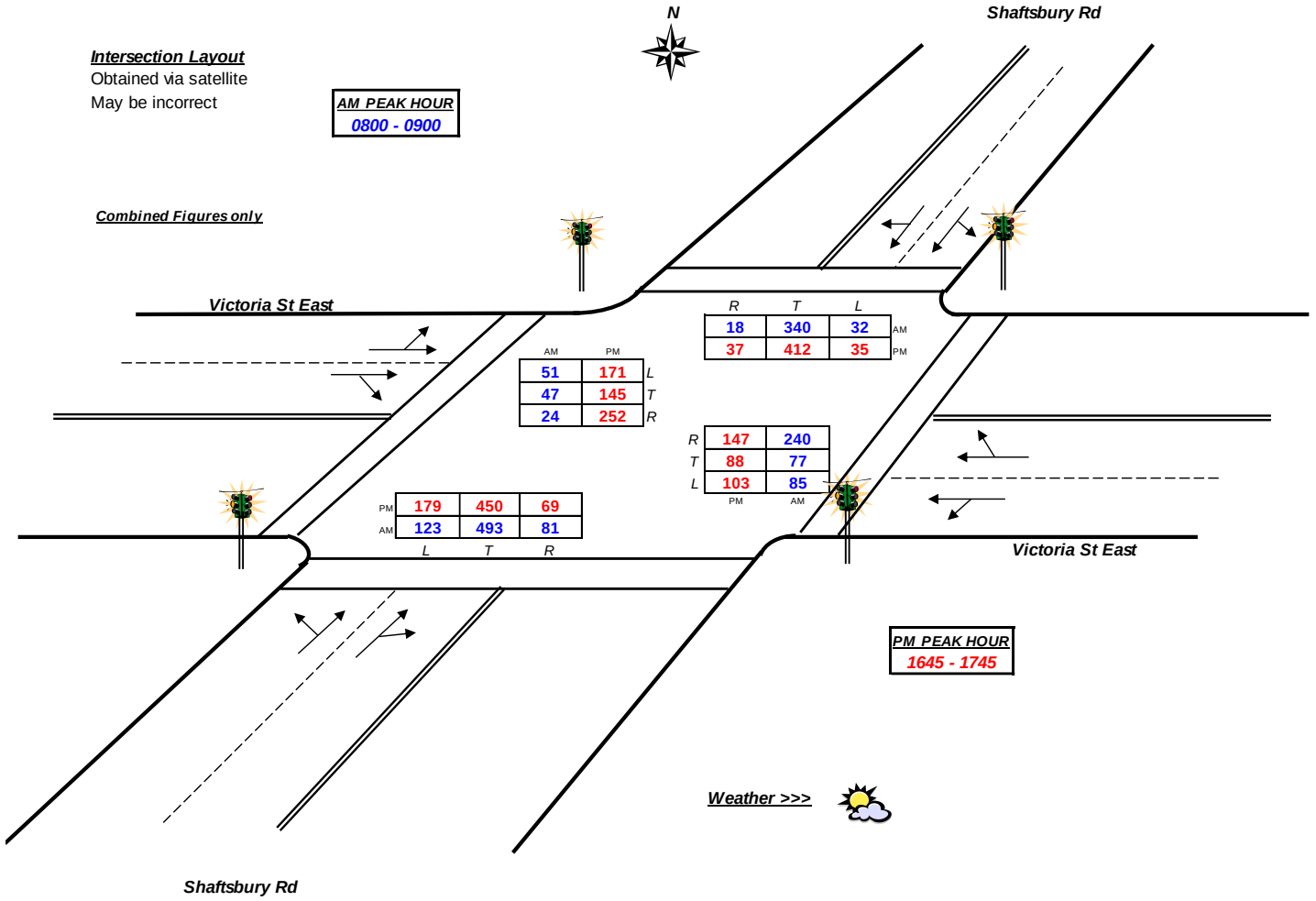
R.O.A.R. DATA
Reliable, Original & Authentic Results
Ph.88196847, Mob.0418-239019

Client : Road Delay Solutions
Job No/Name : 6510 BURWOOD Town Centre Counts
Day/Date : Thursday 20th July 23017

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900

Combined Figures only



PM PEAK HOUR
1645 - 1745

Weather >>>

R.O.A.R. DATA
Reliable, Original & Authentic Results
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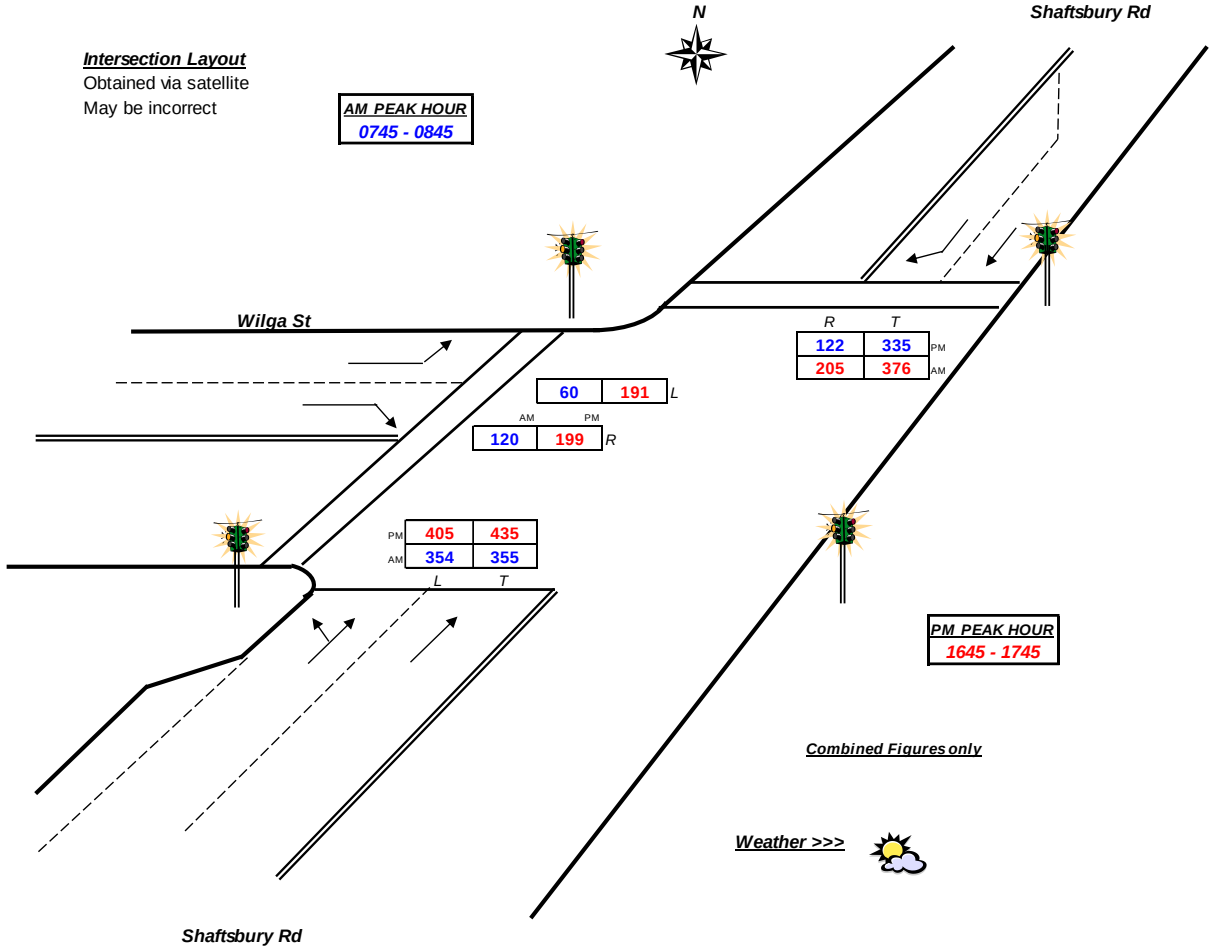
Job No/Name : 6510 BURWOOD Town Centre Counts
Day/Date : Thursday 20th July 23017



APPENDIX B – PERFORMANCE INDICATORS

Level of Service (LoS)

Intersection performance is best measured by the indicators of Level of Service (LoS), Average Vehicle Delay (AVD) and the Degree of Saturation (DS) during peak hours.

This is defined as the assessment of a qualitative effect of factors influencing vehicle movement through the intersection. Factors such as speed, traffic volume, geometric layout, delay and capacity are qualified and applied to the specific intersection control mode, as shown in *Table 1*.

The measure of average delay assessed for traffic signal operation is over all movements. For roundabouts and priority controlled intersections, the critical criterion for assessment is the movement with the highest delay per vehicle.

Simillarly, Network and Route performance is best assessed by the Average Vehicle Delay (AVD) and LoS.

The Network performance is an index based on the operation of traffic within a given road network of linked intersections controlled by like and/or differing control methods. As with intersections, the LoA is rated between 'A' being good to 'F' being completely unsatisfactory and highly congested requiring mitigation treatment. The Route LoS may be the result of a single intersection within the network or a group of intersections. It is the engineer's or planner's responsibility to analyse and determine the critical factors impacting the network operation.

The Route performance again is an indexed value based on the AVD along a defined path. The LoS between 'A' and 'F' is derived from the AVD and reported after consideration of each lanes operation under the specific control method at each intersection in the network.

Average Vehicle Delay (AVD)

The AVD is a measure of the operational performance of a road network or an intersection. AVD is determined globally over a road network or within a cordon during an assignment model run. The AVD exhibited on comparable network models, for analogous peak periods, forms the basis of comparing the operational performance of the road network.

AVD is used in the determination of intersection Level of Service. Generally, the total delay incurred by vehicles through an intersection is averaged to give an indicative delay on any specific approach. Longer delays do occur but only the average over the peak hour period is reported.

Degree of Saturation (DS)

The DS of an intersection is generally taken as the highest ratio of traffic volume on an approach compared with its theoretical capacity, and is a measure of the utilisation of available green time.

The DS reported is generally of a critical movement through the intersection rather than the DS of the intersection unless equal saturation occurs on all approaches.

For intersections controlled by traffic signals, generally both queue length and delay increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its DS is kept below 0.875. When the DS exceeds 0.9, extensive queues can be expected.

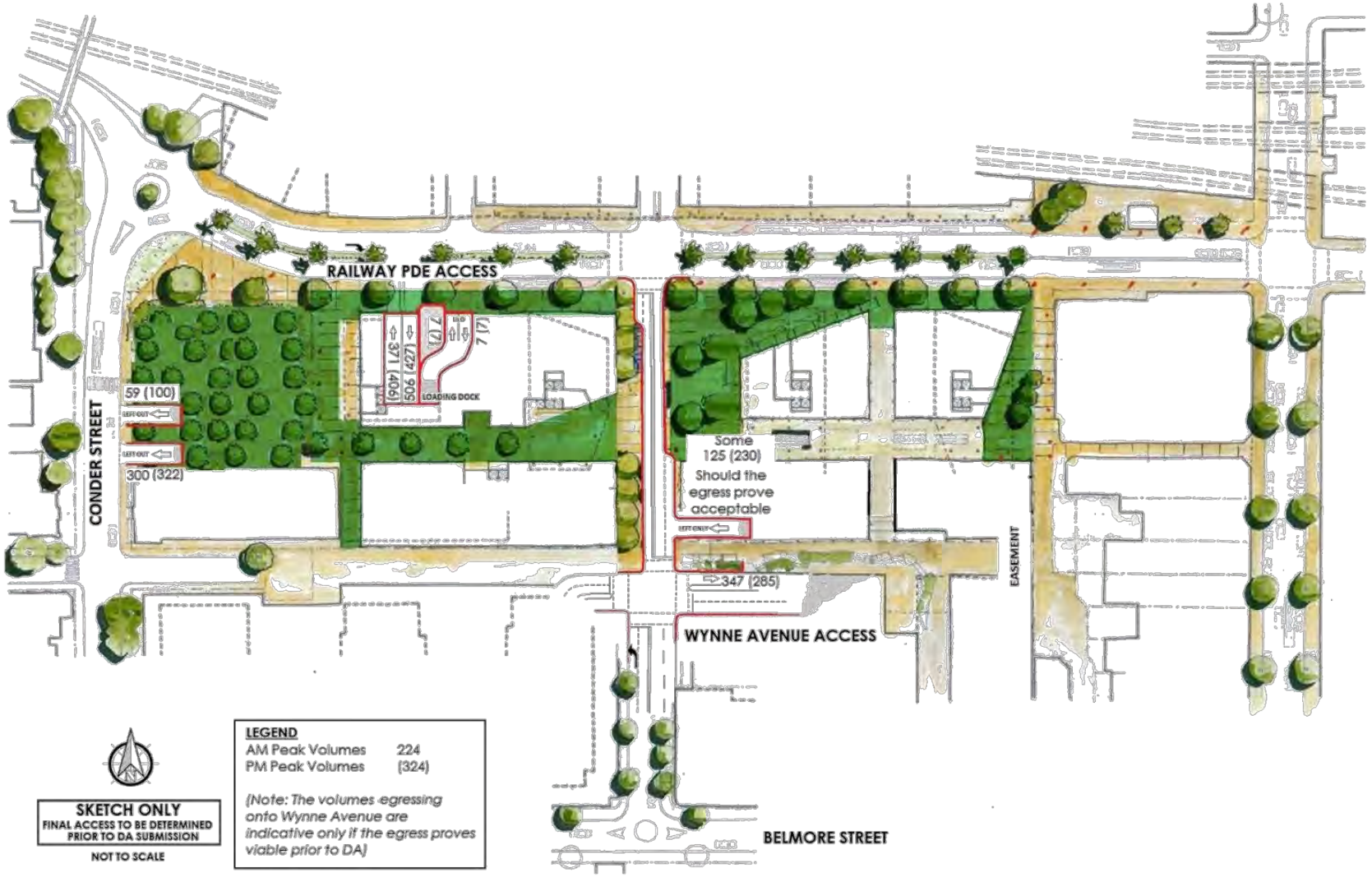
Table 12 Performance Indicators by Control Method

Intersection Control	Performance Measure [Unit]
Sign or Priority Control	Delay of critical movement(s) [seconds/vehicle]
	Average Vehicle Delay [seconds/vehicle]
	Queue length of critical movement(s) [metres]
Traffic Signal Control	Delay of critical movement(s) [seconds/vehicle]
	Degree of Saturation [ratio of vehicles to capacity]
	Average Vehicle Delay [seconds/vehicle]
	Cycle Length [seconds]
	Queue length of critical movement(s) [metres]
Roundabout Control	Delay of critical movement(s) [seconds/vehicle]
	Degree of Saturation[ratio of vehicles to capacity]
	Average Vehicle Delay [seconds/vehicle]
	Queue length of critical movement(s) [metres]

Table 13 Qualified Level of Service by Differing Control Methods

LOS	AVD *secs*	Traffic Signals and Roundabout	Give Way and Stop Sign Priority Control
A	1 to 14	Good operation.	Good operation
B	14 to 28	Good operation with acceptable delays and spare capacity.	Good operation with acceptable delays and spare capacity.
C	28 to 42	Satisfactory.	Satisfactory but accident study and operational analysis required.
D	42 to 56	Operating near capacity.	Near capacity. Acceptable LOS for new developments. Accident study and operational analysis required.
E	56 to 70	Unsatisfactory. Traffic signals incidence will cause excessive delays. Requires additional capacity. Roundabouts require alternative control mode.	At capacity. Requires alternative control mode.
F	>70	Unsatisfactory. Over capacity and unstable operation.	Over capacity. Unstable and unsafe operation.

APPENDIX C – VEHICLE VOLUMES BY ACCESS



NOTE: Provided by the Manager – Traffic and Transport re: Wynne Avenue access.